



PROTECTING
ANTIBIOTICS
FOR THE FUTURE



ANTAIBHEATHAIGH
A CHOSAINT
DON TODHCHAÍ



IRELAND'S NATIONAL ACTION PLAN ON ANTIMICROBIAL RESISTANCE 2017 - 2020



Published by:
The Department of Health
Hawkins House
Hawkins Street
Dublin 2
D02 VW90
Ireland

Tel: +353 (1) 6354000
www.health.gov.ie

October 2017
©Department of Health, October 2017

Citation text

Department of Health (2017). Ireland's National Action Plan on Antimicrobial Resistance 2017-2020. (*i*NAP)
Available at <http://health.gov.ie/national-patient-safety-office/patient-safety-surveillance/antimicrobial-resistance-amr/>

In text citation (Department of Health 2017)

“

*A post-antibiotic era means,
in effect, an end to modern medicine
as we know it.*

– Dr Margaret Chan, Former WHO Director General - March 2012

”

Table of contents

Ministerial Foreword	6
Departmental Foreword	7
Key concepts and definitions	8
1. Introduction	10
2. Situational analyses and assessment – Human Health	15
3. Situational analyses and assessment – Animal Health	38
4. Situational analyses and assessment – Environmental Health	50
5. Governance and responsibilities for implementation of Ireland's National Action Plan on Antimicrobial Resistance 2017-2020	53
6. Ireland's 3-Year Plan - Priority Strategic Interventions and Activities	58
Strategic Objective 1: Improve awareness and knowledge of antimicrobial resistance	65
Strategic Objective 2: Enhance surveillance of antibiotic resistance and antibiotic use	71
Strategic Objective 3: Reduce the spread of infection and disease	77
Strategic Objective 4: Optimise the use of antibiotics in human and animal health	83
Strategic Objective 5: Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions	89
Appendix 1: National Interdepartmental Antimicrobial Resistance Consultative Committee	95
Appendix 2: List of key stakeholders	97
Appendix 3: HPSC surveillance of key pathogens	101
Glossary and abbreviations	103

List of Figures		Page
Figure 1:	Key groups, agencies and health professionals.	16
Figure 2:	Preferred antibiotics in primary care.	23
Figure 3:	Hospital antimicrobial consumption in Defined Daily Dose (DDD) per 100 bed days used (BDU) - Data to end Q4 2016. (Source HPSC).	31
Figure 4:	Total antibiotic use in the community in Ireland, 2007-2016, expressed in DDD per 1000 inhabitants per day. (Source HPSC).	32
Figure 5:	Community antibiotic consumption by county, 2016 expressed in DDD per 1000 inhabitants per day. (Source HPSC).	32
Figure 6:	Total number of <i>S. aureus</i> (MRSA and MSSA) bloodstream isolates and proportion (%) MRSA from acute hospitals (public & private) by year, 2004 to 2016 (Source HPSC).	33
Figure 7:	Total number of <i>E.coli</i> bloodstream isolates and proportions of 3GC-resistant and ESBL-producing isolates from acute hospitals (public & private) by year, 2004 to 2016 (Source HPSC).	33
Figure 8:	Number of <i>MDRKP</i> bloodstream isolates MDRKP proportions from acute hospitals (public & private) by year, 2006 to 2016 (Source HPSC).	34
Figure 9:	Total number of <i>E. faecium</i> (VREfm and VSEfm) bloodstream isolates, and VREfm proportions from acute hospitals (public & private) by year, 2004 to 2016 (Source HPSC).	34
Figure 10:	Annual confirmed carbapenemases – (Source CRE reference laboratory).	36
Figure 11:	Frequency distribution of <i>Campylobacter jejuni</i> isolates completely susceptible and resistant to one to four antimicrobials in broilers in Member States in 2014 (Source: EFSA, ECDC 2016)	39
Figure 12:	Frequency distribution of <i>E. coli</i> isolates completely susceptible and resistant to one to eleven antimicrobial classes in fattening pigs in Member States in 2015 (Source: EFSA, ECDC 2017)	40
Figure 13:	Total volume of veterinary antibiotics used corrected for the size of the animal population taken from the EMA's report on sales of veterinary antimicrobial agents in 29 countries in 2014 (ESVAC 2016).	41
Figure 14:	Pharmaceutical form breakdown of veterinary antibiotics sold in 2015 in Ireland (Source HPRA report 2016)	42
Figure 15:	Distribution of sales of various pharmaceutical forms of veterinary antimicrobial agents for food producing animals, aggregated by the 29 European countries for 2014 (Source ESVAC report 2016)	42

List of Tables		Page
Table 1:	Sales (in tonnes) of veterinary antibiotics for the years 2009 – 2015 (Source HPRA 2016)	40
Table 2:	HSE 3 Year plan Deliverables and theme's.	54
Table 3:	Overview of the wider effects of HCAI	55

Ministerial Foreword



Mr Simon Harris T.D.
Minister for Health



Mr Michael Creed T.D.
Minister for Agriculture,
Food and the Marine

As the Ministers for Health, Agriculture, Food & the Marine, we welcome the publication of this, Ireland's first 'One Health' National Action Plan on Antimicrobial Resistance 2017-2020 (*i*NAP) aimed at tackling the serious and increasing threat posed by antimicrobial resistance (AMR).

AMR is a global threat that cannot be tackled by any one stakeholder grouping, government department, country or international organisation alone. This is why a 'One Health' approach is so vital. A 'One Health' approach recognises that humans and animals share the same environment and involves multiple sectors working together to achieve better health outcomes. The establishment of the National Interdepartmental AMR Consultative Committee led by the Chief Medical Officer and the Chief Veterinary Officer is our commitment to a 'One Health' approach in tackling AMR.

Implementing this plan will show that Ireland is standing up to play its part in tackling the global AMR threat and in helping to preserve better health outcomes for all. We all must take action if we are to halt the increasing rate at which AMR is developing. Our actions will be part of the worldwide country effort to tackle AMR and will support the growing effort to encourage all countries to take action.

This plan is ambitious. It sets out a range of five strategic objectives with targeted interventions and activities to address AMR. It prioritises areas for action in a phased manner. New antibiotics alone will not be sufficient to mitigate the threat of antimicrobial resistance. Their development should go hand in hand with infection prevention and control activities and fostering of appropriate use of existing and future antibiotics through stewardship measures.

It recognises that cross-sectoral cooperation at all levels is the only approach to effectively tackling this modern threat.

We thank the National Interdepartmental AMR Consultative Committee for their leadership and commitment to tackling AMR. The valuable engagement of all stakeholders and partnerships throughout the development of this plan must also be acknowledged. The plan will build on the structures we already have in place for tackling AMR. We are confident that in this plan, a co-ordinated national 'One Health' response to AMR is outlined for the future.



Mr Simon Harris T.D.



Mr Michael Creed T.D.

Departmental Foreword



Dr Tony Holohan
Chief Medical Officer



Dr Martin Blake
Chief Veterinary Officer

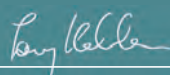
AMR has been described by the World Health Organisation as “a crisis that must be managed with the utmost urgency”. It is estimated, that by 2050, if the world does not address this risk, AMR will be responsible for 10 million deaths annually (more than are currently lost to cancer) and will have cost USD\$100 trillion in lost global production.

AMR is the ability of micro-organisms to continue to cause infections and disease in the presence of medicines that were capable of counteracting those infections and diseases in the past. AMR threatens to undo many of the lifesaving advances in human health care that have been made over the last 100 years (surgery, cancer treatment, organ transplantation etc.).

For these reasons, AMR is now receiving worldwide attention at the highest levels (United Nations, World Health Organisation, World Organisation for Animal Health, European Commission). At the national level, *i*NAP has been developed by both Departments with guidance from the National Interdepartmental AMR Consultative Committee, and in consultation with principal stakeholders across the human and animal health sectors.

This plan seeks to build on actions already being taken by each sector separately, in pursuit of the overall goal of seeking to reduce the overall quantities of antibiotics being used. This can only be done by ensuring antimicrobials are used only where they are absolutely needed, and by reducing the demand for antimicrobials in the first place by reducing the spread of infections and disease. Evidence has shown that these actions will slow the rate at which resistance develops, preserving the effectiveness of existing treatments, and may even help certain antimicrobials to recover their effectiveness.

*i*NAP is Ireland's commitment to action. We all must take action today, if we and future generations are to have access to effective antibiotics tomorrow. We recognise that there are challenges ahead, but we believe this action plan sets out a structured framework for working effectively together across all sectors of Irish society to tackle the serious threat we all face.



Dr Tony Holohan



Dr Martin Blake

Key concepts and definitions

What is 'One Health'?

The 'One Health' concept promotes a "whole of society" approach which recognises that the health of people is connected to the health of animals and the environment. The goal of the 'One Health' concept is to encourage multidisciplinary collaborative efforts across different sectors such as health, agriculture and the environment to achieve the best health outcomes for people and animals.

What are Healthcare Associated Infections (HCAIs)?

A healthcare-associated infection is an infection that is acquired after contact with the healthcare services. This is most frequently after treatment in a hospital, but can also happen after treatment in outpatient clinics, nursing homes and other healthcare settings. Healthcare-associated infections that are picked up in hospital are also known as "hospital-acquired infections".

The five most common HCAIs are:

- Surgical site infection.
- Pneumonia.
- Urinary tract infection.
- Bloodstream infection.
- Gastroenteritis.

What is Antimicrobial Resistance (AMR)?

Antimicrobials are medicines used to treat infections or disease, and are essential in both human and animal health. Antimicrobial resistance occurs when an antimicrobial that was previously effective, is no longer effective to treat an infection or disease caused by a microorganism.

The development of resistance is a natural phenomenon that will inevitably occur when antimicrobials are used to treat disease. The problem at present is that the sheer volume of antimicrobials being used globally in humans, animals and in other situations is leading to significant increases in the rate of development of resistance with the result that common infections are becoming more difficult to treat and microorganisms that are resistant to many antimicrobials, so called 'superbugs', are emerging.

Whilst the term antimicrobial resistance is used throughout this document-much of the detail, and the activities in this, Ireland's first national action plan on AMR are focussed specifically on antibiotic resistance.

What is the difference between antibiotic and antimicrobial resistance?

Antibiotic resistance refers specifically to the resistance developed by bacteria to antibiotics. Antimicrobial resistance is a broader term, encompassing resistance to drugs to treat infections caused by other microbes, such as mycobacteria (e.g. *M. tuberculosis*), parasites (e.g. malaria), viruses (e.g. HIV) and fungi (e.g. *Candida* spp. and *Aspergillus* spp.).

What is Antimicrobial stewardship?

Antimicrobial stewardship is a systematic approach to optimising antimicrobial therapy, through a variety of structures and interventions. Antimicrobial Stewardship includes not only limiting inappropriate use but also optimising antimicrobial selection, dosing, route, and duration of therapy to maximise clinical cure, while limiting the unintended consequences, such as the emergence of resistance, adverse drug events, and cost.

Please note hyperlinks are represented as blue text in this document. If viewed on the PDF version, clicking on these words will direct the reader to the link.

Introduction

Ireland's National Action Plan on Antimicrobial Resistance 2017-2020 (iNAP) recognises the urgent and growing problem of antimicrobial resistance for human health worldwide. It aims to implement policies and actions to prevent, monitor and combat AMR across the health, agricultural and environmental sectors. Reducing the inappropriate use of antimicrobial medicines, as well as preventing the transmission of infections and disease, is vital to stop the development and spread of resistant microorganisms.

iNAP provides a situational analysis overview for the health, agricultural and environmental sectors. It presents key strategic interventions for tackling antimicrobial resistance in line with World Health Organisation (WHO) requirements across the three sectors. These interventions represent Ireland's commitment to the development and implementation of a holistic, cross-sectoral 'One Health' approach to the problem of antimicrobial resistance. They should not be viewed as optional but rather as the basic requirements to ensure the rational use of antimicrobials which can ensure optimal outcomes for those who are patients today and, as importantly, for those who will be patients tomorrow.

The 'One Health' concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of healthcare for humans, animals and the environment. Recognising that human health, animal health and environmental health are inextricably linked, 'One Health' seeks to promote, improve and to defend the health and wellbeing of all by enhancing cooperation and collaboration between all those involved in the protection of human health, animal health and the environment and by promoting strengths in leadership and management to achieve these goals.

Importance of antimicrobial medicines

Since the 1940s, antimicrobial medicines have substantially reduced mortality from infectious diseases and have provided protection against infectious complications for many modern medical practices including surgery, neonatal care and cancer treatment. Surgery, organ transplantation and many advances in modern medicine could not be safely carried out without effective antimicrobial cover.

Antimicrobial drugs are similarly widely used in animal health where they are important tools for the treatment of disease in the farming and companion animal sectors. Their availability and use in farm livestock is of vital importance to the protection of animal welfare, and in the treatment of diseases in animals, including zoonotic diseases (diseases that may be transmitted from animals to humans).

Emergence of AMR as a national risk

AMR is resistance of a microorganism to an antimicrobial drug that was originally effective for treatment of infections caused by it. The extensive use, misuse and overuse of antimicrobials in human health has increasingly raised levels of antimicrobial resistance in a wide range of pathogens in all countries and in patients of all age groups. In the animal population, the rate of development and spread of antimicrobial resistance has also increased. The increasing global demand for affordable food, and in particular animal protein has led to intensification in certain animal sectors, which can

result in higher potential risks of disease outbreaks. Therefore a strong reliance on availability of effective antimicrobials to treat disease and protect animal welfare has occurred.

If AMR continues to rise it will become increasingly difficult and expensive to control and treat infections in medical care. The financial costs of treating antimicrobial-resistant infection places a significant burden on society. This is likely to increase as the number of drug-resistant infections increases. Patients infected with drug-resistant microorganisms are more likely to remain in hospital for a longer period of time and to have a poor prognosis. European estimates indicate that approximately 4.1 million patients are likely to acquire a HCAI in the EU each year with 37,000 attributable deaths (ECDC 2017). The burden of HCAI is also reflected in significant economic losses. According to the ECDC, these infections account for approximately €7 billion in lost production per year. HCAs are identified as a major source of harm in 2.4% of hospitalisations in recent [Canadian](#) research.

There are also increasing concerns about the role the environment may play in the spread of clinically relevant antimicrobial resistance. Environmental regulators monitor and control some of the possible pathways responsible for the release of antimicrobials into the environment, e.g. through water contamination and agricultural run-off. However a greater understanding of many of the key issues in relation to the environmental role will further enhance the delivery of environmental protection from AMR.

The rise in antimicrobial resistance is thus one of the greatest potential threats to human health at global, European and national levels with serious consequences for public health, animal health and welfare.

The Irish Government's National Risk Assessment (NRA) document identifies strategic risks which may have an adverse impact on Ireland's wellbeing and aims to ensure that appropriate prevention and mitigation frameworks are in place. Antimicrobial resistance has been identified as a national risk in the NRA since 2014. These documents recognise that the advances achieved as a result of the use of antimicrobial agents are now seriously in jeopardy because of the emergence and spread of resistant bacteria against which an increasing number of antibiotics are ineffective. In addition, the NRA highlights that if the level of AMR continues to rise, it will become increasingly difficult and expensive to control and treat infections in medical care, and more difficult to maintain animal health and welfare. AMR is also included on the Department of Health's Risk Register and has also been escalated on the Health Service Executive's (HSE) Risk Register.



Global AMR action plans

There is global recognition of the need for all countries to develop a plan to tackle AMR. To this end a *Global Action Plan on Antimicrobial Resistance* was adopted in 2015 by all countries, through the decisions of the WHO World Health Assembly, the Food and Agriculture Organisation (FAO) Conference and the World Assembly of World Health Organisation for Animal Health (OIE). *iNAP* was developed having regard to the requirements of the *WHO Global Action Plan on AMR (2015)* and EU Council Conclusions (17 June 2016) on "*The next steps under a 'One Health' approach to combat antimicrobial resistance*". In September 2016, the United Nations General Assembly made a commitment to address the challenge of AMR, with Heads of State agreeing to a sustainable, multisectoral approach. This was only the fourth time in history that a health issue has been discussed at the General Assembly (previous issues raised have included HIV and Ebola).

The European Commission (EC) has committed to continue and scale up its fight against AMR, with the launch in June 2017 of a second action plan '*A European One Health Action Plan against Antimicrobial Resistance (AMR)*'. This new action plan will focus on supporting Member States, particularly in establishing, implementing and monitoring their national action plans. The plan will bring together EU funds and instruments in order to promote innovation and research in the area of AMR. The plan also aims to strengthen the EU's global leadership role, notably with international organisations and major trading partners.

Development of Ireland's National Action Plan on AMR

In recognition of the serious and increasing threat of antimicrobial resistance, and the requirement for a 'whole of Government' approach to health issues, the Department of Health's Chief Medical Officer and the Department of Agriculture, Food and the Marine's Chief Veterinary Officer established a high level National Interdepartmental AMR Consultative Committee in 2014. Taking a 'One Health' approach, this Committee has provided guidance in relation to the development of *iNAP* in line with the five strategic objectives established in the *WHO's Global Action Plan on AMR (2015)*. Both

Departments engaged in consultation with their respective stakeholders and sought input to inform the five strategic objectives and associated activities. The Department of Health held two workshops with a wide range of stakeholders in the 'health family' and engaged throughout the drafting process with the RCPI/HSE National Clinical Advisory Group on HCAI AMR. Consultation with the Private Hospitals Association was held. In addition a desktop examination of international AMR Actions Plans was conducted to inform *i*NAP.

Aim of Ireland's National Action Plan on AMR

The overall goal of *i*NAP is to ensure, for as long as possible, the availability of effective antibiotic treatment options for both human and animal populations, with safe medicines that are quality-assured, used in a responsible way, and accessible to all who need them.

More specifically, *i*NAP aims to:

Improve awareness and knowledge of AMR

through information campaigns, education, intelligence and data

Enhance surveillance of antibiotic resistance and antibiotic use

through surveillance systems that facilitate greater standardisation of data collection, data linkage and sharing of real time information

Reduce infection and disease spread

through infection and disease prevention and control measures, including national guidelines and standards in relation to hygiene and biosecurity practices

Optimise the use of antibiotics in human and animal health

through development and implementation of antimicrobial stewardship programmes, promotion of prudent prescribing practices and access to rapid diagnostics

Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions

through measuring evaluable costs of HCAI/AMR, identifying research opportunities and working with key stakeholders to develop alternative disease treatment tools.

There are solutions. Effective antimicrobial stewardship, as well as infection and disease prevention and control in hospitals and on farms, can significantly reduce antimicrobial use; the incidence of healthcare associated infections and on-farm diseases; lengths of stay for patients in hospitals, and the prevalence of resistant pathogens not only in humans and animals, but also in the environment.

Improved surveillance systems, with the generation of essential information, can promote responsible antibiotic use in hospitals, the community and in agriculture; and can provide information in relation to the prevalence and pattern of resistant bacteria. Education has a pivotal role to play for all stakeholders – healthcare workers, laboratory staff, veterinarians, farmers and the general public.

This is an ambitious plan. It sets out a comprehensive roadmap to tackle AMR in Ireland. It is intended to design implementation and evaluation processes encompassing 'One Health' and sector specific

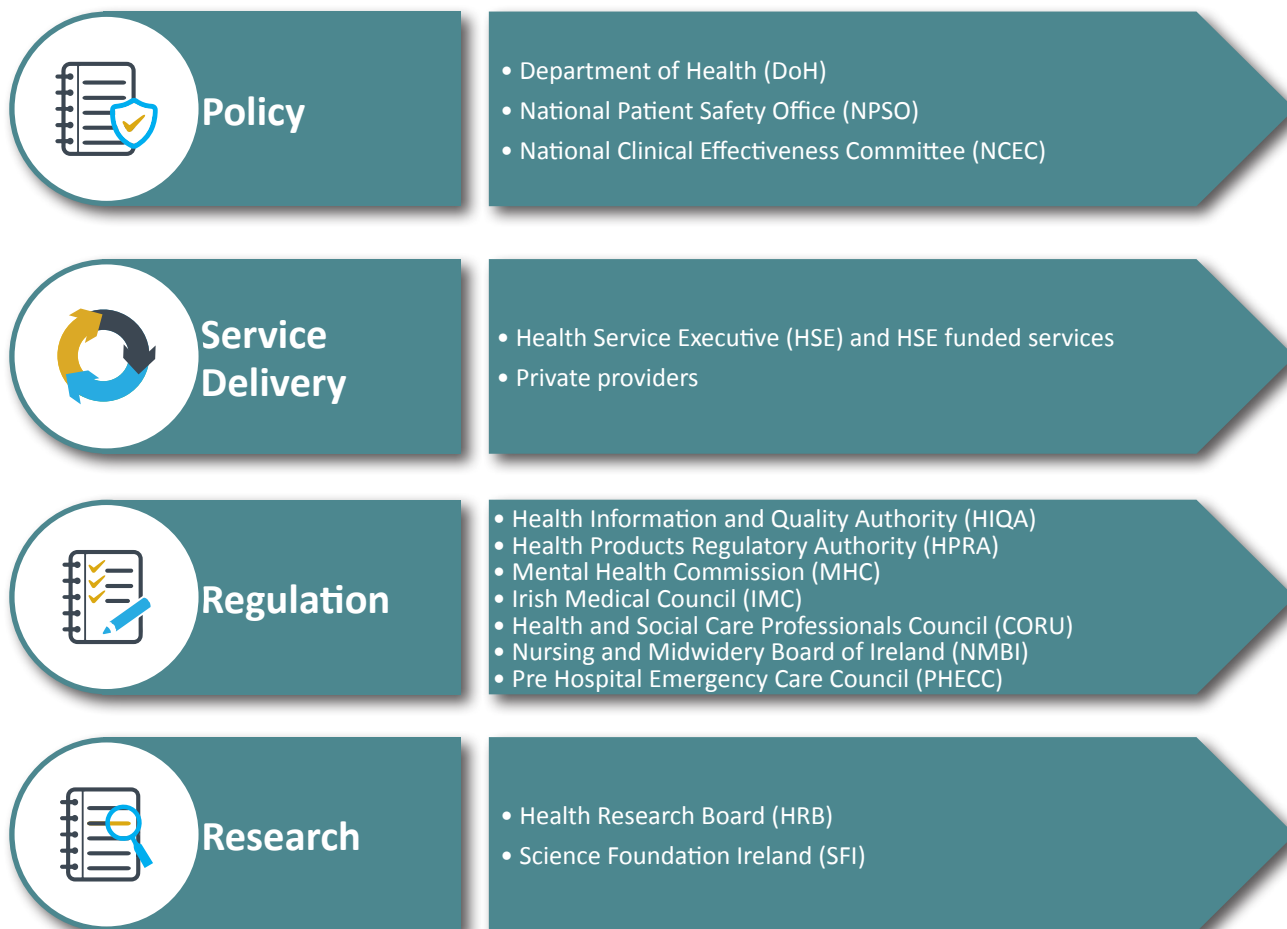
timeframes identifying responsible bodies for each activity over the lifetime of the plan. In the certain sectors, a decision was made to identify certain activities beyond the 3-year lifetime of *i*NAP in order to inform the next action plan, minimise fragmentation of the approach to the required interventions and activities and ensure a comprehensive AMR plan for Ireland. Action is needed now, not just in the human and veterinary medicine sectors, but also from agriculture, finance, environment and education as well as from citizens themselves at global, European and national level. This plan recognises that no one solution will work in isolation.

Section 2

Situational analyses and assessment – Human Health

2.1 Introduction

In Ireland, healthcare delivery is accomplished through a system of healthcare organisations, including public hospitals, private hospitals and community care. Community care is provided by general practice, public and private primary care providers and public and private long-term residential care. In addition to this frontline delivery of care there are a range of organisations which support and regulate, including the Health Protection Surveillance Centre (HPSC) and national microbiological reference laboratories, the Health Information and Quality Authority (HIQA) and the Health Products Regulatory Authority (HPRA). The National Patient Safety Office (NPSO) and the National Clinical Effectiveness Committee (NCEC) at the Department of Health also support this work. In addition, there are a broad range of health professionals with AMR responsibilities from infection prevention to surveillance to optimal use of antibiotics. This group includes doctors, nurses, pharmacists, surveillance scientists, laboratory personnel, dentists and allied health professionals.

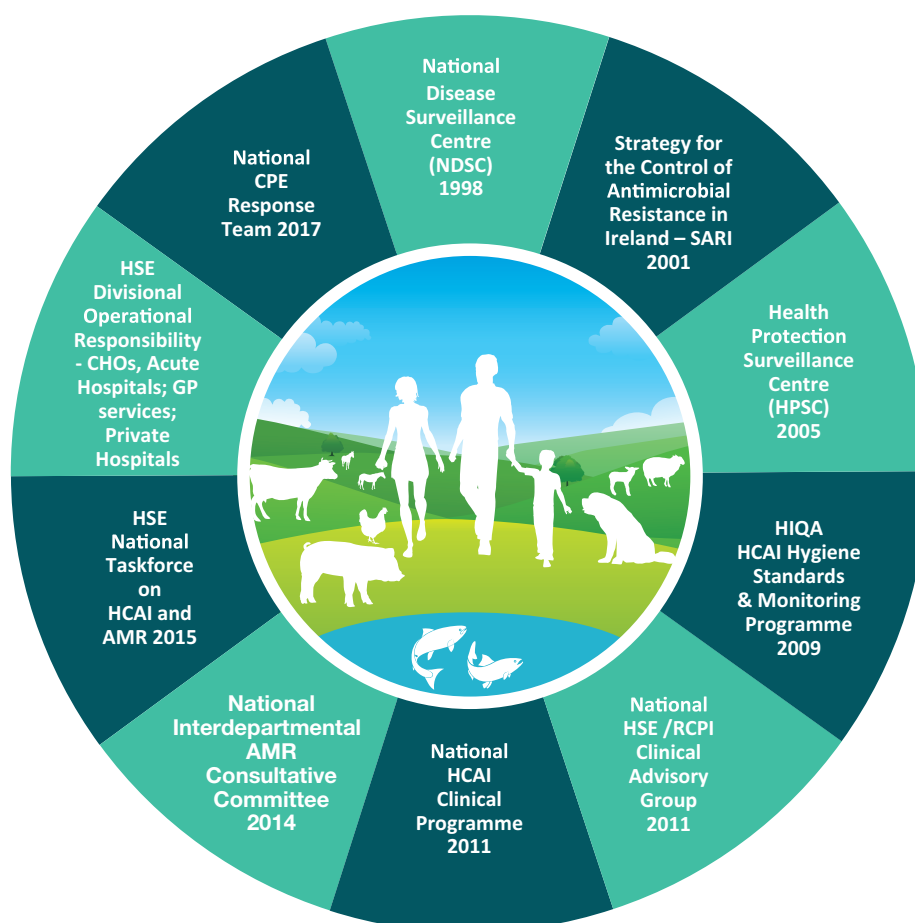


AMR and the prevention and management of HCAs should be central to the role of all organisations and staff involved in the provision of healthcare in Ireland, whether in the public or private, hospital or community settings. A wide range of initiatives aimed at educating and supporting staff and their organisations in combatting AMR and HCAs have been put in place over several years. These include improved surveillance of infections, prudent prescribing, infection prevention and control standards, antimicrobial stewardship initiatives, public and professional awareness raising and a significant emphasis on the education and training of healthcare professionals.

These initiatives have resulted in substantial improvements in the approach to and the management of AMR and HCAs in Ireland. An annual Point Prevalence Survey (PPS) (Point in time Survey) across a range of public and private hospitals suggests that the overall use of antimicrobial therapies has remained stable at approximately 35% to 40% since 2009. This means that on any given day 35-40% of patients in our hospitals are on an antibiotic to treat an infection or prevent them getting an infection. Furthermore, in 2016, the proportion of cases of *Staphylococcus aureus* (*S. aureus*) which were resistant to methicillin (MRSA) was the lowest since surveillance began in 1999.

These improvements are welcome and represent progress made in recent years, through specific initiatives put in place and the commitment of key groups, agencies and health professionals as outlined below.

Figure 1: Key groups, agencies and health professionals.



Many of these initiatives and achievements, have been confined to particular organisations or settings (as set out later in this section) and substantial challenges remain for our system as a whole. For example, specialised infection prevention and control and antimicrobial stewardship resources, are not widely available in community healthcare settings in Ireland. There is wide variation in the use of antibiotics in the community and in our hospitals. We still have one of the highest proportions of MRSA in Europe, while the number of cases of invasive *E. coli* and *K. pneumoniae* are among the most frequent causes of urinary tract and wound infections. These are resistant to certain antibiotics and the proportion of cases continue to rise year-on-year. In addition, improved surveillance systems are required nationally so that emerging problems across care settings can be more effectively identified, and acted upon at an appropriate level.

In order to address these challenges, those tasked with implementation of this iNAP will need to ensure that future initiatives are strategically driven and nationally coordinated so that they cross organisational boundaries and healthcare settings, thereby enabling a whole system approach to tackling AMR and HCAs in Ireland.



2.2 Health service delivery

2.2.1 Health Service Executive (HSE)

The HSE provides all of Ireland's public health services in hospitals and communities across the country. Through various structures a wide range of initiatives have been put in place over several years to address AMR. These include improved surveillance of infections, prudent prescribing, infection prevention and control standards, antimicrobial stewardship initiatives, public and professional awareness raising and a significant emphasis on the education and training of healthcare professionals. The HSE reports a number of HCAI/AMR Key Performance Indicators (KPIs) in its annual Service Plan and its governance for HCAs and AMR has evolved as outlined in Section 5.

The HCAI and AMR health architecture in Ireland has evolved considerably since the establishment of the Health Protection Surveillance Centre (HPSC) in 1998. (Note that the HPSC was known as the

National Disease Surveillance Centre (NDSC) prior to 2005). The NDSC's original wider remit was subsequently narrowed to focus on communicable disease and it was renamed the HPSC in 2005.

In 2001, the NDSC published the **Strategy for the Control of Antimicrobial Resistance in Ireland (SARI)** at the request of the DoH. SARI was steered by the SARI National Committee and supported by the SARI Sub-Committee that advised on specific areas of SARI implementation, such as promotion of prudent antibiotic use, surveillance and infection control. A HCAI National Governance Group operated from 2007 to 2011.

In 2011, the HSE established a **National Clinical Programme for the Prevention of Healthcare-Associated Infection (HCAI) and Antimicrobial Resistance (AMR)**. The SARI committee handed over its functions to the Clinical Programme. Following from this, the **RCPI HSE Clinical Advisory Group (CAG) on HCAI and AMR** was established in September 2011. The role of the CAG is to provide expert advice to the HSE on development and implementation of infection prevention and control strategies and support systems and structures in the public healthcare system. The role includes advising on development of national HCAI surveillance and quality indicators, include strong support for education and training of healthcare personnel, undergraduate and postgraduate trainees and the general public on prevention and control of HCAI AMR.

In 2015, the HSE established a **National Taskforce on HCAI and AMR**. The Taskforce's role is to ensure that there are systems in place within the HSE to minimise the acquisition of preventable HCAs and multidrug resistant organisms acquisition (e.g. MRSA) and reduce inappropriate antibiotic use. In 2017, a national CPE Response Team was established by the Executive to address the increasing threat of CRE/CPE in the health system. A new National Clinical Lead for HCAI/AMR to direct the work of the response team was appointed.

The Health Protection Surveillance Centre

The HPSC has six main areas of responsibility:

- Surveillance of some of the major communicable diseases. Surveillance means collecting, collating, analysing data and communicating information to those who need to know.
- Operational support providing expert advice to, and responding to requests for support from departments of public health or hospitals.
- Training for professionals working in communicable disease control.
- Research identifying and developing best practice in communicable diseases.
- Policy advice providing advice to government departments and appropriate agencies in relation to the development of standards, guidelines and practices, and promoting the adoption of best practice by different agencies.
- Providing information providing information on infectious diseases to the public and the media.



The HPSC has coordinated surveillance data relating to antimicrobial consumption in acute public hospitals in Ireland since 2007. The HPSC is a national coordinating centre, representing Ireland to the European Centre for Disease Prevention & Control (ECDC) and coordinating Ireland's participation in European Point Prevalence Surveys of HCAIs and antimicrobial use in acute hospitals (2012, with repeat survey due in 2017) and long-term care facilities (2010, 2013 and 2016). The HPSC conducts the Healthcare Associated Infections and Antibiotic use in Long Term Care Facilities (HALT) programme of Point Prevalence Surveys as part of the ECDC work programme.

National surveillance for community antimicrobial consumption has been in place since 2003. Data is based on pharmacy wholesale data, rather than on individual prescriptions, and cover 95% of community antimicrobial consumption in Ireland. Data is collected and published bi-annually on the HPSC website. This dataset allows monitoring of local trends over time, comparison of local with national data and acute hospitals to assess the impact of local antibiotic stewardship programmes and identify targets for future interventions. It also allows comparisons with European antimicrobial consumption data. Further detail is provided in Appendix 3.

Since 1999, the HPSC has coordinated national surveillance of antimicrobial resistance in key causative pathogens of bloodstream infections (BSI) diagnosed by microbiology laboratories as part of the former European Antimicrobial Resistance Surveillance System (EARSS) (now called EARS-Net), with 100% coverage of the Irish population by the surveillance system in 2016. (See further under Information Technology for Surveillance).

The HPSC has also coordinated national systems for surveillance of *C. difficile* infection (CDI) since 2009, hand hygiene compliance audits in acute hospitals since 2011 and alcohol based hand rub consumption surveillance in acute hospitals since 2008. In collaboration with the Irish Association of Antimicrobial Pharmacists, a national annual Point Prevalence Survey (PPS) of antimicrobial use takes place in Ireland each autumn, with data analysed by the HPSC.

The Healthy Ireland Survey (*Hi*) is an annual interviewer administered face-to-face survey commissioned by the Department of Health. It is part of the Healthy Ireland Framework to improve the health and wellbeing of people living in Ireland. The survey data plays a number of roles, including supporting the Department in ongoing engagement and awareness-raising activities in policy areas and supporting policy development. Survey questions regarding prescribing of and understanding of the function of antibiotics were included in the 2016 and 2017 Surveys. The 2017 Survey recorded that 39% of participants were prescribed an antibiotic in the past 12 months. Questions regarding understanding of the correct way to take a course of antibiotics, trust in pharmacists' advice and what antibiotics are effective against were also included.

**“39% of
participants were
prescribed an
antibiotic in past
12 months”**

Healthy Ireland Survey 2017

The Medical Officer of Health (MoH) has the responsibility and authority to investigate and control notifiable infectious diseases, clusters of disease and outbreaks, under the Health Acts 1947 and 1953, and the Infectious Disease Regulations 1981 and subsequent amendments to these regulations. Specialists in Public Health Medicine working in Departments of Public Health in the HSE implement the Medical Officer of Health (MoH) legislation.

The legislative functions of the Medical Officer of Health are:

- Investigation, prevention and control of notifiable infections and outbreaks (Infectious Diseases Regulations, 1981- Regulation 11). Statutory Instrument No. 707 of 2003 - Infectious Diseases (Amendment) (No. 3) Regulations 2003 added disease clusters and changing patterns of illness that may be of public health concern to the conditions that must be notified to the Medical Officer of Health. Authority for this function is outlined in Regulation 19 of the Infectious Diseases Regulations, 1981.
- Notification and Surveillance: Under the Infectious Diseases legislation Medical Practitioners must notify the Medical Officer of Health of notifiable events (cases of notifiable infections, outbreaks, clusters) and must comply with requests for information and directions as above. The Medical Officer of Health in turn must notify the Health Protection Surveillance Centre.
- Detention and isolation of a person who is a probable source of infection.

The responsibility and authority to detain and isolate a person who is a probable source of infection are described under Section 38 of the Health Act 1947 and Section 35 of the Health Act 1953.

Ireland is now a member of the WHO's Global Antimicrobial Surveillance System (GLASS) with the HPSC as a National Focal Point, providing technical surveillance expertise. The GLASS initiative follows on from a key element of the *WHO Global Action Plan on AMR* (2015), namely the coordination and implementation of global AMR surveillance, with a coherent multilateral approach. GLASS has been developed to foster standardised AMR surveillance globally. GLASS enables comparable and validated actionable data on AMR to be collected, analysed and shared with countries and partners.

Information technology for surveillance

The HSE's Departments of Public Health use a Computerised Infectious Disease Reporting (CIDR) information system developed to manage the surveillance of infectious diseases in Ireland. This system is based on laboratory and clinical notifications that are notifiable under the Infectious Diseases (Amendment) Regulations 2016 (S.I. No. 276 of 2016). It also provides for surveillance of antimicrobial resistance although this only occurs for a limited number of organisms and does not monitor HCAs or AMR.

CIDR is a shared web-based national information system for the CIDR partners - the HSE, HPSC, Food Safety Authority of Ireland (FSAI), the Food Safety Promotion Board (Safefood) and the Department of Health. All information in CIDR is held in a single shared national information repository with information from laboratories entered electronically or manually. This is then linked to clinical and epidemiological information, provided by public health professionals. It is hosted by the HPSC which produces weekly, quarterly and annual reports which are published on its website.

Ireland is one of 31 countries contributing to EARS-Net, which aims to provide comparable and validated data on the prevalence and spread of major invasive bacteria with clinically and epidemiologically relevant antimicrobial resistance in Europe. This data is provided voluntarily by all laboratories and is based on laboratory capacity and ability to extract data from their information systems. Data from the enhanced EARS-Net system can identify changes in the association of infection over time (e.g. community or healthcare-associated), identify potentially preventable sources of bloodstream infection (e.g. Intravenous Lines (IV) lines and urinary catheters) and help track the progress of improvement programmes. The ultimate aim is to improve overall patient safety. Public Health departments do not have access to this information system; the system is shared between hospital labs, HPSC and EARS-Net.

National Laboratory System

A HSE report '*Development of Clinical Microbiological Reference Laboratory Services within the Health Service Executive (2013)*' outlines the existing formal and informal Microbiology Reference Laboratory Services that are provided throughout the country. It identifies gaps in the service provided and makes recommendations regarding the need to restructure Microbiology Reference Laboratory Services around a number of grouped pathogen areas. The Report also suggests the possibility for sharing existing reference facilities for food, feed and animal health provided by the Department of Agriculture, Food and the Marine laboratories. Co-operation and sharing of data on isolates between human health, food and animal health reference laboratories should occur as appropriate.

HSE HCAI AMR Clinical Programme

The HCAI AMR Clinical Programme's overarching principle is that every patient should expect to receive high quality healthcare in a safe environment without acquiring a preventable HCAI or multidrug resistant organism. The Programme is working as part of a larger HSE patient safety focus alongside other established safety programmes e.g. Sepsis and Medication Management Programmes. A HSE National Patient Safety Programme is in progress.

After reviewing the approaches taken by other countries with respect to HCAI and AMR prevention, the Programme's focus on 'getting back to basics' was established. The aim of the Programme is to facilitate and provide healthcare staff with tools to assist with improvement on key areas every time they care for patients, irrespective of the healthcare setting. These are:

- Use antimicrobials appropriately (antimicrobial stewardship).
- Standard precautions including hand hygiene as outlined by the World Health Organisation's '5 moments of hand hygiene'.
- Prevent medical infections associated with medical devices such as intravenous lines and urinary catheters.



The Programme's body of work has included:



- Development in 2012 of national antimicrobial guidelines for common conditions in the community: www.antibioticprescribing.ie which provides up-to-date guidance (most recently 2016) on antibiotic prescribing for GPs, dentists and others working in non-acute settings.
- Development and launch in 2014 of the HSE's website. This website provides practical advice for the public on minding themselves and their family when sick and information on prudent use of antibiotics.
- Development of a 'Start Smart then Focus' antibiotic care bundle collaborative with acute hospitals participating in improvement work related to antibiotic prescribing. This initiative was incorporated into the NCEC National Clinical Guideline No. 6 Sepsis Management in 2014.
- Implementation of an antimicrobial audit tool for acute hospitals and GPs.
- A 2014 guide: 'Preferred antibiotics for primary care' to help primary care prescribers to reduce unnecessary use of broad spectrum antibiotics. (Figure 2)
- Antimicrobial stewardship project in out-of-hours GP settings with both patient and prescriber education.
- STOP campaign for IV lines implemented in acute hospital Emergency Departments (EDs).
- Establishment of a Community Infection Prevention and Control Nurses' (CIPCN) network for nurses in non-acute settings to meet, share ideas and begin work on agreed projects.
- Hand Hygiene Train the Trainer programme to provide face-to-face training in hand hygiene for non-acute settings.
- In 2016, the HSE introduced a National Policy on Restricted Antimicrobial Agents for acute hospitals; the Policy instructed that access to carbapenems must be restricted and that restrictions of access to other critically important antimicrobials should also be considered. A policy for primary care settings has also been developed.





Antimicrobials regulation, availability, prescribing guidance and cost

The HSE's multi-disciplinary Medicines Management Programme (MMP) was established in 2013. It is headed by the National Medicines Information Centre (NMIC) and the National Centre for Pharmacoeconomics (NCE) in collaboration with the [HSE-Primary Care Reimbursement Service](#) (HSE-PCRS). The MMP aims to provide sustained national leadership relating to issues such as the quality of the medicines management process, access to medicines and overall expenditure on medicines in primary care.

In conjunction with the HCAI AMR Clinical Programme, the MMP developed the preferred antibiotics for primary care. These are based on the national primary care guidelines for antimicrobial prescribing (www.antibioticprescribing.ie). Primary care encompasses GPs, dentists and others working in community settings.

Figure 2: Preferred antibiotics in primary care.

 Preferred Antibiotics in Primary Care		
<p>In many cases in Primary Care the Preferred Antibiotic is No Antibiotic</p> <p>See www.antibioticprescribing.ie/ Below are the preferred first line treatment choices when antibiotics are indicated and which antibiotics we should reduce the use of, to minimise resistance.</p>		
Respiratory Infections (upper and lower)	Urinary Tract Infections	Soft tissue infections – cellulitis, acne
Penicillin V (phenoxymethylpenicillin) Calvopen®	Trimethoprim	Flucloxacillin
Amoxicillin	Nitrofurantoin	Doxycycline
Doxycycline	Fosfomycin	Lymecycline (Tetralysal®)
Amoxicillin and Clarithromycin if Community Acquired Pneumonia (CAP)	Cephalexin	Trimethoprim
Clarithromycin if true penicillin allergy or specific clinical indication		
 Antibiotics to be avoided First Line in Primary Care		
Co-amoxiclav (unless animal or human bite, facial cellulitis, post partum endometritis, caesarean wound infections, pyelonephritis)	Azithromycin – only on advice of consultant or if treating STI	
Ciprofloxacin (only in proven resistant UTI or acute prostatitis)	Moxifloxacin – only on consultant advice	
Most third generation cephalosporins	Macrolides (unless TRUE PENICILLIN ALLERGY or specific indication e.g. mycoplasma, helicobacter eradication)	
Clindamycin		

The SARI Hospital Antimicrobial Stewardship Working Group published guidance on antimicrobial stewardship in hospitals in 2009 and made a number of recommendations for medicines management related to antimicrobial use including:

- Rational antimicrobial usage in hospitals should be a strategic goal of the HSE.
- All acute hospitals should have an antimicrobial stewardship programme in place.
- Hospital managers and/or chief executives should be required to provide annual evidence of their hospitals' performance in relation to each programme's effectiveness.
- Appropriate, trained specialised personnel are provided to enable effective stewardship programmes to be developed.
- National prescribing guidelines should be developed.
- There should be a national programme to advance clinical pharmacy services in hospitals.

- Pharmacy information technology systems should be developed to meet the increased audit and surveillance requirements that stewardship programmes demand.
- The HSE should explore the potential benefits of developing electronic patient records, electronic prescribing and computer-based surveillance in all hospitals.
- Training from academic and professional bodies should be provided for all staff involved in antimicrobial prescribing, handling and administration.

In Ireland, antimicrobials for human health are subject to prescription control. In addition, the supply of prescription only medicines by mail order, including via the internet, is prohibited in Ireland - (Medicinal Products (Prescription and Control of Supply) Regulations 2003, (S.I. No. 540 of 2003), as amended). Pharmacy services in Ireland are subject to the Pharmacy Act 2007 and are regulated by the Pharmaceutical Society of Ireland (PSI).

Multiple approaches to support the introduction of a new antimicrobial should be examined, including:

- Electronic alerts to notify prescribers about the antimicrobial.
- Prescribing guidance about when and where to use the antimicrobial in practice.
- Issuing new or updated formulary guidelines and antimicrobial prescribing guidelines.
- Peer advocacy and advice from other prescribers.
- Providing education or informal teaching on ward rounds.
- Shared risk management strategies for antimicrobials that are potentially useful but may be associated with patient safety incidents.

In 2015 HIQA published *Medicines Management Guidance* for providers of services to older people and for those with disabilities in designated centres. This Guidance is not specific to individual drugs or therapeutic classes but rather outlines best practice for those tasked with assessing, supplying, prescribing, dispensing, administering, reviewing and assisting people with their medicines.

HIQA published its first report on antimicrobial stewardship in acute hospitals in Ireland: *Report of the Review of Antimicrobial Stewardship in Public Acute Hospitals* 2016. This Report defines antimicrobial stewardship as activities which “aim to ensure that every patient receives the right antimicrobial therapy at the right dose, route and duration, and for the right infection type at the right time”. It also noted that higher performing hospitals had demonstrated success in the development of:

- Regularly reviewed evidence based empiric prescribing guidelines.
- Protected antimicrobial prescribing rights for key strategic antimicrobial agents.
- Point-of-care interventions.
- Good collaboration between hospitals to make best use of resources.
- The integration of antimicrobial stewardship with wider medication safety and risk management programmes.

However, the Report also noted that a small number of hospitals did not have a Drugs and Therapeutics Committee (DTC) in place to oversee the antimicrobial stewardship programme. This

was cited as a concern both with respect to antimicrobial stewardship but also in relation to wider medication safety.

In 2016, HIQA commenced its 'Medication Safety Monitoring Programme' in public hospitals. The initial focus is on a baseline review of the governance and operation of medication safety programmes to support positive patient outcomes. While this looks at a wider medication safety approach, it includes assessment of policies and procedures, patient involvement and risk management; all of which are key building blocks for prudent antimicrobial stewardship.



2.2.2 Private hospitals

The Private Hospitals Association (PHA) comprises of 19 hospitals that provide acute and mental health services throughout Ireland. It is the representative body for the independently-funded hospital sector in Ireland. Private Hospitals in Ireland must be accredited by internationally recognised Quality Accreditation organisations, most frequently the Joint Commission International (JCI) and alternatively CHKS (provider of healthcare intelligence and quality intelligence services). Compliance with international best practice standards, including standards addressing antimicrobial resistance is assessed, along with hospitals' compliance with national standards. The most recent revision of JCI standards places considerable additional emphasis on antimicrobial stewardship in line with WHO best practice. This sector identifies that it has infection prevention policies and practices in place and that it is already audited and monitored to achieve accreditation.

The PHA has indicated that it would welcome the opportunity to collaborate and participate in national infection prevention and control programmes, including national policy guidelines in the use of antimicrobial medicines.

2.2.3 Irish College of General Practitioners (ICGP)

The ICGP is the professional body for general practice in Ireland. The College's primary aim is to serve the patient and the general practitioner by encouraging and maintaining the highest standards of general medical practice. It is the representative organisation on education, training and standards in general practice. The ICGP is the recognised body for the accreditation of specialist training in general practice in Ireland and is recognised by the Irish Medical Council (MC) as the representative academic body for the speciality of general practice. Members and associates of the ICGP comprise over 85% of practising GPs in Ireland.

Irish GPs provide lifelong care to both private and public patients i.e. those that are covered by the general medical services scheme (GMS). They provide medical care in many Long-Term Care Facilities (LTCF), both in the private and public sector. They also provide out-of-hours care (OOH) to all the population. The ICGP has representation on HPSC, RCPI, HSE, CAG and the HCAI AMR clinical programme. The ICGP recommends its members use the preferred antibiotics focusing on more narrow than broad spectrum use. The ICGP HCAI AMR Lead chairs the editorial group of the National Primary Care Antimicrobial Prescribing Guidelines (www.antibioticprescribing.ie).

The [WHO Model List of Essential Medicines](#) (20th March 2017 List) is a valuable reference document for prescribers of antibiotics in all settings.



2.3 Healthcare regulation

2.3.1 Health Information and Quality Authority (HIQA)

HIQA undertakes a rolling programme of thematic inspections in public acute hospitals in Ireland to monitor compliance with the *National Standards for the Prevention and Control of Healthcare Associated Infections 2009*. HIQA publishes approximately 39 reports with an overall summary report annually. The aim of these unannounced inspections is to assess hygiene in the hospital as observed by the inspection team and experienced by patients at any given time. It focuses specifically on the observation of the day-to-day delivery of services and, in particular, environment and equipment cleanliness and compliance with hand hygiene practice. The Standards have been reviewed and updated. *National Standards for Prevention and Control of Healthcare Associated Infection in Acute Hospital Services* were published in May 2017.

In 2015, HIQA conducted a review of antimicrobial stewardship in 49 acute public hospitals. Each hospital completed a self-assessment questionnaire on the local antimicrobial stewardship programme (ASP) and 14 were selected for HIQA announced inspection visits. This resulted in the publication of the *Report of the Review of Antimicrobial Stewardship in Public Acute Hospitals (2016)*. HIQA found a progressive approach to monitoring antimicrobial consumption and commented that the HSE has established good systems for recording and benchmarking antimicrobial prescribing, and for recording and comparing antimicrobial resistance rates for serious infections with other European countries. The Report also made recommendations for Government, HSE, HPSC and hospitals to strengthen antimicrobial stewardship in Ireland.

HIQA also has a role in carrying out monitoring inspections of long term care facilities in the private healthcare sector under the *National Quality Standards for Residential Care Settings for Older People in Ireland (2016)* which includes standards for hygiene and infection control.



2.3.2 The Health Products Regulatory Authority (HPRA)

The HPRA's role is to protect and enhance public and animal health by regulating medicines, medical devices and other health products. The HPRA provides a human medicines product database, which is a comprehensive, up-to-date listing of all medicines that have been granted a licence by the HPRA so that they can be marketed in Ireland. The list includes all prescription and over-the-counter medicines. The summary of product characteristics document (known as SmPC) is also provided for each medicine and is a key resource for healthcare professionals. The package leaflet which includes information for patients and members of the public is also available for a number of medicines.

The HPRA is proactive in harmonisation, modernisation and communication of product labelling for older antibiotics using a variety of regulatory tools. It assesses the environmental impact of antibiotics to evaluate and limit potential adverse environmental effects.

2.3.3 National Clinical Effectiveness Committee (NCEC)

Ireland is developing clinical effectiveness through the NCEC, established by the Minister for Health in 2010. The NCEC's role is to recommend guidelines and audit to the Minister for Health to become National Clinical Guidelines (NCG) and National Clinical Audit (NCA) for implementation in Irish healthcare. Currently, it does this by:

- Prioritising clinical guidelines according to key criteria.
- Assessing clinical guidelines against internationally accepted criteria. This ensures that NCGs are based on best available evidence, have involved key people, including patients, in their development and have examined the cost involved in implementation.

Clinical guidelines that successfully go through these steps are recommended to the Minister for Health through the Chief Medical Officer for endorsement and publication as NCEC National Clinical Guidelines. A similar process occurs for clinical audit.

The implementation of clinical guidelines can improve health outcomes for patients, reduce variation in practice and improve the quality of clinical decisions that patients and healthcare staff have to make. NCGs inform patients about the care they should be receiving and assist them to make healthcare choices based on best available information. NCGs can be used to set the standards for measurement in clinical audit.

NCGs that guide practice in relation to HCAI/AMR are:

- NCG No. 2 on Prevention and Control Methicillin-resistant *Staphylococcus aureus* (MRSA) (2013); an update of the previous guideline first published in 1995 with two subsequent revisions.
- NCG No. 3 on Surveillance, Diagnosis and Management of *Clostridium difficile* infection (2014) was an update of the previous guideline first published in 2008. (An update of No. 2 and No. 3 is intended as part of a composite HCAI guideline).
- NCG No. 6 on Sepsis Management (2014) received accreditation by the UK National Institute of Health and Care Excellence (NICE) in 2015. In 2012, the RCPI Hospital AMR Stewardship Working Group adopted a 'Start Smart, then Focus' Antibiotic Care Bundle. This was incorporated into the guideline. An update of No 6 is underway.
- Clinical handover is a key point for communicating issues on infection management and antibiotic therapy. It is guided by - NCG No. 5 Communication (Clinical Handover) in Maternity Services (2014) and NCG No. 11 Clinical Handover in Acute and Children's Hospitals (2015).

In 2015, the *National Standards for Clinical Practice Guidance* were published by the NCEC. These Standards help healthcare staff develop quality policies, procedures, protocols and guidelines (PPPGs) by using an agreed approach nationally. Sharing of best practice will optimise the use of health service resources and expertise.

In 2016, the HSE developed a national framework for developing PPPGs in line with the NCEC standards and plan to establish a HSE National Central Repository.

2.4 Workforce planning for the future

Workforce planning for infection prevention and control and AMR should provide for a workforce that is sustainable, appropriately skilled, agile and patient focused. Effective infection prevention, awareness, surveillance, outbreak control and AMR activities requires processes to ensure that

sufficient staff will be available at the right time, with the right skills, diversity and flexibility to deliver high quality care. Workforce planning must be integrated with service and financial planning and encompass principles for guiding better workforce planning decisions. This structured approach should build capacity for the development of an evidence-based Workforce Plan for the prevention, surveillance and management of HCAs and AMR. This Workforce Plan should identify the optimum team competencies and composition for hospital and community care.

The Workforce Plan should have a specific focus on infection prevention, outbreak control and AMR containment. Outbreak Control Teams (OCTs) consisting of the appropriate combination of expertise should be fully developed across all Community Healthcare Organisations (CHOs) and Hospital Groups. Teams consisting, as appropriate, of a Consultant Microbiologist, Consultant Geriatrician, Infection Prevention and Control Nurses (IPCNs), Antimicrobial Pharmacist, Director of Nursing for IPC, a GP Lead, HCAI/AMR Lead, clerical and support staff should be part of infection prevention and control plans, fully supported at management and group level. Teams should be integrated across hospital and community as appropriate. Both the scheduled and unscheduled acute, non-acute, community and private healthcare sectors should have robust protocols in place for the management of infection prevention and control in their organisation.

2.5 Research

A significant and highly effective research community in infectious diseases exists in Ireland with particular strengths in antibiotic prescribing, MRSA, therapeutics and transmission. A number of Irish funders have provided national research funding for antimicrobial research, including the Health Research Board (HRB), Science Foundation Ireland (SFI), Department of Agriculture, Food and the Marine (DAFM) and Teagasc.

In 2016, the DoH signed up to the *EU Joint Action JA-04-2016 - Antimicrobial Resistance and Health Care Associated Infections* as a collaborative partner (now called EU-JAMRAI). This is one of five Joint Actions funded in 2016 under the third EU Health Programme (2014-2020). The proposed activity for the Department's National Patient Safety Office (NPSO) is to participate in state of the art reviews and development of tools, guidelines and training for supporting and maintaining good practice in clinical care in relation to AMR and HCAI in the hospital, long term care and community settings.



Joint Programming Initiative (JPI)

In 2017, Ireland became a member of the EU Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) with representation on the Management Board from the HRB.

Joint Programming is a Member States-led initiative in Europe which aims to address 'grand challenges' to EU society, by pooling national research efforts to overcome the fragmentation of national research programmes, in order to make better use of Europe's public research and development resources and to tackle common European challenges more effectively in a few key areas. These challenges such as AMR are considered beyond the scope and resources of any one country to tackle and would benefit from a co-ordinated approach to research. JPIAMR is the largest international research initiative aimed at tackling the challenge of AMR through the collaboration of 23 countries.

JPIAMR coordinates national funding and supports collaborative action to fill existing knowledge gaps. JPIAMR's Strategic Research Agenda (SRA) has identified six key priority topics to be supported- i) therapeutics, ii) diagnostics, iii) surveillance, iv) transmission, v) environment and, vi) interventions. To date, 23 countries have joined forces to deliver this SRA which provides a framework to support world-class research on AMR.

JPIAMR works in synergy with other EU research funding initiatives, specifically Framework Programme 8 (Horizon 2020), Innovative Medicines Initiative (IMI) and the ERA-NET scheme (European Research Area scheme), and aims to develop a global approach.

As a member, the HRB contributes funding for relevant joint calls, to enable Irish researchers to participate in the competitive process. There are a number of other EU and national research initiatives related to the AMR agenda including:

- Horizon 2020 ERA-NET Co-fund Work Programme (WP) 2015.
- Horizon 2020 Coordination and Support Action grants (H2020 CSA) on widening global membership WP 2017.
- Horizon 2020 Prize Work Programme (WP) 2017 (Better use of antibiotics – to develop a rapid test that will allow healthcare providers to distinguish at the point of care between patients with upper respiratory tract infections that require antibiotics and those that can be treated safely without antibiotics).
- IMI New Drugs for Bad Bugs (ND4BB) programme 9th call for proposals under IMI 2.
- European Joint Programme Co-Fund Horizon 2020 WP2017 (Work Programme 2020 on One Health (MedVet) led by Department of Agriculture, Food and the Marine under Societal Challenge 2.

Ireland has a high awareness of the need to develop capacity in AMR research and is developing links with European collaborations in order to achieve this.

As part of the implementation of the *Global Action Plan on Antimicrobial Resistance 2015*, the WHO drew up a list of priority antibiotic resistant pathogens to guide research into and the discovery and development of new antibiotics. '*Antibacterial Agents in Clinical Development: An analysis of the antibacterial clinical development pipeline, including tuberculosis*' was published in September 2017

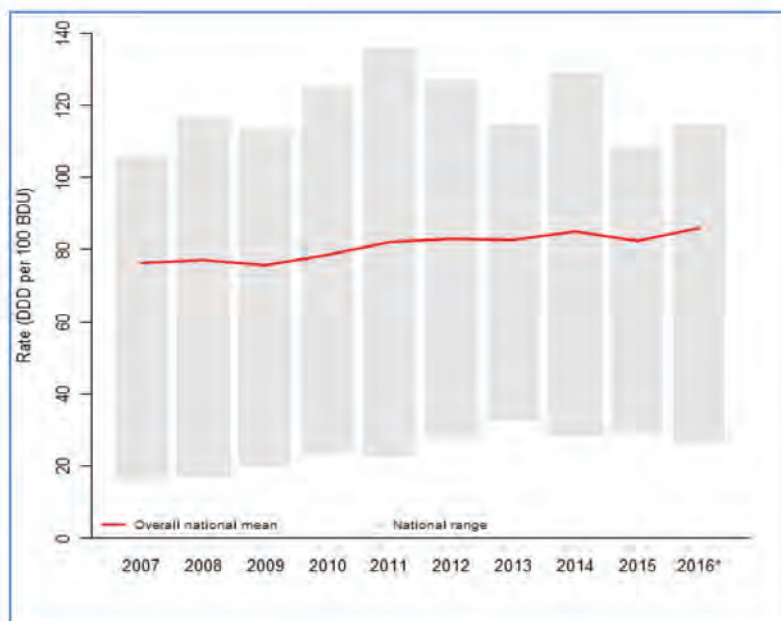
and represents the first steps in understanding the developments in the clinical pipeline for priority pathogens and TB and to identify gaps. The aim is to develop the process and methodology further with input from stakeholders. All data in the WHO report can be downloaded from the [WHO Global Observatory on Health R&D](#).

2.6 Incidence and prevalence of HCAI/AMR

Antimicrobial consumption

Ireland has an established national system for reporting on antimicrobial consumption in acute public hospitals and the community. This system was developed and designed by the HPSC in collaboration with acute hospitals in order to convert raw antimicrobial dispensing data from individual hospital pharmacy departments dispensing records into an internationally comparable unit of usage by agent type (known as the 'defined daily dose' (DDD)).

Figure 3: Hospital antimicrobial consumption in Defined Daily Dose (DDD) per 100 bed days used (BDU) - Data to end Q4 2016. (Source HPSC).



Surveillance of antibiotic usage is one of the key Strategic Interventions of the *i*NAP. Figures 3, 4 and 5 present hospital and community antimicrobial consumption. The majority of human antibiotic consumption in Ireland takes place at community level, thus inclusion of this indicator in the [National Healthcare Quality Reporting System \(NHQRS\)](#) report underlines the importance of having a measure of such consumption.

In both 2016 and 2017 the NHQRS, using data provided by the HPSC, reported the community antimicrobial consumption rates measured in Defined Daily Doses (DDD per 1000 inhabitants per day) from community consumption data. The indicator reported on here is the general indicator "total use, all major antibiotics combined", one of nine general antibiotic consumption indicators developed by the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) to measure antibiotic consumption in primary care in Europe.

The total volume of antibiotics consumed annually has increased over the last 10 years with variations in consumption rates across Ireland. However, high antibiotic consumption does not automatically equate with inappropriate antibiotic use. Recent national antibiotic prescribing guidelines recommend higher doses in certain clinical circumstances, compared to previous guidance. Thus, some of the increase in overall consumption may be due to more appropriate higher dosing.

It should be noted that this data does *not* cover prescribing volumes or rates in private settings, i.e. there is no monitoring of private Long Term Care Facilities (LTCFs) (private nursing homes) or of prescribing of private scripts.

Figure 4: Total antibiotic use in the community in Ireland, 2007-2016, expressed in DDD per 1000 inhabitants per day. (Source HPSC).

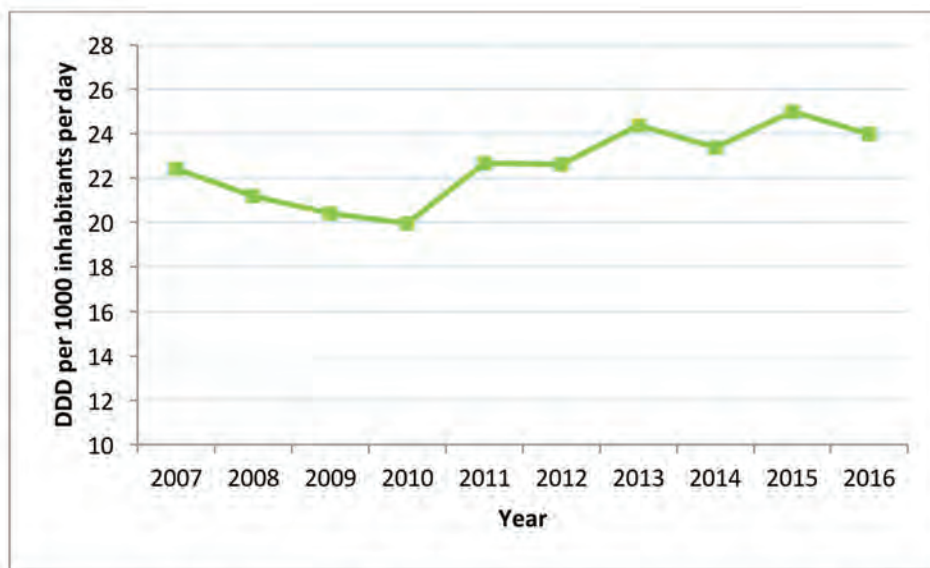
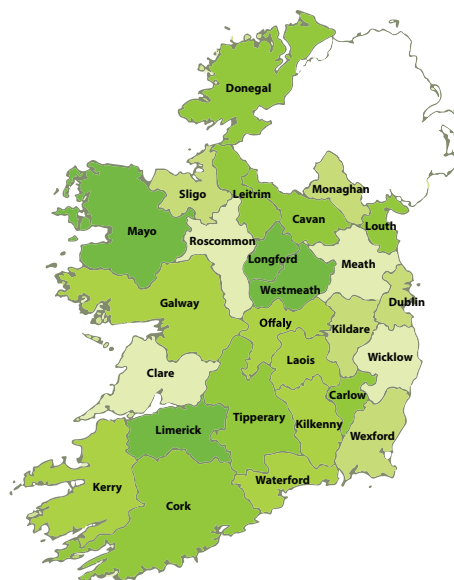


Figure 5: Community antibiotic consumption by county, 2016 expressed in DDD per 1000 inhabitants per day. (Source HPSC).

DDDs per 1,000 inhabitants per day

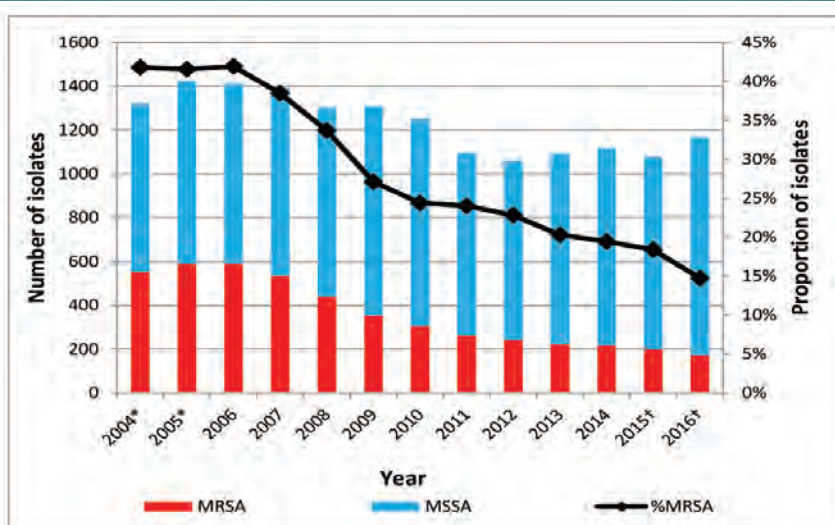
- 19.4 – 20.7
- 20.8 – 22.6
- 22.7 – 25.3
- 25.4 – 28.3
- 28.4 – 32.1



Surveillance data on antimicrobial resistance trends

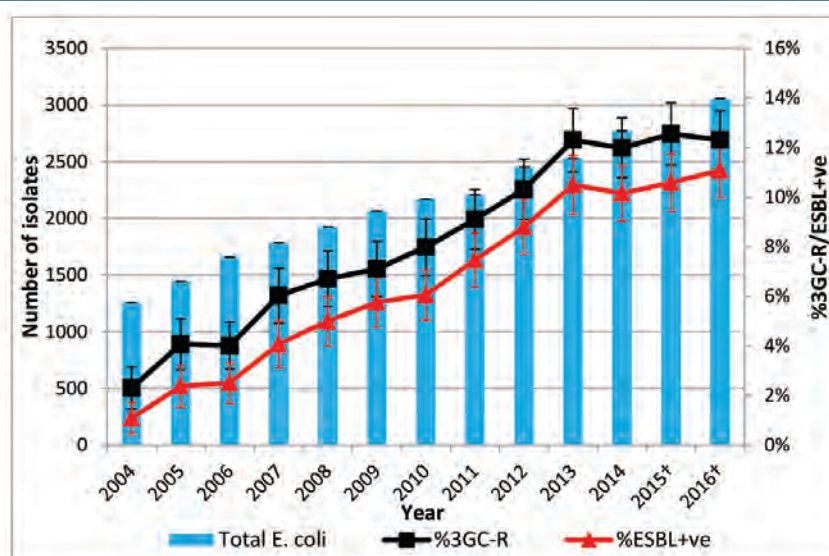
Surveillance data on antimicrobial resistance trends in key causative pathogens of bloodstream infection (BSI) is published quarterly by the HPSC. Whilst there have been welcome reductions in the proportion of *Staphylococcus aureus* BSI that are methicillin resistant (i.e. Methicillin resistant *Staphylococcus aureus* (MRSA)), (Figure 6) there are concerning upward national trends in AMR in Enterobacteriaceae (*E. coli* and *K. pneumoniae*) and enterococci (*E. faecium* and *E. faecalis*). Ireland has had the highest proportion of enterococcal BSI caused by Vancomycin-Resistant Enterococci (VRE) of any EU Member State for several years. (Figures 7, 8 and 9)

Figure 6: Total number of *S. aureus* (MRSA and MSSA) bloodstream isolates and proportion (%) MRSA from acute hospitals (public & private) by year, 2004 to 2016 (Source HPSC).



† 2015 and 2016 incomplete data from 3 and 2 laboratories representing 97% and 99% coverage, respectively.

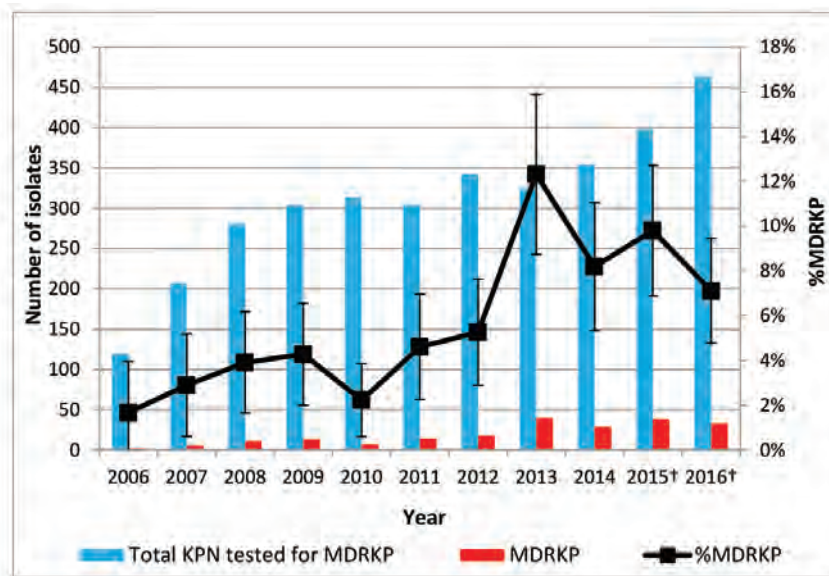
Figure 7: Total number of *E. coli* bloodstream isolates and proportions of 3GC-resistant and ESBL-producing isolates from acute hospitals (public & private) by year, 2004 to 2016 (Source HPSC).



3GC, 3rd-Generation Cephalosporin; **ESBL**, Extended-Spectrum Beta- Lactamase.

† 2015 and 2016 incomplete data from 3 and 2 laboratories representing 97% and 99% coverage, respectively.

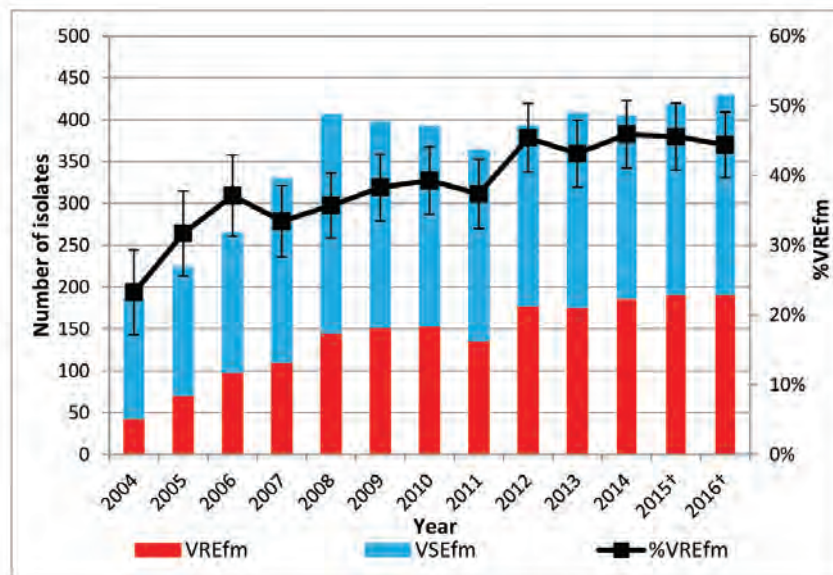
Figure 8: Number of *MDRKP* bloodstream isolates *MDRKP* proportions from acute hospitals (public & private) by year, 2006 to 2016 (Source HPSC).



MDRKP - Multi-drug resistant *k. pneumoniae*;

† 2015 and 2016 incomplete data from 3 and 2 laboratories representing 97% and 99% coverage, respectively.

Figure 9: Total number of *E. faecium* (VREfm and VSEfm) bloodstream isolates, and VREfm proportions from acute hospitals (public & private) by year, 2004 to 2016 (Source HPSC).



VREfm, Vancomycin resistant *E. faecium*; **VSEfm**, Vancomycin susceptible *E. faecium*;

† 2015 and 2016 incomplete data from 3 and 2 laboratories representing 97% and 99% coverage, respectively.

Currently in Ireland, there is no national surveillance programme for AMR in pathogens causing infections other than BSI and there is no national surveillance programme to monitor trends in carriage of Multi Drug Resistant Organisms (MDRO), such as MRSA, VRE, ESBLs, CRE in hospitalised

patients, residents of long-term care facilities or the general population living in community settings; see further.

HCAI surveillance systems are coordinated at European level by the ECDC. EU Member States collect and report national surveillance data and submit data to ECDC. Ireland participates in some of the ECDC's surveillance systems, such as EARS-Net, ESAC-Net and Point Prevalence Surveys of HCAI and antimicrobial use. However, there are several important European infection surveillance systems, such as *Clostridium difficile* Infection (CDI), Intensive Care Unit (ICU) acquired infections and surgical site infections (SSI) to which Ireland does not yet contribute data.

Among *Enterobacteriaceae*, resistance to important and commonly used antimicrobials (beta-lactams) is increasing and can be due to mechanisms which are easily transmitted between bacteria, such as enzymes known as extended spectrum beta lactamases (ESBLs). Many of these bacteria are also resistant to multiple other antimicrobials. Of serious concern is the emergence of what is termed Carbapenemase Producing *Enterobacteriaceae* (CPE), also known as CRE, which results in some cases of bacteria being resistant to all conventionally used antimicrobials, with limited treatment options remaining.

Data produced by the national CPE reference laboratory service in University Hospital Galway since 2012 and reports of outbreaks of CPE in acute hospitals and long-term care indicate a rapid and worrying increase in the incidence of CPE in Ireland. The true cost and extent of this increasing threat cannot be fully estimated at present. However, it has been identified that the impact has resulted in death amongst more than half of all patients who develop CPE infection, significant financial cost to the health system and challenges to effective patient flow in healthcare delivery for scheduled and unscheduled care.

At present CPE infections are fairly uncommon in Ireland. This is changing rapidly, however. The HSE notes that there were nearly seven times (327) as many CPE identified in 2016 as there were in 2013 (50) (Figure 10). CPE also carries a gene called *mcr* and this bacteria is also resistant to colistin which has become one of the few antibiotics that the health service can rely on for treatment of CPE.

In response, a HSE National Taskforce on HCAI AMR, established in late 2015 identified an urgent need to develop a comprehensive plan in response to the on-going and developing situation in relation to management of CPE within the healthcare system. In 2017 a national response team and new National Clinical Lead for HCAI AMR was appointed to direct the work of the response team.

The HSE has developed a set of escalated priority actions to address the immediate threat to public health and sustainability of health service delivery systems with regards to the emergence of CPE. The response team is working with HGs, CHOs and Clinical Directors to:

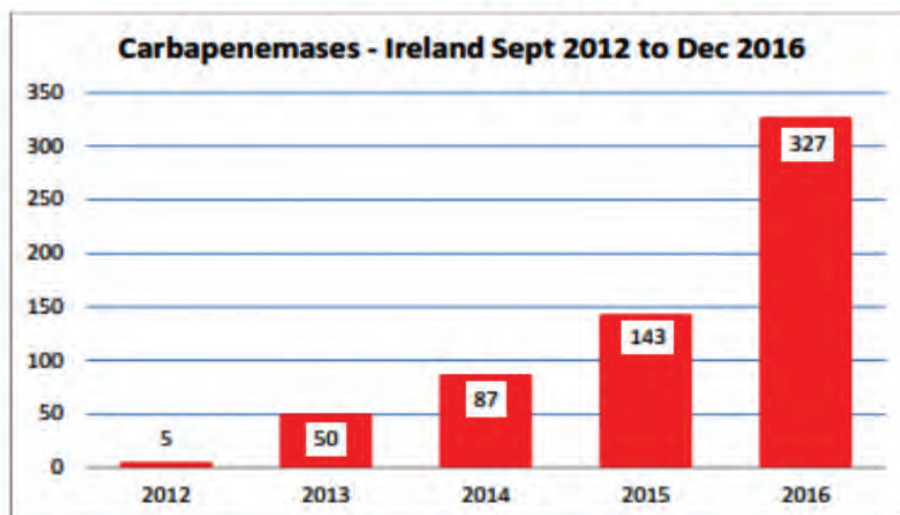
- Address the IPC and AMR structural and resource requirements across hospitals and CHOs.
- Oversee full implementation in all hospitals of the national requirements for screening of at-risk patients to identify those colonised with CPE as a matter of priority.
- Prompt source isolation/cohorting of all CPE colonised/infected patients.
- Limit the use of broad spectrum antibiotics in all settings.

- Ensure strict adherence to Standard and Transmission-Based IPC precautions.
- Improve environmental hygiene.
- Ensure education of patients, staff and members of the public.
- Ensure active local and national surveillance of CPE infection and colonisation.

To effectively control the spread of such 'superbugs' requires aligned leadership at all levels of the healthcare system. It requires finding ways to demonstrably shift and change current practices and behaviours in our healthcare system that facilitate the spread of HCAs and contribute to AMR.

The spread of CPE in Ireland is potentially in a containment phase. However, the window for containment is finite. Immediate vigorous measures are required at acute and community healthcare settings and immediate actions to address the threat to public health and sustainability of health service delivery systems.

Figure 10: Annual confirmed carbapenemases – (Source CRE reference laboratory).



2.7 Conclusion

At policy, operational and regulatory levels Ireland's health service has progressed a programme of work to tackle HCAs and AMR. The health sector is committed to working with all sectors to raise awareness and target fundamental areas for development. *i*NAP provides the opportunity to take stock and examine the next steps required as a country.

This Situational Analysis has identified the requirement for key interventions and activities as outlined in Section 6 of the plan. These build, enhance or add to the current processes and procedures in place to tackle AMR and provide a roadmap for the next three years.

The health sector has a number of key stakeholders which it will work with to increase awareness of AMR and deliver focused education programmes. This group of stakeholders includes healthcare workers across scheduled and unscheduled care settings, community and private settings, healthcare

managers, policy makers, under/postgraduate students, first/second level school students, patients and the general public.

Critical areas identified through the situational analysis for targeting are:

- Awareness and education.
- Surveillance and response systems.
- Antibiotic prescribing.
- New antimicrobials.
- Workforce planning.
- Governance and accountability.
- HSE Service Plan Key Performance Indicators (KPIs).

The current surveillance and response systems for HCAs and AMR require review and enhancement. This will form part of a co-ordinated and integrated approach to surveillance and response feedback systems. Consideration will be given to strategic interventions for prudent and appropriate antibiotic prescribing and medicines management. Specific considerations are required when introducing new antibiotics to ensure an agreed process for the timely introduction, adoption and diffusion of a new antimicrobial when this has been recommended for use.

Internationally Sweden's work on containment of AMR via its STRAMA (Swedish Strategic Programme against Antibiotic Resistance) network of collaborative groups provides a demonstration model for a successful approach to tackling AMR and managing infection outbreaks.

Ireland supports restriction of marketing activities/responsible marketing for antimicrobials. In addition, the need for the development of new antimicrobials is acknowledged. The [2015 Lancet Series](#) makes clear that access to antimicrobials cannot happen on its own. Access to diagnostics, health services, prevention measures, reliable guidance and education, quality-assured medicines, and sustainable financing all need to take place together, at the same time as curbing inappropriate antimicrobial use.

The workforce is integral to gaining progress in tackling AMR. A focused workforce plan, based on evidence which identifies optimum team competencies for HCAs and AMR will guide recruitment and retention plans for short, medium and long-term. Clear governance and accountability across all healthcare settings for HCAs and AMR will ensure clarity of responsibilities and accelerate progress of an AMR programme of work. This should be balanced by a comprehensive set of key performance indicators for HCAs and AMR in the annual HSE Service Plan to provide visibility and transparency of levels of improvement. This is an integral component of the HSE Accountability Framework.

In summary, an integrated targeted programme of work with commitment to further development of appropriate guidelines and standards will drive best practice for managing AMR for Ireland. This will add value and provide a robust approach to implementing iNAP while remaining true to the 'One Health' approach.

Section 3

Situational analyses and assessment – Animal Health



3.1 Introduction

Whilst this is the first time a national action plan on antimicrobial resistance has been launched in Ireland, this is not the first time action has been taken in the agricultural sector to address the societal risk posed by AMR. Many of the key stakeholders have already taken action. There are also significant legislative controls already in place on the use of antibiotics in animals in Ireland.

Farmers across all sectors have worked proactively to implement non-statutory disease control/eradication programmes and higher bio-security measures aimed at reducing dependence on antibiotic usage in their animals. That said, both the experience of other countries and data available in Ireland indicate that it is the intensive ends of the business where improvements both in the prevention of disease and the prudent use of antibiotics are needed.

Maintaining large numbers of animals in close proximity to each other poses a significant difficulty in maintaining hygiene and biosecurity. Immunologically naive animals are particularly vulnerable in such systems. As well as having increased risk of infection and disease, intensive animal production systems also pose a challenge in terms of the administration of medicines, including antibiotics, to large numbers of animals. Often the only effective way to administer medicines to animals in such systems, is to administer the medicines through the feed or water. Farmers spend a significant amount of money on antibiotics for treating infections in their animals. The Irish Farmers Association (IFA) have put a figure of €176 million on the overall annual spend by farmers on veterinary medicines, with an estimated €57 million of that on antibiotics.

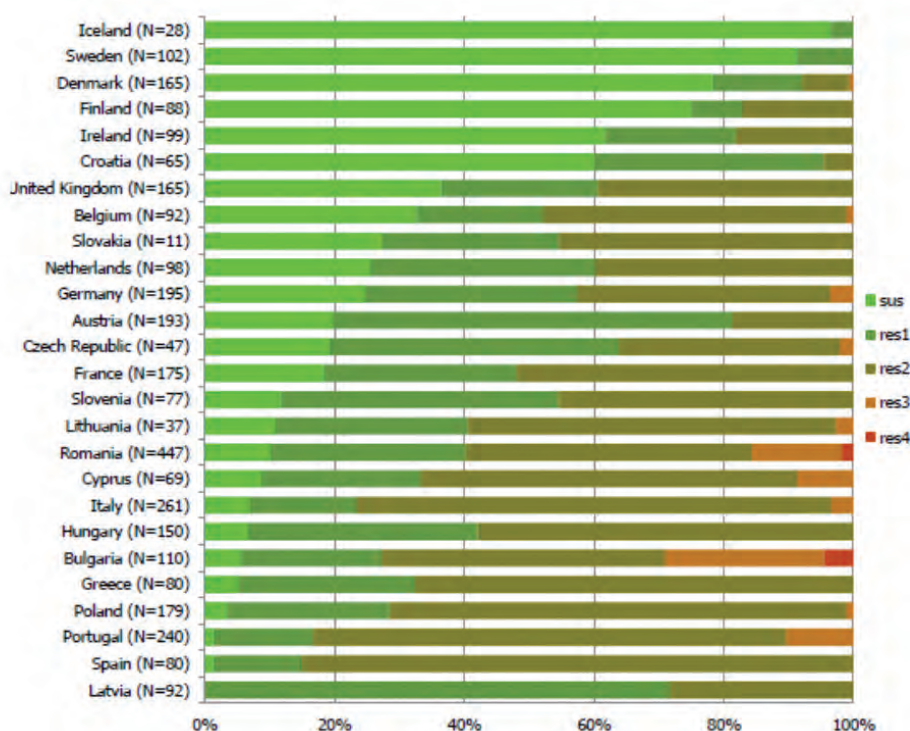
In addition, price volatility and downward pressure on food prices, both at global and national level, can mean returns in certain sectors are quite low making it difficult for farmers to invest in measures that can very much assist in reducing the incidence of infection and disease e.g. good quality housing, ventilation, cleaning and disinfection, vaccination, bio-security and staff training. Farmers need to get a reasonable price for their products, if standards in relation to hygiene and disease control are to be maintained.

3.2 Surveillance

Since 2014, the Department of Agriculture, Food and the Marine has operated a national surveillance programme for antimicrobial resistance, in accordance with legislation laid down at the European Union level. The programme alternates between pigs and poultry from year to year, and involves the testing of foodborne bacteria that are capable of causing disease in humans (so called zoonotic bacteria), and certain types of normal animal gut flora that may contaminate food and are capable of transmitting the ability to resist antibiotics to other types of bacteria (so called commensal bacteria). The programme also includes testing for a particular type of *E. coli*, so called Extended Spectrum Beta Lactamase (ESBL) producing *E. coli*, that are of particular concern in human medicine. Samples are taken from; live animals on farm, slaughtered animals at meat plants, and food at retail level. Target bacteria which have been isolated, are tested for resistance, including resistance to antibiotics considered to be of critical importance in human medicine e.g. beta lactams and carbapenems.

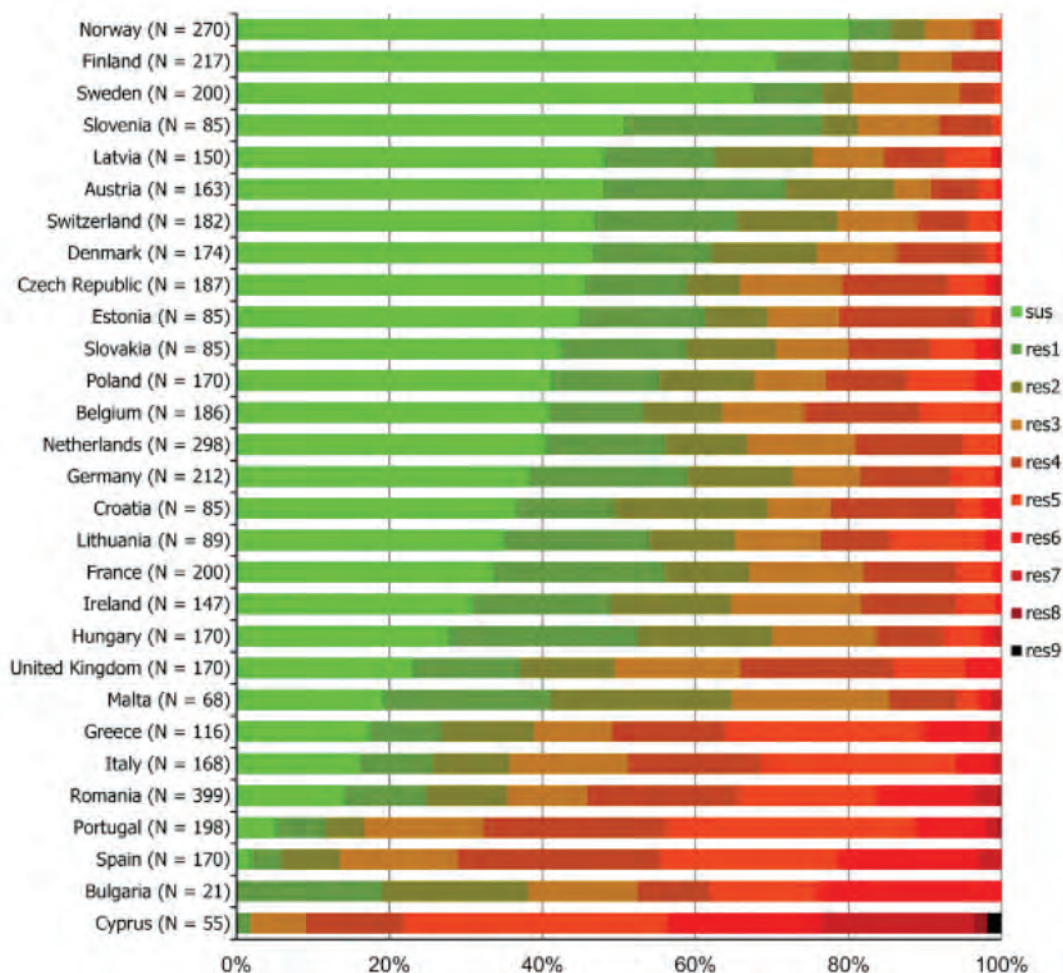
The results of this surveillance programme indicate that levels of resistance in *Campylobacter* in broilers (poultry produced for the purpose of slaughter) are relatively low, and in 2014, were lower in Ireland than in many other EU countries (Figure 11).

Figure 11: Frequency distribution of *Campylobacter jejuni* isolates completely susceptible and resistant to one to four antimicrobials in broilers in Member States in 2014 (Source: EFSA, ECDC 2016)



The levels of antimicrobial resistance in bacteria isolated from pigs is higher with the percentage of resistant versus susceptible isolates in commensal *E. coli* indicated in Figure 12.

Figure 12: Frequency distribution of *E. coli* isolates completely susceptible and resistant to one to eleven antimicrobial classes in fattening pigs in Member States in 2015 (Source: EFSA, ECDC 2017)



Data in relation to veterinary antibiotic consumption is collected at the national level by the Health Products Regulatory Authority (HPRA), as part of the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project run by the European Medicines Agency (EMA). This data is published annually by the HPRA and at intervals by the EMA.

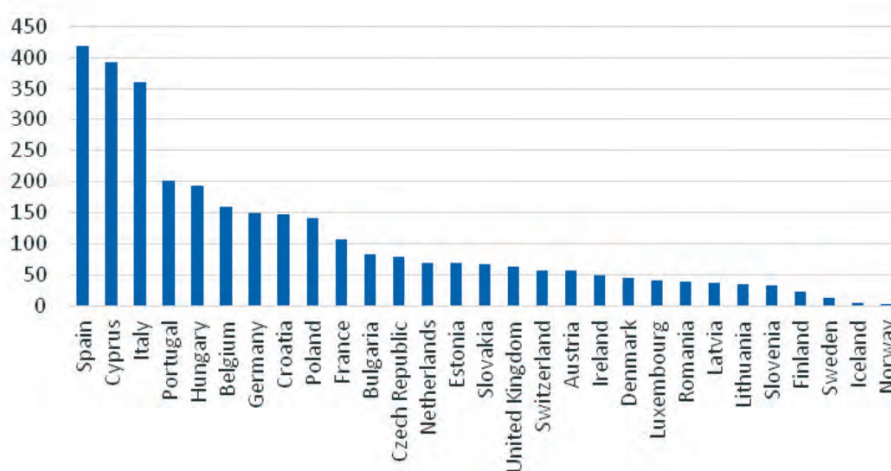
The HPRA figures indicate that somewhere between 88 and 100 tonnes of veterinary antibiotics are sold annually in Ireland (Table 1).

Table 1: Sales (in tonnes) of veterinary antibiotics for the years 2009 – 2015 (Source HPRA 2016)

	2009	2010	2011	2012	2013	2014	2015
Tonnes Sold	88.3	93.9	85.3	97.4	100.2	90.6	96.7

According to the latest report published by EMA (2014 data), the overall amounts of antibiotics sold in Ireland, corrected for the size of the animal population (the population correction unit or PCU) was 48 mg/PCU (Figure 13). This places Ireland below the overall total used in many other Member States. That said, it is important to note that a measure such as the mg/kg of overall liveweight is a crude measure in that it mixes species that are likely to have relatively low usage with species where the usage is likely to be much higher. It does not take account of the type of antibiotic being used, with some formulations having much lower weights of active ingredients than others. In addition the figures are likely to be out of date for some countries, for example the Netherlands, that have made significant progress in reducing the amount of antibiotics since this report was published.

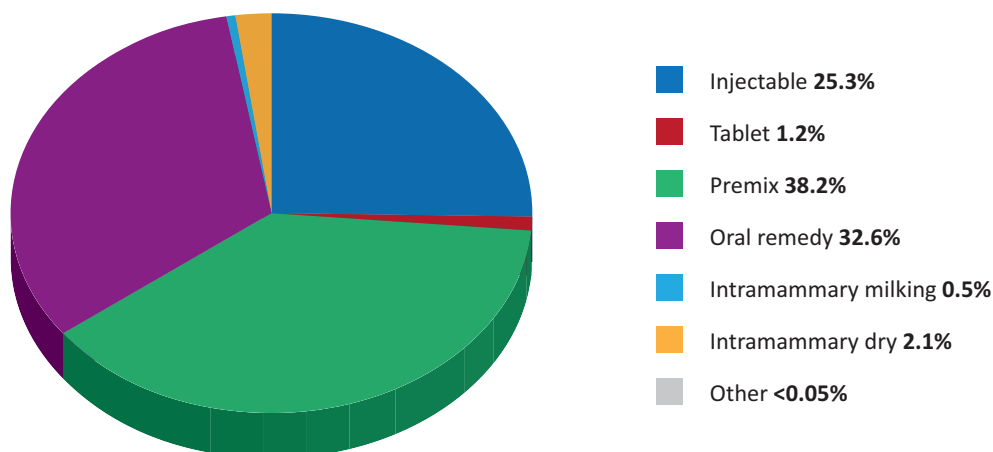
Figure 13: Total volume of veterinary antibiotics used corrected for the size of the animal population taken from the EMA's report on sales of veterinary antimicrobial agents in 29 countries in 2014 (ESVAC 2016).



Breaking down the overall total of antibiotics into the route of administration provides some further information and indications as to where action needs to focus in coming years (figure 14). According to the latest figures available from the HPRA, more than 70% of antibiotics being used in animals in Ireland are being used in oral medications for use in feed and water. Data at the sales level does not allow these medications to be broken down according to species. However, in general, such forms

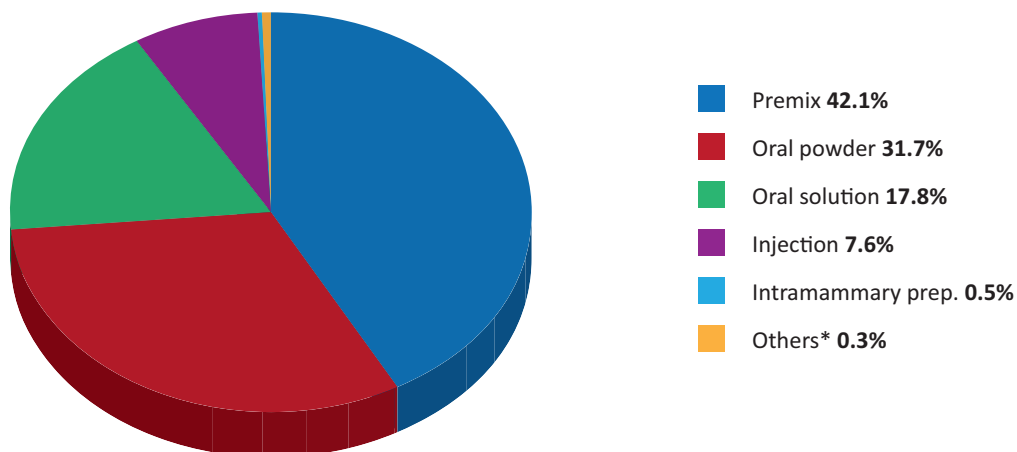
of medication tend to be used where large numbers of animals require medication and as such are more likely to be associated with intensive production systems.

Figure 14: Pharmaceutical form breakdown of veterinary antibiotics sold in 2015 in Ireland (Source HPRa report 2016)



This finding is consistent with the pattern in other EU countries (Figure 15) and in countries at the global level also.

Figure 15: Distribution of sales of various pharmaceutical forms of veterinary antimicrobial agents for food producing animals, aggregated by the 29 European countries for 2014 (Source ESVAC report 2016)



*Oral pastes, boluses and Intrauterine preparations.

In addition to information on total sales of veterinary antibiotics, a number of surveys have been carried out that have measured antibiotic consumption at farm level. Such studies have shown that the level of antibiotic usage varies both within farms, and between farms. On pig farms, piglets at the creep stage, and second stage weaners, are the most likely categories of animals to receive antibiotics. Antibiotic use is not always correlated with live weight at slaughter, with some of the heaviest pigs at slaughter coming from farms with relatively low use of antibiotics.

A study carried out by the Centre for Veterinary Epidemiology and Risk Analysis (CVERA) at UCD, and Animal Health Ireland, in relation to intramammary use on Irish dairy farms from 2003 to 2015, indicates that blanket dry cow therapy levels are high (1,022 DCDvet per 1,000 cows per year) and have increased in the period studied. At the same time, the numbers of intramammaries being used during the lactation phase have declined (now at 466 DCDvet per 1,000 animal per year) almost certainly as a result of the implementation of the CellCheck programme. This provides a clear example of where, if action is taken to tackle the underlying disease, it can produce significant reductions in the total quantities of antibiotics being used.



3.3 Legislative controls

DAFM is the competent authority responsible for the maintenance of the legislation in all areas relating to the manufacture, supply and use of veterinary medicines, including veterinary antibiotics, in Ireland. Controls on the manufacture, supply and use of all veterinary medicines are provided for in S.I. 786 of 2007 (European Communities (Animal Remedies)(No. 2) Regulations 2007). Specific rules relating to the production, supply and use of medicated feeds are provided for in S.I. 176 of 1994 (European Communities (Animal Remedies and Medicated Feedingstuffs) Regulations 1994). In general, veterinary medicines must either be authorised by the HPRA or the EMA. Manufacturers and suppliers of veterinary medicines and medicated feed must be approved, and are under the supervision of; the HPRA (manufacturers), DAFM (wholesalers and veterinary practitioners, compounders and home mixers), or the Pharmaceutical Society of Ireland (pharmacies). Antibiotics are prohibited for use as growth promoters. All veterinary antibiotics are classified as prescription only medicines.

Veterinary antibiotics may only be prescribed by a registered veterinary practitioner who has been given responsibility for the professional veterinary care of the animal/s by the owner or person in charge and has sufficient knowledge of the animal/s. Veterinary antibiotics must be used in accordance with the summary of product characteristics (SPC) that defines the indications for treatment, the dose and duration of treatment. Records of veterinary antibiotic use must be maintained by both veterinary practitioners and owners, or keepers of food producing animals. Veterinary antibiotics may not be advertised to owners, or keepers of animals, both food producing and companion animals.

Feed compounders and home mixers that are authorized to produce medicated feeds must implement controls to ensure homogenization and to prevent cross contamination.

DAFM, the HPRA and the Pharmaceutical Society of Ireland (PSI) operate a comprehensive system of official controls to monitor compliance that covers the entire chain of veterinary medicines from manufacture to use. These controls are divided up into two types; inspections of premises and testing of samples taken from live animals and products of animal origin for residues of veterinary medicines products under the National Residue Control Plan (NRCP).

The NRCP involves the testing of just under 20,000 samples, on an annual basis (19,250 in 2016). Samples are taken at all levels of production, and from all types of animals and products of animal origin. The NRCP builds on the controls implemented by food business operators to ensure that food produced in Ireland complies with food safety standards. The results of the NRCP indicate good levels of compliance with the requirements to safeguard food safety.

The system of official controls on veterinary medicines, including the NRCP, includes protocols to be followed in the event of non-compliance, as well as sanctions and penalties that can be applied in the event of non-compliance. These sanctions and penalties include seizure and destruction of animals, Single Farm Payment disallowances, prosecution, or, in the case of veterinary practitioners, referral to the Veterinary Council of Ireland (VCI) for disciplinary action.

National legislation for the control of veterinary medicines and the production of medicated feeds is based on two pieces of European Union legislation, (Council Directive 2001/82/EC and Council Directive 90/167/EEC) that are currently under review at European level. The directives will be replaced by regulations that will be directly implementable in the Member States. It is expected that negotiations on the regulations will conclude at the end of 2018 with an implementation date of 2021. Both regulations contain measures aimed at the control of AMR that will have implications for both prescribers and users of veterinary antibiotics in Ireland.



3.4 Research

DAFM has provided funding for AMR research, with AMR related projects being part of both DAFM's 2016 and 2017 research calls. One of the projects funded as part of the 2016 call, is the Antimicrobial Use and Resistance in Animal Production (AMURUP) project. This project aims to measure antibiotic usage on pig and poultry farms in Ireland as well as to identify risk factors for high level usage. This project seeks to investigate the effects of antibiotic use on the occurrence of resistance in animal bacteria, and to model the costs of disease and antibiotic usage in pig and poultry production. Another project that is ongoing is the PATHSURVPIGS. This project focuses on the risk factors associated with the development of respiratory disease on pig farms as well as antibiotic usage and economic cost-benefit analysis. It is hoped that the output of such research will assist in the development of policy to tackle AMR.

AMR related research has also been carried out by a number of other organisations and research facilities. An example of this is the research that has been carried out into the use of antibiotic intramammaries for the treatment of mastitis by the Centre for Veterinary Epidemiology and Risk Analysis (CVERA) and Animal Health Ireland (AHI). However, one of the current weaknesses in the system is that a comprehensive list of such research projects is not available at the national level resulting in lost opportunities for synergies and for evidence based policy making.

3.5 Other actions

DAFM

In addition to monitoring compliance with the legislation and implementing AMR surveillance, DAFM has expended significant effort on raising awareness about AMR and the actions needed to address it, among key stakeholders. This has created a solid foundation for the activities that are now detailed in this action plan.

DAFM held two conferences/seminars, one in 2014 and a second one in 2016. A specific webpage has been developed that is located on the Department's website (www.agriculture.gov.ie). AMR related presentations have been given by DAFM staff at a range of meetings/events involving key stakeholders including;

- DAFM Regional Office meetings with veterinary practitioners.
- Animal Health Ireland Beef Health-check and Calf Health events.
- Rural Development Knowledge Transfer events.
- Annual Veterinary Ireland conference.

AMR was one of the topics presented by DAFM at the National Ploughing Championships in 2015. As well as the National Interdepartmental AMR Consultative Committee, DAFM also participates in the Royal College of Physicians in Ireland and Health Service Executive AMR Committee. DAFM also engaged with representatives of the pig industry in the development of a collective industry view on how best to address the challenges faced by the pig industry in Ireland, (Report of the Pig Stakeholder Industry Group). Actions to address AMR are also included in the agri-food sectors' strategy for the next number of years, Food Wise 2020.

DAFM staff have participated in a number of working groups at EU level, including the working group that drew up European guidelines for the prudent use of antimicrobials in veterinary medicines (2015/C 299/04). These guidelines provide recommendations in relation to actions that should be taken by both veterinary practitioners and owners/keepers of animals, to ensure that the use of veterinary antibiotics is kept to a minimum. The Department also contributed to the development of the European Council conclusions on AMR that were adopted in 2016. DAFM is also a member of the European Commission's recently established 'One Health' network.

Under the Targeted Agricultural Modernisation Scheme (TAMS), DAFM has provided grant-aid support for the upgrade of buildings in the pig and poultry sectors, with items such as medicated feed/water dispensers included for support. Under this scheme, 152 applications have been received, 110 have been approved, and payments of an estimated €45,000 have been issued. There is an indicative funding level of €17m for the duration of the Rural Development Programme 2014-2020 for the Scheme.

Health Products Regulatory Authority (HPRA)

In 2016, the HPRA published a report in relation to AMR. The HPRA has also revised the summary of product characteristics for the older veterinary antibiotics on the market in Ireland with a view to encouraging prudent use.

Food Safety Authority of Ireland (FSAI)

In 2015, the FSAI published a report on the '*Potential for Transmission of Antimicrobial Resistance in the Food Chain*'. The main conclusion of the report was that, whilst antibiotic resistant bacteria can be transmitted to humans through the food chain, and the overall contribution being made by the food chain cannot be quantified, action is nevertheless needed in the agri-food sector to combat this growing problem. The report recommends measures aimed at reducing antibiotic use wherever

possible through improved husbandry and disease prevention measures and improving surveillance of antimicrobial use and AMR. The report also identified a number of research priorities.

Animal Health Ireland (AHI)

Animal Health Ireland (AHI) is a public private partnership that works with DAFM and other private sector organisations in the establishment of control programmes for non-regulatory diseases of livestock. As part of this work, AHI leads the implementation of the CellCheck Programme, a national mastitis control programme developed in partnership with industry bodies, aimed at improving udder health and reducing the need for intramammary antibiotic use in cows. AHI also has the lead in relation to the implementation of the National Bovine Viral Diarrhoea (BVD) Eradication Programme. This programme has had considerable success in reducing the prevalence of the disease. Such control programme have an important role to play in reducing the overall quantities of antibiotics being used. Viral diseases such as BVD and IVR can make animals more prone to bacterial infection that may necessitate the use of antibiotics.

Veterinary Council of Ireland (VCI)

The Veterinary Council of Ireland (VCI) is the state body with responsibility for maintaining professional standards in the veterinary practitioner and veterinary nursing professions. The VCI has devised a Code of Professional Conduct with regard to prudent prescribing, and uses its newsletter to inform the professions of issues with regard to AMR. A webinar on the responsible use of antimicrobials was organised by the Council in conjunction with SafeFood and the School of Veterinary Medicines, University College Dublin in 2011, to heighten awareness amongst the veterinary profession with regard to emerging antimicrobial resistance problems in *Enterobacteriaceae*.



Veterinary Ireland (VI)

Veterinary Ireland is the representative body for veterinary practitioners in Ireland. Its work on AMR has involved articles, continuing veterinary education (CVE) lectures, as well as substantive work at EU Level through its affiliation with FECAVA. It has been involved in the drafting, formulation, printing and distribution of educational posters, and other documentation, aimed at providing advice on hygiene, antibiotic usage and susceptibility testing to various stakeholders (veterinary practitioners, farmers, companion animal and equine owners/keepers), as well as to the general public.

Veterinary Ireland has also been involved in groups, committees and programmes operated by Animal Health Ireland (AHI). Similarly, Veterinary Ireland has been involved in the Knowledge Transfer (KT) aspects of the Rural Development Programme 2014-2020. This involvement in both AHI and KT programmes has provided Veterinary Ireland members with the opportunity to advise, inform and educate members of the farming community on veterinary medicines usage, and the risks of AMR.

In 2014, Veterinary Ireland published its Veterinary Ireland Policy on AMR, with a set of eight recommendations to combat AMR. Also in 2016, the Cattle Association of Veterinary Ireland (CAVI) hosted the World Buiatrics Congress, at which there were a number of AMR related lectures, including a key note lecture by Prof. Theo Lam, oral abstracts and posters. This was followed in late 2016 at the Veterinary Ireland AGM and conference which focused specifically on AMR. The conference included an expert panel of speakers providing Veterinary Ireland members the opportunity to reflect upon the challenges faced in Ireland and globally by AMR, as well as possible solutions to this global challenge.

3.6 Conclusion

As detailed above, actions have been taken by many stakeholders in the animal health sector in the last number of years as concerns grow with regard to development and spread of AMR across all sectors internationally. In addition to the actions listed above, individual farmers have worked proactively to implement non-statutory disease control programmes and higher bio-security measures, aimed at reducing the total quantities of antibiotics being used in their animals. At the same time, certain intensive production systems, for example poultry, have made very significant progress in reducing antibiotic use in recent years, indicating that progress is possible. Such situations create the opportunity to identify best practice at farm and sectoral level, that can then be shared with other farmers sectors.

That said, significant challenges still remain. Both the experience of other countries, and data available in Ireland indicated that significant quantities of antibiotics are being used in intensive production sectors.

Further work is required to continue to educate and increase awareness amongst stakeholders in the animal health sector in relation to how to reduce overall quantities of antibiotics being used but also how to prevent outbreaks of disease occurring in the first place.

Improvements in the availability of antibiotic consumption data are needed so that progress in reducing the overall quantities of antibiotics can be demonstrated. Availability of data ensures policy is evidence based and individual farmers and veterinary practitioners can benchmark their antibiotic use. Likewise, improvements are needed in AMR surveillance, so that individual animal keepers and their veterinary practitioners have access to timely information on levels of AMR resistance on individual farms.

Ireland's national AMR action plan showcases government departments and industry stakeholders working together to tackle some of the complex problems society faces today. The primary focus of the animal health actions in this Ireland's first 'One Health' national action plan will be on the more intensive animal production systems, though other sectors such as equines and companion

animals will not be entirely excluded . The strategic interventions and activities outlined for the agri-food sector provide an opportunity for stakeholders to generate outcomes to benefit not just the industry, but society as a whole.



Section 4

Situational analyses and assessment – Environmental Health

The pivotal role which the environment plays in the persistence and spread of AMR is increasingly being recognised. The environment is extremely vulnerable to discharge and release of antimicrobials and resistant bacteria, as well as other resistance-driving chemicals such as biocides and heavy metals, through various routes. There is now a growing need to enhance our understanding of the issue and develop further supportive evidence in order to develop and implement effective risk management and preventative strategies to halt further spread.

The major sources and pathways for entry of resistance-driving chemicals into the environment have been well-described and include the following:

- Inappropriate disposal of medications, including antimicrobials, is unfortunately common practice. Spread of antimicrobials into the environment can occur via wastewater discharges following disposal of antimicrobials into the toilet. Similarly, disposal into domestic bins destined for landfill can enter the environment by leaching into and contaminating soil and groundwater.
- Significant quantities of the antimicrobials given to patients are also shed into wastewater in a form that is still biologically active. Added to this is the large number of AMR bacteria, which may reside in the gut of humans, passed via wastewater every day. Waste water treatment systems are unable to effectively remove all antimicrobials or AMR bacteria, meaning that the resultant “active” effluent is released into the environment.
- Likewise, in the case of the agriculture and food production sector, antimicrobials are used within herds or flocks to treat infection. Similar to the healthcare situation, significant quantities of un-metabolised antimicrobials, as well as resistant bacteria are excreted in urine and manure, entering the surface and groundwater. Moreover, human and animal waste spread across land can contain antimicrobial residues and bacteria, which, in turn, could be absorbed by food crops, thereby possibly further contributing to exposure to, and persistence of, these contaminants.
- Effluent from manufacturing facilities can also contain significant quantities of antimicrobial residues and active pharmaceutical ingredients which can subsequently enter the aquatic environment.

Due to their low concentration, it can be difficult to detect antimicrobial residues in the environment and, at present, it is difficult to determine the extent to which concentrations of antimicrobials reaching our environment are exerting substantial selective pressure on bacteria of importance to public health.

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) is Ireland's statutory body for the balanced and sustainable protection and management of the environment. While significant investment has been made in research to advance and deepen our knowledge of AMR, there are still data and evidence gaps within the environmental sector which leaves us unable to adequately answer many fundamental questions about the drivers and ecology of AMR in the environment. At a national level, the EPA has supported a number of research projects to help further knowledge and understanding of the issue of AMR within Ireland's environment.

One such study ([EPA STRIVE Report 89](#)) highlighted the extent to which certain antimicrobial resistant bacteria are now disseminated in our environment. In some of the rural water supply systems examined, 6% to 80% of *E.coli* detected in water were found to be resistant to the common antibiotic, ampicillin. The research also reported detection of *E.coli* in treated wastewater which harboured resistance to a broad number of antimicrobials including penicillins. A further study ([EPA Research Report 162](#)) examined hospital effluent in Ireland and its impact on the microbial environment and risk to human health. The research found that dealing with hospital effluent in isolation will not substantially address the overall issue of antibiotic-resistant bacteria in urban wastewater. Other resistant bacteria including CPE, ESBLs and gram negative bacteria have been found in Irish water sources. Moreover, it was found that some groups of antibiotics may persist in the environment for extended periods after discharge and some newer classes of antibiotics (quinolones/fluoroquinolones) have the lowest rate of degradation (only 50% degraded after 100 days compared with 99.8% degradation after 100 days for penicillin) and highest resistance forming potential within the environment.



In striving to continually improve the management of Ireland's hazardous waste, including unused medicines such as antimicrobials, the EPA currently has a pivotal role in promoting and coordinating implementation of [Ireland's National Hazardous Waste Management Plan \(NHWMP\)](#) which sets out a number of priorities to be pursued up to 2020. As part of the current NHWMP the EPA, in partnership with the Department of Communications, Climate Action and Environment (DCCAE),

Teagasc, DAFM and others, has run a successful joint initiative to facilitate the collection, recovery and disposal of hazardous waste from farms, including end-of-life veterinary and animal healthcare products. In 2014, 11 tonnes of veterinary medicine wastes, including antimicrobials, were collected nationally through the scheme and subsequently safely disposed of.

Pharmaceutical Society of Ireland (PSI)

The PSI protects the health and safety of the public by regulating pharmacists and pharmacies in Ireland. The PSI has established guidelines on the disposal of medicinal products, including antimicrobials, for a retail pharmacy business to facilitate compliance with legislation and to ensure that the disposal of medicines, within a pharmacy, is carried out in a manner which will not result in any danger to public health or any risk to the environment. These guidelines outline that patients should be facilitated and encouraged to return unwanted or expired medicines to the pharmacy for disposal. Furthermore, the guidelines highlight that pharmacists should inform patients that it is not appropriate to dispose of unused medicines in their household waste or wastewater.



Section 5

Governance and responsibilities for the implementation of iNAP

5.1 'One Health' actions

The National Interdepartmental AMR Consultative Committee will have overall responsibility for monitoring the implementation of the national action plan. The implementation of the plan will be assessed at each of the bi-annual meetings, and at any other meetings considered necessary during the lifetime of the plan (2017-2020). The Committee will monitor progress with the implementation of specific actions in all three sectors; health, agriculture and the environment, and will provide advice and guidance in relation to any issues that arise, in accordance with its existing terms of reference (Appendix 1). Stakeholders will provide updates, at appropriate intervals, to the Committee on progress of the implementation of iNAP. The Committee will support the preparation of the next 'One Health' national antimicrobial resistance action plan.

5.2 Health sector actions

National HSE HCAI/AMR Governance

Health and Wellbeing Directorate has responsibility for coordinating the HSE's HCAI/AMR response and chairs the HSE National Task Force on HCAI AMR. The Assistant National Director, for Public and Child Health reporting to the National Director for Health and Wellbeing leads the management response to HCAIs and AMR. Operational responsibility lies with relevant National Directors, Hospital Group CEOs and Community Health Organisation (CHO) Chief Officers. The HSE's Departments of Public Health support services locally. The National Director, Quality Improvement supports the clinical improvement work being undertaken by the HCAI/AMR Programme. The national cross-divisional governance group (National Taskforce on HCAI AMR) guides and supports a coherent management response to HCAI/AMR. A new response team to address CPE outbreaks is in place.

The following Key Performance Indicators (KPIs) are reported through the HSE National Service Plan 2017:

- Rate of new cases of hospital acquired *Staphylococcus aureus* (*S.aureus*) bloodstream infection.
- Rate of new cases of hospital acquired *C. difficile* infection.
- Percentage compliance of hospital staff with the *WHO 5 moments of hand hygiene* using the national hand hygiene audit tool.

The HCAI/AMR Performance Assurance Group reviews monthly performance data and advises the National Health and Wellbeing Directorate, National Directors for Services, Chief Officers, Hospital Group CEOs and the HSE's National Performance Oversight Group (NPOG) accordingly. The HSE

also supports HCAI management and surveillance in public Long Term Care Facilities (LTCFs) (public nursing homes).

The HSE Accountability Framework outlines accountability arrangements for issues of patient safety. The Accountability Framework reflects the governance and accountability arrangements for HCAI/AMR at all levels of the organisation down to local healthcare institutional level. Responsibility for ensuring healthcare workers comply with infection control precautions is a line-management role, and overall responsibility for management of HCAI AMR rests with the Chief Executive/Manager of each institution.

The HSE has developed a *2016 – 2018 HSE HCAI/AMR Action Plan*. This 3 year plan is being overseen by the HSE National Taskforce on HCAI AMR, established in late 2015. It has a set of deliverables related to key themes as outlined in the Table 2 below:

Table 2: HSE 3 Year plan Deliverables and theme's.
Governance
Surveillance (Effective Care)
Antimicrobial Stewardship (Safe Care)
Hygiene (Safe Care)
Infection Prevention and Control (Safe Care)
Education and Training (Workforce)
Infection Diagnostics (Safe Care)
Resource Comparisons and Performance (Leadership and Governance)
Guideline Development by NCEC for HCAs (Safe Care)

This commitment from the HSE provides a strong and supportive mechanism for the implementation of the *i*NAP.

Costs of HCAI/AMR

HCAIs and AMR are a significant cost to society, to patients and to the Irish healthcare system. However, the costs associated with HCAIs such as prolonged hospital stay, further treatments required, attributable mortality, productivity losses and other complications can be difficult to retrieve as they require complex evaluation, particularly to confirm that they are directly linked to HCAI episodes and not to other factors. The World Bank Group notes in its 2016 discussion document *'Drug-Resistant Infections: A threat to our Economic Future'* that unchecked AMR may cause major economic damage at community, country, regional and global levels. AMR impacts would be felt across all economic sectors'.

Table 3: Overview of the wider effects of HCAI

Health Sector	Patients & Families	Irish Society
<ul style="list-style-type: none"> • In hospitals: Additional inpatient days, investigations (laboratory, radiology, cardiac etc.), procedures & treatment (medical including antimicrobials, surgical) and consultations, scheduled and unscheduled care disruption due to outbreaks. • Primary care services: Additional general practitioner consultations, nursing services – primary care & public health, investigations (laboratory, radiology etc.), antimicrobials, procedures and treatment. • Loss of public confidence. 	<ul style="list-style-type: none"> • Out of pocket expenditures, additional travel, medicines, miscellaneous expenses. • Anxiety, pain/discomfort. • Additional illness. • Increased risk of death. 	<ul style="list-style-type: none"> • Production losses due to morbidity and mortality and production losses of informal carers, time off work. • Delayed time to resume normal activities. • Potential litigation.

Europe

The ECDC assesses European data along with estimated costs of increased hospital stays and treatments. European data indicates that approximately 4.1 million patients are estimated to acquire a HCAI in the EU each year with 37,000 attributable deaths annually and HCAs also contributing to an additional 110,000 deaths (ECDC 2007). On any given day, 5.7% of patients in European hospitals have at least one HCAI.

The burden of HCAI is also reflected in significant financial losses. According to the ECDC, these infections account for approximately €7 billion per year. The ECDC 2011-2012 Point Prevalence Survey (PPS) of HCAs and AMR use in European hospitals estimates that Ireland had 494 patients with a HCAI on any given day. This equated to a mean of 9,554 beds occupied per day.

In the EU, Norway and Iceland AMR cost a total of €1.5 billion in 2007 (ECDC, EMEA, 2009). This cost was calculated as €937 million (total inpatient and outpatient costs) and €596 million in productivity losses.

Ireland

There is limited cost data for AMR in Ireland. The ECDC and EMEA estimate that the annual cost of AMR in Ireland was €48 million in 2007 (ECDC, EMEA, 2009). This estimate incorporates the cost of additional days spent in hospital from AMR infections, outpatient costs and productivity losses due to additional sick days and premature death caused by AMR. The cost of extra days spent in hospital and outpatient costs amount to €16 million. Productivity losses make up the majority of the cost of AMR at €32 million or 66% of total costs. Many costs arising from AMR such as out of pocket medical expenditure and productivity losses of informal carers are not included in these cost estimations. Therefore these figures are likely to underestimate the true cost of AMR.

The HSE has calculated that over 25,000 patients may acquire a HCAI annually at a cost of €118 million. The National Clinical Guideline 'Prevention and Control Methicillin-Resistant *Staphylococcus aureus* (MRSA)', endorsed by the NCEC in 2013 also estimated the cost of HCAI in Ireland for 2011, extrapolated from national (HSE) and international sources, at the above cost with 29,000 patients acquiring a HCAI.

Of serious concern is the emergence of what is termed Carbapenemase producing *Enterobacteriaceae* (CPE), also known as CRE, which results in some cases of bacteria being resistant to all conventionally used antimicrobials, with limited treatment options remaining. Data produced by the national CPE reference laboratory service in University Hospital Galway since 2012 and reports of outbreaks of CPE in acute hospitals and long-term care indicate a rapid and worrying increase in the incidence of CPE in Ireland. Known outbreaks have occurred in eight facilities including University Hospital Limerick (UHL) and Tallaght Hospital. The estimated cost to University Hospital Limerick for 60 cases since 2015 is €4 million and the cost to Tallaght Hospital since 2016 is €2 million with 700 operations postponed (Source HSE, April 2017). The HSE National CPE Response Plan and response support team are in place and the HSE and the Department are progressing this work.

The ECDC and the OECD are embarking on a project to estimate the burden and economic cost of AMR in the EU using national figures. This paper is due to be published in early 2018 and will contain national level estimates which will greatly improve the understanding of the cost of AMR in Ireland.

Ireland's Department of Health considers it critical that a comprehensive cost evaluation of HCAs and AMR is conducted and will commence this work shortly. This will require the input of specialist health economist expertise. In addition HIQA has committed to conduct a Health Technology Assessment (HTA) on the introduction of rapid access diagnostic tools (which will assist in prudent antibiotic prescribing).

Potential future costs of AMR

While more information on the cost of AMR is emerging for the Irish context, it remains limited. Increases in the rates of resistance will lead to large increases in the cost of AMR in the coming years. The O'Neill report (2016) estimated that by 2050 AMR will have cost the global economy \$100 trillion US Dollars (USD) and 10 million lives will be lost each year if nothing is done to curb rising rates of resistance. Projected future global costs of AMR were estimated by RAND using different assumptions on future resistance rates (2014). The study considers only the costs that arise from three bacterial infections (*E.coli*, *K.pneumoniae* and *S.aureus*) and three infectious diseases (HIV,

Tuberculosis (TB) and Malaria). As AMR can arise from many other sources, the figures in this study underestimate the true potential cost of AMR. It was estimated that a global cost of \$2 trillion USD will be incurred by 2050 if current rates of resistance remain constant. In the worst-case scenario where resistance rates increase to 100%, AMR will cost the global economy \$124 trillion USD by 2050.

Information technology for surveillance

There is no national IT system in terms of surveillance and control (case management) for public health or a system in place to address HCAI and AMR. However, some areas have developed local systems for control of some infectious diseases e.g. TB. Further development is resource dependent but could build on previous work to address the development of a national public health management and control system for infectious diseases. Computerised Infectious Disease Reporting (CIDR) could be examined as a possible route for development of such a system but would require investment. In addition, a new 'module' would have to be added to include HCAs and AMR. Workforce and/or other costing exercises should be carried out. In particular, the capital requirements for the development and implementation of any necessary IT systems for surveillance and control of infectious diseases need to be considered.

Ireland is committed to prevention, management and control of HCAs and AMR. However, without planned action, the societal and financial costs of AMR will grow. *i*NAP provides the opportunity to take stock, identify challenges and gaps in the system and outline a programme of work for a number of years.

5.3 Animal health sector actions

All stakeholders will have responsibility for the implementation of the national action plan. DAFM will host a high-level steering group including representatives of all key stakeholders that will monitor the totality of actions being taken in the animal health sector. Groups may be convened from time to time to ensure actions are taken as required.

Section 6

Ireland's 3-Year Plan

Priority Strategic Interventions and Activities

6.1 Ireland's National Action Plan on Antimicrobial Resistance 2017-2020

iNAP presents strategic interventions and activities with reference to the five strategic objectives established by the WHO to tackle AMR;

1. Improving awareness and knowledge of AMR.
2. Enhancing surveillance of antibiotic resistance and antibiotic use.
3. Reducing infection and disease spread.
4. Optimising the use of antibiotics in human and animal health.
5. Promoting research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions.





Improving awareness and knowledge of AMR

Antimicrobial resistance and 'One Health' must be seen as everyone's responsibility and this action plan encourages a whole of society approach to tackling these issues. In order for this to be successful, all sectors of our community – the public, clinicians and veterinarians, health and farming organisations and government – must first understand the extent of the challenges posed by antimicrobial resistance. This action plan aims to build on previous work (e.g. the undertheweather.ie awareness campaign and national conferences for the agri-food sector) to ensure that everyone is aware of these challenges and, more importantly, that they understand the role that they or their organisation can play in addressing them.

Enhance surveillance of antibiotic resistance and antibiotic use

Surveillance, in the context of antimicrobial resistance, involves the generation and timely provision of information that can inform appropriate decision making and action. Implicit in this definition is the fact that undertaking surveillance requires readily available sources of data. Much of the human health data required in Ireland is already generated through the HSE's Departments of Public Health and the HPSC, the public health microbiological laboratories and existing sector specific research projects and computer systems. Comprehensive community surveillance data systems need to be developed.

However, the analysis, interpretation and use of this data for action remains ad hoc and a key element of *i*NAP is the development and implementation of an integrated national surveillance system which ensures that actions taken in response to threats posed by antimicrobial resistance are timely, coordinated, and proportionate. Surveillance data in the animal health sector requires further development and co-ordination both within the animal health sector and with the human health sector so as to provide further evidence to inform future actions in relation to best practice for antimicrobial usage and to address AMR.

Reduction of infection and disease spread

The prevention and control of the spread of infectious agents among people and animals is a key component of strategies to minimise the development of antimicrobial resistance. It is central to the provision of a safe, quality healthcare system, while also being central to efficient, productive and sustainable systems of agriculture. *i*NAP aims to prioritise those elements of infection and disease prevention and control which are common to all who are working towards a 'One Health' agenda. This includes in the human health sector optimising capital investment in facilities to promote reduction in HCAs and AMR, the promotion of immunisation programmes and ensuring that everyone who works as part of a multidisciplinary team understands their role in preventing disease and controlling spread. In agriculture a holistic approach to biosecurity and animal husbandry by stakeholders with a focus on disease prevention and control strategies are integral to addressing the development and spread of AMR.

Optimise the use of antibiotics in human and animal health

A key driver of antimicrobial resistance is the use of antimicrobials in human and animal healthcare systems. Countries that use higher levels of antibiotics show greater levels of antimicrobial resistance. The extent to which these medicines are used and overused is dependent on a range of different factors, including cultural beliefs, public expectation and professional autonomy. No one solution will work in isolation. *i*NAP aims to ensure the development and implementation of multifaceted interventions which will safeguard against inappropriate prescribing, dispensing and consumption of medicines, while simultaneously promoting rational use in patients and animals who are expected to benefit from treatment.



Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions

The challenges faced as a result of antimicrobial resistance will continue to evolve over the lifetime of *i*NAP. By actively participating in research and promoting the development and use of evidence-based, cost-effective solutions to these challenges, Ireland can ensure that its human and animal

populations are best positioned to benefit from vaccines and other novel prevention strategies, while also having access to those treatments which are most effective against drug-resistant microbes. Ireland will commence a process to examine and identify its potential for research activity in the global research field. Research is also key to informing future actions to address AMR so that future initiatives are evidence based and promote best practice in relation to improving human and animal health, thereby reducing overall usage of antibiotics.

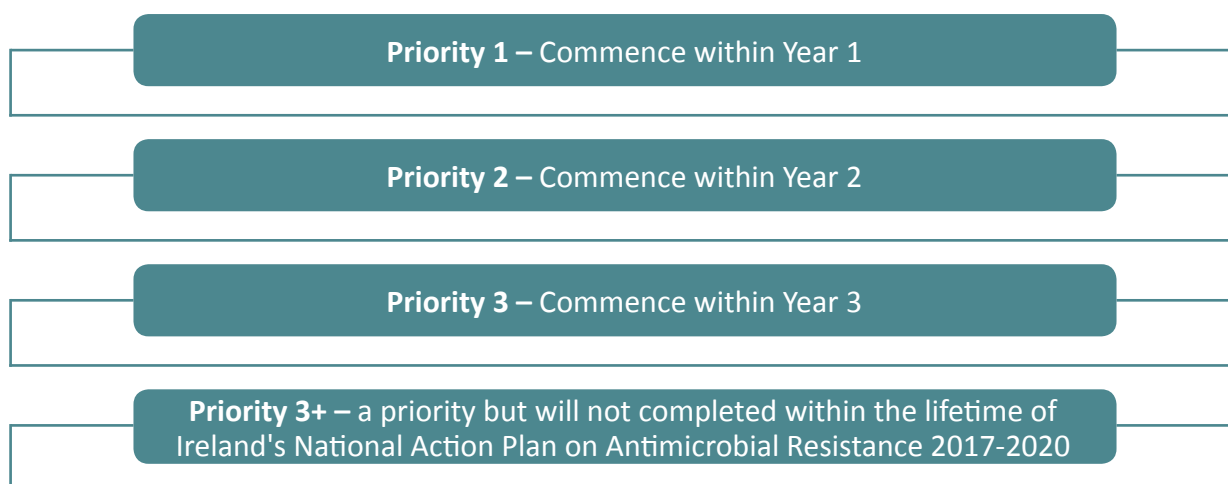
The strategic interventions and associated activities give consideration to specific objectives under the headings of awareness, surveillance, infection and disease prevention, prudent use of antimicrobials and research, which are important elements in addressing the development and spread of AMR within and across all sectors.

Each subdivision contains two tables. The first table lists integrated 'One Health' interventions and activities that are cross sectoral. The second table lists interventions and activities that are specific to each sector (human health, animal health and the environment).

Implementation and evaluation

This is an ambitious plan that sets out a comprehensive roadmap for Ireland in relation to AMR. It is intended to design implementation and evaluation processes encompassing timeframes and identifying lead agency/body responsible for each activity over the lifetime of the plan.

A priority ranking on the commencement of activities is identified. It acknowledges that some activities are ambitious and may not be completed within the lifetime of this, Ireland's first *National Action Plan on Antimicrobial Resistance 2017-2020*. In certain areas a decision was made to identify those activities that go beyond the 3-year lifetime of *iNAP* in order to inform the next action plan; to minimise fragmentation of the approach to the required interventions and activities and ensure a comprehensive AMR roadmap for Ireland. The plan also recognises that no one solution will work in isolation.



Next steps

6.2 Implementation plan

In order to commence implementation of the *i*NAP, the appropriate lead should be identified for all activities under each strategic intervention. An implementation plan will be developed, separately for each sector that will identify time-frames for interventions and activities, having regard to their priority status. The Implementation phase will approach this work with consideration of 'SMART' aims for activities.

“

*Without action you aren't
going anywhere.*

– Mahatma Gandhi

”

Strategic Objective 1

Improve awareness and knowledge of AMR

WHEN **AMR** OCCURS THEN
ANTIMICROBIALS
PARTICULARLY **ANTIBIOTICS**
ARE NO LONGER
EFFECTIVE
TO TREAT INFECTIONS

BACTERIA
BECOME
RESISTANT
NOT US

A white outline icon of a bacterium with a wavy, irregular shape and three small circles inside representing internal structures.

ONE
PERSON DIES
EVERY 15 MINS
IN EUROPE AS A
RESULT OF AN
AMR RELATED INFECTION

DUMPING OF **UNUSED**
ANTIBIOTICS
CONTRIBUTES TO
ENVIRONMENTAL
CONTAMINATION



Strategic Objective 1
Improve awareness and knowledge of AMR

Strategic interventions	Activities
<p>A. Deliver AMR public awareness campaigns</p>	<p>A.1. Design AMR campaigns in line with a best practice approach to effective campaigns.</p> <p>A.2. Implement AMR campaigns utilising a variety of messaging/ campaign platforms to capture widest reach e.g. website, social media, patient stories, radio and TV.</p> <p>A.3. Monitor public knowledge of and attitudes towards antibiotics.</p> <p>A.4. Monitor effectiveness of awareness campaigns.</p>
<p>B. Education and training across all sectors</p>	<p>B.1. Deliver accredited continuing professional development programmes through a variety of learning/knowledge platforms to capture widest reach e.g. website, e-learning, train the trainer programmes, social media, patient stories.</p> <p>B.2. Undergraduate and post-graduate core curriculum training and examinations to include infection and disease prevention, AMR and responsible use of antibiotics. It is important that training is across all relevant specialist areas.</p>

Sector Specific Interventions

Strategic Objective 1 Improve knowledge and awareness of AMR			
Strategic interventions	Activities	Responsible	Timeline
1.1. Design and implement awareness strategies for: <ul style="list-style-type: none"> - Healthcare workers - Healthcare managers - Policy makers - Undergraduate and Postgraduate healthcare students - General public & patients - First and second level school students 	1.1.1 Develop and deliver AMR and Infection Prevention Control (IPC) awareness sessions/campaigns.	DoH, HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, HSE/RCPI Clinical Advisory Group, professional regulators, ICGP, education providers, DES, HEA, Private Healthcare Providers	Priority 1
	1.1.2 Establish a variety of messaging/campaign platforms to capture widest reach e.g. website, social media, patient stories, radio and TV. <i>This will involve development of bespoke material such as: national campaigns including publicising of www.undertheweather.ie and European Antibiotic Awareness Day (EAAD) campaign themes each year.</i>		Priority 2
	1.1.3 e-Bug initiative should be incorporated into primary, post primary curriculum for schools.		As above and Science Foundation Ireland (SFI)

1.2. Education of Healthcare workers and the general public: <ul style="list-style-type: none"> - Healthcare workers - Healthcare managers - Policy makers - Undergraduate and Postgraduate healthcare students - General public & patients - First and second level school students 	<p>1.2. Establish a competency framework for AMR and IPC to include standard precautions and AMR prescribing.</p>	<p>HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, HSE/RCPI Clinical Advisory Group, professional regulators, ICGP, education providers, DES, HEA, Private Healthcare Providers</p>	Priority 1
	<p>1.2.2 Develop and deliver AMR and IPC training programmes.</p>		Priority 1
	<p>1.2.3 Continuing professional development programmes to ensure maintenance of competence and compliance with mandatory systems is monitored.</p>		Priority 2
	<p>1.2.4 Establish variety of learning/ knowledge platforms linking relevant sources (HPSC, RCPI, ICGP etc.) to capture widest reach e.g. website, e-learning, train the trainer programmes, social media, patient stories.</p>		Priority 2
	<p>1.2.5 Undergraduate and Post-graduate core curriculum training and examinations to include education on AMR and IPC.</p>		Priority 2
	<p>1.2.6 Monitor level of knowledge in line with competency framework.</p>		Priority 3
	<p>1.2.7 Involve patients in the design and delivery of education e.g. incorporate patient stories into education programmes.</p>		Priority 1

1.3 Design and implement both general and specific awareness strategies in the animal health sector	<p>1.3.1 Further development of DAFM, Veterinary Council and FSAI websites/newsletters, as well as production and distribution of posters, leaflets, surveys etc. for placement in DAFM Regional Offices, meat plants, marts, veterinary practices etc.</p>	<p>Veterinary Council of Ireland, Veterinary Ireland, processors, Animal Health Ireland, Teagasc, farm organisations, FSAI, DAFM</p>	<p>Priority 2</p>
	<p>1.3.2 Re-circulation of Veterinary Ireland AMR Policy Document, with inclusion of AMR-related topics in the Irish Veterinary Journal and each major Veterinary Ireland continuing education event over the next three years.</p>	<p>Veterinary Ireland</p>	<p>Priority 2</p>
1.4 Design and implement educational modules for animal keepers and for the veterinary profession	<p>1.4.1 Develop and implement specific AMR CPD module for veterinary practitioners and a specific Further Education Training Awards Council (FETAC) module for animal keepers, and encourage as many members of both professions to take them.</p>	<p>Veterinary Council of Ireland, Teagasc, farm organisations, DAFM</p>	<p>Priority 2</p>
	<p>1.4.2 Develop and implement specific AMR and disease prevention modules in the syllabus of undergraduate veterinary and agricultural courses.</p>	<p>Veterinary College, agricultural colleges, Teagasc, DAFM</p>	<p>Priority 2</p>
	<p>1.4.3 Develop and implement a training strategy for farmers in relation to AMR and disease prevention, through newsletters, websites, online media, one to one and area meetings.</p>	<p>Teagasc, Animal Health Ireland, farm organisations, DAFM</p>	<p>Priority 2</p>
	<p>1.4.4 Distribution of information in relation to the important changes to the benefit risk profile of antimicrobials and updated product information.</p>	<p>HPRA</p>	<p>Priority 2</p>

<p>1.5 Provide information to improve understanding and awareness around correct disposal of antimicrobials</p>	<p>1.5.1. Use of the Live Green website (a National Sustainability Information Portal for Householders (www.epa.ie/livegreen), to provide advice on medicines (including antimicrobials) in the home and how to dispose of them correctly.</p>	<p>EPA, PSI</p>	<p>Priority 1</p>
<p>1.6 To educate and improve understanding of AMR amongst the general public</p>	<p>1.6.1. Feature topic on AMR to be included in RTÉ series <i>Eco-Eye</i> and/or <i>10 Things to Know About</i>.</p>	<p>EPA, PSI</p>	<p>Priority 3</p>

Strategic Objective 2

Enhance surveillance of antibiotic resistance and antibiotic use



SINCE 2009
HPSC & DAFM
HAVE COORDINATED
NATIONAL SURVEILLANCE FOR AMR
IN FOODBORNE BACTERIA



SINCE 2009 HPSC
HAS COORDINATED
NATIONAL SURVEILLANCE
OF **C.DIFFICILE INFECTION**

THERE ARE **8,500**
FOOD SAMPLES **TESTED**
ANNUALLY IN IRELAND
FOR **TRACES OF** 
ANTIBIOTICS

NATIONAL SURVEILLANCE FOR
AMR IN PIGS AND
POULTRY

HAS BEEN CARRIED OUT
SINCE 2009

Strategic Objective 2
Enhance surveillance of antibiotic resistance and antibiotic use

Strategic interventions	Activities
A. Co-ordinate national surveillance systems for AMR across all sectors	A.1. Examine integration and further development of current surveillance systems in place to monitor AMR development and spread across the Health, Agriculture and Environment sector. A.2. Produce joint surveillance report(s) between animal and human health sector.

Sector Specific Interventions

Strategic Objective 2			
Enhance surveillance of antibiotic resistance and antibiotic use			
Strategic interventions	Activities	Responsible	Timeline
2 .1. Strengthen national surveillance system to ensure integration and timely information for: 1. AMR 2. Antimicrobial use 3. HCAIs	2.1.1 Conduct gap analysis of current surveillance capabilities and develop business case for enhancement of the system with reference to requirements outlined below:	HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, PSI, PCRS, HPRA	Priority 1
	<ul style="list-style-type: none"> • A national surveillance database with timely access to reference laboratory systems. 		Priority 3
	<ul style="list-style-type: none"> • A coordinated approach to sharing of data for action across health sectors e.g. development of integrated community and hospital databases with public health and epidemiological data systems. 		Priority 3
	<ul style="list-style-type: none"> • A real time laboratory-based alert system for MDROs to identify outbreaks and relevant events and ensure such outbreaks are reported in a timely fashion to the Medical Officer for Health as legally required. 		Priority 1-2
	<ul style="list-style-type: none"> • A real time audit and surveillance system for antimicrobial prescriptions in primary care potentially utilising a new module on the Irish Primary Care Research Network (IPCRN). 		Priority 1-2
	<ul style="list-style-type: none"> • A real time audit and surveillance system for antimicrobial prescriptions in hospitals. 		Priority 1-2
	<ul style="list-style-type: none"> • Active surveillance feedback mechanisms to inform performance and activities and promote improvement. 		Priority 3

	<ul style="list-style-type: none"> • HPSC capacity as the national coordinating centre for AMR and HCAI surveillance with the mandate to oversee AMR surveillance programmes, including collecting, aggregating and sharing data. • Roll out of National Infection and Control Data System (IPCRESS). • AMR relevant topics are included as part of national eHealth developments. • The feasibility of development of a surveillance system to enable regular assessment of the cost of agreed interventions/strategies linked to Activity Based Funding (ABF) and other initiatives as appropriate. <p>2.1.2 Review HSE Service Plan KPIs to ensure a balanced suite of reportable indicators. These should be capable of identifying performance thresholds within the HSE Accountability Framework.</p>		<p>Priority 1</p> <p>Priority 2</p> <p>Priority 1</p> <p>Priority 1</p> <p>Priority 1</p>
<p>2.2 Develop and implement a national laboratory system with capacity to produce high-quality microbiological data for patient management and to support surveillance activities in both human and animal sectors.</p>	<p>2.2.1 Develop proposals for integrated microbiological reference laboratories.</p> <p>2.2.2 Implement single national laboratory system (MEDLis).</p>	<p>HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR</p>	<p>Priority 1</p> <p>Priority 2</p>
<p>2.3 Research deliverables on activities and initiatives relating to responsible use of antimicrobial agents and better practice in infection prevention in human health</p>	<p>2.3.1 Develop a plan to ensure that AMR is a priority in Irish research and innovation programmes (HRB and HPRA).</p> <p>2.3.2 Examine the clinical and cost-effectiveness of rapid access testing/near patient testing for hospitals and community, including GPs.</p>	<p>DoH, HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, ICGP, HRB, HPRA, HIQA</p>	<p>Priority 2</p> <p>Priority 1</p>

2.4 Further develop the national AMR surveillance system in the animal health sector	2.4.1 Develop a network that provides accurate, cost effective antibiotic susceptibility tests for farmers and veterinary practitioners.	Private testing laboratories, DAFM	Priority 2
	2.4.2 Broaden the scope of the AMR surveillance programme in animals and food to include additional bacterial species, higher number of overall samples and increased genotyping of resistant isolates.	Private testing laboratories, DAFM	Priority 3
2.5 Improve awareness of AMR surveillance activities in Ireland	2.5.1 Collaborate with the health sector in the production of a One Health AMR Surveillance Report.	DAFM, DoH, HPSC, HSE	Priority 1
2.6 Implement a national system for the collection of data on antimicrobial use	2.6.1 Develop and implement a system for the collection of specific information in relation to antimicrobial sales from manufacturers and wholesalers.	Manufacturers, wholesalers, DAFM	Priority 1
	2.6.2 Develop and implement a system for the collection of data in relation to antibiotic usage on pig and poultry farms in Ireland.	Animal keepers, veterinarians, farm organisations, Veterinary Ireland, DAFM, Teagasc, feedmills	Priority 1
	2.6.3 Develop a system for the collection of data from veterinary practices.	Veterinary Ireland, veterinary practitioners, DAFM	Priority 2
	2.6.4 Develop and implement a system for the collection of data in relation to usage of intramammary tubes in the dairy sector.	AHI, farm organisations, Veterinary Ireland, DAFM	Priority 3
	2.6.5 Develop and carry out a survey to measure antibiotic usage in other animal sectors apart from dairy, pig and poultry.	Food industry, farm organisations, Teagasc, DAFM	Priority 3

<p>2.7 Research to focus on assessing the potential impact of AMR, as well as antimicrobials, in environmental compartments.</p>	<p>2.7.1 Continued funding of research focusing on assessing the potential environmental impact of AMR and antimicrobial use, with the ultimate aim of identifying pressures, informing policy and developing solutions around the topic.</p> <p>2.7.2 Funding of research which will characterise hotspots, examine and develop feasible solutions enabling detection and removal of antimicrobials from environmental compartments, for example removal of antimicrobials in conventional and advanced wastewater treatment, rapid and low concentration detection methods, timely identification and characterisation of emerging AMR microbes of environmental concern.</p> <p>2.7.3 Research to determine baseline levels of antimicrobial residue and antimicrobial resistance present in relevant targeted industries.</p> <p>2.7.4 National participation in Horizon 2020 Societal Challenge Five initiatives around AMR.</p> <p>2.7.5 National participation in Joint Programming Initiative on Antimicrobial Resistance (JPI on AMR), particularly with regard to priority topics related to environment.</p>	<p>EPA, IRC</p>	<p>Priority 3</p>
<p>2.8 Monitoring and reporting programme for EU designated priority substances.</p>	<p>2.8.1 Collection and reporting of data regarding levels and persistence of certain antimicrobials (e.g. macrolide antibiotics) within specific environments in line with priority list of substances for Union-wide monitoring.</p>	<p>EPA</p>	<p>Priority 1</p>

Strategic Objective 3

Reduce the spread of infection and disease



AN ESTIMATED **494**
PATIENTS IN IRISH
HOSPITALS **HAVE A**
HCAI ON ANY GIVEN DAY



WHO
5 MOMENTS OF
HAND HYGIENE
STANDARD HAND
HYGIENE PRECAUTION 

- BETTER** BIO SECURITY
- BETTER** HUSBANDRY
- BETTER** HOUSING
- BETTER** HEALTH

VACCINATION
IS BETTER THAN
TREATMENT
PREVENTION
IS BETTER THAN **CURE**



Strategic Objective 3
Reduce the spread of infection and disease

Strategic interventions	Activities
<p>A. Implement measures that will improve the health status in both human and animal populations.</p>	<p>A.1. Improve current infection and disease prevention programmes.</p>
<p>B. Minimise the risk of spread of AMR by water systems.</p>	<p>B.1. Examine mechanisms and approaches to reduce and eliminate discharge of untreated hospital waste in collaboration with the Environmental Protection Agency (EPA) and relevant others through standards and monitoring programmes.</p>

Sector Specific Interventions

Strategic Objective 3 Reduce the spread of infection and disease			
Strategic interventions	Activities	Responsible	Timeline
3.1 Optimise physical infrastructure of hospitals and healthcare settings in relation to prevention and control of HCAs.	3.1.1 Establish processes to create a requirement that all new builds and refurbishment programmes comply with relevant national standards and are developed with engagement of IPC personnel.	DoH, HSE Health & Wellbeing, HPSC, HSE National Divisions	Priority 1
	3.1.2 Existing builds - establish processes to ensure that national equipment replacement and capital planning programmes are in place.		Priority 1
	3.1.3 Minimum specification of infection prevention resources should be identified and provided appropriate to facilities such as single use medical devices and Personal Protective Equipment for all clinical scenarios.		Priority 1
3.2 Ensure clear governance and accountability structure exists for Infection Prevention & Control (IPC), HCAs, AMR throughout all healthcare settings.	3.2.1 Establish clear accountability and governance structures across healthcare settings.	HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, HSE/RCPI CAG, professional regulators, ICGP, education providers	Priority 1
	3.2.2 Capacity building should be in line with Workforce Plan for the prevention, surveillance and management of HCAs and AMR. (See Strategic Intervention 4.3)		Priority 1 - 3
	All healthcare workers have IPC responsibility. 3.2.3 Implement national guidance in line with <i>NCEC Standards for Clinical Practice Guidance</i> for infection prevention and control for all healthcare settings.		Priority 1


	3.2.4 Ensure IPC is risk rated and included in all relevant risk registers, along with agreed control measures and part of Hospital Patient Safety Indicator Reports.		Priority 1
3.3 Optimise patient flow within hospitals, within community settings and long-stay facilities and between hospital and community settings to reduce spread of infection.	3.3.1 Clinical Handover and Transfer of Care Protocols/ guidance to encompass HCAI & AMR issues.	HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, HSE/RCPI CAG, professional regulators, ICGP, education providers, members of the public	Priority 1
	3.3.2 Establish processes to ensure that the design of clinical care pathways and patient flow systems operate efficiently to minimise unnecessary contact with and within healthcare settings. This includes hospital in the home programmes.		Priority 2
	3.3.3 Develop and implement programmes to support self-care.		Priority 2
3.4 Vaccination programmes.	3.4.1 Maximise uptake of immunisation for general population and healthcare workers in all healthcare settings.	Members of the public, HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, HSE/RCPI CAG, professional regulators, ICGP, education providers, DoH	Priority 1-2
	3.4.2 Monitor and publish associated KPIs.		Priority 1
3.5 Implement measures aimed at improving infection and disease prevention on farms in Ireland, thereby reducing the need for antibiotics.	3.5.1 Prepare case studies in relation to farms that have been successful at reducing the need for antibiotics and share these with other animal keepers.	Farmers, veterinarians, farm organisations, Teagasc, AHI, DAFM	Priority 1
	3.5.2 Carry out studies in relation to methods that have been deployed in other Member States to reduce the need for antibiotics on farm and implement strategies to disseminate best practice.		Priority 3

<p>3.6 Implement relevant priorities identified in the National Hazardous Waste Management plan.</p>	<p>3.6.1 Ensure that actions within the plan are appropriately executed by the designated responsible body, including but not limited to, those relating to disposal of antimicrobials.</p> <p>3.6.2 Continued operation of the National Farm Hazardous Waste Collection initiative nationally to increase collection of veterinary medicine wastes, including antimicrobials, as well as many other hazardous farm waste streams.</p>	<p>EPA</p>	<p>Priority 3</p> <p>Priority 3</p>
<p>3.7 Consider implications of emerging AMR research findings in the context of EPA licensing procedures.</p>	<p>3.7.1 Liaise with research funders and performers on the implications of emerging research findings in this area.</p>	<p>EPA</p>	<p>Priority 3</p>
<p>3.8 Minimise the risk of spread of AMR by water systems.</p>	<p>3.8.1 Assess the extent to which interventions to reduce and eliminate discharge of untreated hospital waste may be achieved in conjunction with relevant agencies.</p>	<p>EPA</p>	<p>Priority 3</p>

Strategic Objective 4

Optimise the Use of
Antibiotics in Human and
Animal Health

 ANTIBIOTICS WERE
FIRST DISCOVERED
NEARLY
100 YEARS AGO
ONLY THROUGH RESPONSIBLE USE WILL
THEY BE EFFECTIVE FOR ANOTHER 100 YEARS

ANTIBIOTIC CONSUMPTION HAS
 **DECREASED
BY 6%**
IN THE EU OVER THE LAST 7 YEARS

ANTIBIOTICS ^{CAN}  **ONLY BE GIVEN**
 TO AN ANIMAL ON FOOT OF A
**VETERINARY
PRESCRIPTION** 
 FOR AN ANIMAL UNDER
HIS/HER CARE 

RIGHT DRUG



RIGHT DOSE



RIGHT DURATION

Strategic Objective 4
Optimise the Use of Antibiotics in Human and Animal Health

Strategic interventions	Activities
A. Antibiotic Stewardship Programmes.	<p>A.1. Develop National Policy Guidelines for prudent prescribing practice for the medical and veterinary professions as part of a programme to promote responsible prescribing practice.</p> <p>A.2. Develop guidelines for end user or person administering antibiotics.</p> <p>A.3. Commit to specific human and animal sector actions with the aim of minimising the use of 'critically important antimicrobials' (CIAs) and examine potential regulatory mechanisms.</p>
B. Maintain access to effective disease treatment options.	<p>B.1. Examine the feasibility of development of programmes to promote consistent availability and access to high quality antimicrobials in order that they remain available on the market with indications for use classified appropriately.</p>

Sector Specific Interventions

Strategic Objective 4 Optimise the Use of Antibiotics in Human and Animal			
Strategic interventions	Activities	Responsible	Timeline
4.1 Antibiotic stewardship programmes in humans.	4.1.1 National guidance for good antibiotic prescribing practice for all healthcare settings are available and updated as required in line with <i>NCEC Standards for Clinical Practice Guidance</i> . These need to be integrated with clinical care programmes.	HSE Health & Wellbeing, HPSC, HSE National Divisions, National Taskforce on HCAI AMR, HSE/RCPI CAG, professional regulators, ICGP	Priority 1-3
	4.1.2 Develop a guide for prescribers to support decisions and promote prudent prescribing.		Priority 1
	4.1.3 Examine the need for a national programme for progressive restriction of access to 'critically important antimicrobial' agents to prescribers with specific competence.		Priority 3
4.2 Supply and pricing of antibiotics: encourage supply to market of narrow-spectrum antibiotics in humans.	4.2.1 Explore and develop programmes to promote consistent availability and access to high quality antimicrobials.	DoH, HSE, HPRA, NCPE	Priority 2
	4.2.2 Develop mechanisms to ensure access to antimicrobials recommended in prescribing guidelines.		Priority 2
	4.2.3 Support appropriate access to prevention measures, diagnostics, health services, reliable guidance and education, quality-assured medicines, and sustainable financing mechanisms, so that access to appropriate antimicrobials is complemented and reinforced.		Priority 3

	<p>4.2.4 Continue to implement HSE's Medicines Management Programme, including negotiations on drug pricing and provision of prescribing advice.</p> <p>4.2.5 Examine the restriction of sales of on-line prescribing of antibiotics.</p> <p>4.2.6 Antibiotics should remain prescription only.</p> <p>4.2.7 HPRA to ensure that all antimicrobials are appropriately classified for supply and promotion to facilitate prudent use.</p>		<p>Priority 1</p> <p>Priority 1</p> <p>Priority 1</p> <p>Priority 1</p>
<p>4.3 Evaluation of system capacity – Workforce Planning.</p>	<p>4.3.1 Develop a Workforce Plan for HCAI/AMR across all healthcare settings. The Workforce Plan should identify optimum team competencies and composition for hospital and community care. This should include infection prevention and outbreak control teams. The Workforce Plan should detail scope of practice, responsibilities and an accountability framework.</p> <p>4.3.2 Following development of the Workforce Plan a gap analysis for the workforce should be conducted.</p> <p>4.3.3 Based on Workforce Plan and the gap analysis a recruitment and retention plan should be developed and implemented.</p>	<p>HSE Health & Wellbeing, HPSC, HSE National Divisions, DoH, professional regulators</p>	<p>Priority 1</p> <p>Priority 1</p> <p>Priority 2-3</p>


<p>4.4 Develop sector specific guidelines in relation to prudent use of antimicrobials in animals.</p>	<p>4.4.1 Develop and implement sector specific codes of good practice for veterinary practitioners and farmers.</p>	<p>Veterinary Ireland, Veterinary Council, Farm organisations, DAFM, processors</p>	<p>Priority 1</p>
	<p>4.4.2 Develop and implement a voluntary code of good practice to restrict the use of highest priority critically important antibiotics as defined by the European Medicines Agency.</p>	<p>Veterinary Ireland, Veterinary Council, DAFM, farm organisations</p>	<p>Priority 1</p>
	<p>4.4.3 Update the Code of Ethical Veterinary Practice to ensure it provides for the maintenance of professional standards in relation to prudent use of antibiotics in accordance with international best practice.</p>	<p>Veterinary Council, Veterinary Ireland, DAFM</p>	<p>Priority2</p>
	<p>4.4.4 Carry out a review of the use of medicated feed in Ireland with a view to identifying ways of better targeting antibiotic treatment in intensive animal production systems.</p>	<p>IGFA, Teagasc, DAFM</p>	<p>Priority 2</p>
	<p>4.4.5 Investigate ways of incentivising the prudent use of antibiotics on farms in Ireland including engaging with the retail sector with a view to promoting 'antibiotic responsible' rather than 'antibiotic free' campaigns.</p>	<p>Farm organisations, processors, Bord Bia, FSAI</p>	<p>Priority 2</p>
	<p>4.4.6 Develop tools that allow farmers to readily assess the volume and the cost of antibiotics being used on their farms.</p>	<p>Farm organisations, Teagasc, DAFM</p>	<p>Priority 2</p>

<p>4.5 Ensure legislation provides a mechanism for tackling inappropriate use.</p>	<p>4.5.1 Review legislation underpinning the prescription, sale and supply of antimicrobials in the animal health sector to better reflect current best knowledge, and international standards to ensure that the legislative framework more clearly supports and promotes best practice with regard to prudent use.</p>	<p>DAFM</p>	<p>Priority 1</p>
<p>4.6 Harmonisation and updating of product labelling for older antibiotics.</p>	<p>4.6.1 Carry out a review of summary of product characteristics (SPCs) for veterinary antibiotics with the objective of ensuring that they comply with international best practice in relation to prudent use.</p>	<p>HPRA, DAFM</p>	<p>Priority 2</p>

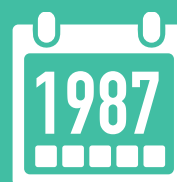

Strategic Objective 5

Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions


18 ANTIBIOTICS IN DEVELOPMENT WITH BIG PHARMA IN **1990**



6 ANTIBIOTICS IN DEVELOPMENT WITH BIG PHARMA IN **2016**



THE LAST TIME A NEW CLASS OF ANTIBIOTIC CAME TO THE MARKET

€1.3 BILLION  HAS BEEN INVESTED BY EU SINCE 1999 **FOR AMR RESEARCH**

Strategic Objective 5 Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions	
Strategic interventions	Activities
A. Ireland's contribution/participation in AMR innovation and research.	<p>A.1 Examine the case for incentives to promote interventions for the prevention of infection or disease and avoiding inappropriate antimicrobial prescribing.</p> <p>A.2 Identify Ireland's contribution including funding and research activity in the global research field. This could include examination of the World Economic Forum (Davos) project on public/private sector collaboration on tackling AMR.</p>
B. Research to be carried out in relation to development of better rapid diagnostic tools, alternative disease prevention and treatment options.	<p>B.1. Ensure mechanisms are in place which facilitate research findings across sectors.</p> <p>B.2 Assess cost and clinical effectiveness of rapid diagnostic tools.</p> <p>B.3 Examine methods to promote the development of alternative treatment and prevention options.</p>

Sector Specific Interventions

Strategic Objective 5			
Promote research and sustainable investment in new medicines, diagnostic tools, vaccines and other interventions			
Strategic interventions	Activities	Responsible	Timeline
5.1 Carry out health economic analysis of cost of HCAI/AMR.	5.1.1 Measure all evaluable costs of HCAI & AMR (e.g. colonisation, Workforce Plan, new tests, technologies, vaccines, antibiotics etc.).	DoH	Priority 1
	5.1.2 Examine case for incentives to promote prevention of infection and avoiding inappropriate antimicrobial prescribing.	DoH, HSE	Priority 3
5.2 Research in relation to development of better rapid diagnostic tools, alternative disease prevention and treatment options.	5.2.1. Develop mechanisms to facilitate research findings across sectors.	DoH, HSE, HRB	Priority 3
	5.2.2 Examine options for establishing links with academic and industry partners to promote the development of new medicines as alternative treatment options.	DoH, HSE, HRB HIQA	Priority 3
	5.2.3 Assess cost and clinical effectiveness of rapid diagnostic tools.	HIQA	Priority 1
5.3 Research in relation to development of better rapid diagnostic tools, alternative disease prevention and treatment options.	5.3.1 Discuss promotion of further research in this area.	HRB, SFI, Enterprise Ireland, Pharmaceutical Companies	Priority 1
	5.3.2 Develop a more defined structure and funding to investigate new antibiotics.		Priority 2
5.4 Take actions to address research gaps.	5.4.1 Carry out a survey to identify research currently underway or that has been carried out in the area of AMR and animal populations and identify gaps in knowledge needed to inform future policy options with the purpose of guiding future research funding by DAFM.	DAFM, 3rd level institutions and other research establishments	Priority 3

	<p>5.4.2 Carry out a study in relation to the use of selective dry cow therapy in dairy cows and impact on mastitis control and farm profitability.</p>	<p>AHI</p>	<p>Priority 2</p>
	<p>5.4.3 Carry out a study in relation to the economic effect of the introduction of infection and disease control measures on pig farms in Ireland.</p>	<p>Teagasc, DAFM</p>	<p>Priority 2</p>
	<p>5.4.4 Make a presentation to Science Foundation Ireland with a view to encouraging the development of new diagnostic tools, vaccines and other interventions.</p>	<p>DAFM</p>	<p>Priority 3</p>

“

*Every small action matters because
when 7 billion people do that thing,
it changes the world.*

– Achim Steiner, Administrator - United Nations Development Programme

”

Appendix 1: National Interdepartmental Antimicrobial Resistance Consultative Committee

The National Interdepartmental AMR Consultative Committee was launched in November 2014 on European Antibiotic Awareness Day. The Committee is a true 'One Health' committee that brings together many of the key stakeholders in the human health, animal health and environmental sectors. The function of the Committee is as follows:-

- Within the context of 'One Health' to raise public and professional awareness in both the Health and Agricultural sectors of the public and animal health threat of AMR, and the potential repercussions for human health, the agricultural and food industry, and the environment.
- Provide guidance as to how best ensure that the matter of AMR is addressed holistically and in a coordinated way across both sectors at a national level, in a setting where the challenges faced by both sectors are understood by all.
- Provide guidance as how best to encourage, coordinate and support existing and planned work on the issue of AMR including research activities by various stakeholders across both sectors.
- Provide commentary and advice which will serve to inform future evidence-based intersectoral policy decisions and actions in relation to AMR.

The Committee meets at least on a bi-annual basis but may meet more frequently as the need arises. The membership of the Committee is as follows:

Membership	
Co-Chairs	
Dr Tony Holohan	Chief Medical Officer, Department of Health
Mr Martin Blake	Chief Veterinary Officer, Department of Agriculture, Food and the Marine
Members	
Dr Niamh O'Sullivan	Chair, HSE/RCPI Clinical Advisory Group on HCAI
Dr Robert Cunney	Clinical Lead, HSE HCAI/AMR Clinical Programme
Dr Darina O'Flanagan Dr Karen Burns	Director, Health Protection Surveillance Centre (to April 2016) Consultant Clinical Microbiologist
Dr Stephanie O'Keeffe	National Director, Health & Wellbeing Directorate, HSE
Dr Margaret O'Sullivan	Chair, National Zoonoses Committee
Mr Pat O'Mahony Dr Lorraine Nolan	CEO, Health Products Regulatory Authority (to December 2015) CEO, Health Products Regulatory Authority (from January 2016)

Membership	
Ms Sheila O'Connor	Patient Representative (from October 2016)
Dr John Egan	Senior Superintending Research Officer, DAFM Laboratory Services
Mr John O'Rourke	President, Veterinary Ireland (to September 2016)
Ms Mairead Wallace-Pigott	President, Veterinary Ireland (from October 2016 – January 2017)
Mr John O'Connor	President, Veterinary Ireland (from February 2017)
Mr Bill Cashman	President, Veterinary Council of Ireland (to December 2015)
Mr Ray Finn	President, Veterinary Council of Ireland (from January 2016)
Mr John Comer	President, Irish Creamery Milk Suppliers Association
Prof Alan Reilly	CEO, Food Safety Authority of Ireland (to February 2015)
Dr Pamela Byrne	CEO, Food Safety Authority of Ireland (from March 2015)
Mr Eddie Downey	President, Irish Farmers' Association (to 2016)
Mr Joe Healy	President, Irish Farmers' Association (from October 2016)
Ms Laura Burke	Director General, Environmental Protection Agency
Mr Joe Flaherty	CEO, Animal Health Ireland (from March 2017 – September 2017)
Department of Agriculture, Food & the Marine	
Ms Hazel Sheridan	Senior Superintending Veterinary Inspector
Ms Caroline Garvan	Superintending Veterinary Inspector
Mr Patrick Clune	Veterinary Inspector
Ms Breeda Meehan	Higher Executive Officer
Department of Health	
Dr Kathleen Mac Lellan	Director, National Patient Safety Office (NPSO)
Ms Rosarie Lynch	Head, Patient Safety Surveillance NPSO
Ms Eithne Barron	Assistant Principal Officer, Project Lead NPSO
Ms Sarah Delaney	Executive Officer NPSO
Ms Maeve Guilfoyle	Clerical Officer NPSO
Dr Ronan Glynn	Specialist in Public Health, Officer of the Chief Medical Officer
The minutes of the Committee meetings are published on both the Department of Health and the Department of Agriculture, Food & the Marine websites.	

Appendix 2: List of key stakeholders



Animal Health Ireland functions as a partnership between private sector organisations and businesses in the agri-food sector and the Department of Agriculture, Food and the Marine. AHI provides the knowledge, education and coordination required to establish effective control programmes for non-regulated diseases of livestock.



The Animal and Plant Health Association is the representative body for manufacturers and sole distributors of animal health (veterinary medicines) and plant health (plant protection/ agrochemical) products in Ireland.



Bord Bia is an Irish State Agency with the aim of promoting sales of Irish food and horticulture both abroad and in Ireland itself.



The Environmental Protection Agency is at the front line of environmental protection and policing. They ensure that Ireland's environment is protected and they monitor changes in environmental trends to detect early warning signs of neglect or deterioration.



The Food Safety Authority of Ireland is a statutory, independent and science-based body, dedicated to protecting public health and consumer interests in the area of food safety and hygiene. They come under the aegis of the Minister for Health.



The Higher Education Authority leads the strategic development of the Irish higher education and research system with the objective of creating a coherent system of diverse institutions with distinct missions, which is responsive to social, cultural and economic development of Ireland and its people.



The Health Information and Quality Authority is an independent authority established to drive high-quality and safe care for people using our health and social care services in Ireland. HIQA's role is to develop standards, inspect and review



HPRA's role is to protect and enhance public and animal health by regulating medicines, medical devices and other health products. They are a state agency that put the health of people and animals at the core of what they do.



The Health Protection Surveillance Centre is Ireland's specialist agency for the surveillance of communicable diseases. It works with service providers and sister organisations in Ireland and around the world to provide the best possible information for the control and prevention of infectious diseases.



The Health Research Board is a statutory agency under the aegis of the Department of Health. It is the lead agency in Ireland responsible for supporting and funding health research, information and evidence.



The Health Service Executive provides all of Ireland's public health services in hospitals and communities across the country.



The Irish Co-operative Organisation Society serves and promotes commercial co-operative businesses and enterprise, across multiple sections of the Irish economy.



The Irish College of General Practitioners is the professional body for general practice in Ireland. Its primary aim is to serve the patient and the general practitioner by encouraging and maintaining the highest standards of general medical practice. It is the representative organisation on education, training and standards in general practice.



The Irish Creamery Milk Suppliers Association represents all farmers, particularly dairy & livestock farmers. It aims to promote the interests of all engaged in agriculture at local, national & EU levels, and to advise on the protection and regulation of the agricultural industry in Ireland.. It places special emphasis on preserving the family farm structure and defending the rights and incomes of farm families.



The Irish Farmers Association works to promote, foster and develop agriculture and defend the interests of Irish farmers and their families. It works across all sectors to accomplish its mission – to improve the incomes and conditions of all farm families.



The Irish Grain and Feed Association is the representative body of the grain and feed industry and is recognized by Government as the official voice of the industry.



Meat Industry Ireland provides a wide variety of services for its members including up-to-date information on all technical, legislative developments and policy changes that may affect the meat industry processing sectors.



The National Clinical Effectiveness Committee is a Ministerial Committee established to provide a framework for quality assurance and endorsement of National Clinical Guidelines and audit.



The National Patient Safety Office was established to provide patient safety policy leadership through a programme of patient safety policy including legislation, clinical effectiveness and patient safety surveillance.



The National Zoonoses Committee will help to advance the control of zoonotic diseases in Ireland through its support of regional zoonoses committees, its promotion of information-sharing and linkages between key stakeholders, and its identification and advice on potential zoonotic risks.



The Private Hospitals Association co-ordinates the representation of private hospitals and offers a forum for exchange of information and best practice between members.



The Pharmaceutical Society of Ireland is an independent statutory body, established under the Pharmacy Act 2007. It is charged with, and is accountable for, the effective regulation of pharmacy services in Ireland.



The principal function of the Veterinary Council of Ireland is to regulate and manage the practice of veterinary medicine and veterinary nursing in the State in the public interest.



Science Foundation Ireland is the national foundation for investment in scientific and engineering research. It invests in academic researchers and teams who are most likely to generate new knowledge, leading edge technologies and competitive enterprises in the fields of science, technology, engineering and maths (STEM).



Teagasc is the national body providing integrated research, advisory and training services to agriculture and the food industry.



Veterinary Ireland's role is to represent veterinary surgeons in Ireland and to facilitate the veterinary profession in its commitment to improving the health and welfare of animals under its care, to protecting public health and to serving the changing needs of its clients and the community through effective and innovative leadership.

Appendix 3: HPSC Surveillance of Key Pathogens

EARS-Net

- ***Escherichia coli***: The proportion of patients with BSI caused by *E. coli* producing extended-spectrum β -lactamases (ESBLs)
- ***Enterococcus faecium***: The proportion of *E. faecium* BSI that were vancomycin resistant (i.e., VRE)
- ***Pseudomonas aeruginosa***: The proportion of patients with BSI caused by MDR-*P. aeruginosa*
- ***C. difficile* infection (CDI)**: The national rate of new hospital-acquired CDI per 10,000 BDU

SURVEILLANCE OF MULTI-DRUG RESISTANT ENTEROBACTERIACEAE

- **MDR-*K. pneumoniae* (MDRKP)**: National MDRKP surveillance programme was established in January 2014
- **Carbapenem resistant *Enterobacteriaceae* (CRE)**: The reference laboratory service (CPEaRLS)

SURVEILLANCE OF ANTIMICROBIAL CONSUMPTION

- **Hospitals**: The rate of antimicrobial consumption in acute hospitals increased defined daily doses (DDD) per 100 bed days used (BDU),
- **Community**: The rate of community antimicrobial consumption DDD per 1,000 inhabitants per day (DID)

HAND HYGIENE COMPLIANCE AUDIT & ALCOHOL-BASED HAND RUB USE IN ACUTE HOSPITALS

- **Hand hygiene compliance audit**: Observational hand hygiene audits are the gold standard. They occur bi-annually in all acute hospitals.
- **Alcohol-based hand rub (ABHR) use**: This is an indirect measure of hand hygiene (not very helpful).

HAND HYGIENE

- **CRE surveillance in Ireland**: In response to the increasing incidence of CRE in Ireland, all microbiology laboratories will be required to submit data on all confirmed carbapenemase-producing CRE to HPSC on a quarterly basis from 1st January 2017. This surveillance scheme will replace the voluntary enhanced surveillance of CRE, which was established in 2011. Invasive CRE infections (e.g. BSI) and CRE outbreaks remain notifiable to Departments of Public Health.

- **Candidaemia surveillance in Ireland:** Surveillance of BSI due to *candida* species (aka candidaemia) has been included in the EARS-Net surveillance protocol for Ireland from 1st January 2017 and all microbiology laboratories are invited to participate. This will enable prospective monitoring of the incidence of candidaemia, along with the causative species and antifungal susceptibility patterns. ECDC published a rapid risk assessment on the emergence of a multi-drug resistant *Candida auris* in December 2016.
- **Point prevalence survey (PPS) of hospital acquired infections & antimicrobial use in acute hospitals:** All acute hospitals in Ireland have been invited to participate in this European PPS, scheduled to take place during May 2017. The PPS was last undertaken in May 2012.
- **PPS of HCAI & antimicrobial use in Irish long term care facilities (HALT):** In May 2016, 223 Irish LTCF participated in the HALT PPS. Local reports have been issued to participating LTCF and the national HALT report was published in March 2017.

Glossary and abbreviations

Glossary

What is the General Medical Services (GMS) Scheme?

The General Medical Services Scheme provides access to medical and surgical services for persons for whom acquiring such services would present undue hardship. Under the GMS scheme, persons are entitled to a Medical Card (MC) or a GP Visit Card (GPVC).

From an examination of the number of Medical Card and GP Visit Cards in place in March 2017 and based on the 2016 Census of Population figures compiled by the Central Statistics Office (CSO), 45% of the population are covered under the GMS scheme. This consists of 35% Medical Card holders and 10% GP Visit Cards. Medical Card holders receive free GP care, including prescriptions; holders of GP Visit Cards receive free GP visits but must cover the cost of their medication up to an agreed monthly limit.

Abbreviations

European & International	
AMR:	Antimicrobial Resistance
BDU:	Bed days used
BSI:	Bloodstream Infection
BVD:	Bovine Viral Diarrhoea
C.difficile:	<i>Clostridium difficile</i>
CDI:	<i>Clostridium difficile</i> Infection
CIAs:	Critically Important Antimicrobials
CPD:	Continuing Professional Development
CPE:	Carbapenemase Producing <i>Enterobacteriaceae</i>
CRE:	Carbapenem Resistant <i>Enterobacteriaceae</i>
DDD:	Defined Daily Dose
EARS-Net:	European Antimicrobial Resistance Surveillance Network
ECDC:	European Centre for Disease Control
E.coli:	<i>Escherichia coli</i>
EFSA:	European Food Safety Authority
EMA:	European Medicines Agency
EARS-Net Scheme:	European Research Area Scheme
ESAC-Net:	European Surveillance of Antimicrobial Consumption Network

ESBL:	Extended spectrum beta lactamase
ESVAC:	European Surveillance of Veterinary Antimicrobial Consumption
EU:	European Union
FAO:	Food and Agriculture Organisation
FVE:	Federation of Veterinarians of Europe
H2020 CSA:	Horizon 2020 Coordination and Support Action grants
HALT:	Healthcare Associated Infections and Antibiotic use in Long-Term Care Facilities
HCAI:	Healthcare Associated Infection
HIV:	Human Immunodeficiency Virus
ICU:	Intensive Care Unit
IPC:	Infection Prevention and Control
IPCN:	Infection Prevention and Control Nurse
IMI:	Innovative Medicines Initiative
IV:	Intravenous
JA AMR HCAI: (now called EU-JAMRAI)	Joint Action JA-04-2016 - <i>Antimicrobial Resistance and HealthCare Associated Infections</i>
JPIAMR:	Joint Programming Initiative on Antimicrobial Resistance
KRE:	<i>Klebsiella pneumoniae</i>
MDRO:	Multi-Drug Resistant Organism
MRSA:	Methicillin Resistant <i>Staphylococcus aureus</i>
MS:	Member States
NAP:	National Action Plan
ND4BB:	New Drugs for Bad Bugs
NICE:	National Institute of Health and Care Excellence
OECD:	Organisation for Economic Co-operation and Development
OCT:	Outbreak Control Teams
OIE:	World Health Organisation for Animal Health
PCU:	Population Correction Unit
PPE:	Personal Protective Equipment
PPS:	Point Prevalence Survey
QA:	Quality Assurance
<i>S. aureus</i> / <i>Staph. aureus</i>:	<i>Staphylococcus aureus</i>
SRA:	Strategic Research Agenda
STRAMA:	Swedish Strategic Programme Against Antibiotic Resistance
TB:	Tuberculosis
UHI:	Unique Health Identifier
USD:	United States Dollars
VRE:	Vancomycin-resistant <i>Enterococci</i>
WHO:	World Health Organisation

Irish	
ABF:	Activity Based Funding
AHI:	Animal Health Ireland
AMURAP:	Antimicrobial Use and Resistance in Animal Production
AHI:	Animal Health Ireland
AMS:	Antimicrobial Stewardship
ASP:	Antimicrobial Stewardship Programme
BVD:	Bovine Viral Diarrhoea
CAG:	Clinical Advisory Group
CAVI:	Cattle Association of Veterinary Ireland
CEO:	Chief Executive Officer
CHO:	Community Healthcare Organisation (primary healthcare networks)
CIDR:	Computerised Infectious Disease Reporting
CIPCN:	Community Infection Prevention & Control Nurses
CMO:	Chief Medical Officer
CORU:	Regulator for Health and Social Care Professionals
CVERA:	Centre for Veterinary Epidemiology & Risk Analysis
CVO:	Chief Veterinary Officer
DAFM:	Department of Agriculture, Food & the Marine
DCCA:	Department of Communications, Climate Action and Environment
DES:	Department of Education and Skills
DoH:	Department of Health
DTC:	Drug and Therapeutics Committee
EPA:	Environmental Protection Agency
FETAC:	Further Education & Training Awards Council
FSAI:	Food Safety Authority of Ireland
GMS	Scheme: General Medical Services Scheme
GP:	General Practitioner
GPVC:	GP Visit Card
HCAI:	Healthcare Associated Infection
HEA:	Higher Education Authority
HIQA:	Health Information and Quality Authority
HIV:	Human Immunodeficiency Virus
HPRA:	Health Products Regulatory Authority
HPSC:	Health Protection Surveillance Centre
HRB:	Health Research Board
HSE:	Health Service Executive
HSE-PCRS:	HSE Primary Care Reimbursement Service
ICGP:	Irish College of General Practitioners
ICMSA:	Irish Creamery and Milk Suppliers Association
ICOS:	Irish Co-Operative Organisation Society

IDIA:	Irish Dairy Industries Association
IPCRESS:	Infection Prevention and Control System
IPCRN:	Irish Primary Care Research Network
IRC:	Irish Research Council
ISDMB:	International Strategy Decision-Making Body
IFA:	Irish Farmer's Association
KPI:	Key Performance Indicator
LTCF:	Long Term Care Facility
MC:	Medical Council
MHC:	Mental Health Commission
MII:	Meat Industry Ireland
MMP:	Medicines Management Programme
NCA:	National Clinical Audit
NCEC:	National Clinical Effectiveness Committee
NCG:	National Clinical Guidelines
NCPE:	National Centre for Pharmacoeconomics
NDSC:	National Disease Surveillance Centre
NHQRS:	National Healthcare Quality Reporting System
NHWMP:	National Hazardous Waste Management Plan
NMBI:	Nursing and Midwifery Board of Ireland
NMIC:	National Medicines Information Centre
NPOG:	National Performance Oversight Group
NPSO:	National Patient Safety Office
NRCP:	National Residue Control Plan
PHA:	Private Hospitals Association
PHECC:	Pre-Hospital Emergency Care Council
PPPG:	Policies, Procedures, Protocols and Guidelines
PSI:	Pharmaceutical Society of Ireland
PPE:	Personal Protective Equipment
PVP:	Private Veterinary Practitioner
RCPI:	Royal College of Physicians of Ireland
SARI:	Strategy for the Control of Antimicrobial Resistance in Ireland
SFI:	Science Foundation Ireland
SmPC:	Summary of Product Characteristics
SPC:	Summary of Product Characteristics
UCD:	University College Dublin
UHL:	University Hospital Limerick
VCI:	Veterinary Council of Ireland
VI:	Veterinary Ireland
VICAS:	Veterinary Ireland Companion Animal Society

Bibliography

1. Australian Commission on Safety and Quality in HealthCare (2015). AURA 2016: first Australian Report on Antimicrobial Use and Resistance in Human Health – Summary Report. Sydney: Australian Commission on Safety and Quality in HealthCare (ACSQHC).
2. Bernhard Bonk, Mathias (2015). Responses to the Antimicrobial Resistance Threat. Bern: Swiss Federal Office of Public Health. Available at: <http://health.gov.ie/national-patient-safety-office/patient-safety-surveillance/national-healthcare-quality-reporting-system-annual-report-2016/>
3. Canadian Institute for Health Information (2016). Measuring Patient Harm in Canadian Hospitals October 2016. Available at: https://www.cihi.ca/sites/default/files/document/cihi_cpsi_hospital_harm_en.pdf
4. Council of the European Union (2017). *Council conclusions on the next steps under a One Health approach to combat antimicrobial resistance*. [ONLINE] Available at: <http://www.consilium.europa.eu/en/press/press-releases/2016/06/17-epsco-conclusions-antimicrobial-resistance/>. [Accessed 28 September 2017].
5. Department of Health [Ireland] (2016). *National Healthcare Quality Reporting System (NHQRS) Second Annual Report 2016*. Dublin: Department of Health. Available at: <http://health.gov.ie/national-patient-safety-office/patient-safety-surveillance/national-healthcare-quality-reporting-system-annual-report-2016/>
6. Department of Health [Ireland] (2017). *National Healthcare Quality Reporting System (NHQRS) Annual Report 2017*. Dublin: Department of Health. Available at: <http://health.gov.ie/national-patient-safety-office/patient-safety-surveillance/national-healthcare-quality-reporting-system-annual-report-2016/>
7. Department of Health [Philippines] (2015). The Philippine Action Plan to Combat Antibiotic Resistance: One Health Approach. [ONLINE] Available at: <http://www.pidsphil.org/pdf/2016/16LEC-09-Philippine-Action-Plan-to-Combat-Antibiotic-Resistance-Celia-Carlos.pdf>. [Accessed 20 March 2017].
8. Department of Health [Republic of South Africa] (2014). Antimicrobial Resistance National Strategy framework. [ONLINE] Available at: <https://www.medbox.org/south-africa/antimicrobial-resistance-national-strategy-framework-2014-2024/preview?>. [Accessed 21 March 2017].
9. Department of Health. Department of Agriculture [Australia] (2015). National Antimicrobial Resistance Strategy 2015–2019. Canberra: Department of Health.
10. Department of Health. Department of Environment, Food and Rural Affairs [UK] (2013). UK Five Year Antimicrobial Resistance Strategy 2013 to 2018. Whitehall: Department of Health.
11. Dumartin, Catherine (2015). Prudent use of antimicrobial agents in human medicine : third report on implementation of the Council recommendation. Brussels: European Commission Directorate General for Health and Food Safety.

12. European Food Safety Authority (2016). THE EUROPEAN UNION SUMMARY REPORT ON ANTIMICROBIAL RESISTANCE IN ZOOLOGICAL AND INDICATOR BACTERIA FROM HUMANS, ANIMALS AND FOOD IN 2014. Available at <https://www.efsa.europa.eu/en/efsajournal/pub/4380>
13. European Commission (2011). *Communication from the Commission to the European Parliament and the Council: Action Plan against the rising threats from Antimicrobial Resistance*. Brussels: European Commission.
14. European Commission (2017). *A European One Health Action Plan against Antimicrobial Resistance (AMR)*. [ONLINE] Available at: https://ec.europa.eu/health/amr/action_eu_en. [Accessed 28 September 2017].
15. European Medicines Agency (2016). Sales of veterinary antimicrobial agents in 29 European countries in 2014. Available at: http://www.ema.europa.eu/docs/en_GB/document_library/Report/2016/10/WC500214217.pdf
16. Environmental Protection Agency (EPA) (2012). STRIVE REPORT 2012 Enhancing Human Health through Improved Water Quality. Available at [http://www.epa.ie/researchandeducation/research/researchpublications/strivereports/EPA_Cormican_EHHWC_webFin%20\(1\).pdf](http://www.epa.ie/researchandeducation/research/researchpublications/strivereports/EPA_Cormican_EHHWC_webFin%20(1).pdf)
17. Environmental Protection Agency (EPA) (2015). Hospital Effluent: impact on the microbial environment and risk to human health. Available at: <http://www.epa.ie/pubs/reports/research/health/EPA%2016%20final%20web.pdf>
18. Environmental Protection Agency (EPA) (2014). National Hazardous Waste Management Plan 2014-2020. Available at: http://www.epa.ie/pubs/reports/waste/haz/NHWM_Plan.pdf
19. Federal Department of Home Affairs [Switzerland] (2015). Strategy on Antibiotic Resistance Switzerland. Bern: Federal Department of Home Affairs.
20. Federal Ministry of Health. Federal Ministry of Food and Agriculture [Germany] (2015). DART 2020 Fighting antibiotic resistance for the good of both humans and animals. Berlin: Federal Ministry of Health.
21. Food, Medicine and HealthCare Administration and Control Authority of Ethiopia (FMHACA) (2015). 1 National Strategic Framework for Prevention and Containment of Antimicrobial Resistance. [ONLINE] Available at: http://www.fmhaca.gov.et/documents/National_AMR_Strategy.pdf. [Accessed 20 March 2017].
22. Food Safety Authority of Ireland (2015). Potential for Transmission of Antimicrobial Resistance in the Food Chain. Available at : https://www.fsai.ie/publications_AMR [Accessed 20 March 2017].
23. Government of Japan (2016). National Action Plan on Antimicrobial Resistance (AMR) 2016 - 2020. [ONLINE] Available at: <http://www.mhlw.go.jp/file/06-Seisakujouhou-10900000-Kenkoukyoku/0000138942.pdf>. [Accessed 20 March 2017].
24. Ministry of Health and Social Affairs [Sweden] (2016). Swedish strategy to combat antibiotic resistance. Stockholm: Ministry of Health and Social Affairs.

25. Norwegian Ministry of Health and Care Services (2015). Strategy National Strategy against Antibiotic Resistance 2015–2020. Oslo: Norwegian Government Security and Service Organisation.
26. Public Health Agency of Canada (2014). ANTIMICROBIAL RESISTANCE AND USE IN CANADA A FEDERAL FRAMEWORK FOR ACTION. Ottawa: Public Health Agency of Canada.
27. Public Health Agency of Canada (2015). PROTECTING CANADIANS FROM ILLNESS FEDERAL ACTION PLAN ON ANTIMICROBIAL RESISTANCE AND USE IN CANADA BUILDING ON THE FEDERAL FRAMEWORK FOR ACTION. Ottawa: Public Health Agency of Canada.
28. Review on Antimicrobial Resistance [UK](2014). Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. [ONLINE] Available at: https://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf [Accessed 21 March 2017].
29. Review on Antimicrobial Resistance [UK](2015). Tackling a global health crisis: initial steps. [ONLINE] Available at: <https://amr-review.org/sites/default/files/Report-52.15.pdf>. [Accessed 21 March 2017].
30. Review on Antimicrobial Resistance [UK](2015). SECURING NEW DRUGS FOR FUTURE GENERATIONS: THE PIPELINE OF ANTIBIOTICS. [ONLINE] Available at: https://amr-review.org/sites/default/files/SECURING%20NEW%20DRUGS%20FOR%20FUTURE%20GENERATIONS%20FINAL%20WEB_0.pdf [Accessed 21 March 2017].
31. Review on Antimicrobial Resistance [UK] (2015). RAPID DIAGNOSTICS: STOPPING UNNECESSARY USE OF ANTIBIOTICS. [ONLINE] Available at: <https://amr-review.org/sites/default/files/Paper-Rapid-Diagnostics-Stopping-Unnecessary-Prescription-Low-Res.pdf>. [Accessed 21 March 2017].
32. Review on Antimicrobial Resistance [UK](2015). SAFE, SECURE AND CONTROLLED: MANAGING THE SUPPLY CHAIN OF ANTIMICROBIALS. [ONLINE] Available at: <https://amr-review.org/sites/default/files/SafeSecureandControlledShortPaper.pdf>. [Accessed 21 March 2017].
33. Review on Antimicrobial Resistance [UK] (2015). ANTIMICROBIALS IN AGRICULTURE AND THE ENVIRONMENT: REDUCING UNNECESSARY USE AND WASTE. [ONLINE] Available at: <https://amr-review.org/sites/default/files/Antimicrobials%20in%20agriculture%20and%20the%20environment%20-%20Reducing%20unnecessary%20use%20and%20waste.pdf>. [Accessed 21 March 2017].
34. Review on Antimicrobial Resistance [UK] (2016). VACCINES AND ALTERNATIVE APPROACHES: REDUCING OUR DEPENDENCE ON ANTIMICROBIALS. [ONLINE] Available at: <https://amr-review.org/sites/default/files/Report-52.15.pdf>. [Accessed 21 March 2017].
35. Review on Antimicrobial Resistance [UK] (2016). INFECTION PREVENTION, CONTROL AND SURVEILLANCE: LIMITING THE DEVELOPMENT AND SPREAD OF DRUG RESISTANCE. [ONLINE] Available at: https://amr-review.org/sites/default/files/Health%20infrastructure%20and%20surveillance%20final%20version_LR_NO%20CROPS.pdf. [Accessed 21 March 2017].

36. Review on Antimicrobial Resistance [UK] (2016). Tackling drug-resistant infections globally: Final Report and Recommendations. 2016. AMR review. [ONLINE] Available at: https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf. [Accessed 20 March 2017].
37. Spanish Agency of Medicines and Medical Devices (2015). Strategic Action Plan to reduce the risk of selection and dissemination of antibiotic resistance . 2nd ed. Madrid: Spanish Agency of Medicines and Medical Devices (AEMPS).
38. The World Bank (2017). *Drug-Resistant Infections: A threat to our Economic Future*. Washington, D.C.: The World Bank.
39. United States Government. (2015) NATIONAL ACTION PLAN FOR COMBATING ANTIBIOTIC-RESISTANT BACTERIA. [ONLINE] Available at: https://obamawhitehouse.archives.gov/sites/default/files/docs/national_action_plan_for_combating_antibiotic-resistant_bacteria.pdf. [Accessed 20 March 2017].
40. World Health Organization (2015). *Global Action Plan on Antimicrobial Resistance*. Geneva: WHO Document Production Services. Available at: <http://www.who.int/antimicrobial-resistance/global-action-plan/en/>
41. World Health Organisation (2017). *WHO Model List of Essential Medicines*. [ONLINE] Available at: http://www.who.int/medicines/publications/essentialmedicines/20th_EML2017_FINAL_amendedAug2017.pdf?ua=1. [Accessed 28 September 2017].

