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Progress report on the Action plan against the rising threats from Antimicrobial Resistance

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INTRODUCTION

Antimicrobial Resistance (AMR) is a serious, worldwide, public health concern for both humans and animals. According to data from 2009[1], 25000 patients in the EU die annually as a result of infections caused by resistant bacteria. The costs incurred by AMR amount to an estimated EUR 1.5 billion annually, due to loss of productivity and an increase in healthcare expenditure costs.

Antimicrobial resistance is therefore a priority for the Commission with initiatives developed over the past decades in both human and veterinary medicine.

To further strengthen its commitment, the Commission launched in November 2011 a 5 year Action Plan against Antimicrobial Resistance[2]. The Plan is based on a holistic approach involving all sectors and aspects of antimicrobial resistance (public health, animal health, food safety, consumer safety, research, non-therapeutic use of antimicrobials, etc.). It aims at strengthening the prevention and control of antimicrobial resistance across the sectors and at securing the availability of effective antimicrobial agents. The Action Plan covers seven areas and sets out 12 concrete actions both in the human and veterinary field. Prudent use of antibiotics in human and veterinary medicine, enhanced surveillance systems, development of new antimicrobials and prevention of infections must be pursued in parallel to effectively address AMR. International cooperation is also a key element of the action plan. Collaboration with international organisations such as WHO, FAO and OIE is essential in view of the global nature of AMR.

On 11 December 2012 the European Parliament adopted the own-initiative report on the Microbial Challenge-rising threats from Antimicrobial Resistance[3]. The report calls on the Commission services to publish an integrated road map and a progress report on the implementation of the AMR 5 year Action Plan.

The Commission services have already published a roadmap[4] detailing the operational and concrete activities and deadlines for each of the 12 specific actions described in the Action Plan.

With this document the services of the Commission are further informing the European Parliament, Member States and other stakeholders about the progress made so far on the implementation of the Action Plan. The outcome of the Joint Conference on AMR held in Brussels the 11 December 2013[5] and the discussions about the challenges ahead, the drivers and limitations have been considered for the drafting of this progress report and for the further implementation of the Commission Action Plan.

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1 http://www.ema.europa.eu/docs/en_GB/document_library/Report/2009/11/WC500008770.pdf
2 http://ec.europa.eu/dgs/health_consumer/docs/communication_amr_2011_748_en.pdf
3 http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=en&reference=2012/2041(INI)#documentGateway
4 http://ec.europa.eu/health/antimicrobial_resistance/policy/index_en.htm
5 http://ec.europa.eu/health/antimicrobial_resistance/events/ev_11122013_en.htm

A. APPROPIATE USE OF ANTIMICROBIALS

Action 1: Strengthen the promotion of the appropriate use of antimicrobials in human medicine

The European Parliament has allocated funds for a preparatory action to promote the appropriate use of antimicrobials in human medicine. Based on a Commission Decision and as a result of a call for tender in 2013, the Commission services awarded a service contract to a project consortium. The ARNA project ("Antimicrobial resistance and causes of non-prudent use of antibiotics in human medicine") will provide a study identifying the key factors that drive the sales and non-prudent use of antibiotics in human medicine obtained without medical prescription, assess the level of enforcement of the legal prescription-only requirement for antimicrobial agents in the EU and document best practices aimed at strengthening a more prudent use of antimicrobial agents. Furthermore, based on the findings, policy options for the Member States to promote a more prudent use of antibiotics will be developed. The findings and policy options will be presented and discussed with relevant stakeholders during expert's workshops in selected countries and at a main workshop. The project will be finalised in 2016.

The Antibiotic Resistance and Prescribing in European children (ARPEC) project funded under the Health Programme (2010-2013), aims at improving the quality of antibiotic prescribing for children in Europe and to reduce the prevalence of antimicrobial resistance in bacterial infections in children. The ARPEC project identified the specific antibiotics used to treat common childhood infections in primary care in different Member States, specific antibiotics and doses to treat common infections in hospitals, and antimicrobial resistance patterns for the six key bacterial pathogens causing serious bacterial infection in children. Furthermore, the project collected, collated and compared specific primary care and hospital antibiotic prescribing guidelines for the most common childhood infections.[6]

The project "Genomics to combat Resistance against Antibiotics in Community acquired low respiratory tract infections in Europe" (GRACE), funded under the EU's Seventh Framework Programme for Research and Technological Development, demonstrated that antibiotics should not be generally prescribed to patients with uncomplicated lower respiratory tract infections (non-pneumonic infections).[7] A further project "The appropriateness of prescribing antibiotics in primary health care in Europe with respect to antibiotics resistance" (APRES) assesses the appropriateness of prescribing antibiotics in primary care in 9 European countries.[8]

On request of the services of the Commission, the European Medicines Agency (EMA) organised a workshop on ' Best use of medicines legislation to bring new antibiotics to patients and combat the resistance problem' (8 November 2013).[9] The workshop highlighted the necessity of enforcing of a 'prescription only' policy for antibacterials by

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6 www.arpecproject.eu

7 http://www.grace-lrti.org/portal/en-GB/homepage

8 Amoxicillin for acute lower-respiratory-tract infection in primary care when pneumonia is not suspected: a 12-country, randomised, placebo-controlled trial. Lancet Infect Dis. 2013 Feb;13(2):123-9

9 http://www.ema.europa.eu/docs/en_GB/document_library/Report/2013/12/WC500158230.pdf

the National Competent Authorities of the Member States and that antibacterials be prescribed in accordance with the current therapeutic guidelines.

Due to the geographic differences across the EU in the epidemiology of some infectious diseases, and due to the somewhat different clinical situations and regional specificities, therapeutic guidelines should be developed at national or regional level. The sentence 'Consideration should be given to official guidance on the appropriate use of antibacterial agents' in the summary of product characteristics (SPC) of all newly approved antibacterial agents should be systematically included in the SPC of already approved ("old") antibacterials.

The up-to-date and evidence-based medicinal product information should be one of the key elements supporting an appropriate use of antimicrobials. The pharmaceutical legislation provides for a regulatory instrument for harmonisation of the SPC of a particular medicinal product across the EU. Several antibiotics for human use have been subject to this procedure, which involves a review of the evidence to support efficacy, replacement of older broad indications that are no longer used with more specific indications based on the available data and a review of the posology in all age groups. This scientific evaluation is usually complex because of varying indications across the Member States and level of scientific evidence for their support.

The Commission services will publish later in 2015 data and information provided by the Member States in order to further strengthen the prudent use of antimicrobials in human medicines in the EU and to continue to monitor through evidence based indicators the implementation report of Council recommendation 2002/77/EC[10].

Action 2: Strengthen the regulatory framework on veterinary medicines and on medicated feed

It is acknowledged that the current veterinary medicines legislation does not provide sufficient tools to ensure that risks to human health arising from the use of antimicrobials in animals are adequately managed. On 10 September 2014, the Commission adopted proposals for veterinary medicinal products and medicated feed. They are currently undergoing the ordinary legislative procedure in the European Parliament and the Council. The proposal on veterinary medicinal products contains specific provisions on veterinary antimicrobials to address the health threat of AMR. Those provisions cover the granting of marketing authorisations for veterinary antimicrobials, the use of antimicrobials, including the use of an antimicrobial not in accordance with the terms of the marketing authorisation, a legal tool to preserve certain antimicrobials for human use and a requirement to gather information on the use of veterinary antimicrobials. The proposal on medicated feed provides a prohibition on the preventive use of antimicrobials included in medicated feed.

In the margins of the revision of the Directive on medicated feed it is envisaged to ensure a more precise dosage of antimicrobials administered to farmed animals in order to avoid sub-therapeutic exposure of the animals with antimicrobials. Additionally, thresholds for residual levels of antimicrobials in ordinary compound feed should be established in order to avoid that such residues create a significant risk for the development of AMR.

[10] Council Recommendation 2002/77/EC of 15 November 2001 on the prudent use of antimicrobial agents in human medicine (OJ L 34, 5.2.2002, p.43)

Action 3: Introduce recommendations for prudent use in veterinary medicine

Prudent use of antimicrobials is regarded as a cornerstone in addressing antimicrobial resistance.

Animals and humans are often susceptible to the same microorganisms causing infections, and the same classes of antimicrobials are often used in human medicine and veterinary medicine to treat these infections. Therefore the use of antimicrobials in animals may generate resistance to the same, or related, classes of antimicrobials as being used in human. Indications exist that antimicrobial resistance in animals is transmitted to humans through zoonotic bacteria, by direct contact or through the food chain. The importance of animals and of food of animal origin to the emergence, spread and persistence of antimicrobial resistance in humans has not yet been completely established but the inappropriate therapeutic use and the non-therapeutic use of antimicrobials in animals is considered to be one of the drivers for the development of resistance in the human sector. The recently by the EU's Seventh Framework Programme for Research and Technological Development (FP7) funded project EFFORT[11] aims to provide scientific evidence to inform decision makers, the scientific community and other stakeholders about the consequences of AMR in the food chain.

Within the process of approval of veterinary medicines the SPC is the tool to make available information to users of medicines and to specify conditions of use that will minimise the emergence of antimicrobial resistance. The indications should be clear, precise, up-to-date and should clearly describe the specific conditions under which the authorised antimicrobial is to be used.

The EMA has published reflection papers and associated recommendations on the use of the most critically important antimicrobials, namely quinolones, 3rd and 4th generation cephalosporines and macrolides[12]. The EMA reflection papers and recommendations promote certain risk mitigation measures such as the need to restrict the use of certain antimicrobials for second line use or with other restrictions for use. For example, fluoroquinolones and 3rd to 4th generation cephalosporines are second line antimicrobials to be reserved for conditions that have responded poorly or are likely to respond poorly to other classes of antimicrobials.

The Committee for Medicinal Products for Veterinary Use (CVMP) has also published recommendations to address the problems related to the use of veterinary medicines and MRSA (methicillin-resistant *Staphylococcus aureus*) and MRSP (methicillin-resistant *Staphylococcus pseudointermedius*).

In Annex I an overview is provided on the list of scientific guidelines as developed by the EMA.

Regardless of the efforts carried out to improve the prudent use of veterinary antimicrobials it is also necessary to update marketing authorisations to take into account of the latest scientific developments and to ensure that veterinary medicines on the market have a positive benefit-risk balance. Therefore several cases were referred by

[11] http://www.effort-against-amr.eu

[12] http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/landing/veterinary_medicines_regulatory.jsp&mid=

Member States and the Commission services for consideration (so called referrals) to EMA concerning antimicrobials (see Annex II). In total EMA provided recommendations on 45 referrals encompassing more than 10 classes of antimicrobials and numerous veterinary medicinal products.

In 2013 EMA updated its recommendations made in 2010 for referrals of veterinary medicines containing antimicrobials critically important for human health and developed a revised list of six priorities for referrals. This list will be the guiding document for the Commission services to launch referrals on veterinary antimicrobials in the coming years.

On 14 February 2013 the Commission services sent a request for advice to the EMA on the impact on public health and animal health of the use of antibiotics in animals. This advice provides the scientific basis to develop and to use the appropriate tools to address the challenge of the development of antimicrobial resistance by the use of antimicrobials in animals. The first part of the advice was on 'old' classes of antibiotics that have been re-introduced or have a new use to treat multi-resistant bacteria in humans, in particular colistin and tigecycline. The EMA recommended that colistin should only be used in the veterinary sector for treatment of disease (and should not be used for prophylactic use), and that the SPCs of veterinary medicines containing colistin should be revised. Based on this recommendation, the Commission services have launched a referral on oral forms of colistin to revise the marketing authorisations of medicines containing colistin for oral administration. The second part of the advice aims to limit the development of antimicrobial resistance (AMR) linked to the use of antibiotics in animals. The proposed measures focus in particular on promoting the responsible use in veterinary medicine of antibiotics that are critically important in human medicine, provides advice on development of new antimicrobials and categorises antimicrobials. The advice was developed by an interdisciplinary group of experts coordinated by EMA.

The Commission services are finalising the drafting of Guidelines for prudent use of antimicrobials in veterinary medicine. The purpose of the guidelines is to provide an overview of the prudent use principles to be considered by Member States when developing national strategies and actions to promote and strengthen the prudent use of antimicrobials, especially antibiotics in veterinary medicine. In order to make the guidelines as practical as possible, different EU-Member States' approaches are provided as examples for possible sources of inspiration for other Member States. The Guidelines are additional to existing legal provisions in the European Union.

In the course of evaluation of the Member States' residue monitoring plans for 2013 the Food and Veterinary Office (FVO) checked whether plans include testing for some of the critically important medicines (fluoroquinolones, 3rd and 4th generation of cephalosporins and macrolides). The report on the ability of the national laboratories to effectively monitor for residues of these substances has been produced by the EU Reference Laboratory in February 2014 and is pending the FVO assessment (work in progress). This could provide a tool for checking whether good veterinary practice has been complied with in respect of following the label indications.

The verification of measures taken by the Member States to reduce the carry-over of veterinary medicinal products in non-target animal feed was introduced in the scope of the FVO audits for 2014 in order to verify compliance with the legislation in place (where applicable) and to identify good practices.

B. PREVENT MICROBIAL INFECTIONS AND THEIR SPREAD

Action 4: Strengthen infection prevention and control in healthcare settings

Council Recommendation 2009/C 151/01on patient safety, including the prevention and control of healthcare associated infections (HAI) foresees a number of actions on general patient safety and on HAI.[13] In 2012, the Commission services published a first report on the implementation of this Council Recommendation[14]. The report showed that in the area of prevention and control of HAI, 26 out of 28 responding countries implemented a combination of actions to prevent and control such infections, in most cases (77 %) in the context of a national/regional strategy and/or an action plan. Thirteen Member States reported that the adoption of the Recommendation had triggered initiatives on HAI, in particular on implementation of inter-sectoral mechanisms, on monitoring and assessing strategies to prevent and control infections, and on strengthening information campaigns towards healthcare workers. The report also shows that a number of areas need particular attention. More efforts are needed to ensure adequate numbers of specialised infection control staff, receiving regular training, and with dedicated time for this task in hospitals and other healthcare settings. Tailored basic infection prevention and control structures and practices in nursing homes and other long term care facilities should be reinforced. Finally, information on HAI to patients should be improved and their involvement in the compliance with infection prevention and control measures should be strengthened.[15]

In order to allow consistent reporting of HAI, Member States have to report HAI according to the case definitions and reporting instructions laid down in Commission Decision 2002/253/EC[16]. These case definitions of HAI will help not only to considerably improve surveillance across the EU but will also allow assessing the impact at EU level of the preventive measures undertaken.

In June 2014, the Commission services published its second patient safety report, broadly confirming the findings of the first report in the area of HAI.[17] The report also highlights that further measures by Member States are needed to improve the routine case ascertainment of HAI, through the development of national diagnostic guidelines, continued training of healthcare workers in applying case definitions of HAI and the reinforcement of laboratory and other diagnostic capacity in healthcare institutions.

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13 Council Recommendation 2009 C 151/01 of 9 June 2009 on patient safety, including the prevention and control of healthcare associated infections (OJ C 151, 3.7.2009, p.1)

14 Report from the Commission to the Council on the basis of Member States' reports on the implementation of the Council Recommendation (2009/C 151/01) on patient safety, including the prevention and control of healthcare associated infections, COM(2012) 658final

15 http://ec.europa.eu/health/patient_safety/policy/index_en.htm

16 Commission Decision 2002/253/EC laying down case definitions for reporting communicable diseases to the Community network under Decision No 2119/98/EC of the European Parliament and of the Council (OJ L 86, 3.4.202, p. 44)

17 Report from the Commission to the Council. The Commission's Second Report to the Council on the implementation of Council Recommendations 2009/C 151/01 on patient safety, including the prevention and control of healthcare associated infections, COM(2014)371

Furthermore, HAI are covered by the new Decision on serious cross border health threats.[18] The Decision strengthens the Health Security framework in the EU as regards preparedness planning, risk assessment, risk management and coordinating measures including risk communication aspects. Its provisions apply to HAI.

The European Centre for Disease Prevention and Control (ECDC) network for the surveillance of healthcare-associated infections (HAI-Net) coordinates different modules to support Member States in establishing or strengthening active surveillance systems as foreseen in article II.8.c of the Recommendation on patient safety. Since the publication of the recommendation, one EU-wide point prevalence survey was organised in acute care hospitals in 2011-2012[19] and two in long-term care facilities (LTCFs)[20]. Targeted surveillance of HAIs was implemented continuously through the surveillance of surgical site infections (SSI) and the surveillance of HAIs in intensive care units (ICU).

The ECDC has produced the following guidance documents and reports to support Member States to prevent and control HAIs: In 2013, ECDC published its systematic review and evidence-based guidance to improve the compliance of healthcare professionals with appropriate administration, timing, dosage and duration of perioperative antibiotic prophylaxis for the prevention of surgical site infections. Furthermore, ECDC published a systematic review on hospital organisation, management, and structure in the context of HAI prevention identified a manageable set of 10 key components of hospital infection control programmes. For nursing homes and other long-term care facilities, ECDC developed and assessed national performance indicators for infection prevention and control and antimicrobial stewardship that can be used as a basis for monitoring improvements of Member States in this area. By publishing guidance infection prevention and control in healthcare settings, ECDC contributes to the development of guidelines and recommendations in Member States. In 2014 ECDC has started building a repository of existing guidance and other documents on the prevention and control of AMR and HAI produced by Member States and professional organisations, to further foster the exchange of best practices and the development of such guidance documents in settings where they do not yet exist.

By providing a standardised methodology and framework for national surveillance ECDC contributes to establishing or strengthening already existing surveillance systems at national level. In particular, the point prevalence survey of HAIs and antimicrobial use in European acute care hospitals organised by ECDC in 2011-2012 and which published in 2013 successfully promoted collection of data on HAIs, even in Member States that had not started with this activity.

In 2013, ECDC published a technical document on core competencies for infection control and hospital hygiene professionals in the EU.[21] This document is being used by Member States as a reference for the standardisation of professional competencies. In particular, Member States have started submitting national curricula for infection control

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18 Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health and repealing Decision No 2119/98/EC (OJ L 293, 5.11.2013, p. 1)

19 http://www.ecdc.europa.eu/en/publications/publications/healthcare-associated-infections-antimicrobial-use-pps.pdf

20 http://www.ecdc.europa.eu/en/healthtopics/healthcare-associated_infections/pages/index.aspx

21 http://www.ecdc.europa.eu/en/publications/publications/infection-control-core-competencies.pdf

training to ECDC for their evaluation against the published core competencies. In addition ECDC is preparing the publication of a first catalogue of courses that are available for the training of European healthcare workers specialised in infection control and hospital hygiene.

Action 5: Adoption of a proposal for an EU Animal Health Law

The Commission proposal for a Regulation on animal health was adopted in May 2013.[22] It is currently undergoing the ordinary legislative procedure in the European Parliament and in the Council. Its objective is to create an EU animal health legal framework for the control of major transmissible animal diseases. It is based on the principle "prevention is better than cure". The proposal lays down the responsibilities of:

- operators (e.g. animal keepers) for the health of the animal under their care and to ensure the required level of biosecurity measures and to have basic knowledge in animal diseases, including interaction between animal health, animal welfare and human health.

- veterinarians and aquatic animal health professionals for appropriate measures to prevent the spread of pathogens and to raise awareness as well as to ensure the early detection of diseases by carrying out proper diagnosis and differential diagnosis to rule out or confirm a disease before symptomatic treatment is commenced.

- competent authorities who not only must be capable to protect animal health, human health and the environment through reduction of the risks arising from pathogens but also support operators in acquiring basic knowledge in animal health and inform the general public of the nature of the risk and the measures taken.

The legislative proposal also provides for an assessment, prioritisation and categorisation of diseases or disease agents. It includes where appropriate, the capacity to generate resistance to treatment (e.g. antimicrobial resistance) as one criterion to decide about appropriate measures. It contains all the possible measures related to pathogens which can be equally applicable to AMR pathogens (e.g. notification, surveillance, eradication).

All the above mentioned elements alone and in combination have the potential for, and are expected to deliver a more proactive and preventive approach in the EU towards improved animal health, i.e. for the control of major transmissible animal diseases. Furthermore, they also contribute to a better husbandry, less pathogen pressure and indirectly, to the reduction of infections in animals. As a result this would lead to a possible subsequent reduction of the need for the use of antimicrobials.

[22] COM(2013) 260 final

C. DEVELOP NEW EFFECTIVE ANTIMICROBIALS OR ALTERNATIVES FOR TREATMENT

Action 6: To promote, in a staged approach, unprecedented collaborative research and development efforts to bring new antibiotics to patients

As rapid response, the New Drugs for Bad Bugs (ND4BB) programme was launched in May 2012 within the Innovative Medicines Initiative (IMI) - a Joint Undertaking between the European Union, represented by the European Commission, and the European Federation of Pharmaceutical Industries and Associations (EFPIA). IMI has brought together partners from academia, small and medium enterprises (SMEs), regulators, patient organisations and large industry, creating a new model for open innovation in the pharmaceutical research area. The open innovation model means that research sectors and individual companies now provide unprecedented access to each other's data and collaborate on solving problems of public health concern. ND4BB is a programme in which academic and other public partners, SMEs and large pharmaceutical industry join forces to spur the development of new antibiotics. Since the launch of the programme, seven ND4BB projects with a total committed budget of more than € 600 million have either started or are under development, nine large pharmaceutical companies are participating. They have five principal objectives: 1) To create a sustainable European clinical investigator and laboratory network with the capacity to run large-scale antibiotic clinical trials; 2) To use that network for improved and more efficient clinical development of new antibiotic drug candidates; 3) To advance our understanding of the underlying science, notably penetration barriers and efflux mechanisms in Gram-negative bacteria; 4) To progress promising novel hit or lead molecules into early clinical development; and 5) To develop options for novel economic models of antibiotic R&D and responsible use of antibiotics.

One of the first large projects funded under the ND4BB programme is COMBACTE[23], which focuses on addressing the barriers to clinical development by identifying developing new ways of designing and implementing efficient clinical trials for novel antibiotics. Project TRANSLOCATION[20] aims to generate knowledge on how potential antibiotic drugs can enter the protective envelope of Gram-negative bacteria and remain in the bacteria to destroy them. TRANSLOCATION is also creating an information centre to collect pre-existing and on-going antibacterial research data. The goal is to drive the sharing of data and knowledge to increase the probability of success in the development of new antimicrobials, thus accelerating the delivery of quality medicines to patients. The recently launched project ENABLE[20] puts in place an antibiotic drug development platform. The project aims to advance the most promising early discovery stage of novel antibiotic molecules from the academic and SME sector to early clinical development. Of the projects currently in preparatory phases, three are addressing clinical development challenges and one will be investigating new business models for antibiotic R&D and responsible use of antibiotics.

The ND4BB programme addresses all key challenges along the value chain from basic science to new business models. Unique in its scale, ambition, and potential benefits, it will revolutionise antimicrobial drug development in Europe.

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[23] http://www.imi.europa.eu/content/ongoing-projects

ND4BB project DRIVE-AB[24] focuses on the urgent need to develop a new business model for antibiotic development that will reinvigorate investments in this vital area while also addressing the issue of the responsible use of antibiotics. This new project will develop concrete recommendations for new commercial models that provide industry with an incentive to invest in this area while ensuring that new antibiotics are used wisely. The project was launched in October 2014.

This public-private cooperation continues under IMI2 that builds on and extends IMI. The partnership is now also open to health-related life science industries beyond pharma, such as animal health. The research agenda of IMI2 is based on the update of the WHO Medicines for Europe and the World Report[25]. One of the aims of IMI2 is to deliver at least two new medicines which could either be new antibiotics or new therapies for Alzheimer's disease

In January 2012, the EMA updated its guidance to companies developing antibiotics which addresses how they should carry out studies to test these medicines' benefits and risks[26]. This is accompanied by an addendum[27] that provides information on how to study medicines for the most common indications and discusses existing options for clinical development of antibacterial agents, in particular for multi-drug resistant pathogens. Both documents aim to facilitate the development and timely approval of new antibacterials. As already mentioned under Action 1, 8 November 2013, a workshop on "Best use of medicines legislation to bring new antibiotics to patients and combat the resistance problem" took place at the EMA[28]. The existing regulatory framework was considered "fit for purpose" by the attending stakeholders. Industry and EU authorities were strongly encouraged to make effective use of the current regulatory possibilities for the approval of new antibacterials.

The Commission and the European Investment Bank are jointly developing a pilot financial facility which aims to target Infectious Diseases (ID). The pilot will complement H2020 InnovFin products with risk-adapted loans and aims to stimulate the development of new treatments, vaccines and diagnostics for infectious diseases. It is expected to be launched in 2015.

Action 7: Promote efforts to analyse the need for new antibiotics into veterinary medicine

Ideally several different treatment options should be available for all infections and all species in the veterinary sector. It is acknowledged that there are certain gaps between the approved indications for veterinary antimicrobials and the needs of veterinarians. In particular the availability of different narrow spectrum antimicrobials is of special importance as these are essential to allow targeted treatment. The development of new veterinary antimicrobials is reported to have stalled because of the uncertainty of future

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24 http://drive-ab.eu/

25 http://www.who.int/medicines/areas/priority_medicines/en/

26 http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003417.pdf

27 http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2013/11/WC500153953.pdf

28 http://www.ema.europa.eu/ema/index.jsp?curl=pages/news_and_events/events/2013/09/event_detail_000781.jsp&mid=WC0b01ac058004d5c3

regulatory requirements. There is an overall view amongst stakeholders that this area needs to be improved. Therefore, the Commission services requested the advice of EMA[29] on the impact on public health and animal health of the use of antibiotics in animals. On 10 September 2014, the Commission adopted a proposal on veterinary medicinal products (see Action 2). It is currently undergoing the ordinary legislative procedure in the European Parliament and the Council. The proposal on veterinary medicinal products provides incentives for the development of new types of veterinary antimicrobials.

D. JOINING FORCES WITH INTERNATIONAL PARTNERS TO CONTAIN THE RISKS OF SPREADING AMR

Action 8: Develop and/or strengthen multilateral and bilateral commitments for the prevention and control of AMR in all sectors

Antimicrobial resistance is a worldwide public health threat and international cooperation is needed in order to address the issue. The Action Plan is furthering global action in its bilateral collaborations and in cooperation with international organisations.

The WHO considers AMR an increasingly serious threat to global public health. The World Health Assembly adopted in May 2014 a Resolution which welcomes the establishment of the WHO Global Task Force on Antimicrobial Resistance and the tripartite collaboration between WHO, FAO and OIE and foresees the development of a global action plan under the WHO leadership. The Commission services are supporting and actively cooperating with the WHO in this mandate.

Collaboration on antimicrobial resistance between the Commission services and WHO/Europe is a key element of the "Health Security Roadmap" which defines European Commission-WHO/Europe collaboration in the area, based on the Moscow Declaration. The collaboration includes implementation of the WHO European strategic action plan on antibiotic resistance, Council Recommendation of 15 November 2011 on the prudent use of antimicrobial agents in human medicine (2202/77/EC) and overall the Action plan against the rising threats from antimicrobial resistance COM(2011)748. Technical collaboration between WHO/Europe and ECDC covers surveillance of AMR, of antimicrobial consumption and of HAI, in particular in non-EU Member States in the WHO/European Region. Furthermore, the Commission services participate and provide input to the work of the WHO Strategic Advisory Group.

The European Reference Laboratory for Antimicrobial Resistance (EURL-AMR), funded by the Commission, is actively collaborating with WHO supporting activities of the Global Foodborne Infections Network (GFN) and the Advisory Group in surveillance of Antimicrobial resistance (AGISAR) which has the aim to develop global standards for monitoring of antimicrobial resistance. Furthermore, the EURL-AMR supports capacity building for AMR monitoring in the food chain in member countries of the WHO/Europe region.

[29] http://www.ema.europa.eu/ema/index.jsp?curl=pages/special_topics/general/general_content_000439.jsp

In the veterinary sector Commission services have been cooperating with OIE, supporting the organisation of the Global conference on the Responsible and Prudent Use of Antimicrobial Agents for Animals "International Solidarity to Fight against Antimicrobial Resistance" which was held in Paris, France, from 13 to 15 March 2013. Experts of the Commission, EMA and EFSA have also participated in the further development of the OIE standards on antimicrobial resistance and in the *ad hoc* group AMR which has revised and updated the chapters on AMR of the OIE Terrestrial Animal Health Code and the *ad hoc* group AMR which is setting up a global database on the use of antimicrobial agents in animals.

Experts of the Commission, EFSA and EMA actively collaborated in the drafting of the Codex Alimentarius *Guidelines for Risk Analysis of Foodborne Antimicrobial Resistance*[30] adopted in 2011. The guidelines provide science-based guidance on processes and methodology for risk analysis and its application to foodborne AMR related to non-human use of antimicrobial agents. These processes and methodologies are followed by the European Commission and its agencies, EMA, EFSA and ECDC and are the basis of their risk assessment activities to assess the risk to human health associated to foodborne AMR and the risk management decisions to reduce the risk of AMR in the EU. The Transatlantic Taskforce on Antimicrobial Resistance (TATFAR) was created in 2009 with the goal of improving cooperation between the US and the EU in three key areas: (1) appropriate therapeutic use of antimicrobial drugs in medical and veterinary communities, (2) prevention of healthcare- and community-associated drug-resistant infections, and (3) strategies for improving the pipeline of new antimicrobial drugs. TATFAR identified and adopted 17 recommendations for future collaborations between the US and the EU. On the 13th of May 2014 TATFAR published a report summarising the progress and the outcomes of the implementation of the recommendations[31]. TATFAR collaboration has led to increased information exchange, understanding of best approaches and practices, and development of peer relationships. The mandate of the taskforce has been extended for two additional years. The collaboration on, and the implementation of, fifteen recommendations will continue as previously defined and two recommendations have ceased. Most importantly though, as antibiotic use in animals can select for antibiotic resistance that may represent a risk to man, TATFAR is working on a new recommendation establishing an international working group to identify key knowledge gaps in understanding the transmission to man arising as a result of the use of antimicrobial drugs in animals and on the development of effective intervention measures to prevent this transmission, including the development of alternatives to antimicrobial drugs.

Bilateral cooperation with China has also started. During his visit to China in March 2012, the Commissioner for Health and Consumers and the Chinese Minister for Health had jointly identified the fight against AMR as a strategic area for increased cooperation between the EU and China. More specifically, it was agreed to hold a series of expert seminars to map out the areas where an exchange of experience would be beneficial. The first EU-China Seminar on antimicrobial resistance was held on 6 and 7 March 2013 in Beijing. It was a first approach to explain and understand the situation in the area of antimicrobial resistance in China and the EU, and policy initiatives to tackle the problem. Follow-up activities to continue collaboration in the field of antimicrobial resistance both

30 Guidelines for Risk Analysis of Foodborne Antimicrobial Resistance (CAC/GL 77- 2011)

31 http://www.cdc.gov/drugresistance/tatfar/report.html

in human and veterinary medicines were discussed and agreed. For example, to share data and information regarding antimicrobial resistance and the use of antimicrobial substances with a view to better understand and address the situation on antimicrobial resistance in China and the EU.

Furthermore, AMR has also been prioritised as topic of cooperation in the context of EU-Russian Federation dialogue on communicable diseases, and has by now become a standing item on the agenda of its bi-annual meetings.

In April 2014 the Joint Programming Initiative on AMR (JPIAMR) launched its strategic research agenda identifying 6 priority topics for research to combat AMR (see Action 11), and called to join forces globally against drug resistant bacteria.[32]

The Commission services are also contributing to the work against antimicrobial resistance in developing countries. A programme of EUR 3.5 million, aiming at ensuring a quality pharmaceutical response to malaria was implemented by WHO in 6 African Countries until end 2011. Specific results to be noted are the technical guidance provided to artemisinin-based combination therapy (ACT) manufacturers on Good Manufacturing Practices, inspections of manufacturing sites of ACT Active Pharmaceutical Ingredients (APIs) and finished dosage formulations conducted, and the training of the regulators working in NQCLs (National Quality Control Labs), with a special focus on monitoring of specific Adverse Drug Reactions (ADRs).

A renewed partnership with WHO and the ACP group of States has been signed in 2012 for EUR 10 million, to help implement the National Pharmaceutical Policies in 15 African countries. The two specific results areas which are worth being mentioned are the strengthening of the medicine quality assurance, through activities carried out to strengthen the performance of national regulatory authorities, and the emphasis given to evidence based selection, prescribing and rational use of medicines.

The Commission services have begun to develop a strategic approach to the pollution of water by pharmaceuticals. On the request of the Commission services, a study report prepared by an external consultancy on the risks from pharmaceuticals in the environment was published in June 2014[33], examining environmental risk through the lifecycle of pharmaceuticals, from design to disposal. It was followed by a workshop organised by the Commission on 11 September 2014 at which a wide range of healthcare and environment stakeholders discussed key issues and possible options. The strategic approach is to be delivered by September 2015, followed by proposals in 2017 for specific measures to address the possible impacts.

E. MONITORING AND SURVEILLANCE

Action 9: Strengthen surveillance systems on AMR and antimicrobial consumption in human medicine

Transfer of the European system for surveillance of antimicrobial consumption in human medicine to ECDC was completed in 2012. The system is now integrated as part of ECDC surveillance as the European Surveillance of Antimicrobial Consumption

[32] http://www.jpiamr.eu/wp-content/uploads/2014/05/SRA1_JPIAMR.pdf
[33] http://ec.europa.eu/health/human-use/environment-medicines/index_en.htm

Network (ESAC-Net). Two reports have been published and a third report is being drafted and will be published in 2014. The ESAC-Net interactive database is available from the ECDC website and includes data on antimicrobial consumption in human medicine in Member States for 1997-2012.

The Europe-wide point prevalence survey on HAI and antimicrobial use coordinated by ECDC in 2011-2012 provides data on the prevalence and indications of antimicrobial use in hospitalised patients from all Member States, plus Iceland and Norway, and data are available from a specific interactive database on the ECDC website.

EU data on surveillance of AMR in human medicine are available from the European Antimicrobial Resistance Surveillance Network (EARS-Net) as part of ECDC surveillance. Data are available from the EARS-Net interactive database from the ECDC website as well as from detailed EARS-Net reports published each year in November. The EARS-Net report 2013 will be published in November 2014. Since 2012, EARS-Net added collection of AMR data on *Acinetobacter* spp., an emerging microorganism responsible mainly for HAI. All Member States, plus Iceland and Norway, report AMR data to EARS-Net.

In addition, every year EFSA and ECDC publish the European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food, which includes data on AMR in *Salmonella* and *Campylobacter* infections in humans[34].

The generic case definitions for AMR laid down in Commission Decision 2002/253/EC[35] refer to EUCAST[36] clinical breakpoints for defining AMR. Between 2011 and 2012, the percentage of clinical microbiology laboratories that reported external quality assessment data to EARS-Net based on EUCAST clinical breakpoints or their national EUCAST-compatible equivalent increased from 48% to 61%. In March 2014, ECDC published an protocol for harmonised monitoring of AMR in human *Salmonella* and *Campylobacter* isolates[37]. This protocol recommends Member States to report quantitative AMR data (MICs or zone diameters) to ECDC in order to ensure comparability of AMR in foodborne pathogens from human infections with that of food animals and foods.

Carbapenemase-producing *Enterobacteriaceae* – a new type of highly resistant bacteria – represent a new threat for European hospitals. ECDC is conducting a European Survey on Carbapenemase-producing *Enterobacteriaceae* (EuSCAPE) with the aim of building capacity for the diagnostic and surveillance of specifically these highly resistant bacteria in Europe, thus fostering the timely detection and reporting of such alert, healthcare-associated organisms in Member States.

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34 http://www.efsa.europa.eu/en/efsajournal/pub/3590.htm

35 Commission Decision 2002/253/EC laying down case definitions for reporting communicable diseases to the Community network under Decision No 2119/98/EC of the European Parliament and of the Council (OJ L 86, 3.4.202, p. 44)

36 The European Committee on Antimicrobial Susceptibility Testing (www.eucast.org)

37 http://www.ecdc.europa.eu/en/publications/Publications/AMR-salmonella-campylobacter-protocol-monitoring.pdf

Action 10: Strengthen surveillance systems on AMR and antimicrobial consumption in veterinary medicine

It is acknowledged that it is important to establish a strategy for the containment of antimicrobial resistance in the veterinary sector, based on the surveillance of the occurrence of antimicrobial resistance and the use of antimicrobials. In 2008, the European Council, through the Council conclusions on antimicrobial resistance, called upon the Member States to strengthen surveillance systems and improve data quality on antimicrobial resistance and on consumption of antimicrobial agents within both human and veterinary sectors.

In response to the Council conclusions, the Commission services requested the EMA to take the lead in the collection of data on sales of veterinary antimicrobial agents in the Member States. In order to guarantee an integrated approach, the EMA was requested to consult ECDC, EFSA and the European Community Reference Laboratory for Antimicrobial Resistance (EURL-AMR). The European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project collects information on how antimicrobial medicines are consumed in animals across the EU.[38]

On 15th October 2013 the third report of the ESVAC project was published with data submitted by 25 EU and European Economic Area (EEA) countries. Approximately 95% of the food-producing animal population in the EU and EEA are located in these 25 countries. The report highlights that identification of the determining factors and reasons behind the changes observed in the consumption of different classes or subclasses of antimicrobial agents remains difficult without data by species, and without taking into account differences in daily dose and length of treatment.

The fourth ESVAC report was published on 15th October 2014. The report presents data on the sales of veterinary antimicrobial agents from 26 Member States and EEA (Economic European Area) countries in 2012. The report contains, for the first time, a chapter describing changes across time on consumption of veterinary antimicrobials. Between 2010 and 2012, a total of 18 of the 20 countries that provided sales data for these years reported a decrease in sales (range 0.4%-49%). Overall in those 20 countries, a nearly 15% of decline in the sales was observed. The animal population in these countries was stable during this period, what means that the decrease was accounted for by decrease in sales. Tentative explanations provided by the countries for the decline in sales are, among others, implementation of responsible-use campaigns, changes in animal demographics, restrictions of use, increased awareness of the threat of antimicrobial resistance, and/or the setting of targets.

It is generally agreed that it takes at least three to four years in order to establish a valid baseline for the data on sales of veterinary antimicrobial agents. Consequently, the data from countries that have collected such data for the first or even second time should be interpreted with due caution. Furthermore, it should be emphasised that the data presented in the ESVAC report should be considered together with data from other sources.

[38] http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000302.jsp

ESVAC will focus the coming years on the possibilities to obtain data by animal species and to take into account differences in dosing between the various antimicrobials agents and the pharmaceutical forms when reporting the data. Also, if possible, the project should be enlarged to all Member States and include detailed data of on-farm use of antimicrobials for the major animal species. On 10 September 2014, the Commission adopted a proposal on veterinary medicinal products. It is currently undergoing the ordinary legislative procedure in the European Parliament and the Council. The proposal on veterinary medicinal products provides an obligation for collecting data on use of veterinary antimicrobials.

Regarding the surveillance of AMR, and based on data submitted by the Member States, specific summary reports on the occurrence of AMR in both zoonotic and indicator bacteria from food-producing animals and foodstuffs in the EU have been yearly published by EFSA since 2010. Prepared in joint collaboration with ECDC since 2011, the summary reports have also addressed the resistance in zoonotic isolates from human cases since then. For the sake of data comparability, EFSA had also issued technical specifications on AMR monitoring in 2007 and 2008. Further to their implementation by the Member States, incremental improvements in AMR monitoring and reporting in the EU have been recorded over the last 5 years, which thus paved the way for proposing a new legislation on AMR monitoring more ambitious and more up-to-date, accounting for the most recent scientific knowledge.

Annex 3 provides an overview of the list of scientific opinions, EU summary reports and scientific reports on antimicrobial resistance as developed by EFSA. In order to improve and harmonise further the surveillance systems of AMR in the veterinary and food sectors in the EU, the Commission services asked the European Food Safety Authority (EFSA) to revise the existing technical specifications on the monitoring and reporting of antimicrobial resistance in the food chain and issue related scientific reports.

These scientific reports, as well as other scientific opinions of EFSA, constitute the firm foundation of the reviewed EU legislation on AMR in the food chain, Commission Implementing Decision 2013/652/EU[39] which entered into force on 1 January 2014. The legislation lays down the minimum requirements for the harmonised monitoring of the resistance to the most relevant antimicrobials from a public health perspective, combinations of bacterial species/food producing animal populations/food and includes detailed rules for sampling, analysis of the isolates and interpretations of the results. The legislation includes also the requirements for the harmonised monitoring and reporting of ESBL-, AmpC and carbapenemase-producing bacteria in certain animal populations and in certain food types.

The new legislation ensures harmonised monitoring systems in Europe, fosters comparability between the Member States and between the human and veterinary sectors and facilitates the monitoring of patterns of multi-drug resistance in the EU. Reliable and comparable data are essential to assess the sources of AMR, to conduct a risk assessment process and to evaluate the impact of the mitigation measures in place. Where possible, in order to minimise the burden, the monitoring is based on biological samples or isolates collected by the Member States in the framework of national control programmes already

[39] Commission Implementing Decision 2013/562/EU of 12 November 2013 on the monitoring and reporting of antimicrobial resistance in zoonotic and commensal bacteria (OJ L 303, p26)

established. Furthermore, the Commission services co-finances the costs of the sampling and testing related to the harmonised AMR monitoring carried out by the Member States. A training course for National Reference Laboratories, funded by the Commission services, was held at the EURL-AMR facilities in Denmark in November 2013 to introduce the methodologies required by the new legislation on AMR monitoring and to facilitate implementation in the Member States. A follow-up training was held in September 2014.

The information collected by the three agencies EFSA, EMA and ECDC on antimicrobial resistance and antimicrobial consumption needs to be combined and jointly analysed in order to assess the relationship between use of antimicrobials and antimicrobial resistance in animals and in humans at the European level. The Agencies have established a joint expert working group to perform this analysis. On 30 January 2015 the three agencies published the results of the first integrated analysis of the 2011 and 2012 monitoring data currently available from humans and animals[40].

In addition, the proposal for a Regulation on animal health (see Action 5, point 5.2) lays down obligations to ensure and strengthen appropriate surveillance and early detection of listed pathogens in animals, among those, potentially, AMR ones. This creates a legal basis hitherto missing and complements already existing legislation detailed above for a complete coverage of monitoring AMR pathogens in animals. Further details of this remain to be defined in the future in delegated and implementing acts once the Regulation has been adopted by the European Parliament and the Council.

Since September 2012, during almost all audits carried out on *Salmonella* National Control Programmes, the FVO has also gathered information on AMR monitoring in *Salmonella* in poultry. The notes produced by the FVO after these audits concluded that in all visited Member States, the competent authorities carried out this monitoring in compliance with the EU requirements in force (Commission Decision 2007/407/EC on a harmonised monitoring of antimicrobial resistance in Salmonella in poultry and pigs). During most of these audits the FVO was supported by national experts although it was often difficult to ensure the availability of national experts having specific expertise in the AMR area.

The project on the (forthcoming) evaluation of the implementation of Decision 2013/652/EU by Member States (monitoring and reporting of antimicrobial resistance) was adopted by the FVO management in September 2014.

[40] http://www.ema.europa.eu/docs/en_GB/document_library/Report/2015/01/WC500181485.pdf

F. ADDITIONAL RESEARCH AND INNOVATION

Action 11: Reinforce and coordinate research efforts

After the launch of the Action Plan, research on AMR has been further supported by the Commission services with a total budget of approx. €130 million under the EU's Seventh Framework Programme for Research and Technological Development via coordination between the Health, Food, Agriculture & Biotechnology (KBBE) and Nanotechnology (NMP) programmes. The projects address clinical research on off-patent antibiotics, multidisciplinary research on the evolution and transfer of antibiotic resistance, management of Gram-negative multidrug-resistant infections, development of multi-analytic diagnostic tests and tools to control microbial biofilms with relevance to clinical drug resistance, as well as the development of diagnostic tools for the detection of bacteria and resistance markers.[41] One project started in 2012 develops and evaluates diagnostic products for "Rapid identification of respiratory tract infections" (RID-RTI).[42] An epidemic outbreak caused by resistant pathogens, is planned to be tackled by the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R) which works to improve the global research response to a potential outbreak of a new or re-emerging infectious disease.[43] The EU funded "Platform for European Preparedness Against (Re-) emerging Epidemics" (PREPARE) provides a network for harmonised large-scale clinical research studies on infectious diseases in order to rapidly respond to any severe ID outbreak including in the case of an outbreak caused by resistant pathogens.[44]

In 2013, 15 new research projects with a cumulative budget of more than €90 million were funded by the EU's *Seventh Framework Programme for Research and Technological Development*. Seven of the new projects aim to develop novel antibiotics, vaccines or alternative treatments (such as phage therapy) for drug-resistant microbial infections. Other projects set out to identify better methods to use currently available antibiotics, study antibiotic resistance within the food chain, or utilise novel nanotechnology for the delivery of antimicrobial drugs[45]. As these calls included a novel initiative to unlock the potential of small and medium-sized enterprises (SMEs), the projects will also boost the European economy by directly supporting the work of 44 innovative SMEs. One project addresses the ecology of drug resistant bacteria and transfer of AMR throughout the food chain. See project EFFORT under Action 3[46].

As AMR is a global problem which requires consolidation of otherwise fragmented research activities, a *Joint Programming Initiative on AMR* (JPIAMR) has been set up, bringing together 17 Member States, Israel and Canada to coordinate their research, in order to allow greater impact and avoid duplication. Since 2012 the JPIAMR is supported by the EC via a Coordination and Support Action grant of €2 million. The strategic research agenda of JPIAMR was launched on 3 April 2014[47], and provides a

41 http://ec.europa.eu/research/health/infectious-diseases/antimicrobial-drug-resistance/projectsfp7_en.html
42 http://www.rid-rti.eu/rid-rti/home_page
43 http://glopidr.globe-network.org/
44 http://www.prepare-europe.eu/
45 http://europa.eu/rapid/press-release_MEMO-13-996_en.htm?locale=en
46 http://www.effort-against-amr.eu/page/sitemap.php
47 http://www.jpiamr.eu/slider/strategic-research-agenda/

framework for future investment and research priorities. The first transnational joint call of JPIAMR was launched end of January 2014 with a total budget of €14,5 million. This call aims to combine resources, infrastructures, and research strengths of the member countries in order to facilitate the generation and application of new approaches to overcome AMR[48]. On 4 April 2014 a joint workshop (EC/JPIAMR/IMI/EFPIA) on "Antibiotics and their alternatives – fixing and feeding the pipeline" was organised in Brussels to promote dialogue and collaboration amongst the different actors along the "value chain", in order to ensure synergies and maximise the impact of investments by effective exploitation of results[49].

The new EU framework programme Horizon 2020 continues to give research on infectious diseases including AMR a high priority. The European Commission has in 2014 devoted €28m to the development of new vaccines candidates against tuberculosis, and has earmarked €25m for HIV vaccine research in 2015. An innovative inducement prize will be launched in February 2015 on the 'Better use of antibiotics'. It will be awarded for a rapid test to identify, at the point of care, patients with upper respiratory tract infections that can be treated safely without antibiotics[50].

Under the Agricultural European Innovation Partnership (EIP)[51], the Commission services established a focus group on the reduction of antimicrobials in pig production to explore practical innovative solutions to problems or opportunities in the field, and draw on experience derived from related projects. The experts of the focus group were selected through the publication of a call on the EIP website followed by a selection procedure. The report was published on the EIP website[52] and contains the following information: a list of existing underused best practices needing promotion-dissemination, research results that need field testing and implementation, a list of existing operational groups and ideas for new ones[53] and needs for practical innovation and research.

G. COMMUNICATION, EDUCATION AND TRAINING

Action 12: Communication, education and training: Survey and comparative effectiveness research

The European Antibiotic Awareness Day (EAAD) is a European health initiative coordinated by ECDC to raise awareness about the prudent use of antibiotics. It provides support to Member States by providing toolkits that contain key messages and template communication materials targeted at the general public and at prescribers, for adaptation and use in national campaigns, at EU-level events, and as strategy and media materials. These toolkits are translated into the official languages of the EU and are available from a dedicated EAAD website. The EAAD Technical Advisory Group, comprised of Member State representatives, provides advice to ECDC on EAAD and provides a platform for exchange as to national initiatives. In July 2013, ECDC provided training on

48 http://www.jpiamr.eu/activities/joint-calls/
49 http://ec.europa.eu/research/health/events-18_en.html
50 www.ec.europa.eu/horizonprize/antibiotics
51 http://ec.europa.eu/eip/agriculture/
52 http://ec.europa.eu/eip/agriculture/en/content/animal-husbandry
53 http://ec.europa.eu/agriculture/eip/pdf/fact-sheet-operational-groups_en.pdf

the development, implementation and evaluation of prudent antibiotic use campaigns to 29 participants from 20 Member States and Norway.

Since 2008, each year the 18th of November, the EAAD has been marked by events and activities in Member States and by an EU stakeholder event in Brussels. A forthcoming report on the five-year evaluation of EAAD shows the wide participation of and uptake of EAAD toolkits by Member States[54]. Since 2012, participation of the WHO Regional Office for Europe (WHO/Europe) resulted in a total of 44 European countries (compared to 32 countries in 2010 and 37 countries in 2011) having activities on the prudent use of antibiotics related to the Day. These countries included all EU Member States, Iceland, Norway, and all EU potential candidate and candidate countries.

Each year, EAAD attracts strong media interest across Europe. In 2013, 677 articles published during a two-month period (in print or online) referred to "European Antibiotic Awareness Day". It is estimated that these articles reached more than 67.9 million readers (compared to 60.4 million in 2012). Since 2009, the ECDC campaign TV spot on prudent use of antibiotics broadcasted on Euronews reached on average 14 million EU citizens each year and among them an average of 1.5 million working in the healthcare sector.

Since 2011, ECDC has increasingly used social media to convey EAAD messages. On 18 November 2013, a joint Twitter chat organised for the second time by ECDC together with the Commission services and WHO/Europe resulted in more than 3500 tweets from more than 1500 participants (compared to 694 tweets from 255 participants in 2012) and reached more than 13 million Twitter users or impressions (compared to 2.4 million impressions in 2012).

The date of 18 November is increasingly being recognised and is becoming a landmark for raising awareness about prudent use of antibiotics not only in Europe, but also in the United States, Canada and Australia, and on other continents. EAAD has provided a platform for pre-existing national campaigns and encouraged similar campaigns to develop in countries where neither political support had been secured, nor financial support was available. As a result, year on year, participating countries have expressed their strong support for ECDC to continue its work on EAAD. This has been endorsed by a steadily increasing number of countries participating and the growing interest of varied professional and stakeholder organisations.

It should be noted that an overall evaluation of EAAD in terms of understanding its direct impact on antibiotic consumption and on antibiotic resistance is difficult because (i) the effects will vary depending on the country as a result of variations in the extent and the intensity of the national campaign in each country and (ii) these effects are unlikely to be immediate as shown from previous national campaigns in some Member States. In addition, it is important to remember that since the campaigns have been applied heterogeneously at national levels, according to local needs and resources, a uniform impact analysis evaluation is difficult. In November 2013, a Special Eurobarometer Survey on antimicrobial resistance was published[55]. The report showed that just over one third (35%) of respondents say that they have taken antibiotics in oral form at any time in the last 12 months, which represents a decline of 5 percentage points

[54] www.eurosurveillance.org

[55] http://ec.europa.eu/health/antimicrobial_resistance/eurobarometers/index_en.htm

since the last survey in 2009. This is a significant positive development that may reflect the continuous efforts made by Member States in the framework of EAAD.

The Special Eurobarometer also revealed that differences between countries on this question are quite significant, but less pronounced and regionally differentiated than in 2009. As regards knowledge questions about antibiotics, only over a fifth (22%) of Europeans give the right answer. Most Europeans (84%) are aware that unnecessary use of antibiotics makes them become ineffective, and two thirds (66%) know that frequent use of antibiotics can lead to side-effects. However, nearly half (49%) of Europeans do not know that antibiotics are ineffective against viruses, and over two fifths (41%) do not know that they are ineffective against colds and flu. Despite the fact that antibiotics cannot treat flu, nearly a fifth (18%) of respondents say it was the reason they last took antibiotics. Those with low levels of education are particularly likely to have misconceptions about the nature and efficacy of antibiotics. Two key conclusions emerged from the findings as to how to reach out to Europeans: 1. Media campaigns are efficient at disseminating information, but they should be targeted more effectively at those who currently lack knowledge. 2. Information can only take us so far: as trusted and influential authorities, doctors and pharmacies have a key role to play in changing views and behaviour. As a result of the Eurobarometer report, doctors and pharmacies have agreed to be more actively involved in European Antibiotic Awareness Day 2015.

The Commission services held a one-day "Joint Conference on Antimicrobial Resistance: State of Play of the 5-year Action Plan" on Wednesday 11 December 2013 in Brussels. The objective was to make a mid-term review of the Commission's action plan against the rising threats from antimicrobial resistance. In addition to presenting the state of play of the plan in the human, veterinary and research sectors, the aim was to focus discussions on the challenges ahead and the drivers and possible limitations of the envisaged measures to reduce the AMR threat. Representatives from Member States, International Organisations, European stakeholder associations and third countries were invited. The afternoon session comprised three panel discussions on challenges in the field of risk assessment and research, risk management and challenges for stakeholders. The participants agreed that the key element to be successful in the fight against AMR is to tackle the problem taking a holistic approach, ensuring that all relevant parties carry out their responsibilities. AMR is a global problem needing a global response but requiring solutions adapted to national, regional and local needs and practices. One of the most important challenges ahead will be balancing competing interests and needs, balancing the long term need of keeping antimicrobials effective with the short term need of treating infections in humans and animals. For example the possible restriction of the use of new class of antimicrobials in order to keep efficacy and the access of individual patients to effective treatments, the interest of having a competitive European farming sector and the need to invest in preventive measures to limit the need of using antimicrobials. The participants acknowledged the lack of appropriate data to evaluate the economic and health impacts of AMR and highlighted that more needs to be done in order to ensure that risks are detected early enough, at global level. Harmonised, comparable data on resistance and use of antimicrobials, both in human and veterinary medicine are of critical importance for risk management decisions and essential for an accurate evaluation of the measures taken. The major part of the participants agreed that Europe should take the lead in a global dialogue on AMR, and on the development of a global research agenda to promote a coordinated research programme that would complement national and European initiatives.

During final discussions and in the closing speech, it was recognised that many activities are ongoing in the EU and worldwide against the AMR threat but it was also highlighted that there is a lot more which needs to be done. A holistic approach and global cooperation are two of the most essential elements. The conclusions of the Conference as well as the questionnaire used as basis for the panel discussions have been taken into account for the preparation of this progress report and the further implementation of the Action Plan.

ANNEX 1: LIST OF SCIENTIFIC GUIDELINES AND SCIENTIFIC RECOMMENDATIONS ON ANTIMICROBIAL RESISTANCE AS DEVELOPED BY EMA

- ECDC/EFSA/EMA first joint report on the integrated analysis of the consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from humans and food-producing animals. Stockholm/Parma/London: ECDC/EFSA/EMA, 2015. EFSA Journal 2015;13(1):4006, 114 pp. doi:10.2903/j.efsa.2015.4006 http://www.ema.europa.eu/docs/en_GB/document_library/Report/2015/01/WC500181485.pdf
- Draft Reflection paper on the risk of antimicrobial resistance transfer from companion animals (EMA/CVMP/AWP/401740/2013): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2013/10/WC500152665.pdf
- Answer to the second, third and fourth request from the European Commission. Request for scientific advice on the impact on public health and animal health of the use of antibiotics in animals (EMA/381884/2014): http://www.ema.europa.eu/docs/en_GB/document_library/Other/2014/07/WC500170253.pdf
- Answer to the first request from the European Commission. Request for scientific advice on the impact on public health and animal health of the use of antibiotics in animals (EMA/363834/2013): http://www.ema.europa.eu/docs/en_GB/document_library/Other/2013/07/WC500146812.pdf
- Use of colistin products in animals within the European Union: development of resistance and possible impact on human and animal health (EMA/755938/2012): http://www.ema.europa.eu/docs/en_GB/document_library/Report/2013/07/WC500146813.pdf
- Use of glycylcyclines in animals in the European Union: development of resistance and possible impact on human and animal health (EMA/291760/2013): http://www.ema.europa.eu/docs/en_GB/document_library/Report/2013/07/WC500146814.pdf
- Concept paper for a guideline on antimicrobial resistance risk assessment (EMA/CVMP/680258/2012): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2013/01/WC500137444.pdf
- Reflection paper on use of pleuromutilins in food-producing animals in the European Union: development of resistance and impact on human and animal health (EMA/CVMP/SAGAM/119489/2012): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2014/02/WC500161930.pdf
- Reflection paper on methicillin-resistant *Staphylococcus pseudintermedius* (EMEA/CVMP/SAGAM/736964/2009): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2011/02/WC500102017.pdf
- Reflection paper on the use of macrolides, lincosamides and streptogramins (MLS) in food-producing animals in the European Union: development of resistance and impact on human

and animal health (EMA/CVMP/SAGAM/741087/2009): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2011/11/WC500118230.pdf

- Joint scientific report of ECDC, EFSA and EMEA on methicillin resistant *Staphylococcus aureus* (MRSA) in livestock, companion animals and food. Summary of the scientific Opinion of the Panel on Biological Hazards (EFSA/BIOHAZ) on "Assessment of the Public Health significance of methicillin resistant Staphylococcus aureus (MRSA) in animals and foods" and the Reflection paper of the Committee for Medicinal Products for Veterinary Use (EMEA/CVMP) on "MRSA in food producing and companion animals and in the European Union: Epidemiology and control options for human and animal health: http://www.ema.europa.eu/docs/en_GB/document_library/Report/2009/10/WC500004306.pdf
- Joint Opinion on antimicrobial resistance (AMR) focused on zoonotic infections. Scientific Opinion of the European Centre for Disease Prevention and Control; Scientific Opinion of the Panel on Biological Hazards; Opinion of the Committee for Medicinal Products for Veterinary Use; Scientific Opinion of the Scientific Committee on Emerging and Newly Identified Health Risks: http://www.ema.europa.eu/docs/en_GB/document_library/Other/2009/11/WC500015452.pdf
- Reflection paper on MRSA in food producing and companion animals in the European Union: Epidemiology and control options for human and animal health (EMEA/CVMP/SAGAM/68290/2009): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004311.pdf
- Revised reflection paper on the use of 3rd and 4th generation cephalosporins in food producing animals in the European Union: Development of resistance and impact on human and animal health (EMEA/CVMP/SAGAM/81730/2006-Rev.1): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004307.pdf
- Reflection paper on antimicrobial resistance surveillance as post-marketing authorisation commitment (EMEA/CVMP/SAGAM/428938/2007): http://www.ema.europa.eu/docs/en_GB/document_library/Other/2009/10/WC500005150.pdf
- Public statement on the use of (fluoro)quinolones in food-producing animals in the European Union: Development of resistance and impact on human and animal health (EMEA/CVMP/SAGAM/184651/2005): http://www.ema.europa.eu/docs/en_GB/document_library/Public_statement/2009/10/WC500005152.pdf
- VICH Topic GL27. Step7. Guidance on pre-approval information for registration of new veterinary medicinal products for food producing animals with respect to antimicrobial resistance (CVMP/VICH/644/01-FINAL): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004308.pdf
- Concept paper on further guidance on interpretation of the data from VICH GL27 (Guidance on pre-approval information for registration of new veterinary medicinal products for food producing animals with respect to antimicrobial resistance) (EMEA/CVMP/1034/04-Consultation):

http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004313.pdf

- CVMP strategy on antimicrobials 2011-2015 (EMA/CVMP/287420/2010): http://www.ema.europa.eu/docs/en_GB/document_library/Report/2011/07/WC500109137.pdf
- Draft revision of the CVMP Guideline for the demonstration of efficacy for veterinary medicinal products containing antimicrobial substances (EMA/CVMP/261180/2012) http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2013/05/WC500143698.pdf
- Guideline on the evaluation of medicinal products indicated for treatment of bacterial infections (CPMP/EWP/558/95 rev2): http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003417.pdf
- Addendum to the note for guidance on evaluation of medicinal products indicated for treatment of bacterial infections (CPMP/EWP/558/95 REV 2) to address indication-specific clinical data http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2013/11/WC500153953.pdf

ANNEX 2: LIST OF VETERINARY MEDICINAL PRODUCTS CONTAINING ANTIMICROBIALS THAT WERE CONSIDERED BY EMA IN ACCORDANCE WITH ARTICLES 33, 34 AND 35 OF DIRECTIVE 2001/82/EC (REFERRALS)

PRODUCT NAME	ACTIVE SUBSTANCE(S)	TARGET SPECIES
Orbax, tablets 6.25, 25, 75mg	Orbifloxacin	Dogs
Long acting benzathine penicillins, solution for injection	Benzathine penicillin	Cattle, sheep, pigs, horses
Micotil 300, solution for injection 300 mg/ml	Tilmicosin	Cattle, sheep, rabbits
Suramox 15% LA, suspension for injection 300mg/ml	Amoxicillin	Cattle, pigs
Cobactan IV, powder and solvent for injection	Cefquinome sulphate	Horses
Cobactan DC, intramammary ointment	Cefquinome	Cattle
Doxyprex, premix	Doxycycline hyclate	Pigs
Methoxasol T, oral solution	Trimethoprim, sulfamethoxasol	Pigs, chicken (broiler)
Tribrissen, oral paste	Trimethoprim, sulfadiazine	Horses
Amoxicillin	Amoxicillin	Dogs
Pulmotil AC, oral solution	Tilmicosin	Pigs, Poultry, Turkeys, Calves
Enro K 10%, oral solution	Enrofloxacin	Chicken, Turkeys
Unisol (Aviflox), oral solution	Enrofloxacin	Chicken, Turkeys
Pharmasin 100% W/W soluble granules	Tylosin tartrate	Pigs, chickens (broilers, pullets), turkeys and calves
Pulmotil Premix, premix for medicated feeding stuff	Tilmicosin	Pigs
Clavobay LC and associated names, intramammary injection		Cattle
Shotaflor, solution for injection	Florfenicol	Cattle
Fenflor, solution for injection	Florfenicol	Cattle
Pulmotil AC, oral solution	Tilmicosin	Pigs, poultry, Turkey, Calves
Tiamutin premix	Tiamulin fumarate	Pigs, Chickens, Turkeys, Rabbits
Doxycicline hyclate, water soluble powders and oral solutions containing doxycicline hyclate	Doxycycline hyclate	Poultry
Colistin, 2 MIU/ml concentrate for oral solution	Colistin	All food producing species
Quinolones/ Fluoroquinolones	Quinolones/Fluoroquinolones	All food producing species
Synulox Lactating cow, intramammary suspension	Amoxicillin, clavulanic acid and prednisolone	Cattle
Doxycycline 50% WSP and associated names	Doxycycline hyclate	Poultry, cattle and pigs
Doxyfar 50% and associated names	Doxycycline hyclate	Poultry, pigs

Combimox Lactating Cow Intramammary Suspension	Amoxicillin, clavulanic acid and prednisolone	Lactating cattle
Nisamox Lactating Cow Intramammary Suspension	Amoxicillin, clavulanic acid and prednisolone	Lactating cattle
Combisyn Lactating Cow Intramammary Suspension	Amoxicillin, clavulanic acid and prednisolone	Lactating cattle
Baytril 10% oral solution and associated names	Enrofloxacin	Poultry, rabbits
Clavudale 50mg tablets for cats and dogs	Amoxicillin, clavulanic acid	Cats and dogs
Veterinary medicinal products containing systemically administered (parenteral or oral) 3rd and 4th generation cephalosporins intended for use in food producing species	Ceftiofur, cefquinome and cefaperazone	All food producing species
All pre-mixes for medicated feedingstuffs containing 40, 100 or 200g tilmicosin per kg pre-mix and administered to rabbits	Tilmicosin	Rabbits
Nuflor 300 solution for injection for cattle and sheep	Florfenicol	Cattle, sheep
Hipralona Enro-S and its generics intended for rabbits	Enrofloxacin	Rabbits
Nuflor Swine Once 450 mg/ml	Florfenicol	Pigs
Micotil 300, solution for injection 300mg/ml	Tilmicosin	Cattle, sheep, rabbits
Florgane 300 mg/ml suspension for injection for cattle and pigs	Florfenicol	Pigs
Strenzen 500/125 mg/g powder for use in drinking water for pigs	Amoxicillin, clavulanic acid	Pigs
Suanovil 20 and associated names, Captalin and associated names and generic products thereof, including pending applications	Spiramycin	Cattle, calves and pigs
Linco-Spectin 100 and its associated names	Lincomycin, spectinomycin	Pigs, chickens
All veterinary medicinal products containing enrofloxacin to be administered via the drinking water to chickens and turkeys	Enrofloxacin	Chickens, turkeys
Soludox 500 mg/g powder for use in drinking water for pigs and chickens	Doxycycline hyclate	Pigs, chickens
Baytril 2.5% injectable, Baytril 5% injectable and Baytril 10% injectable and their associated names	Enrofloxacin	Cattle, pigs, sheep, goats, rabbits and pets
Baytril 2.5% injectable, Baytril 5% injectable, Baytril 10% injectable and associated names, and related veterinary medicinal products	Enrofloxacin	Food producing species and companion animals
All veterinary medicinal products containing tylosin to be administered orally via feed or the drinking water to pigs	Tylosin	Pigs
Resflor solution injectable and its associated names	Florfenicol, flunixin	Cattle
All veterinary medicinal products containing gentamicin presented as solutions for injection to be administered to horses	Gentamicin	Non-food producing horses
All veterinary medicinal products containing colistin to be administered orally	Colistin	All food producing species

ANNEX 3: LIST OF SCIENTIFIC OPINION, EU SUMMARY REPORTS AND SCIENTIFIC REPORTS ON ANTIMICROBIAL RESISTANCE AS DEVELOPED BY EFSA

A. Scientific Opinions on antimicrobial resistance

- 2013, EFSA Panel on Biological Hazards. Scientific Opinion on Carbapenem resistance in food animal ecosystems. EFSA Journal 2013;11(12):3501 [70 pp.]. doi:10.2903/j.efsa.2013.3501
  http://www.efsa.europa.eu/en/efsajournal/pub/3501.htm

- 2011, EFSA Panel on Biological Hazards. Scientific Opinion on the public health risks of bacterial strains producing extended-spectrum β-lactamases and/or AmpC β-lactamases in food and food-producing animals. EFSA Journal 2011;9(8):2322 [95 pp.]. doi:10.2903/j.efsa.2011.2322
  http://www.efsa.europa.eu/en/efsajournal/pub/2322.htm

- 2011. Technical Report. EFSA approaches to risk assessment in the area of antimicrobial resistance, with an emphasis on commensal microorganisms. EFSA Journal 2011; 9(10):196, 29 pp. doi:10.2903/j.efsa.2011.196.
  http://www.efsa.europa.eu/en/efsajournal/doc/196e.pdf

- 2010. Revision of the joint AFC/BIOHAZ guidance document on the submission of data for the evaluation of the safety and efficacy of substances for the removal of microbial surface contamination of foods of animal origin intended for human consumption. EFSA Journal 2010; 8(4):1544 [32 pp.]. doi:10.2903/j.efsa.2010.1544
  http://www.efsa.europa.eu/en/efsajournal/pub/1544.htm

- 2009. Short report on antimicrobial resistance (AMR) focused on zoonotic infections based on the information currently available (Collaboration EFSA, EMEA, ECDC, SCENIHR). EFSA Journal 2009; 7(11):1372 [78 pp.]. doi:10.2903/j.efsa.2009.1372
  http://www.efsa.europa.eu/en/efsajournal/pub/1372.htm

- 2009. Opinion of the Scientific Panel on Biological Hazards (BIOHAZ) on Assessment of the Public Health significance of meticillin resistant *Staphylococcus aureus* (MRSA) in animals and foods (Self-task). The EFSA Journal (2009) 993, 1-7
  http://www.efsa.europa.eu/en/efsajournal/pub/993.htm

- 2009. Joint scientific report of ECDC, EFSA and EMEA on meticillin resistant *Staphylococcus aureus* (MRSA) in livestock, companion animals and food.
  EFSA Scientific Report (2009) 301, 1-10 and
  EMEA/CVMP/SAGAM/62464/2009.doi:10.2903/j.efsa.2009.301r
  http://www.efsa.europa.eu/en/efsajournal/pub/301r.htm

- 2009. Consolidated presentation of the joint Scientific Opinion of the GMO and BIOHAZ Panels on the "Use of Antibiotic Resistance Genes as Marker Genes in Genetically Modified Plants" and the Scientific Opinion of the GMO Panel on "Consequences of the Opinion on the Use of Antibiotic Resistance Genes as Marker Genes in Genetically Modified Plants on Previous EFSA Assessments of Individual GM Plants". doi:10.2903/j.efsa.2009.1108
  http://www.efsa.europa.eu/en/efsajournal/pub/1108.htm

- 2008. Opinion of the Scientific Panel on Biological Hazards (BIOHAZ) on Foodborne antimicrobial resistance as a biological hazard. doi:10.2903/j.efsa.2008.765 http://www.efsa.europa.eu/en/efsajournal/pub/765.htm

- 2008. Opinion of the Scientific Panel on Biological Hazards (BIOHAZ) on the Assessment of the possible effect of the four antimicrobial treatment substances on the emergence of antimicrobial resistance. doi:10.2903/j.efsa.2008.659 http://www.efsa.europa.eu/en/efsajournal/pub/659.htm

- Participation as part of the EU delegation on the joint FAO/WHO food standards programme *ad hoc* Codex intergovernmental task force on antimicrobial resistance proposed draft guidelines for risk analysis of foodborne antimicrobial resistance (n01-2008, n02-2008, n03-2008). http://codextfamr.kfda.go.kr/eng_site/main/index_new.html

- 2008. Technical Guidance - Update of the criteria used in the assessment of bacterial resistance to antibiotics of human and veterinary importance. Prepared by the Panel on Additives and Products or Substances used in Animal Feed. doi:10.2903/j.efsa.2008.732 http://www.efsa.europa.eu/en/efsajournal/pub/732.htm

- 2007. Statement of the Scientific Panel on Genetically Modified Organisms on the safe use of the *npt*II antibiotic resistance marker gene in genetically modified plants. doi:10.2903/j.efsa.2007.742 http://www.efsa.europa.eu/en/efsajournal/pub/742.htm

- 2004. Opinion of the Scientific Panel on Genetically Modified Organisms on the use of antibiotic resistance genes as marker genes in genetically modified plants. doi:10.2903/j.efsa.2004.48 http://www.efsa.europa.eu/en/efsajournal/pub/48.htm

B. EU Summary Reports on the occurrence of antimicrobial resistance in animals and food

- EFSA and ECDC, 2014. The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2012. EFSA Journal 2014;12(3):3590, 315 pp. doi:10.2903/j.efsa.2014.3590 http://www.efsa.europa.eu/en/efsajournal/pub/3590.htm

- EFSA and ECDC, 2013. The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2011. EFSA Journal 2013;11(4):3129 [250 pp.]. doi:10.2903/j.efsa.2013.3129 http://www.efsa.europa.eu/en/efsajournal/pub/3129.htm

- EFSA and ECDC, 2012. The European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2010. EFSA Journal 2012;10(3):2598 [233 pp.]. doi:10.2903/j.efsa.2012.2598 http://www.efsa.europa.eu/en/efsajournal/pub/2598.htm

- EFSA and ECDC, 2011. The European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in the European Union in 2009.EFSA Journal 2011;9(7):2154 [321 pp.]. doi:10.2903/j.efsa.2011.2154 http://www.efsa.europa.eu/en/efsajournal/pub/2154.htm

- EFSA and ECDC, 2010. The Community Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from animals and food in the European Union in 2008. EFSA Journal 2010; 8(7):1658 [261 pp.]. doi:10.2903/j.efsa.2010.1658 http://www.efsa.europa.eu/en/efsajournal/pub/1658.htm

- EFSA and ECDC, 2010. The Community Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from animals and food in the European Union in 2004-2007.
  http://www.efsa.europa.eu/en/efsajournal/pub/1309.htm

C. Scientific Reports of EFSA on harmonised monitoring of AMR in animals and food

- Scientific Report of EFSA, 2014. Technical specifications on randomised sampling for harmonised monitoring of antimicrobial resistance in zoonotic and commensal bacteria. EFSA Journal 2014; 12(5):3686, 33 pp. doi:10.2903/j.efsa.2014.3686
  http://www.efsa.europa.eu/en/efsajournal/doc/3686.pdf

- Scientific Report of EFSA, 2012. Technical specifications on harmonised monitoring and reporting of AMR in *Salmonella*, *Campylobacter* and indicator *E. coli* and *Enterococci* bacteria transmitted through food. EFSA Journal 2012; 10(6):2742, 64 pp.
  http://www.efsa.europa.eu/en/efsajournal/doc/2742.pdf

- Scientific Report of EFSA, 2012. Technical specifications on harmonised monitoring and reporting of AMR in MRSA in food-producing animals and food. EFSA Journal 2012; 10(6):2742, 64 pp. doi:10.2903/j.efsa.2012.2742.
  http://www.efsa.europa.eu/en/efsajournal/doc/2897.pdf

- Scientific Report of EFSA, 2012. Technical specifications for the analysis and reporting of data on AMR in the EU Summary Report. EFSA Journal 2012;10(2):2587, 53 pp. doi:10.2903/j.efsa.2012.2587
  http://www.efsa.europa.eu/en/efsajournal/pub/2587.htm

- Scientific Report of EFSA, 2008. Report from the Task Force on Zoonoses Data Collection including guidance for harmonized monitoring and reporting of antimicrobial resistance in commensal *Escherichia coli* and *Enterococcus* spp. from food. doi:10.2903/j.efsa.2007.96r
  http://www.efsa.europa.eu/en/efsajournal/pub/96r.htm

- Scientific Report of EFSA, 2007. Report of the Task Force on Zoonoses Data Collection including a proposal for a harmonized monitoring scheme of antimicrobial resistance in *Salmonella* in fowl (*Gallus gallus*), turkeys and pigs and *Campylobacter jejuni* and *C. coli* in broilers.
  http://www.efsa.europa.eu/en/efsajournal/pub/96r.htm

D. Scientific reports of EFSA on a baseline survey on MRSA in pig primary production

- Scientific Report of EFSA, 2010. Analysis of the baseline survey on the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) in holdings with breeding pigs, in the EU, 2008 - Part B: factors associated with MRSA contamination of holdings.EFSA Journal 2010; 8(6):1597, 67 pp. doi:10.2903/j.efsa.2010.1597
  http://www.efsa.europa.eu/en/efsajournal/pub/1597.htm

- Scientific Report of EFSA, 2009. Analysis of the baseline survey on the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) in holdings with breeding pigs, in the EU, 2008 - Part A: MRSA prevalence estimates. EFSA Journal 2009; 7(11):1376, 82 pp. doi:10.2903/j.efsa.2009.1376
  http://www.efsa.europa.eu/en/efsajournal/pub/1376.htm

- Scientific Report of EFSA, 2007. Report of the Task Force on Zoonoses Data Collection on a proposal for technical specifications for a baseline survey on the prevalence of

Methicillin Resistant *Staphylococcus aureus* (MRSA) in breeding pigs. doi:10.2903/j.efsa.2007.129r
http://www.efsa.europa.eu/en/efsajournal/pub/129r.htm

ANNEX 4: LIST OF SURVEILLANCE REPORTS, SURVEYS, RISK ASSESSMENTS, GUIDANCE DOCUMENTS AND OTHER DOCUMENTS ON ANTIMICROBIAL RESISTANCE AS DEVELOPED BY ECDC

A. Surveillance reports

a. Antimicrobial resistance

- Antimicrobial resistance surveillance in Europe 2012. Annual Report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). ECDC, 2013. http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-surveillance-europe-2012.pdf

- Antimicrobial resistance surveillance in Europe 2011. Annual Report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). ECDC, 2012. http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-surveillance-europe-2011.pdf

- Antimicrobial resistance surveillance in Europe 2010. Annual Report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). ECDC, 2011. http://www.ecdc.europa.eu/en/publications/Publications/1111_SUR_AMR_data.pdf

- Antimicrobial resistance surveillance in Europe 2009. Annual Report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). ECDC, 2010. http://www.ecdc.europa.eu/en/publications/Publications/1011_SUR_annual_EARS_Net_2009.pdf

- Gonococcal antimicrobial susceptibility surveillance in Europe 2011. ECDC, 2013. http://www.ecdc.europa.eu/en/publications/publications/gonococcal-antimicrobial-susceptibility-surveillance-27-mar-2013.pdf

- Gonococcal antimicrobial susceptibility surveillance in Europe 2010. ECDC, 2012. http://www.ecdc.europa.eu/en/publications/Publications/1206-Gonococcal-AMR.pdf

- Gonococcal antimicrobial susceptibility surveillance in Europe 2009. ECDC, 2011. http://ecdc.europa.eu/en/publications/publications/1101_sur_gonococcal_susceptibility_2009.pdf

- The European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2012. EFSA & ECDC, 2014. http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-in-zoonotic-and-indicator-bacteria-summary-report-2012.pdf

- The European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2011. EFSA & ECDC, 2013. http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-in-zoonotic-and-indicator-bacteria-summary-report-2011.pdf

- The European Union Summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2010. EFSA & ECDC, 2012. http://www.ecdc.europa.eu/en/publications/Publications/1203-SUR-ECDC-EFSA-report-antimicrobial-resistance.pdf

- The European Union Summary Report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in the European Union in 2009. EFSA & ECDC, 2011.
  http://www.efsa.europa.eu/en/efsajournal/doc/2154.pdf

b. Antimicrobial consumption

- Antimicrobial consumption surveillance in Europe 2011. Annual report of the European Surveillance of Antimicrobial Consumption Network (ESAC-Net). ECDC, 2014.
  http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-consumption-europe-surveillance-2011.pdf

- Antimicrobial consumption surveillance in Europe 2010. Annual report of the European Surveillance of Antimicrobial Consumption Network (ESAC-Net). ECDC, 2013.
  http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-antibiotic-consumption-ESAC-report-2010-data.pdf

c. Healthcare-associated infections

- Point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities April-May 2013. ECDC, 2014.
  http://www.ecdc.europa.eu/en/publications/Publications/healthcare-associated-infections-point-prevalence-survey-long-term-care-facilities-2013.pdf

- Point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities May-September 2010. ECDC, 2014.
  http://www.ecdc.europa.eu/en/publications/Publications/healthcare-associated-infections-antimicrobial-consumption-point-prevalence-survey-long-term-care-facilities-2010.pdf

- Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals 2011-2012. ECDC, 2013.
  http://www.ecdc.europa.eu/en/publications/Publications/healthcare-associated-infections-antimicrobial-use-PPS.pdf

- Surveillance of surgical site infections in Europe, 2010-2011. ECDC, 2013.
  http://www.ecdc.europa.eu/en/publications/Publications/SSI-in-europe-2010-2011.pdf

- Surveillance of surgical site infections in Europe, 2008-2009. ECDC, 2012.
  http://www.ecdc.europa.eu/en/publications/Publications/120215_SUR_SSI_2008-2009.pdf

- Surveillance of healthcare-associated infections in Europe, 2007. ECDC, 2012.
  http://www.ecdc.europa.eu/en/publications/Publications/120215_SUR_HAI_2007.pdf

B. Surveys

a. Antimicrobial resistance

- Carbapenemase-producing bacteria in Europe. Interim results from the European survey on carbapenemase-producing *Enterobacteriaceae* (EuSCAPE) project 2013. ECDC, 2013.
  http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-carbapenemase-producing-bacteria-europe.pdf

- Livestock-associated methicillin-resistant *Staphylococcus aureus* in humans, Europe. Emerg Infect Dis 2011;17(3):502-5. http://wwwnc.cdc.gov/eid/article/17/3/pdfs/10-1036.pdf

- New Delhi metallo-beta-lactamase 1-producing *Enterobacteriaceae*: emergence and response in Europe. 2010. Eurosurveillance 2010;15(46). pii: 19716. http://www.eurosurveillance.org/images/dynamic/EE/V15N46/art19716.pdf

b. Healthcare-associated infections

- The European Centre for Disease Prevention and Control (ECDC) pilot point prevalence survey of healthcare-associated infections and antimicrobial use. Eurosurveillance 2012;17(46). pii: 20316. http://www.eurosurveillance.org/images/dynamic/EE/V17N46/art20316.pdf

- *Clostridium difficile* infection in Europe: a hospital-based survey. Lancet 2011;377(9759):63-73. http://www.ecdc.europa.eu/en/activities/sciadvice/_layouts/forms/Review_DispForm.aspx?ID=633&List=a3216f4c-f040-4f51-9f77-a96046dbfd72

- Update of *Clostridium difficile*-associated disease due to PCR ribotype 027 in Europe, 2008. Eurosurveillance 2008;13(31). pii: 18942. http://www.eurosurveillance.org/images/dynamic/EE/V13N31/art18942.pdf

- Update of *Clostridium difficile*-associated disease due to PCR ribotype 027 in Europe. Eurosurveillance 2007;12(3-6):163-6. http://www.eurosurveillance.org/images/dynamic/EQ/v07n02/v07n02.pdf

c. **Public awareness campaigns**

- European Antibiotic Awareness Day: a five-year perspective of Europe-wide actions to promote prudent use of antibiotics. Eurosurveillance 2014;19(41). pii=20928. http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20928

- The role and utilisation of public health evaluations in Europe: A case study of national hand hygiene campaigns. BMC Public Health 2014;14:131. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3931350/pdf/1471-2458-14-131.pdf

- National hand hygiene campaigns in Europe, 2000-2009. Eurosurveillance 2009;14(17). pii: 19190. http://www.eurosurveillance.org/images/dynamic/EE/V14N17/art19190.pdf

- Antibiotic Awareness Day, 2008 - the first Europe-wide public information campaign on prudent antibiotic use: methods and survey of activities in participating countries. Eurosurveillance 2009;14(30). pii: 19280. http://www.eurosurveillance.org/images/dynamic/EE/V14N30/art19280.pdf

C. Risk assessments and guidance documents

a. Antimicrobial resistance

- Risk assessment on the impact of environmental usage of triazoles on the development and spread of resistance to medical triazoles in *Aspergillus* species. ECDC, 2013. http://www.ecdc.europa.eu/en/publications/Publications/risk-assessment-impact-environmental-usage-of-triazoles-on-Aspergillus-spp-resistance-to-medical-triazoles.pdf

- Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clin Microbiol Infect 2012;18(3):268-81. http://onlinelibrary.wiley.com/doi/10.1111/j.1469-0691.2011.03570.x/pdf

- Response plan to control and manage the threat of multidrug-resistant gonorrhoea in Europe. ECDC, 2012. http://www.ecdc.europa.eu/en/publications/publications/1206-ecdc-mdr-gonorrhoea-response-plan.pdf

- Risk assessment on the spread of carbapenemase-producing *Enterobacteriaceae* (CPE) through patient transfer between healthcare facilities, with special emphasis on cross-border transfer. ECDC, 2011. http://www.ecdc.europa.eu/en/publications/Publications/110913_Risk_assessment_resistant_CPE.pdf

- Updated ECDC risk assessment on the spread of New Delhi metallo-β-lactamase (NDM) and its variants within Europe. ECDC, 2011. http://www.ecdc.europa.eu/en/publications/Publications/1111_TER_Risk-assessment-NDM.pdf

- ECDC/EMEA Joint Technical Report "The bacterial challenge: time to react". ECDC & EMEA, 2009. http://www.ecdc.europa.eu/en/publications/Publications/0909_TER_The_Bacterial_Challenge_Time_to_React.pdf
- Joint Opinion on antimicrobial resistance (AMR) focused on zoonotic infections. Scientific Opinion of the European Centre for Disease Prevention and Control; Scientific Opinion of the Panel on Biological Hazards; Opinion of the Committee for Medicinal Products for Veterinary Use; Scientific Opinion of the Scientific Committee on Emerging and Newly Identified Health Risks. ECDC, EFSA, EMEA & SCENIHR, 2009. http://www.efsa.europa.eu/en/efsajournal/doc/1372.pdf

- Joint scientific report of ECDC, EFSA and EMEA on meticillin resistant *Staphylococcus aureus* (MRSA) in livestock, companion animals and food. ECDC, EFSA & EMEA, 2009. http://www.efsa.europa.eu/en/efsajournal/doc/301r.pdf

b. Antimicrobial consumption

- Systematic review and evidence-based guidance on perioperative antibiotic prophylaxis. ECDC, 2013. http://www.ecdc.europa.eu/en/publications/Publications/Perioperative%20antibiotic%20prophylaxis%20-%20June%202013.pdf

c. Healthcare-associated infections

- Core competencies for infection control and hospital hygiene professionals in the European Union. ECDC, 2013. http://www.ecdc.europa.eu/en/publications/Publications/infection-control-core-competencies.pdf

- Infection control measures to limit the spread of *Clostridium difficile*. Clin Microbiol Infect 2008;14(Suppl 5):2-20. http://onlinelibrary.wiley.com/doi/10.1111/j.1469-0691.2008.01992.x/pdf

D. Other documents

a. Antimicrobial resistance

- EU protocol for harmonised monitoring of antimicrobial resistance in human *Salmonella* and *Campylobacter* isolates. ECDC, 2014.
  http://www.ecdc.europa.eu/en/publications/Publications/AMR-salmonella-campylobacter-protocol-monitoring.pdf

- Drug-resistant *Salmonella enterica* serotype Kentucky in Europe. Lancet Infect Dis 2014;14(4):270-1.
  http://www.sciencedirect.com/science/article/pii/S1473309914707030#

- The rise of carbapenem resistance in Europe: just the tip of the iceberg?
  Antimicrob Resist Infect Control 2013;2(1):6.
  http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3691711/pdf/2047-2994-2-6.pdf

- *Escherichia coli* and *Staphylococcus aureus*: bad news and good news from the European Antimicrobial Resistance Surveillance Network (EARS-Net, formerly EARSS), 2002 to 2009.
  Eurosurveillance 2011;16(11). pii: 19819.
  http://www.eurosurveillance.org/images/dynamic/EE/V16N11/art19819.pdf

- Methicillin-resistant *Staphylococcus aureus* (MRSA): burden of disease and control challenges in Europe. Eurosurveillance 2010;15(41). pii:19688.
  http://www.eurosurveillance.org/images/dynamic/EE/V15N41/art19688.pdf

b. Healthcare-associated infections

- Concordance between European and US case definitions of healthcare-associated infections.
  Antimicrob Resist Infect Control 2012;1(1):28.
  http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3527198/pdf/2047-2994-1-28.pdf

- Pathways to clean hands: highlights f successful hand hygiene implementation strategies in Europe. Eurosurveillance 2010;15(18). pii: 19560.
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ANNEX 5: LIST OF AMR-RELATED RESEARCH PROJECTS FUNDED UNDER THE EU'S SEVENTH FRAMEWORK PROGRAMME FOR RESEARCH AND TECHNOLOGICAL DEVELOPMENT, HORIZON 2020 AND UNDER THE INNOVATIVE MEDICINES INITIATIVE (IMI) JOINT UNDERTAKING

FP7

Acronym	Title	Website
ANTIRESDEV	The effects of antibiotic administration on the emergence and persistence of antibiotic-resistant bacteria in humans and on the composition of the indigenous microbiotas at various body sites	www.ucl.ac.uk/antiresdev
BACTERIAL SPORES	Investigating the nature of bacterial spores	http://cordis.europa.eu/project/rcn/87574_en.html
CONCORD	Control of community-acquired MRSA: Rationale and development of counteractions	www.concord-mrsa.eu
DIVERSITY	Evolution of pathogen and host diversity	http://cordis.europa.eu/project/rcn/99103_en.html
EVOLOME	Genetic and phenotypic precursors of antibiotic resistance in evolving bacterial populations: from single cell to population level analyses	http://cordis.europa.eu/project/rcn/96390_en.html
EVORESIN	Multidrug resistance and the evolutionary ecology of insect immunity	http://cordis.europa.eu/project/rcn/96082_en.html
EVOTAR	Evolution and transfer of antibiotic resistance	http://www.evotar.eu/index.php
GENTB	Human genetics of tuberculosis	http://cordis.europa.eu/project/rcn/99258_en.html
GUTDROSO	Gut immunity and homeostasis in Drosophila	http://cordis.europa.eu/project/rcn/90145_en.html
HYPERDIFF	The physiological basis of hypervirulence in Clostridium difficile: a prerequisite for effective infection control	www.clostridium-difficile.com
INTERPLAY	Interplay of microbiota and gut function in the developing pig Innovative avenues towards sustainable animal production	http://cordis.europa.eu/project/rcn/92294_en.html
LISTA-LTA	A functional analysis of Listeria and Staphylococcus lipoteichoic acid	http://cordis.europa.eu/project/rcn/95708_en.html
MALARES	Genetics of resistance to malaria parasites in the mosquito Anopheles gambiae	http://cordis.europa.eu/project/rcn/99130_en.html
MICROTRANS	Microbial translocation across host barriers	http://cordis.europa.eu/project/rcn/96590_en.html
MODELIST	Understanding the infection by the bacterium Listeria monocytogenes as a way to address key issues in biology	http://cordis.europa.eu/project/rcn/91083_en.html
OPAL	Origins, proliferation and pathogenesis of L-form (cell wall deficient) bacteria	http://cordis.europa.eu/project/rcn/94131_en.html
PBDR	The population biology of drug resistance: Key principles for a more sustainable use of drugs	http://cordis.europa.eu/project/rcn/99462_en.html

PGNFROMSHAPETOVIR	The role of peptidoglycan in bacterial cell physiology: from bacterial shape to host-microbe interactions	http://cordis.europa.eu/project/rcn/87435_en.html
PNEUMOPATH	A comprehensive dissection of pneumococcal-host interactions	www.pneumopath.org
RUPTEFFECTS	Revealing the mechanism of host membrane rupture by invasive pathogens and its role in triggering the immune response	http://cordis.europa.eu/project/rcn/98072_en.html
SECMESSBIOFILM	Cyclic-di-GMP: New concepts in second messenger signaling and bacterial biofilm formation	http://cordis.europa.eu/project/rcn/94576_en.html
SYBARIS	Finding biomarkers of anti-microbial drug resistance via a systems biology analysis of fungal pathogen interactions with the human immune system	www.sybaris-fp7.eu
SYM-BIOTICS	Dual exploitation of natural plant strategies in agriculture and public health: enhancing nitrogen-fixation and surmounting microbial infections	http://cordis.europa.eu/project/rcn/99431_en.html
TAPAS	Tracing antimicrobial peptides and pheromones in the amphibian skin	http://cordis.europa.eu/project/rcn/88362_en.html
TERNANOMED	Terpenoylation: An original concept for the discovery of new nanomedicines	http://cordis.europa.eu/project/rcn/94409_en.html
TRANSLATIONMACHINERY	Integrative structure and function study of the bacterial and human protein synthesis machinery	http://cordis.europa.eu/project/rcn/92857_en.html
CRIMALDDI	The coordination, rationalisation and integration of antimalarial drug discovery and development initiatives	www.crimalddi.eu
PHARMAS	Ecological and human health risk assessments of antibiotics and anti-cancer drugs found in the environment	http://www.isoe.de/english/projects/pharmas.htm
APRES	The appropriateness of prescribing antibiotics in primary health care in Europe with respect to antibiotic resistance	www.nivel.eu/apres
BIOHYPO	Confronting the clinical relevance of biocide induced antibiotic resistance	www.sites.google.com/site/biohypo/home
DebugIT	Detecting and eliminating bacteria using information technology	www.debugit.eu
PAR	Predicting antibiotic resistance	www.imbim.uu.se/PAR/index.html
PROHIBIT	Prevention of hospital infections by intervention and training	www.prohibit.unige.ch
R-GNOSIS	Resistance in Gram-negative organisms: Studying intervention strategies	http://www.r-gnosis.eu/
SATURN	Impact of specific antibiotic therapies on the prevalence of human host resistant bacteria	www.saturn-project.eu
BIG_IDEA	Building an integrated genetic infectious disease epidemiology approach	http://cordis.europa.eu/project/rcn/96331_en.html
C4L	Chips for life	http://www.chips4life.eu/
ChagasEpiNet	Comparative epidemiology of genetic lineages of Trypanosoma cruzi	www.ki.se/chagasepinet
CHAIN	Collaborative HIV and anti-HIV drug resistance network	http://www.chain-hiv.eu/index.php?page=1

FAST-XDR-DETECT	Development of a two-approach plate system for the fast and simultaneous detection of MDR and XDR M. tuberculosis	https://room.projectcoordinator.net/~oligocolor
INTOPSENS	A highly integrated optical sensor for point of care label free identification of pathogenic bacteria strains and their antibiotic resistance	http://www.ee.kth.se/intopsens/
KALADRUG-R	New tools for monitoring drug resistance and treatment response in Visceral Leishmaniasis in the Indian subcontinent	www.leishrisk.net/leishrisk/Default.aspx?Menu=MenuMain&MIID=35&WPID=41&L=E
MALACTRES	Multi-drug resistance in malaria under combination therapy: Assessment of specific markers and development of innovative, rapid and simple diagnostics	www.malactres.eu
PARCIVAL	Partner network for a clinically validated multi-analyte lab-on-a-chip platform	http://www.parcival-project.eu/
PILGRIM	Preventing community and nosocomial spread and Infection with MRSA ST 398 - instruments for accelerated control and integrated risk management of antimicrobial resistance	www.fp7-pilgrim.eu
RESISTOME	Towards an individualised therapy and prevention of multi-drug resistant disease	http://cordis.europa.eu/project/rcn/96459_en.html
TB PAN-NET	TB PAN-NET: Pan-European network for study and clinical management of drug resistant tuberculosis	www.tbpannet.org
TEMPOtest-QC	An Integrated tool-kit for the clinical evaluation of microbial detection and antibiotic susceptibility point-of-care testing technologies	www.tempotest-qc.eu
THERAEDGE	An integrated platform enabling theranostic applications at the point of primary care	http://cordis.europa.eu/project/rcn/85784_en.html
TROCAR	Translation research on combating antimicrobial resistance	http://www.trocarproject.eu/
AEROPATH	Identification, characterisation and exploitation of novel Gram-negative drug targets	www.aeropath.eu
AIDA	Preserving old antibiotics for the future: assessment of clinical efficacy by a pharmacokinetic/pharmacodynamic approach to optimize effectiveness and reduce resistance for off-patent antibiotics	http://www.aida-project.eu/
ANTIBACTERIALS	Natural products and their cellular targets: A multidisciplinary strategy for antibacterial drug discovery	http://cordis.europa.eu/project/rcn/96776_en.html
ANTIFLU	Innovative anti-influenza drugs excluding viral escape	http://www.antiflu-project.eu/
AntiPathoGN	Identification and validation of novel drug targets in Gram-negative bacteria by global search: a trans-system approach	www.antipathogn.eu
BacAttack	A stealth attack tool for preventing clinical drug resistance through a unique self-regenerating surface	https://www.bacattack.eu/

BACTERIOSAFE	Active wound dressings based on biological mimicry	http://www.mpip-mainz.mpg.de/eu-projekte/bacteriosafe/
BALI	Biofilm alliance	http://www.bali-consortium.eu/
BIOSURF	Development and implementation of a contact biocide polymer for its application as antimicrobial and anti-deposit surfaces in the food industry	http://cordis.europa.eu/project/rcn/92307_en.html
CAREPNEUMO	Combating antibiotic resistant pneumococci by novel strategies based on in vivo and in vitro host-pathogen interactions	www.helmholtz-hzi.de/en/carepneumo/home/
CATAFLU.OR	Organocatalytic approaches towards easy synthesized, economical and high yielding Tamiflu derivatives	www.catafluor.eu
COATIM	Development of antibiofilm coatings for implants	http://eu-researchprojects.eu/coatim
DIVINOCELL	Exploiting Gram-negative cell division targets in the test tube to obtain antimicrobial compounds	www.cnb.csic.es/~divinocell/
EMBEK1	Development and analysis of polymer based multi-functional bactericidal materials	http://www.mpip-mainz.mpg.de/eu-projekte/embek1/
FLUCURE	Development of novel antiviral drugs against influenza	www.vironova.com
FluDrugStrategy	Combating influenza using a novel drug strategy	www.fludrugstrategy.com
FLU-PHARM	New drugs targeting influenza virus	www.flupharm.eu
I.D.A.C.	Implant disposable antibacterial coating (I.D.A.C.): a novel approach to implant-related infections in orthopaedics and trauma surgery	http://www.i-dac.eu/
MagicBullet	Optimisation of treatment with off-patent antimicrobial agents of ventilator-associated pneumonia (VAP)	http://www.magicbullet7fp.eu/
NABATIVI	Novel approaches to bacterial target identification, validation and inhibition	www.nabativi.org
NAFISPACK	Natural antimicrobials for innovative and safe packaging	http://www.nafispack.com/
NOVO	Novel approaches for prevention and degeneration of pathogenic bacteria biofilms formed on medical devices e.g. catheters	http://www.fp7-novo.eu/
RNANTIBIOTICS	RNA-mediated virulence gene regulation: Identification of novel antibacterial compounds	http://cordis.europa.eu/project/rcn/95859_en.html
SAFE CATHETER	Development of a cost-effective anti-bacterial device for the 37 million urethral catheters used in enlarged Europe	http://cordis.europa.eu/project/rcn/99232_en.html
SILVER	Small-molecule inhibitor leads versus emerging and neglected RNA viruses	http://cordis.europa.eu/project/rcn/96747_en.html
TINN	Evaluation of antibiotics (ciprofloxacin and fluconazole) for the treatment of infections in preterm and term neonates	http://www.tinn-project.org/
MacroSys	Macrophage systems biology applied to disease control	http://www.macrosys-project.eu/

TB-STEP	Strategies for the eradication of bovine tuberculosis	http://www.vigilanciasanitaria.es/tb-step/
QUANTOMICS	From sequence to consequence - Tools for the exploitation of livestock genomes	http://www.quantomics.eu/
ROBUSTMILK	Innovative and practical breeding tools for improved dairy products from more robust dairy cattle	http://www.robustmilk.eu/
DISCONTOOLS	Development of the most effective tools to control infectious diseases in animals	http://www.discontools.eu/home/index
LOWINPUTBREEDS	Development of integrated livestock breeding and management strategies to improve animal health, product quality and performance in European organic and low input milk, meat and egg production	www.lowinputbreeds.org
INTERPLAY	Interplay of microbiota and gut function in the developing pig Innovative avenues towards sustainable animal production	http://cordis.europa.eu/project/rcn/92294_en.html
CamCon	Campylobacter control - novel approaches in primary poultry production	http://www.camcon-eu.net/
3SR	Sustainable solutions for small ruminants	http://www.3srbreeding.eu/
ROUTINE	ROutine diagnostic tool for Urinary Tract INfections caused by Esbl and carbapenamase producing bacteria	http://www.routinefp7.eu/
RiD-RTI	Rapid Identification of Respiratory Tract Infections	http://www.rid-rti.eu/home_page
NABARSI	New AntiBacterials with Inhibitory activity on Aminoacyl-tRNA Synthetases	http://www.nabarsi.eu/
NeoStrep	Development of Group B Streptococcal vaccine to alleviate emerging antibiotic resistance through elimination of current prophylactic antibiotic strategies in GBS prevention	http://www.neostrep.eu/
BELLEROPHON	ComBinig cELLular and humoral immunE RespOnses as a vaccine strategy against staPHhylOcoccus aureus pathogeN	http://www.bellerophon-project.eu/
CDVAX	Oral Vaccination against *Clostridium difficile* Infection	http://cdvax.org/
PHAGOBURN	Evaluation of phage therapy for the treatment of *Escherichia coli* and *Pseudomonas aeruginosa* burn wound infections (Phase I / II clinical trial)	http://www.phagoburn.eu/
NOFUN	Novel antifungals to treat resistant organisms	https://www.nofunproject.org/
TAILORED-Treatment	Development of tailored antimicrobial treatment regimens and novel host-pathogen insights for respiratory tract infections and sepsis	http://www.tailored-treatment.eu/
FUNGITECT	Optimized Diagnostics for Improved Treatment Stratification in Invasive Fungal Diseases	http://www.igb.fraunhofer.de/en/competences/molecular-biotechnology/infectious-diseases/fungitect.html
CFMATTERS	Cystic Fibrosis Microbiome-determined Antibiotic Therapy Trial in Exacerbations: Results Stratified	http://www.cfmatters.eu/

MON4STRAT	Therapeutic Beta-Lactam Monitoring for Stratified Treatment of hospital-acquired pneumonia, improved dose-dependent efficacy, decreased treatment duration, and prevention of emergence of resistance	http://www.mon4strat.ulg.ac.be/
EFFORT	Ecology from Farm to Fork Of microbial drug Resistance and Transmission	http://www.effort-against-amr.eu/
FORAMP	Innovative Nanoformulation of Antimicrobial Peptides to Treat Bacterial Infectious Diseases	http://formampproject.com/en/Sidor/default.aspx
NAREB	Nanotherapeutics for antibiotic resistant emerging bacterial pathogens	http://nareb.eu/
PNEUMONP	Nanotherapeutics to treat antibiotic resistant Gram-negative bacteria caused pneumonia Infections	http://cordis.europa.eu/project/rcn/110689_en.html
THINPAD	Targeting the HIV-1 Nucleocapsid Protein to fight Antiretroviral Drug Resistance	http://www.thinpad.unisi.it/project/
JPIAMR	Joint Programming Initiative on antimicrobial resistance	http://www.jpiamr.eu/
Infect-ERA	Coordination of European funding for infectious diseases research	http://www.infect-era.eu/
EVODRTB	Compensatory Evolution and Epistasis in Multidrug-resistant Mycobacterium tuberculosis	http://cordis.europa.eu/project/rcn/107659_en.html
NEOMERO	European multicenter network to evaluate pharmacokinetics, safety and efficacy of Meropenem in neonatal sepsis and meningitis	http://www.neomero.org/
SONO	A pilot line of antibacterial and antifungal medical textiles based on a sonochemical process	http://www.fp7-sono.eu/
PHARMASEA	Increasing Value and Flow in the Marine Biodiscovery Pipeline	http://www.pharma-sea.eu/pharmasea.html
ROBODAR	Role of Biotransformation on the Dynamics of Antimicrobial Resistance	http://cordis.europa.eu/project/rcn/99976_en.html
PLASREVO	Evolution of plasmid-mediated resistance in Pseudomonas aeruginosa	http://cordis.europa.eu/project/rcn/104262_en.html
ICADIGE	The Integron Cassette Dynamics and the Integrase Gene Expression	http://cordis.europa.eu/project/rcn/103886_en.html
R-EVOLUTION PNEUMO	The role of recombination in evolution and epidemiology of bacterial pathogen Streptococcus pneumoniae	http://cordis.europa.eu/project/rcn/108188_en.html
NONANTIRES	Non-genetic mechanisms of intrinsic antimicrobial resistance	http://cordis.europa.eu/project/rcn/109222_en.html
DIVANTI	The dividing cell membrane: a promising target for novel antibiotics	http://cordis.europa.eu/project/rcn/109398_en.html
DNA-TRAP	DNA-TRAP – Delivery of Nucleic Acid-Based Therapeutics for the TReatment of Antibiotic-Resistant Pathogens	http://cordis.europa.eu/project/rcn/110153_en.html
ITRIBIS	Improving Translational Research Potential at the Institute of Biomedicine of Seville	http://cordis.europa.eu/project/rcn/108680_en.html
NANOTI	Development of a titanium dental implant with superior antibacterial properties	http://cordis.europa.eu/project/rcn/111600_en.html
ASFORCE	Targeted research effort on African swine fever	http://asforce.org/

FDM-DISCONVAC	Development, enhancement and complementation of animal-sparing, foot-and-mouth disease vaccine-based control strategies for free and endemic regions	http://cordis.europa.eu/project/rcn/90972_en.html
PIROVAC	Improvement of current and development of new vaccines for theileriosis and babesiosis of small ruminants	http://www.theileria.org/pirovac/work.htm
PoRRSCon	New tools and approaches to control Porcine reproductive and respiratory syndrome (PRRS) in the EU and Asia	http://www.porrscon.ugent.be/
PROHEALTH	Sustainable intensive pig and poultry production	http://www.fp7-prohealth.eu/project
WildTBvac	Integrated solutions for tuberculosis control in animals combining vaccination and multi-species diagnostics	https://www.visavet.es/wildtbvac/

IMI projects

Acronym	Title	Website
RAPP-ID	Development of rapid point-of-care test platforms for infectious diseases	http://www.ua.ac.be/main.aspx?c=RAPP-ID&n=93905
COMBACTE	Combatting Bacterial Resistance in Europe	https://www.combacte.com/
TRANSLOCATION	Molecular basis of the bacterial cell wall permeability	http://www.nd4bb.eu/
ENABLE	European Gram-negative Antibacterial Engine	www.nd4bb-enable.eu
DRIVE-AB	Driving Reinvestment in R&D and Responsible Antibiotic Use	http://drive-ab.eu/
PreDiCT-TB	Model-based preclinical development of anti-tuberculosis drug combinations	http://www.predict-tb.eu/

HORIZON 2020

Acronym	Title	Website
COMPARE	Collaborative management platform for detection and analyses of (re)-emerging and foodborne outbreaks in Europe	
EMI-TB	Eliciting Mucosal Immunity in Tuberculosis	
TBVAC2020	Advancing novel and promising TB vaccine candidates from discovery to preclinical and early clinical development	
Pro-Staph-ID	Clinical biomarker and rapid diagnostic test for Staphylococcus aureus induced ventilator-associated pneumonia	
PoC-Cycle	Innovative Molecular Diagnostics point-of-care device for MRSA	
Fluorobot	Robotic fluorescent microscope for smear slide screening in Tuberculosis Diagnosis	
PneumoSIP	A cost-effective solution for the rapid diagnostic of pneumonia	
LimitMDR	Utilizing evolutionary interactions to limit multidrug resistance	

TB-ACCELERATE	Integrating genomics, epidemiology and evolution to accelerate tuberculosis eradication	
BacBio	Mechanistic and functional studies of Bacillus biofilms assembly on plants, and their impact in sustainable agriculture and food safety	
RuMicroPlas	The Plasmidome: a Driving Force of Rumen Microbial Evolution from Birth to Adulthood	
ComBact	How complement molecules kill bacteria	
SCENT	SCENT: Hybrid Gels for Rapid Microbial Detection	
MtbTransReg	Translational regulation in the persistence and drug susceptibility of Mycobacterium tuberculosis	