D-1.1.A report of AMR and AMU data (and data collection activities) in livestock and humans in the six participating countries, and with indication to its quality, comparability and purpose.

Antibiotic Resistance Dynamics (ARDIG): The influence of geographic origin and management systems on resistance gene flows within humans, animals an the environment.

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Introduction

Antimicrobial resistance (AMR) has become a serious and global threat to public health that requires urgent actions all over the world. ARDIG is a One Health European Joint Programme (EJP) project which is carried out under the need to increase knowledge about AMR (1). The project aims to understand the dynamic of AMR by assessing national trends, Farm/hospital trends and isolate trends from six different European countries (Spain, Norway, Germany, Netherlands, France and United Kingdom) with the final objective of developing strategies that help to reduce the spread of resistant bacteria at European level.

This report is focussed on defining and describing available epidemiological data from humans, animals (especially cattle, poultry and pig), food and environment and data collection systems in the 5 EU countries, Norway and in Europe addressing the task 1.1. of WP1 ARDIG of exploring and collecting data available on AMR and AMU.

Surveillance and monitoring systems are highly relevant to control AMU and AMR being one out of five strategies of Global Action Plan (GAP) of WHO(2).

However, major challenges need to be faced up in order to harmonize data on AMU and AMR area. Thus, AMR surveillance and monitoring systems vary substantially in the data type collected among sectors such as antimicrobials tested, type of samples, sampling design, laboratory methods and choice of breakpoints, analysis and reporting. Likewise, AMU data is difficult to obtain and AMU collection systems are based on different sources such as sales or wholesale distribution, imports, production, clinical or prescribing data (3).

The harmonization process between AMU and AMR, which entails a series of difficulties based on characteristics previously defined, is of great relevance to enable to compare data.

Methodological approach

Task 1.1: Exploration and collection of data available on AMR, AMU and potential risk factors

In order to accomplish this first task of the WP1 in ARDIG project, AMR and AMU datasets will be built up based on data collected through surveillance and monitoring programmes (at national and European levels) from the veterinary sector (animal farms: pigs, broilers, cattle, turkeys) and also from the human medicine sector (general practice and hospitals).

Besides, additional existing data from other sources such as research projects and industry will be collected in order to create an overall suitable dataset to carry out subsequent analysis that will be conducted in later project tasks.

To collect national AMU and AMR surveillance data from the six involved countries, a preliminary survey was set in Google-sheet (GS) format and sent on July 27th to all participating countries. This survey draft was designed as the first step on the data compilation as it will help to better appraise the data availability and the potential data type that can be collected from the different countries. These countries also have the opportunity to comment, adapt and even enhance the survey taking into account the data available. GS format has been selected not only because of its versatility compared to others but also because it allows collaborative and concurrent editing of the same time and the feed-back might be very quick.

The survey was formed by one GS document based on 9 sheets which are commented below:

1. Starting sheet: This sheet has been created to ease to the user the GS use and it is strongly recommended to read it since it contains the basic instructions on how to fill in the form properly. Besides, it shows all sheet names with a brief description and a linkage to each questionnaire.
2. Humans-AMU: This sheet collects general data about AMU in humans. *
3. Humans-AMR:This sheet collects general data about AMR in humans. *
4. Animals-AMU:This sheet collects general data about AMU used in animals. *
5. Animals-AMR: This sheet collects general data about AMR in animals. *
6. Food: This sheet collects available data on food isolates (including retail). Years (separated by commas) for which data on a pathogen are available in a food matrix should be noted in this table. Other food matrixes and pathogens may be added to the table if it is considered interesting.
7. Panel_Bacteria / Antimicrobial: An “X” is used to indicated which antimicrobials are tested / used against a specific bacterial species. One table like this must be completed for each system on AMR with the name of the system written on top. Other bacteria and antimicrobials may be added to the table if it is considered necessary.
8. Bacteria / Animal population: Years (separated by commas) for which data on a pathogen are available in a population type should be noted in this table. Other bacteria may be added to the table if it is considered necessary.
9. Population / Year: An “X” is used to indicate the population groups for whom data are available per year. One table like this must be completed for each system on AMU with the system name written on top.

*It is structured to acquire all data on a single system, therefore, as many sheets as there are systems available must be attached.

It was not compulsory to fill in any template sheet if additional documentation was provided that clearly indicated the answers to the questions required in it.

Figure 1 shows the general structure of the generated GS for the compilation of AMR and AMU data in human and animals. The requested information is distributed into rows giving the appearance of a common questionnaire.

Antimicrobial use / Consumption data / Sales data in humans

Information required	Availability of data	Comments	Example of information required	Data
Database system name			Antimicrobial Consumption Surveillance	
Database system acronym			AVS	
Type of system (Surveillance, Screening, Monitoring)			Surveillance	
Which country does the data come from?			Germany	
Which is the data source?			Hospital information system and Pharmacy dispensing data	
Which is the organisation in charge of the database system?			RKI/Charité (NRZ nosocomial infections)	
Who is the funding organisation?			Governmental	
Who is the contact person in the organisation?			Tim Eckmanns	
Type of data level provided in the database			Aggregated level	
Is continous data from 2014 to 2017 available? If not please provide information on changes!	Yes			
At which level is the antimicrobial information available?			Information per substance	
Unit of measurement (ATC/DDD). If other unit is used, please comment it	Yes		(WHO-ATC)DDD/100 Patient days	
Is there a protocol description? If 'Yes', please send it.	Yes			
Is the administration route available?	Yes			

Figure 1. Antimicrobial use / Consumption data / Sales data in humans.

Once all surveys were filled in, they were assessed in order to select all relevant and available datasets for comparison of AMU and AMR between the selected countries. All the selected data will be requested from the different countries and compiled in a final dataset.

During the final phase of this task, the quality and comparability of the available data will be evaluated, and the major common gaps and biases of the dataset will be described.

Description of Systems

The National Food Institute of the Technical University of Denmark (DTU Food) is a WHO Collaborating Centre for antimicrobial resistance and the EU Reference Laboratory for Antimicrobial resistance (EURL-AR). It provides an overview over some national surveillance and zoonosis reports including AMR(4). According to the EU legislation(5-7), Member States (MS) have to collect data that are sufficiently relevant and comparable to identify and define hazards and do an exposure assessment and a risk characterization of a zoonotic agent based on the result of the monitoring programmes. In addition, MS shall provide comparable data on AMR occurring in zoonotic bacteria and other bacteria considered relevant for human health. Unfortunately, antimicrobials and bacteria of interest differ often in the veterinary and human fields, and due to that, the "One Health concept" is not clearly reflected in medical and veterinary surveillance systems.

Surveillance systems for livestock and meat in the EU may be divided into the following types: (i) Antimicrobial resistance monitoring programmes co-financed by EU;(ii) supranational programmes financed by the industry and (iii) national antimicrobial resistance monitoring programmes (8).

As these surveillance systems provide information at different sectors (industry, national level and EU level), the compilation of the different types of data provided by a selection of these sources would be of extreme importance to study AMU and AMR trends in humans and animals. However, it is not a simple task as in some important and representative sectors, data owners are reluctant to share the data as they consider them confidential or require a payment such as FARMVET SYSTEMS in UK.

A detailed description of the data sources on AMU and AMR currently available in human and animal areas in the European countries considered in this review is provided in Table 1.

Table 1: Data sources on AMU and AMR in human and animal areas by region.

Re-gion	Animal/ Food/ Human sector	Data-base (Yes/ No)	Data source name	Description
SPAIN	A/F	Yes	"Red de Vigilancia Veterinaria de Resistencias a Antibióticos, VAV". Spanish Veterinary Antimicrobial Resistance Surveillance Network. (9-12)	A surveillance system created to monitor AMR consisting of three programmes dealing respectively with healthy animals (since 1998), sick animals (since 1997) and food of animal origin (since 2000) performed by the Ministry of Agriculture, Fisheries and Food (MAPAMA). This network publishes annual reports covering animal health and public health including products of clinical use in veterinary and human medicine. Antimicrobials were tested according to the following criteria: Authorized use in veterinary field, authorized use in human field and antibiotic spectrum. To test antimicrobials, two methods were established: microplate dilution and disk diffusion. VAV data are submitted to the EFSA and included in the annual reports of EFSA (13, 14) and the ECDC (European Center for Disease Prevention and Control), together with data from the other MS, and also presented to the MAPAMA.
	A	Yes	"European Surveillance of Veterinary Antimicrobial Consumption - SPAIN" ESVAC-ES (15)	ESVAC-ES is a project from the National Antibiotic Resistance Plan (PRAN) (16, 17) and carried out by the Spanish agency of medicaments and sanitary products-AEMPS (18) which reports annually on antimicrobial sales data from the veterinary sector. Antimicrobial sales data are obtained from laboratories, wholesalers, licensed livestock producers, pharmacies and retail distributors. Notification of sales data is compulsory for

				all, except for laboratories according to the mandatory EU legislation (19).
	H	Yes	IQVIA (20) (former IMS health) (16)	Since 2016, private AMU data in the community and hospitals sector are estimated through representative antibiotic sales data dispensed in pharmacies employing the Spanish IQVIA database. Previously there was no AMU surveillance system in hospitals (16).
	H	Yes	"Sistema Nacional de Salud. SNS". National Healthcare System	The General Directorate of Basic Services of the National Health and Pharmacy System is responsible for the SNS dataset maintenance which provides data on antimicrobials dispensed on official prescriptions in the public system (21). The database for Pharmacoepidemiological Research in Primary Care (BIFAP) (22) and the Primary Care Clinical Database (BDCAP) (23) provide primary care data which are integrated into the SNS. Until 2016, hospital AMU data on primary care was only reported from annual prevalences (do not document risk factors and cause and effect relationships) and only reimbursement data (data on antimicrobials financed by the national health system) but not global antimicrobials sales (no data on private prescriptions or sale of over the counter medicines). Through the IQVIA dataset, Spain is able to provide estimated private primary and secondary care sales data.(16) Community AMU data financed by SNS are currently collected from electronic prescriptions. However contributing data is a voluntary initiative. Private prescriptions and antibiotics without prescription data are not included in the electronic prescriptions.
	H	Yes	"Plan nacional de Resistencia a Antibióticos,	PRAN is the national plan to tackle and reduce AMR and it has been set up by

			PRAN". National Antibiotic Resistance Plan (16, 17, 24)	AECOSAN from 2014 to 2018. It provides charts with estimates on AMU in hospitals per drug since 2012 and in primary care since 2014 through the official prescription and estimates of privat prescription expressed in DDD/1000 habitants and day (25). The ESVAC-ES project is included in the plan. In addition, PRAN publishes a simplified report on zoonoses and antimicrobial resistance of chickens and turkeys for poultry professionals and a simplified report on zoonoses, which provides results on AMR rates in *Salmonella* spp., *C jejuni, C. coli,* and *indicator E. coli* obtained from broilers and turkeys from 2005 to 2014, and antimicrobial resistance of laying hens for professionals in the laying hen sector (26).
	A/H	No	"Informe de zoonosis y resistencias antimicrobianas". Report on zoonoses and antimicrobial resistance. (27, 28)	An annual report published by MAPAMA informs on the most relevant zoonosis data in Spain based on the annual EFSA report "Trends and sources of zoonoses and zoonotic agents in foodstuffs, animals and feeding stuffs" (13). Data provided in the report refer to pathogens and diseases in animals, humans and food in addition to data on AMR in some zoonotic bacteria and indicator bacteria (Last version 2016) according to the legislation (5, 29).
	A/H	No	"Informe JIACRA España. Primer análisis integrado del consumo de antibióticos y su relación con la aparición de resistencia". Joint Interagency Antimicrobial Consumption and Resistance Analysis (JIACRA-ES) (24)	A report carried out by PRAN includes the latest trends in AMU at national level, including primary care (official prescriptions supplied by SNS), hospital AMU estimates and the total sum of antimicrobial sales for the veterinary sector (by ESVAC-ES). It analyses and shows the evolution of both AMU and AMR in humans and animals over time and takes into account data limitations. Pathogen strains and commensal or non-

				invasive strains have been collected in livestock farms or slaughterhouses from healthy animals.
GERMANY	H	Yes	"Antibiotika Verbrauchs-Surveillance, AVS". Antibiotic consumption surveillance (30, 31)	This surveillance system housed by RKI and the Charité in Berlin, Germany, collects data from Germany and Austria on antimicrobial consumption for individual substances and groups substances in acute care hospitals and rehabilitation centres since 2015 (2014 pilot study). In addition, data can be stratified according to ward type, hospital size, application form and calculation basis. Data are collected in aggregated form from acute care hospitals (excluding outpatient/day clinics), wards, departments, but not from rehabilitation centers and specialized clinics. It is using the ATC/DDD method of the WHO and the data are provided in DDD or RDD/100 patients days or cases (source: Hospital informations system, pharmacy dispensing data) (32). Aggregated results of the dataset are displayed online, after clearance by the participants (30).
	H	Yes	Pharmaceutical atlas (33, 34)	Created by IGES (Institute for Health and Social Research, IHS), it analyses sales changes covered by SHI since 2006.
	H	Yes	Health care atlas (33, 35)	It analyses prescription rates, sales data and market trends. This atlas offers a publicly accessible source of information on community medical care in Germany. It is organised by the Central Research Institute of Ambulatory Health Care (ZI) of the national Association of Statutory Health Insurance Physicians. The atlas includes pharmacy dispensing data of prescribed pharmaceutical products in the ambulatory non-private sector (based on the Arzneiverordnungsdaten § 300 Ab. 2. SGB V (Book V of the German Social Security Code)), excluding dentist data. Data are according to ATC-WHO, and reported as DDD/1000 insured per year in

				an aggregated form(32).
	H	No	Rapid prescription feedback system of the SHI (GAmSi) (33, 36)	It is an analysis system, developed by the Scientific Institute of the AOK (WIdO), which monthly evaluates drug prescriptions supplied by pharmacies to the health insurance (37).
	H	No	Drug Prescription Report (33, 38)	It is an annual report (since 1985) on drug prescriptions reported by panel physicians.
	H	No	GEK Drug Report (33, 39)	It is a brochure which contains analyses of the pharmaceutical consumption of members insured by the Barmer Ersatzkasse (Statutary Health Insurance Fund).
	H	Yes	SHI /WidO data (33, 37)	It is based on the SHI Drug Index which is a project conducted by WIdO (Research Institute of the largest German public non-private Health Insurance AOK) on behalf of the SHI (Statutory Health Insurance Funds) and the Central Research Institute of Ambulatory Health Care in Germany. The database was set up in 1980. It collects a representative sample of antimicrobial prescriptions submitted by pharmacies to health insurance funds (based on the Arzneiverordnungsdaten § 300 Ab. 2. SGB V (Book V of the German Social Security Code)) from panel physicians under statutory health insurance, but since 2001 all prescription data have become available to the SHI drug index. Data are according to the ATC-WHO classification, and reported as DDD/1000 insured per year.
	A/F	Yes	"Zoonosen-Monitoring, ZOMO". Zoonosis Monitoring (40)	This monitoring program is carried out in Germany since 2009. Monitoring programs are designed by the German Federal Institute for Risk Assessment (BfR) and derived isolates are also characterized and tested in that institute. Samples are collected and analysed by the regional authorities and isolates submitted to the

				National Reference Laboratories at the BfR. Results are published in an annual report by the Federal Office of Consumer Protection and Food Safety (BVL). The report contains data about zoonotic bacteria in the different food chains including non clinical isolates of zoonotic bacteria and commensal *E. coli* from healthy animals and food. Data supplied include antimicrobial resistance data on standard panels of antimicrobials prevalence data on zoonotic bacteria, numbers and types of sample (matrix), quantitative data along with cut-offs, AMR values and resistance percentage per antimicrobial and minimal and maximal Minimal Inhibitory Concentration (MIC) along with the cut offs according to the EUCAST standard. Since 2014, it also includes large parts of the EU-wide monitoring on AMR based on Commission Implementing Decision 2013/652/EU.
	A	Yes	”Resistenzsituation bei klinisch wichtigen tier-pathogenen Bakterien, GERM-VET “. Resistance situation in clinically important animal pathogenic bacteria (41)	Since 2001 a report on AMR in Germany in clinical isolates from companion and food producing animals has provided quantitative data on MIC values of standard panels of antimicrobials. MIC values are interpreted using clinical breakpoints of CLSI. For bacteria/drug combinations where no clinical breakpoints are available, The MIC_{90}, I e. the antimicrobial concentration that inhibits growth of 90 % of the isolates is reported. The report results are based on the GERM-VET database. The report is published by the Federal Office of Consumer Protection and Food Safety (BVL).
	A/H	No	Report on the consumption of antimicrobials and the spread of antimicrobial resistance in human and	Since 2008 a report on AMU and AMR in human and veterinary medicine in Germany is released on a regular basis. AMU data in humans are based on the data collected by the Scientific Institute of

			veterinary medicine in Germany, GERMAP. English version available (33)	the Health insurances (WIdO). They are provided from hospital and outpatient level expressed in DDD and RDD showing information on German federal states, age groups and specialist wards. AMU data in the veterinary field are on the one hand provided as sales data. On the other hand the median and the 3. quartile of therapy frequencies based on the regulations in the German drug act (§§58a to d) are provided. Besides, it reports on trends in resistance development in clinical isolates from the medical and veterinary field. The latter are mostly from the GERM-VET System (see above).
	H	Yes	"Surveillance der Antibiotika-Anwendung und bakteriellen Resistenzen auf Intensivstationen, SARI", Surveillance of Antimicrobial Use and Bacterial Resistance in Intensive Care Units (42-44)	SARI is part of a research network called SIR (Spread of nosocomial Infections and Resistant pathogens) set up in Germany in the year 2000. It measures AMU (DDD/1000 patients days) and the incidence of multi-resistant pathogenic bacteria in intensive care units. SARI collected on a voluntary basis aggregated data on antimicrobial sensitivity for selected pathogenic bacteria, AMU-AMR development and AMU-AMR correlation from 2000 to 2006. After 2006 the project was continued by the Institute for Hygiene and Environmental Medicine (Charité Berlin, National Reference Center for Nosocomial Infections). Results are shown in different standards (DIN, CLSI and EUCAST). It has finally become a KISS module including resistance data (see below)(33).
	H	Yes	Medical Antimicrobial Use Surveillance and Evaluation, MABUSE (42)	MABUSE aimed to integrate ambulatory and hospital care data on AMU and AMR at regional level. This project has been collaborating with the Association of German Hospital Pharmacists (ADKA) since 2007 and it is integrated in ADKA-if-DGI surveillance.

	H	Yes	Project INTERUNI-II (42)	A pilot study aiming to collect AMU data in DDD in German university hospitals was established from 1998 to 2000 using retrospective data.
	H	Yes	”Krankenhaus-Infektions-Surveillance-System,KISS“, Hospital Infection Surveillance System (45)	It is a surveillance of nosocomial infections in hospitals and it is formed by a number of systems including AMBU-KISS, CDAD-KISS, HAND-KISS, ITS-KISS, MRSA-KISS, NEO-KISS, ONKO-KISS, OP-KISS and STATIONS-KISS. KISS data are collected from clinical or screening findings. The most meaningful subsystem for this report is MRSA-KISS since it collects MRSA data.
	H	Yes	”Antibiotika Resistenz Surveillance, ARS”. Antibiotics Resistance Surveillance (46)	A national laboratory-based surveillance network created by the German Federal Ministry of Health within the “German antibiotic resistance strategy (DART)”. The system is run by the German Federal Institute of Health (Robert Koch-Institute, RKI). Within the dataset, qualitative and partly quantitative AMR inpatient and outpatient data are collected. Data can be filtered by demographics (e.g. age, gender), region, specimen type, antibiotic, health care facility setting and specialty. Participation of laboratories is voluntary. In 2017, 53 laboratories participated, which included ca. 500 hospitals and 18.000 practices. ARS as a national surveillance network is a cooperation partner of the European Antimicrobial Resistance Surveillance Network (EARS-Net) (47). Data source are routine microbial analyses, interpreted with CLSI or EUCAST clinical breakpoints.
	H	No	ARVIA – ARS + AVS integrated analyses	ARVIA (“ARS and AVS – integrated analysis“) is a surveillance tool that aims to analyze data for antibiotic consumption and antibiotic resistance in an integrated approach. The analysis is based on data from the national antibiotic consumption

				surveillance “AVS” and antibiotic resistance surveillance “ARS”. Both systems are described above. ARVIA aims to test for an association of antibiotic consumption and antibiotic resistance on hospital level. The objective is to test if changes in antibiotic consumption are associated with changes in antibiotic resistance. The analysis includes a descriptive analysis and a statistical analysis. Participants of the project are hospitals. ARVIA requires that the hospital participates in AVS and their cooperating laboratory participates in ARS. Participants in ARVIA get access to an interactive database, where variables for the analysis can be specified according to the local needs and reports can be downloaded.
	H	Yes	“Deutschen Institut für Medizinische Dokumentation und Information, DIMDI“. German Institute for Medical Documentation and Information (48)	Antimicrobial sales data from the industry to veterinarians in Germany are reported annually until March 31 of each year by the industry and wholesalers since 2011 to DIMDI in Cologne. Data are analysed and reported to the national level and to ESVAC by BVL (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit, Federal Office for Consumer Protection and Food Safety).
	H	Yes	“Antibiotika-Resistenz-Monitoring in Niedersachsen, ARMIN“. Antibiotic resistance monitoring in Lower Saxony (49)	The ARMIN monitoring system systematically registers relevant AMR data in hospitals (including intensive care units) and ambulatory sectors in the German federal state of Lower Saxony. Up to now, 14 accredited labs are part of ARMIN providing MIC data for the majority of studied bacteria. Diffusion agar test is only carried out for pathogens when other test systems are not available. Next to qualitative (sensitive, intermediate, resistant) AMR results, gender, age, postal code, and test material are attached in the

				dataset compiled. CLSI and EUCAST standards are used by labs. In order to avoid bias, isolates of the same strain are discarded within 90 days and a minimum of 50 strains per year are required for the analyses. Some laboratories are providing results to ARS and ARMIN.
	H	Yes	"Paul-Ehrlich-Gesellschaft für Chemotherapie e.V., PEG". Paul Ehrlich Society for Chemotherapy (50)	A database with quantitative (MIC) and qualitative (S,I,R) data is provided for the hospital and community sector using EUCAST standard from 1975 to 2013. Open access to database.
	H	Yes	ADKA-if-DGI Surveillance (32, 51)	This surveillance system was set up in 2010 and provides AMU data in hospitals. The system is supported by the German society for infectious Diseases (DGI) and German ABS. This network was originally funded by the MABUSE project (see above) which was joined to ADKA (Bundesverband Deutscher Krankenhausapotheker) in 2007 creating a new project called ADKA-if. ADKA-if collaborates with RKI since 2010 giving a new name to the network and it was ADKA-if-RKI. Since 2015 the network is supported by DGI and it is called ADKA-if-DGI. It is planned to merge the surveillance project to the AVS system of RKI in the future (33). Data are collected in aggregated form using the ATC/DDD method of the WHO, and provided in DDD or RDD/ 100 patients (source: pharmacy dispensing data from hospitals). These data are based on voluntary reporting and published in the GERMAP report (see above) (32).
	H	Yes	BARDa (52)	In 2019, a new surveillance system will be set up in the German federal state of Bavaria in the ambulatory and hospital sector which will support the ARS surveillance system with Bavarian data.
	A	Yes	Antibiotikamonitoring (QS Qualität und Sicherheit	This industry based database system collects data since 2012 on AMU in

			GmbH) (53-55)	broilers, turkeys, ducks, veal and pork productions. QS carries out three monitoring programs that are relevant for the topic: “antibiotic monitoring” (on AMU in the named species), “*Salmonella* monitoring” based on serological investigations in pigs at slaughter according to the respective German regulation on the control of *Salmonella* in fattening pigs, and “Feed monitoring”. AMU data are mainly provided as therapy frequency, i.e. number treated animals, number of treatments days and antimicrobial product used. The system calculates and publishes a therapy index based on the number of animal days under treatment divided by the number of animals at risk.
	A	Yes	HI-Tier, HIT (54, 56)	BVL publishes results of HIT database hosted by the Bavarian Ministry for the Food Chain, Agriculture and Forestry since 2014. Data collection is based on the German medicine act and includes treatment data on pigs, turkeys, broilers, calves <8 month and beef cattle >8 months of age . This AMU database is supported by farmers and vets adding the antimicrobial product, treatment days and number of treated animals. Data entry is by farmers, vets or other appointed organizations. Some data are transferred from the “Antibiotic monitoring” of QS (see above). Based on the German medicine act, use of the data is restricted to the calculation of benchmarks. To this end, the law defines the median farm specific therapy frequency and the third quartile as benchmarks. Farmes using more antibiotics than the median in the respective population need to consider action. Farmer treating mor than the third quartile need to present a report to the veterinary authorities stating how they will

				be reducing antimicrobial use.
	A	Yes	VetCAb (54, 56-58)	The VetCAb (Veterinary Consumption of Antibiotics) is a sentinel project carried out by the Institute for Biometry, Epidemiology and Information Processing of the Hanover University of Veterinary Medicine Foundation ("Stiftung Tierärztliche Hochschule Hannover, TIHO"). The project started in 2007 in collaboration with the Veterinary Faculty of the University of Leipzig. It aims to describe and assess AMU in farm animals in Germany collecting the number of treatment days, the route of application, name and amount of the antimicrobial product used, the number of treated animals and the indication (i.e. reason for treatment). The animal categories studied are: • Pigs: sows, finishers, weaners and sucklers. • Poultry: broilers. • Cattle: dairy cows, beef cattle and fattening calves.
NORWAY	A/H	No	"Folkehelseinstituttet, FHI". Norwegian Institute of Public Health, NIPH (59)	NIPH Informs on AMR in its web page. The latest report on Drug Consumption in Norway 2013–2017 was published in 2018 (60). Besides, the NIPH provides sales data for drugs used in farm animals through the Norwegian Prescription Database (NorPD)(61).
	H	Yes	The NORM surveillance programme for antimicrobial resistance in human pathogens(62). English version available	This surveillance programme provides yearly updated data on AMU and AMR in the human sector in Norway and it is integrated in the national strategy for the prevention of infections. Datasets managed to provide AMU data in humans are the hospital pharmacies drug statistics database ("Sykehusapotekenes Legemiddelstatistikk") provided by NorPD and collected since 2006, a national

				prescription database (ambulatory care data retrieved from NorPD and situated at NIPH) and the Norwegian drug wholesales statistics database (wholesalers database provided by NIPH). Several surveillance systems submit data to NORM such as the surveillance programme of Salmonella or the Norwegian surveillance system for communicable diseases (MSIS).
	A/H	Yes	Norwegian drug wholesales statistics database (63)	The NIPH provides the wholesales drug statistics database containing all sales data in Norway.
	A/F	Yes	The NORM-VET monitoring programme for antimicrobial resistance in the veterinary and food production sectors (62). English version available	This monitoring programme carried out by the Norwegian Veterinary Institute (NVI) provides annually updated data on the occurrence and distribution of AMU and AMR in the animal field and it is along with NORM integrated in the national strategy for prevention of infections. AMU sales data in animals are collected from the NIPH trough wholesalers and feed mills, which are of mandatory notification to ESVAC. Besides, Norway collects AMU animal data based on prescription data obtained from VetReg. Animal population data is obtained from Statistics Norway (https://www.ssb.no). Indicator bacteria from animals, food and feed are also provided.
	A	No	Use of Antibiotics in Norwegian Aquaculture. English version available (64)	It is a report created by the NVI where AMU and prescriptions per species are reported in the aquaculture field, plus total sales and quantity of antibiotics used per kilogram fish produced. The Norwegian wholesalers and feed mills must provide sales data to the NPHI which are published annually (65).
	A	Yes	Veterinary Prescription Register, VetReg (62, 66)	VetReg is a register owned by the Norwegian Food Safety Authority (NFSA) which applies to veterinarians, pharmacies

				and feed mills and where data on farmed fished (since 2011) and terrestrian animal (since 2012) prescriptions are stored. Reporting food-producing animals data to VetReg is mandatory for veterinarians and feed mills while non-mandatory for fur and companion animals. Pharmacies must report all prescriptions (54).
	A	Yes	"Statistisk sentralbyrå". Statistics Norway (67)	Data on animal population, including farmed fish biomass, were obtained from Statistics Norway (67).
	H	Yes	"Norsk overvåkingssystem for antibiotikabruk og helsetjenesteassosierte infeksjoner, NOIS", Norwegian Surveillance System for Antibiotic Consumption and Healthcare-Associated Infections (68, 69)	NOIS is a nationwide mandatory system set up in 2005 and administrated by NIPH. It aims to describe the occurrence of healthcare-associated infections. It is largely based on hospital automated data extraction on AMU containing representative data by hospital size and type (for most procedures), age and sex.
	H	Yes	"Reseptregisteret". Norwegian Prescription Database , NorPD. (61, 70, 71). English version available	This database contains dispensed drugs in hospitals and nursing homes from pharmacies in Norway. Data contains the following variables: Patient (birth data, death data, gender and place of residence), Prescriber (birth data, gender, profession and specialty), Drug (brand, nordic article number, dosage, package size, ATC code, DDD value, DDD unit prescription and pharmacy price), pharmacy (name, licence number and place of it) and information about each dispensed drug (number of packages dispensed, DDD, prescription category, prescription regulation, dispensing date, reimbursement code, prize per filled prescription and in case of animal: animal species) (71). Data can be exported in csv file or excel file in the online database.
	H	Yes	"MSIS statistikk". The Norwegian Surveillance System for Communicable	MSIS together with NORM and NORM-VET systems are the three AMR programme for surveillance in Norway (74). MSIS

			Diseases. English version available (72, 73)	managed by NIPH collects mandatory data from all doctors in Norway.Results are daily updated and can be downloaded as excel-files locally according to the disease, year, month, county, place of infection, sex and age groups. MSIS notifies infectious diseases in Norway contributing to international surveillance in community and hospital sector as well.
	A	Yes	The surveillance programme for methicillin resistant *Staphylococcus aureus* in pigs in Norway (English). Latest version 2017 (75)	This surveillance programme was set up in 2008 and is performed by the Norwegian Veterinary Institute. It studies the prevalence of MRSA in pigs in the framework of a control program. These results are reported to NORM-VET.
FRANCE	H	No	"Observatoire National de l'Epidémiologie de la Résistance Bactérienne aux Antibiotiques (ONERBA)". National Observatory of the Epidemiology of Bacterial Antibiotic Resistance. Last version 2015 (76)	This annual report includes the prevalence, quantitative (inhibition diameters or MICs) and qualitative (S,I,R) data on AMR from the human and animal field. It is based on data from different networks such as REUSSIR, Ile de France, EARS France and AZAY Résistance. It provides methodological recommendations for surveillance of bacterial resistance. Clinical breakpoints are based on Antibiogram Committee of the French Society for Microbiology (CA-SFM).
	H	Yes	"Réseau national de prevention des infections associées aux soins. CPIAS" National Network for the Prevention of Care-Related Infections (77)	CPIAS supports Centres for the Prevention of Healthcare-Associated Infections collect AMR data in humans. The French database on nosocomial infection control, NOSOBASE ("Base de données sur l'hygiène hospitalière et la maîtrise, des infections nosocomiales NOSOBASE")(78) is a part of CPIAS collecting AMR data on nosocomial infections.
	H	Yes	Systéme National des Données de Santé (SNDS) or SNIIRAM, National Health Data System (79)	SNIIRAM is a large French healthcare database which covers 98.8% of the French population. The dataset provides prescription data covering primary and secondary care in the ambulatory and

				hospital sectors. It includes systems such as CNAMTS (for salaried workers), RSI (for independent workers) and MSA (for farmers) among others. It was set up in 2003 with only CNAMTS data. The "Echantillon généraliste de bénéficiaires (EGB)": It is a random sample part of the SNIIRAM dataset and it was set up in 2004 including RSI and MSA since 2011. The main difference between SNIIRAM and EGB is the data structure and the smaller dataset size for EGB. MEDIC'AM is a spreadsheet containing all medication reimbursement data through the CNAMTS and it provides the costs to the system (overall and reimbursement) and packages sold (79, 80)
	H	Yes	French hospital discharge database, (PMSI) (79, 81)	The national hospital dataset offers public and private hospital data including procedures, especially costly drugs, stay duration and diagnoses. In addition, admissions in medical, surgical and obstetrical wards are provided. Although data on rehabilitation centres and psychiatric hospitalisations are collected, these are currently not reliable.
	H	Yes	National death registry (CepiDC) (82)	The main target of the CépiDc is the annual production of statistics on the medical causes of death in France. CépiDc is a WHO Collaborating Centre for the Family of International Classifications in French (CIM). Currently only mortality data are included in the dataset but not the cause of death. The registry was set up in 1968.

	H	Yes	National reference centre (NRC) (83, 84)	The NRC is located in a government institution called Public Health France, previously known as the French Institute for Public Health Surveillance, InVS (Santé Publique France, SPF). The NRC is formed by independent laboratories in hospitals and at the Institut Pasteur collecting AMR human data and being supported by the SPF. SPF reports to the Ministry of Health on surveillance and alert of public health. NRC database collects AMR data in humans. NRC for AMR is in 4 different places (CHRU de Besançon, CHU de Rennes, CHU de Clermont-Ferrand, CHU de Bicêtre). However, resistance for *S. aureus*, *M. tuberculosis, Neisseria, Salmonella* or *S. pneumoniae* are monitored by specific NRCs.
	H	Yes	Antibiotic Consumption Monitoring (ATB RAISIN) (85)	ATB RAISIN database provides AMU data in the hospital sector (expressed as DDD/1000 patient days) according to WHO ATC system. ATB RAISIN is also connected to the CPIAS network.
	H	Yes	Alert, Investigation and Surveillance of Nosocomial Infection Network (RAISIN) (81, 86)	RAISIN coordinates nationally nosocomial infection surveillance coordination centres (French acronym CCLIN) which in turn monitore MRSA and ESBL. Since 2001 RAISIN carries out a surveillance on nosocomial infections. This network includes severals surveillance systems: • Surgical site infection surveillance (ISO-RAISIN) • Monitoring for multidrug-resistant bacteria (BMR-RAISIN)(87) • Surveillance of nosocomial bacteremia (BN-RAISIN) • Monitoring of blood exposure accidents among caregivers (AES-RAISIN) • Surveillance of nosocomial infections in intensive care (REA-RAISIN) • Monitoring of Antibiotic

				consumption (ATB-RAISIN)(85)
	H	Yes	Monitoring for multidrug-resistant bacteria (BMR-RAISIN)(87)	This monitoring system supplies AMR hospital data and sometimes global care data (hospital+community) using DIN standard.
	H	No	"La consommation d'antibiotiques en France en 2016" Antibiotic consumption in France in 2016 (88)	The French National Agency for Medicine and Health Products Safety "Agence nationale de sécurité du medicament et des produits de santé (ANSM)" reports mainly on outpatient and hospital AMU in humans, critical antibiotics and AMU in Europe. Data presented in the report are expressed in DDD according to OMS methodology showing results as DDD/1000h/day (WHO methodology). In addtion, the number of days that patients spend in hospital per year are also registered. Data have been extracted from ANSM, IQVIA (former IMS-HEALTH), EPPM L´EPPM, OPEN-MEDIC and ECDC.
	H	Yes	"Base complète sur les dépenses de médicaments interrégimes, Open Medic". Complete database on interplan drug expenditures (80, 89)	The National Health Insurance System (SNIIRAM)(79, 90) stores antimicrobial sales data (reimbursement of healthcare). Data can be studied by product boxes, substance, age group, sex, region of residence or information on the prescriber's specialty. Drug data are recorded using the ATC classification. The Open Medic database was set up in 2014.
	A	Yes	"Base de Donnée su suivi des ventes d'Antibiotiques". Database for monitoring Antibiotics sales, ESVAC-FR(56, 91-93)	ANSES (The French Agency for Food, Environmental and Occupational Health & Safety) annually carries out the monitoring of sales of veterinary drugs containing antibiotics in France ("Suivi des ventes de medicaments vétérinaires contenant des antibiotiques en France") (91) providing AMU data on the animal sector together with estimations per species. Companion animal data are also provided every two years by FACCO (Chambre syndicale des fabricants d'aliments pour chiens, chats, oiseaux et autres animaux familiers) (94).

				Antibiotic sales evolution and exposure on family and pharmaceutic form per species is also available. National and European data are displayed in the report. The National Agency for Veterinary Medicines (L'Agence nationale du médicament vétérinaire ANMV) within ANSES, is the Competent Authority in France for risk assessment and management with regard to veterinary medicinal products. They are responsible to submit sales data to ESVAC.
	A	Yes	"Réseau d´épidémiosurveillance de l´antibiorésistance des bacteéries pathogènes animals, RESAPATH" (95). English version	This annual report compiles AMR data for the primary bacterial species and general isolates from sick animals for each animal sector. Data also refer to the animal species, pathology and age group in relation to antimicrobial panel results. This network collaborates with ONERBA. This surveillance system started in 1982 under the name of RESABO (only for bovine species). In 2000, It was extended to pigs and poultry and in 2007 to other species including small ruminants, horses and companion animals. Inhibition zone diameters are subsequently categorized as S, I or R according to the recommendations provided by veterinary part of the CA-SFM. RESAPATH is a passive or 'eventbased' surveillance network. Member laboratories (75 in total throughout France) join the RESAPATH on a voluntary basis.
	H	Yes	EARS-Net France (96)	The European Antimicrobial Resistance Surveillance Network in France is coordinated by the ECDC and AMR national data are transmitted in June each year by Santé publique France (formerly called Institut de veille sanitaire or InVS).
NETHERLANDS	H	No	Consumption of	This annual report on AMU and AMR in

			antimicrobial agents and antimicrobial resistance among medically important bacteria in the Netherlands NethMap (97). English version	humans is published by the Dutch Working Party on Antibiotic Policy (SWAB) in collaboration with RIVM. AMU data are reported for outpatient, inpatient and care in nursing homes. AMR is provided in primary care and hospital care (and its main departments). Community AMU data are extracted from the SFK (Foundation for Pharmaceutical Statistics, Tthe Hague) in DDD. These data are collected from Dutch community pharmacies, prescriptions from general practitioners and prescriptions from outpatient clinics and dentists. Hospital AMU data are expressed in DDD/100 patients-days from all Dutch hospital pharmacists. Electronic prescriptions for antibiotics on patient level were extracted from Dutch hospital electronic prescribing systems over the year. MIC and disk zone diameter values according to EUCAST breakpoints provided by ISIS-AR are available. Resistance levels from general practice, outpatient departments, inpatient departments (excl. intensive care units), intensive care units, urology departments, and long-term care facilities are shown. Several surveillance systems report their results to Nethmap such as ISIS-AR, Neisseria meningitidis surveillance program (98), Neisseria gonorrhoeae surveillance program (98) ,Mycobacterium tuberculosis surveillance program (98), Resistance among anaerobic pathogens (98), Influenza antiviral drugs surveillance program (98), Clostridium difficile surveillance program (98) and Azole resistance in Aspergillus fumigatus surveillance program (98)

	H	Yes	"Infectieziekten Surveillance Informatie Systeem-Antibiotica Resistentie, ISIS-AR". Infectious Disease Surveillance Information System on Antibiotic Resistance (99, 100)	Since 2008, a surveillance program aimed at AMR in major pathogens created by the Ministry of Health, Welfare and Sport and the Dutch Society of Medical Microbiology (NVMM) and it is coordinated by the Centre for Infectious Disease Control at the National Institute for Public Health and the Environment (RIVM). Isolates are got from general practitioners, hospitals and nursing homes and all available antimicrobial susceptibility data from laboratories in the Netherlands are collected including the MIC values and disk zone diameters according to EUCAST. These results are interpreted with clinical breakpoints and included into NethMAP. It provides a web site whith interactive reports on AMR in Netherlands (100).
	H	Yes	Surveillance of antibiotic resistance in the Netherlands, SARIN (101)	It is a programme set up within the SWAB surveillance programme formed in turn by the programmes SERIN (Surveillance of Extramural Resistance in The Netherlands) and SIRIN (Susceptibility of Intramural Resistance in the Netherlands). SERIN collects AMR data in the community (primary care and nursing homes) sector and SIRIN in the hospital sector (secondary care).
	H	Yes	Gonococcal Resistance to Antimicrobials Surveillance, GRAS (102)	This surveillance system was set up in July 2006 as a part of the Dutch sexually transmitted infections sentinel surveillance network submitting the results directly to the RIVM.
	A	Yes	Monitoring of Antimicrobial Resistance and Antibiotic Usage in Animals in the Netherlands in 2017 MARAN (56, 98)	This annual report includes AMU data from three ways. • FIDIN provides antibiotic sales data • LEI Wageningen UR provides antibiotic use per animal species • Centralised registration systems in some farms

				In addition, the report provides food borne pathogen resistance data and commensal indicators. Antimicrobial susceptibility data along with disk zone diameters and MIC values are interpreted through EUCAST ECOFFs. Data on commensal and zoonotic bacteria and resistance in companion animals are also displayed.
	A	Yes	"Diergeneesmiddelen, SDa". Netherlands Veterinary Medicines Institute (103)	This independent institute promotes responsible drug consumption. SDa collects sales data in animals. The SDa method to calculate the drug substance mass is used since 2011 (56).
	A	No	Usage of antibiotics in agricultural livestock in the Netherlands in 2016 (103)	It is a report in English from SDa where trends on AMU and sales in veal, broiler, turgey, cattle, pig and farming sector in 2016 are displayed.
	A	No	Usage of antimicrobial drugs in horses and companion animals 2012 – 2014 (103)	This report is the result of a survey on AMU in companion animals and horses perfomed from 2012 to 2014.
	A	Yes	Federation of the Dutch veterinary pharmaceutical industry FIDIN (56, 104)	FIDIN provides veterinary sales data covering approximately 98% of sales but only the sales data to wholesalers and veterinarians on 90.6% of the major livestock farming sectors (pigs, broilers, turkey, veal calves, dairy- and other cattle) in 2017. These data are reported to ESVAC. FIDIN extracts the data from the Vetindex and in addition with antimicrobial veterinary medicinal products data of non FIDIN members.
	A	Yes	Farm accountancy Data Network, FADN (56)	This Network run by the Wageningen Economic Research Institute of the Wageningen University and Research (WUR) monitors currently all farms on

				AMU per animal species.
	H	Yes	*Neisseria meningitidis* surveillance programme (98)	Since 1994, *Neisseria meningitidis* surveillance programme aims at resistance surveillance. Isolates are collected from hospitals. Data are included in the MARAN database.
	H	Yes	*Neisseria gonorrhoeae* surveillance programme (98)	Since 2006, Neisseria gonorrhoeae surveillance programme aims at resistance surveillance. Isolates are collected from sexually transmitted infection centres. Data are included in the MARAN database.
	H	Yes	*Mycobacterium tuberculosis* surveillance programme (98)	Since 1993, *Mycobacterium tuberculosis* surveillance program aims at resistance surveillance. Isolates are collected from general population. Data are included in the MARAN database.
	H	Yes	Influenza antiviral drugs surveillance programme (98)	Since 2005, Influenza antiviral drugs surveillance program aims at resistance surveillance. Isolates are collected from community, general practitioners, nursing homes and hospitals. Data are included in the MARAN database.
	H	Yes	Resistance among anaerobic pathogens (98)	Since 2010, anaerobic pathogen surveillance programme aims at resistance surveillance. Isolates are collected from hospitals. Data are included in the MARAN database.
	H	Yes	*Clostridium difficile* surveillance programme (98)	Since 2005, *Clostridium difficile* surveillance programme aims at resistance surveillance. Isolates are collected from hospitals and nursing homes. Data are included in the MARAN database.
	H	Yes	Azole resistance in *Aspergillus fumigatus* surveillance programme (98)	Since 2011, *Aspergillus fumigatus* surveillance programme aims at resistance surveillance. Isolates are collected from Hospitals. Data are included in the MARAN database.
	H	Yes	"Stichting Werkgroep Antibioticbeleid, SWAB".	SWAP contributes to avoid AMR development and increased AMU costs

			Foundation Antibiotics Policy Working Group, SWAB (105)	optimizing education and antibiotic resistance surveillance. Aggregated AMU data are collected from hospitals and pharmacies.
	F	Yes	"Nederlandse Voedsel- en Warenautoriteit". Netherlands Food and Consumer Product Safety Authority, NVWA. (106)	It is responsible of animal and plant health and food and product safety. It houses a database on AMR in food samples.
	A	Yes	"Database Diergeneesmiddelen runderen, Medirund". Database Veterinary medicines cattle (107)	It is the central database funded in January 2012 for the mandatory registration of antibiotics in cattle in Netherlands. Data must be registered within 14 days after treatment by a vet. AMU (expressed as DDD) are reported quarterly (108) It is annually evaluated and managed by the veterinary medicine authority foundation (VMAF)(109).
	H	Yes	"PREventie van ZIEkenhuisinfecties door Surveillance, PREZIES". Surveillance of healthcare associated infections (hospitals) (110)	It is a surveillance system of healthcare associated infections in hospitals providing information on the infection frequency. The main objective of this survey is to reduce the infection incidence.
	H	Yes	National sentinel surveillance network for infectious diseases in nursing homes, SNIV (111)	It is a surveillance system based on the data collected in nursing homes in order to improve the antimicrobial stewardship.
	H	Yes	Hospital-acquired Infection and Antimicrobial Resistance Monitoring Group. SO-ZI/AMR (112)	A database funded in 2012 manages healthcare infection outbreaks, the assessment of incidents and the support of efforts to avoid the spread and dissemination of infections. SO-ZI/AMR assesses the potential outbreak risks in public health and may advise hospitals to improve the health service.
UNITED KINGDOM	A/H	No	UK One Health Report: Joint report on human and animal antibiotic use, sales and resistance, 2013(113)	The report presents AMR data for key zoonotic and indicator bacteria (*Campylobacter* spp., *Salmonella* and *Escherichia coli*) and antibiotic usage/sales for the human and veterinary sector in the

				UK in 2013. In addition, three standard criteria to interpret AST are used between human and animal clinical AMR data in the UK. CBPs of BSAC and EUCAST have been harmonised for determining resistance and since 2016 BSAC has adopted the EUCAST disk diffusion criteria (ECOFFs) improving the harmonisation across Europe.
	A	Yes	Veterinary Medicines Directorate, VMD (114)	The VMD reports sales data from wholesalers, veterinarians, farmers and veterinary pharmacies to ESVAC. VMD collects all veterinary antibiotic sales data in the UK from the pharmaceutical companies since 2013 being a statuty requirement since 2005. In addition, VMD is working on a voluntary basis with pig, poultry and cattle sector capturing AMU data per species (eMB, BEIC, FarmVet Systems and BPC).
	H	Yes	British Society for Antimicrobial Chemotherapy, BSAC. Resistance Surveillance Programme (115)	The BSAC Antimicrobial Resistance Surveillance Project publishes antibiotic resistance data for a range of clinically significant bacteria for community (from 1999) and hospital-onset (from 2008) respiratory tract infections and bloodstream infections (from 2001) from participating laboratories in the UK and Ireland. BSAC results are openly available as qualitative data (S,I,R according to BSAC and EUCAST breakpoints) and quantitative data (MIC values by agar diffusion method) along with AMR prevalence data.
	H	Yes	DataStore (116)	This open access database reports AMR data from Wales to EARS-Net database covering all hospital labs. Voluntary data from community are collected since 1996 from general practice whereas hospital data are originated from hospital in-patients and out-patients. In 2012/2013 EUCAST methodology was established across laboratories in Wales. Before, different AST methods were used.

				Susceptibility results recorded as 'intermediate' are included in the category 'resistant'.
	H	Yes	Modular Open Laboratory Information System, MOLIS (117)	MOLIS continuously collects and stores Public Health England's routine and reference laboratory information, including data from the AMR reference laboratory. The data are not openly available.
	H	Yes	Prescribing Information Data Warehouse	This Wales database managed by Public Health Wales (PHW) covers 100% of Welsh dispensing contractors and collects prescribing data in the human sector manually and automatically.
	H	Yes	Medusa	This database owned by PHW covers 100% of hospital pharmacies in Wales and collects data automatically.
	F	Yes	Evaluation of meat, fruit and vegetables from retail stores in five United Kingdom regions as sources of extended-spectrum beta-lactamase (ESBL)-producing and carbapenem-resistant *Escherichia coli*. Randall et al (119)	UK data on AMR on beef, chicken and pork food samples from 2013 to 2014 were collected for a study.
	H	Yes	Gonococcal Resistance to Antimicrobials Surveillance Programme, GRASP (120)	This sentinel surveillance system collects continuously *Neisseria gonorrhoeae* data on AMR for a fixed time period (point prevalence surveillance) in England and Wales since 2000. GRASP uses EUCAST breakpoints to define susceptibility to a given antimicrobial. Data from January 2015 to June 2017 were from SGSS. Prescription data are available since 2016. PHE coordinates EuroGASP and submits AMR data to EuroGASP, WHO GASP and GLASS.
	A	Yes	Surveillance Study of Antimicrobial Resistance in	In 2016, a representative study on *Salmonella*, *Campylobacter* and

			UK retail chicken and pork (Baseline study) (121)	commensals in chicken and pork food samples is carried out on a voluntary basis in the UK.
	F	Yes	Antimicrobial Resistance in *Campylobacter jejuni* and *Campylobacter coli* from Retail Chilled Chicken in the UK (*Campylobacter* in retail survey) (122)	A survey (2015-2016) on *Campylobacter* in food samples was carried out in the UK on a voluntary basis.
	A	Yes	National Milk Records, NMR (123)	This UK database collects data on AMU in dairy farms since 2017, covering from 100 to 500 farms.
	A	Yes	MOLSIG	A project collecting voluntarily AMR data (not representative) from pigs at slaughter in England from 2014 to 2015.
	F	No	A systematic review of AMR bacteria in pork, poultry, dairy products, seafood and fresh produce at UK retail level (124)	In 2016, a systematic review has been carried out by the Royal Vet College and published by the Food Standards Agency on AMR in food at retail level in the UK.
	A	Yes	REHAB	REHAB project collects AMR data in Oxfordshire county on pigs, and dairy cattle on voluntary basis in 2017.
	A	No	UK-Veterinary Antibiotic Resistance and Sales Surveillance, UK-VARSS (125)	A report promoted by the UK government providing details on veterinary AMR and sales data in the UK is carried out annually by the VMD. Sales data are supplied by pharmaceutical companies according to ATCvet (126) and to the Veterinary Medicines Regulation (127). AMU pig data are extracted from eMB which covered 56% of the UK pig production in 2015 and 62% of the pig production in 2016. AMU meat poultry data (chicken, turkey and duck) are provided by the BPC which collates producers data. Producers submit every three months for chickens and annually for turkeys and ducks. BPC

				submits an annual report on AMU. AMU in laying hens data are reported by BEIC which provides an annual report. Producers provide compulsorily data on AMU in laying hens to BEIC every three months. AMU cattle data are taken from the FarmVet Systems. AMU data are provided for companion animals by prescriptions. To collect AMR data, disk diffusion methods are carried out and results are interpreted using clinical break points. Isolates are classified as sensitive or resistant. If veterinary drugs are not published on BSAC guidelines, historical APHA veterinary breakpoints are indicated. EUCAST ECOFFs and clinical breakpoints are applied to interpret results.
	H	Yes	NHS Digital. General Practise prescribing data	An open database in England displays Antibiotic prescribing and AMR indicators. It allows to check trends and compare indicators and areas. List of all medicines, dressings and appliances prescribed by all practices in England, by month since September 2011 are shown in the website. Open access database (128).
	H	Yes	IQVIA (20)	IQVIA set up in 2017 (formerly IMS Health and Quintiles) is a Healthcare science company. IQVIA shares national AMU data (secondary care at specialty level) with PHE. Data are not openly available.
	H	No	English surveillance programme for antimicrobial utilisation and resistance (ESPAUR). Latest Report 2018 (129)	ESPAUR was established in 2013 in response to the UK government's five-year AMR strategy. The annual ESPAUR reports (2014-2018) publish national data on antimicrobial resistance and prescribing. The data are openly available via annexes.
	A	Yes	Electronic Medicine Book,	This English dataset set up in 2016 covered 62% of the UK pig production. It was

			eMB (130)	created by the Agriculture and Horticulture Development Board (AHDB) and provides AMU data on the pig industry. Since November 2017 eMB will be a requirement under the Red Tractor. It feeds the VMD database.
	A	Yes	British Poultry Council, BPC (131)	It provides poultry AMU data at farm level in the UK since 2012 covering nearly 90% of the UK production. This database feeds VMD.
	A	Yes	FarmVet Systems (132)	This database (currently not representative), set up in 2015 and owned by FarmVet Systems, collects AMU data from cattle on dairy farms on a voluntary basis in Great Britain.
	A	Yes	Vet Pathogens APHA (133)	This database for England and Wales covers all relevant bacteria species except *Salmonella*. It provides AMR line level data from clinical samples collected on a voluntary basisby farmers and veterinarians. AST are based on disk diffusion or Iso-Sensitest Agar were used as AST and interpreted using clinical breakpoints (125).
	A	Yes	Salmonella APHA	This AMR database for England and Wales on *Salmonella* collects mandatorily data from clinical samples.
	A/F	Yes	EU harmonized surveillance (latest report meat_2017)(134)	AMR Data on indicator commensal bacteria and Enterobacteriaceae (*E. coli*, *Salmonella* and *Campylobacter*) from meats and caecal contents of healthy animals (chicken, turkey and pigs) are collected using EU methods (135) providing MICs by broth microdilution. MIC interpretation is based on ECOFFs (EUCAST). It is based on Commission Implementing Decision 2013/652/EU.
	H	Yes	Second Generation Surveillance System, SGSS (136)	Public Health England's Second Generation Surveillance System (SGSS) captures routine laboratory surveillance data on infectious diseases and antimicrobial

				resistance from 98% of National Health Service (NHS) laboratories across England. Access is subject to access control mechanisms. AMR data submission to EARS-Net/GLASS is based on SGSS data.
	A	Yes	Practice Management Systems by the Small Animal Veterinary Surveillance Network, SAVSNET system (137)	This network is managed by the University of Liverpool and aims among other tasks to prioritise the research on AMR. It was set up to collect data on small animals but there are also some AMU data on livestock reported by a number of vet clinics which are not though representative.
EUROPE	H	Yes	European surveillance of Antimicrobial Consumption Network, ESAC-Net (ECDC) (138)	ESAC-Net, formerly ESAC, is a dataset coordinated by ECDC launched in November 2001 which provides data on European AMU in community and hospital sector. AMU data are collected by MS in the community and hospital sectors or both (total care). The MS should report data quarterly by age group, gender and prescriber type reporting either via national registry data (antimicrobial consumption data at medicinal product level, expressed as the number of packages sold or reimbursed) or as aggregated numbers of DDD at the ATC substance level. ESAC-Net collects data aiming its harmonization, standardization and comparability in order to obtain adequate results. It produces an annual report. "Antimicrobial consumption - Annual Epidemiological Report for 2017"
	A/F/H	No	Trends and sources of zoonoses and zoonotic agents in foodstuffs, animals and feeding. (139)	An annual report on trends and sources of zoonoses and zoonotic agents in foodstuffs, animals and feeding stuffs for each EU country (in case the country has not previously produced it) is carried out by EFSA and ECDC according to the EU law (5).
	A/F/H	No	The European Union	An annual report on AMR in zoonotic and

			summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food (14)	indicator bacteria from humans, animals and food is published by EFSA and ECDC according to the EU law (5).
	H	Yes	The Healthcare-Associated Infections Surveillance Network, HAI-Net (140)	HAI-Net is coordinated by the European Centre for Disease Prevention and Control (ECDC). The main priorities of HAI-Net are the coordination of the European point prevalence survey of HAI and antimicrobial use in acute care hospitals, the European surveillance of surgical site infections, the European surveillance of HAI in intensive care units and the repeated prevalence surveys of HAI and antimicrobial use in European long-term care facilities.
	F	Yes	The European Food Safety Authority, EFSA	EFSA is the European agency responsible of providing independent scientific advice and communicating on food chain risks. EFSA collects AMR food data from MSs.
	A	Yes	European Surveillance of Veterinary Antimicrobial Consumption, ESVAC (141)	The European Medicines Agency (EMA) monitors AMU through the ESVAC which was launched in September 2009 (142). Guidance on data collection (143) is provided along with other valuable documents in the EMA web site (144). Since July 2018, AMU data can be estimated for different species by allocating a proportion of the total sales to each species. An annual report is published by EMA tackling the situation across Europe (latest report published in October 2018 about data from 2016).
	H	Yes	European Antimicrobial Resistance Surveillance Network, EARS-Net (145)	EARS-Net, formerly EARSS, is an AMR surveillance network in accordance with the legislation (146) for EU and EEA members (147). Through this surveillance, ECDC carries out annually a report called "Surveillance of antimicrobial resistance in Europe" where AMR data and prevalence

				against bacteria and trend analysis are reported. In addition, quantitative and qualitative data and hospital denominator data are displayed. Data are based on clinical isolates from blood stream infections and in humans. Latest version (148).
	A/F/H	Yes	European Food and Waterborne Diseases and Zoonoses Network, FWD-Net (149)	Established at ECDC, it includes AMR data for humans, food and waterborn diseases and zoonoses. AST results obtained from hospitals, local laboratories or National research laboratories (NRLs) and interpreted with clinical breakpoints.
	A/H	No	ECDC/EFSA/EMA second 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. Joint Interagency Antimicrobial Consumption and Resistance Analysis (JIACRA) Report (150)	This joint ECDC, EFSA and EMA report provides an integrated analysis on AMU and AMR in bacteria in European countries from 2013 to 2015 in humans and food-producing animals.
	H	Yes	Europe-wide point prevalence study on the incidence of nosocomial infections and the use of antibiotics in acute hospitals (151)	It is a point prevalence study, carried out on a regular basis (at five-year intervals). Data are collected from hospital information systems expressing data with WHO ATC Classification System.
	H	Yes	Europe-wide point prevalence study on the incidence of nosocomial infections and the use of antibiotics in long-term care facilities (152)	It is a point prevalence study collecting data voluntarily from nursing facilities on hospital and community sector, using the WHO ATC Classification System.
	H	Yes	Antibiotic Resistance and Prescribing in European	It is a point prevalence study carried out with voluntary hospital participation in

			Children, ARPEC (153, 154)	neonatology.
	A/F	Yes	"Centre Européen d´Etudes pour la Santé Animale, CEESA." European Animal Health Study Centre (8)	CEESA is a non-governmental organization financed by the veterinary pharmaceutical industry researching on AMR. CEESA is formed by four AMR systems in Europe(8). • European Antimicrobial Susceptibility Surveillance in Animals (EASSA). This program examines the antimicrobial susceptibility of foodborne and commensal bacteria in food animals since 1998. • VetPath. This program examines the antimicrobial susceptibility of major disease causing bacterial pathogens in food animals since 1998. • ComPath.This program examines the antimicrobial susceptibility of major disease causing bacterial pathogens in companion animals since 2008. • MycoPath. This program examines the antimicrobial susceptibility of major disease causing mycoplasma species from food animals since 2008.

Table 2: Overview of all databases

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
SP	1997	VAV											V	V					V
SP	2010	ESVAC-ES	V																
SP	2016	IMS health			V	V	V	V	V										
SP		SNS+BIFAP+BDCAP				x	x			x									
SP	2015	AVS				V		V			V								
De	1980	SHI (Data WIdO)				V						M							
De	2009	ZOMO												M					M
De	2001	GERM-VET											V						
De	1996	KISS														V	V		

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
De	2008	ARS													V	V	V	V	
De	2011	DIMDI	M																
De	2006	ARMIN													V	V	V	V	
De	2007	ADKA-if-DGI				V					V								
De	2014	HIT		M															
De	2012	QS		V										V					
De	2007	VetCab		S															
No	2011	VetReg		M															
No	2000	NORM															x	x	
No	1999	NORM-VET	M										x	x					x

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
No	1970	Norwegian drug wholesales statistics (NIPH)			M						M	M							
No	2006	Hospital pharmacies drug statistics (NorPD)			M						M								
No	2004	Prescription database (NIPH)				M					M	M							
No	2004	NFSA																	x
No	2005	NOIS									x								
No	1977	MSIS													M	M	M	M	
Fr	2001	BMR-RAISIN															x	x	
Fr	2001	ATB-RAISIN									V								
Fr	2003	SNDS or SNIIRAM			M	x	x	x	x	x	x	x							

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
Fr		CPIAS													?	?			
Fr		NOSOBASE									x						x		
Fr		PMSI									x								
Fr		NRC													x	x	x	x	
Fr	1997	ONERBA													x	x	x		
Fr	1965	FACCO		x									?	?					
Fr	1999	ESVAC-FR	Msince2015																
Fr	1982	RESAPATH											V						

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
Fr	1998	EARS-Net France														x	x		
Ne	2008	ISIS-AR													V		V		
Ne	2002	MARAN	V										x	M					
Ne	1996	SWAB									M	M							
Ne	2010	SDa	M																
Ne	1998	FIDIN	V																
Ne	2004-2011	LEI Wageningen UR	S																
Ne	2012	MediRund	M																
Ne		NVWA																	M
Ne	2018	SNIV										x							

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
Ne	2012	SO-ZI/AMR														V	V		
UK	2008	SAVSNET		V									V						
UK	2001-2017	BSAC															S	S	
Wales	1996	DataStore															V		
England	12003	MOLIS															V (R)	V (R)	
Oxfordshire	(2017 year)	REHAB study												V					
Wales	2000	Prescribing Information Data Warehouse				V					V								
Wales	1995	Medusa			V														
England	2014-2015	MOLSIG study												V					

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
England and	2000	GRASP				X(since 2016)											S	S	
UK	1989	VMD	V																
UK	2017	NMR		V															
Great	2015	FarmVet system		V															
UK	1986	BEIC		V															
England	2016	eMB		V															
UK	2012	BPC		V															
England	2010	NHS Digital General Practisce prescribing data				V	V			X		V							
England-Wales	2014	EU harmonized surveillance												M					M

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
England	2012-2017	IQVIA			x	x	V	V			x								
England-	1999	Vet Pathogens APHA											V						
England-	1972	Salmonella APHA											M						
England	2014 (AMR)	SGSS													V	V	V		
EU	2002	ESAC-Net									x	x							
	2008	HAI-Net						x											
	2010	ESVAC	V																
	1998	EARS-Net														x	x		
	2002	EFSA																	x
	2011-2012	Point prevalence study in acute hospitals									V								

Region	Since	Data source name	AMU animal		AMU human								AMR animal		AMR human				AMR
			Sales	Prescription	Sales	Prescription /pharmacy dispensing	Primary care	Secondary care	Private	Public	Hospital	Community	Clinical isolates	Non-clinical isolates	*Primary care	**Secondary care	Hospital	Community	Food
		Point prevalence study in long-term care facilities									V	V							
	In 2011	ARPEC									V						V		
	1983	CEESA											x	x					x

M=Mandatory; V=Voluntary; S=Sentinel; R=Referrals; X= Data provided (mandatory-Voluntary bases unknown); *Primary care: The first place people go when they need health advice or treatment; **Secondary care: The health service provided by a specialist with a particular expertise.

Discussion

Antimicrobial sales and use in animals and humans

During the first year of the project, a big effort was carried out to identify as many data sources and collect as much data as possible from publicly available sources on AMU and AMR in humans and animals in the UK, Spain, France, Germany, Norway and The Netherlands. The ARDIG team collected information on accessibility of databases, types of data collected (sales data / prescription data), units used and their definitions, voluntary / mandatory data collection, representativeness of data, AST methods, standards used to interpret data and whether data are referred to primary or secondary care and community or hospital sector defining primary care as the first place people go when they need health advice or treatment and secondary care as the health service provided by a specialist with a particular expertise.

All data collected on AMU and AMR in humans and animals are being explored in order to determine which bacteria and antibiotics meet the requirements for a joint analysis of the countries represented by the ARDIG partners, from 2014 to 2017.

Data on antimicrobial sales and use in animals

After a thorough review on AMU in animals, several country-level databases (ESVAC-ES (SP)*, DIMDI (DE), NORM-VET (NO), ANSES (FR), FIDIN (NE) and VMD (UK)) on sales data were identified, which submit data to the voluntary ESVAC project (EU). However, the administrative system of each country makes data collection different. Thus, the scope and format of these databases are slightly different. As an example, some databases are based on voluntary data collection at national level (Spain, UK and The Netherlands) while others are mandatory (France, Norway and Germany), which can lead to bias (155). The mandatory data collection in France started in 2015 due to a new law published at the end of 2014 (155). French sales data included products sold on special licence until 2015 but not later. Spain changed its data collection system in 2014, and prior data to 2014 are assumed to be underestimated (156). In addition, Spanish sales data did not exclude sales between wholesalers or marketing authorization holders until 2015, in contrast to the other countries (141).

The VMD database in the UK compiles sales data not only from pharmacies and wholesalers, but also from other databases which are collecting data on a voluntary basis (eMB since 2016, BPC since 2012, FarmVet systems since 2016, BEIC since 1986 and GFA). Unfortunately, although the ARDIG project shows interest to include the eMB, BPC and FarmVet systems datasets, only the first two datasets were available since the third one required a payment for accessing any non-published data (some aggregated data are published publicly in the VARSS report and therefore available). In addition, UK used until 2015 a different methodology compared to ESVAC to calculate the amount of active substance per antibiotic and the mg/PCU calculation. To achieve harmonization, the UK adopted the European methodology implemented in ESVAC in 2015 according to UKVARSS-2015 (125).

ESVAC annually collects antibiotic sales data. Some units such as PCU (Population Correction Unit), DCD (Defined Course Dose) or DDD (Described daily dose) have been developed in order to harmonize data and obtain comparable results. Although collecting sales data is a good parameter for measuring the overall AMU, it also has some limitations:

Many antimicrobial products are licensed for use in several animal species. Therefore use per animal species cannot be accurately deduced. In 2018, the EMA therefore started collecting data from 2017 by animal species. This will substantially increase the quality of routine data collection and allow for more precise AMU estimates.

Some of the antimicrobial products may expire before use and at the beginning and the end of the year there are overlaps with the previous or following year, i.e. not all antimicrobials will be used in the year when they were sold.

As data are primarily collected in national systems, some exchange may occur across borders which is not accurately reflected in the sales data.

Although prescription data per animal species is a suitable data source for AMU, they are not consistently collected by all countries and also not provided to ESVAC yet. Collection of these data is laborious if they are not available in electronic formats. However, in most countries, prescription data are collected at least from a part of the animal population. Some examples are Spain (collecting prescription data on a voluntary basis from farm and companion animals through the electronic prescription), UK (collecting prescription data on a voluntary basis from companion animals through SAVSNET) and Norway (mandatory data collection of prescription data from food producing animals in VetReg and on a voluntary basis from companion animals). In Germany, prescription data for a sentinel of cattle, pig and broilers are collected in an long-term research project (VetCAb). Besides that treatment records are collected on a mandatory basis in a database for fattening pigs, broilers, turkeys and cattle for meat production and in an industry run database.

One major issue with prescription or treatment data is their accessability. They are mostly available on a highly aggregated level, which limits the data analysis options within the project. This is even true for data in public databases, such as the German HIT-system.

Due to the limitations mentioned, the evaluation of the usefulness of AMU studies for ARDIG should be done carefully since some factors may directly influence the results.
As an example, awareness campaigns on antibiotic consumption may reduce the dose and the number of treatment days. Differences in dosage regimes and treatment durations between hospitals and countries might result in an erroneous assessment of the treatment numbers if they are deduced from the amount of drug sold. Another bias results from human antibiotics used.
Overall, sales data reported to ESVAC only constitute a minor part of the data collected in the different countries. Use of the available prescription data will allow for a more detailed analysis of treatment and AMR data, compared to the European analyses carried out in the JIACRA process by EFSA, EMA und ECDC.

Data on antimicrobial sales and use in humans

Several AMU databases for the medical side were identified in each country represented in ARDIG, but only some of them are submitting data to the ESAC-Net database (see Table 2 for the overview). The data submitted to ESAC-Net originate from the following datasets:

- Spain -> SNS
- The Netherlands -> SWAB
- Germany -> WIdO
- France -> SND-SNIIRAM
- UK -> IQVIA, NHS DIGITAL
- Norway-> The Norwegian wholesales statistic database

In addition, the institutions responsible of providing the data are(157):

- Spain: Agency of Medicines and Medical Devices (AEMPS) (www.aemps.gob.es), University Hospital Son Espases (www.hospitalsonespases.es/) and University Hospital of Bellvitge (www.bellvitgehospital.cat)
- Germany: Robert Koch Institute using data analysed by the Wissenschaftliches Institut der AOK (WIdO) (www.rki.de; www.wido.de)
- Norway: Norwegian Institute of Public Health (www.fhi.no)
- France: Public Health France and the Agency for the Safety of Health Products (www.invs.sante.frwww.ansm.sante.fr/)
- Netherlands: National Institute for Public Health and the Environment (Dutch working group on antibiotic policy) (www.rivm.nlwww.swab.nl)
- UK: Public Health England, Health Protection Scotland (www.hpa.org.uk), Public Health Agency (www.hps.scot.nhs.uk), University of Dundee (www.dundee.ac.uk), University Hospital of South Manchester (www.uhsm.nhs.uk), Public Health Wales (www.wales.nhs.uk), The British Society for Antimicrobial Chemotherapy (www.bsac.org.uk)

Differences in data types provided by these countries to ESAC-Net complicate between-country comparisons. Consumption data types include reimbursement data, total care (primary and secondary sector) and sales data (138).
Frequently, it is assumed that primary care refers to community/ambulant/outpatient sector and secondary care to hospitals/inpatient/stationary sector. However, the categorisation of primary care versus secondary care depends on the country structure. As an example, primary care in Spain is mainly provided by the community sector (general practitioners) and health care centres (small hospitals), and secondary care is dispensed by hospitals and health care centres. In Germany, primary care is mainly provided by general practitioners, while secondary care is mainly dispensed by hospitals. Due to the lack of harmonisation of these data among countries, it is necessary to obtain additional information on the coverage of these data, reported as community/hospital sector, primary/secondary care and whether they are referring to the private, public or both sectors.

The ARDIG partner countries supply the following AMU data to ESAC-Net(158):

- Community sector

Germany has provided reimbursement data since 1997. Similarly, Spain provided also reimbursement data since 1997 but only until 2015 not submitting any data subsequently. Spanish estimates from private AMU data are based on the the IMS health dataset since 2017 (16), and are currently collected from electronic prescription data (voluntary data).

Norway, the Netherlands and France are providing sales data since 2014. UK has reported different data types since 2014; In 2014, it submitted total care and reimbursement data, in 2015 total care and in 2016 reimbursement data.

Additional sources such as the prescription data collected from GPs, outpatient clinics and dentist from The Netherlands may be added to improve ESAC-Net.

- Hospital sector

Norway, The Netherlands and France are submitting sales data since 2014. UK has presented different data types since 2014. Thus, in 2014 it presented total care, in 2015 total care and in 2016 reimbursement data for hospital sector. However, no hospital data are provided by Spain and Germany to ESAC-Net. Since 2016, private Spanish AMU data are estimated through sales data dispensed by pharmacies collected by IQVIA (formerly IMS health) dataset(16).

In order to improve the data quality submitted to ESAC-Net, some additional sources may be used such as the electronic prescription in Spain, AMU data collected through the databases AVS and ADKA-if-DGI in Germany or prescription data collected since 2004 from NorPD in Norway. However, when using several data sources care has to be taken to avoid double reporting.

Antimicrobial resistance in animals and in humans

A review of public data sources on AMU and AMR in animals and humans in the countries represented in ARDIG was carried out. The results are displayed in the annexes from A to D corresponding to the years from 2014 to 2017. The results highlight the lack of standardization among the the countries represented in ARDIG to monitor AMU and AMR for the same pathogens. Fortunatelly, European legislation(5-7) obliges the EU countries to monitor zoonotic *Salmonella* spp., *Campylobacter* spp. and *Campylobacter jejuni* as well as *E. coli* as indicator from food-producing animals thereby providing a highly standardized and comparable core data set. However, the compilation shows that a tremendous wealth of data is available. Ways to improve harmonization of these data should be explored to support transnational analyses.

Data on antimicrobial resistance in animals

The following databases are reporting annually on AMR to EFSA:

- Spain-> VAV
- The Netherlands-> MARAN

- Germany-> ZOMO supplemented with Salmonella isolates from the national control plans for Salmonella in poultry.
- France->
- UK-> EU Harmonized Surveillance
- Norway-> NORM-VET

Data on antimicrobial resistance in humans

Many AMR databases (described in Table 2) have been found in this section but those reported to EARS-Net are:

- Spain->SNS
- The Netherlands-> ISIS-AR / NETHMAP
- Germany-> ARS
- France-> ONERBA / BMR-RAISIN
- UK-> SGSS
- Norway-> NORM/MSIS

EARS-Net collects annually AMR data on pathogens from blood stream infections and cerebrospinal fluids in humans (*Escherichia coli*, *KlebsiellaKlebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter* spp., *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Enterococcus faecalis* and *Enterococcus faecium*) from European countries.

However, not all EU countries report each of the above-mentioned pathogens and data is not harmonised as a result of different sampling methods, laboratory routines and population coverage (159).

Table 3: The European data collection system and accessible data sources (monitoring / surveillance systems) per ARDIG country for the AMU in animals and humans.

Consumption	Human		Animal
	Community / Outpatient	Hospital / Inpatient	
Spain	SNS+BIFAP+BDCAP/ IMS health(2016) /Eprescription	SNS+BIFAP+BDCAP/ IMS health (2016)	ESVAC-ES /**Electronic prescription
Germany	WIdO (Pharmacy dispencing data in the ambulatory non-private sector (Book V of the German Social Security Code))	AVS / ADKA-if-DGI	DIMDI /QS /VetCab
United Kingdom	NHS Digital	IQVIA	VMD / eMB / BPC / FarmVet Systems
Norway	Prescription database (NorPD) / Norwegian drug wholesales statistics database (NIPH)	Hospital pharmacies drug statistics database(NorPD) / Norwegian drug wholesales statistics database (NIPH)	VetReg / NORM-VET usage
France	SNDS-SNIIRAM / ONERBA	SNDS-SNIIRAM / ATB-RAISIN	ESVAC-FR
Netherlands	SWAB	SWAB	SDa
Europe	ESAC-Net	ESAC-Net	ESVAC

Table 4: The European data collection system and accessible data sources (monitoring / surveillance systems) per ARDIG country for the AMR in animals and humans.

Resistance	Human		Animal		AMR-Food
	Community / Outpatient	Hospital / Inpatient	Clinical isolates	Non-clinical isolates	
Spain	SNS+BIFAP+BDCAP+IMS health (2016)	SNS+BIFAP+BDCAP+IMS health (2016)	VAV(EUCAST-CLSI Breakpoints? Or ECOFFs?)	VAV(EUCAST-CLSI Breakpoints? Or ECOFFs?)	VAV(EUCAST-CLSI Breakpoints? Or ECOFFs?)
Germany	ARS(EUCAST-CLSI-DIN Breakpoints	ARS (EUCAST-CLSI-DIN Breakpoints) / KISS	GERM-Vet (CLSI Breakpoints)	ZoMo (EUCAST ECOFFs) / QS	ZoMo (EUCAST ECOFFs) / QS????
United Kingdom	SGSS (EUCAST Breakpoints?)	SGSS (EUCAST Breakpoints?)	APHA Vet Pathogens (BSAC cut offs) / APHA Vet Salmonella (BSAC cut offs)	EU Harmonized Surveillance (EUCAST ECOFFs)	EU Harmonized Surveillance (EUCAST ECOFFs)
Norway	NORM (EUCAST Breakpoints)	NORM (EUCAST Breakpoints)	Norm-Vet (EUCAST ECOFFs)	Norm-Vet (EUCAST ECOFFs)	Norm-Vet (EUCAST ECOFFs) / NFSA
France	ONERBA / CPIAS / PMSI	ONERBA / CPIAS / PMSI	RESAPATH		
Netherlands	ISIS-AR (EUCAST Breakpoints)	ISIS-AR (EUCAST Breakpoints)	MARAN (EUCAST-ECOFFs)	MARAN (EUCAST-ECOFFs)	MARAN (EUCAST-ECOFFs) / NVWA
Europe	EARS-Net / FWD-Net	EARS-Net / FWD-Net		EFSA	EFSA

Specific analyses to be carried out within the ARDIG project WP1

A first approach on the AMR study is to consider *E. coli* in the ARDig countries from humans and animals since the amount of available data in excess of the data reported to EFSA and ECDC in the framework of the European systems is largest. Data on AMR in *E. coli* from various human, animal and food sample types can be found from 2014 to 2017 in these countries (Annex E). As predominantly data on *E. coli* from human blood stream infections and cerebrospinal fluid are submitted to ECDC, using data from other sample types (e.g. urinary tract infections) will expand the possible range of analyses..
With respect to AMU, it is proposed to study the consumption using medical and veterinary prescription data rather than sales data that have been the basis of the JIACRA analyses. As mentioned before, a major issue here will be data accessability as quite a proportion of the use data have respective limitations (Annexes from F to Q).
Further options are available based on cooperation with previous projects such as in WP5 of the EFFORT project that collected samples in animals for the AMU-AMR study on Enterococcus.

In Germany limitations on veterinary use data accessability may be overcome by a report that is currently prepared in the framework of evaluating legal measures that were taken in 2014 and are the basis of the HIT database. However the level of detail provided in the report is not yet fully clear. The report is expected to be published in April 2019.

Annexes

Annex A. Overview on AMU and AMR data available in ARDig countries in 2014

2014						
Animal data sources	Germ-Vet 2014-2015 (Clinical isolates) and ZOMO 2014 (food)	MARAN 2015 (Poultry data in salmonella (non clinical) /Cattle and swine data in salmonella (clinical))	RESAPATH 2014 (Clinical isolates)	UK-VARSS 2014 (EU Harmonized surveillance->non clinical/Vet Pathogen->Clinical)	NORM-VET 2014 (Non-clinical samples) (Salmonella-> clinical and nc cases joined)	Informe zoonosis 2014 (Healthy animals)
Human data sources (Clinical isolates)	Germap 2011-2014 ARS	NETHMAP 2015	ONERBA 2015	ESPAUR 2015 (SGSS). Only England data.	NORM 2014	
	GE	NL	FR	UK	NO	SP
Humans						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						I.Zoonosis 2014
Campylobacter jejuni						I.Zoonosis 2014
Carbapenemase-producing *Enterobacteriaceae*						
E. coli	GERMAP / ARS	NETHMAP	ONERBA	ESPAUR	NORM	
E. coli 0157						
E. coli- ESBL producing			ONERBA			
Enterobaceae						
*Enterobacteriae*ESBL producing-ESBL producing			ONERBA			
Enterococcus sp.	ARS			ESPAUR	NORM	
Enterococcus faecalis	GERMAP	NETHMAP			NORM	
Enterococcus	GERMAP	NETHMAP			NORM	

faecium						
Enterococcus faecium teicoplanin resistance	GERMAP					
Enterococcus faecium vancomycin resistance	GERMAP					
ESBL CARBA-producing *Enterobacteriaceae*						
Haemophilus influenzae		NETHMAP			NORM	
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.	ARS				NORM	
Klebsiella ESBL						
Klebsiella non ESBL						
Klebsiella oxytoca				ESPAUR	NORM	
Klebsiella pneumoniae		NETHMAP	ONERBA	ESPAUR	NORM	
Mannheimia sp.						
MRSA	GERMAP		ONERBA		NORM	
Mycoplasma sp.						
Pasteurella sp.						
Salmonella sp.						
Salmonella 1,4,(5),12:I:-						I.Zoonosis 2014
Salmonella derby						
Salmonella enterica						
Salmonella enteritidis		NETHMAP				I.Zoonosis 2014
Salmonella flexneri					NORM	
Salmonella infantis						
Salmonella parathyphi						
Salmonella parathyphi var.Java						
Salmonella sonnei					NORM	
Salmonella thyphi						
Salmonella Typhimurium		MARAN				I.Zoonosis 2014
Salmonella Typhimurium monophasis						
Shigela sp.						
Staphylococcus sp.	ARS					
Staphylococcus epidermidis	GERMAP					

Staphylococcus aureus		NETHMAP	ONERBA		NORM	
Staphylococcus cuagulase negative			ONERBA			
Staphylococcus haemolyticus	GERMAP					
Streptococcus sp.						
Streptococcus agalactiae					NORM Sterile site	
Streptococcus pneumoniae	ARS	NETHMAP	ONERBA	ESPAUR	NORM	
Streptococcus pyogenes					NORM	
Yersinia enterocolitica						
Yersinia pseudotuberculosis						
Cattle						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						
Campylobacter jejuni	ZOMO (milk)				NORM-VET	
Carbapenemase producing *Escherichia coli*			RESAPATH			
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli (selective isolation)*			RESAPATH			
E. coli	Germ-Vet / ZOMO (milk)	MARAN/meat	RESAPATH	UKVARSS-clinical		
E. coli STEC non-0157						
Enterococcus sp.			RESAPATH			
Enterococcus faecalis	Germ-Vet					
Enterococcus faecium	Germ-Vet					
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						

Histophilus somni				UKVARSS-clinical		
Klebsiella sp.	Germ-Vet		RESAPATH			
Klebsiella oxytoca						
Klebsiella pneumoniae			RESAPATH	UKVARSS-clinical		
Listeria monocytogenes						
Mannheimia haemolytica	Germ-Vet		RESAPATH	UKVARSS-clinical		
MRSA *(selective isolation)*	ZOMO (milk)					
Mycoplasma sp.						
Pasteurella multocida	Germ-Vet		RESAPATH	UKVARSS-clinical		
Quinolone resistant *Escherichia coli*			RESAPATH			
Salmonella sp.				UKVARSS-clinical	NORM-VET	
Salmonella derby						
Salmonella enterica					NORM-VET	
Salmonella enteritidis					NORM-VET	
Salmonella Mbandaka			RESAPATH			
Salmonella Montevideo			RESAPATH			
Salmonella parathyphi					NORM-VET	
Salmonella thyphi					NORM-VET	
Salmonella Typhimurium		MARAN	RESAPATH		NORM-VET	
Salmonella thyphimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH	UKVARSS-clinical		
Staphylococcus coagulase negative			RESAPATH			
Staphylococcus coagulase positive			RESAPATH			
Streptococcus agalactiae	Germ-Vet		RESAPATH			
Streptococcus dysgalactiae	Germ-Vet		RESAPATH	UKVARSS-clinical		
Streptococcus uberis	Germ-Vet		RESAPATH	UKVARSS-clinical		
VTEC	ZOMO					

Yersinia enterocolitica					NORM-VET	
Pigs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica	Germ-Vet					
Campylobacter sp.						
Campylobacter coli		MARAN/meat				
Campylobacter jejuni						
Carbapenemase producing *Escherichia coli*						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
E. coli		MARAN/meat	RESAPATH	UKVARSS-clinical		
E. coli STECO157						
E. coli STEC/STEC/VTEC						
Enterococcus sp.						
Enterococcus faecalis		MARAN/meat				
Enterococcus faecium		MARAN/meat				
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA					NORM-VET (STUDY)	
Mycoplasma sp.						
Pasteurella multocida			RESAPATH	UKVARSS-clinical		
Quinolone resistant *Escherichia coli*						
Salmonella sp.				UKVARSS-clinical	NORM-VET	
Salmonella derby						
Salmonella enterica						
Salmonella						

enteritidis						
Salmonella rissen						
Salmonella Typhimurium		MARAN				
Salmonella Typhimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus						
Staphilocuccus hyicus						
Streptococcus suis	Germ-Vet		RESAPATH	UKVARSS-clinical		
VTEC	ZOMO					
Yersinia enterocolitica						
Poultry						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli	Germ-Vet / ZOMO	MARAN/meat				I.Zoonosis 2014
Campylobacter jejuni	Germ-Vet / ZOMO	MARAN/meat		UK-VARSS-non-clinical		I.Zoonosis 2014
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli	Germ-Vet / ZOMO	MARAN/meat	RESAPATH	UK-VARSS-clinical / non-clinical	NORM-VET	I.Zoonosis 2014
Enterococcus sp.					NORM-VET	
Enterococcus faecalis						
Enterococcus faecium						
ESBL/AmpC-producing Escherichia coli			RESAPATH		NORM-VET / NORMVET(meat)	
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						

MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *E. coli*			RESAPATH		NORM-VET / NORMVET(meat)	
Salmonella sp.	ZOMO (Skin and meat)			UK-VARSS-clinical / non-clinical	NORM-VET	I.Zoonosis 2014
Salmonella enterica		Meat				
Salmonella enteritidis		MARAN /// meat				I.Zoonosis 2014
Salmonella infantis						I.Zoonosis 2014
Salmonella Kentucky						I.Zoonosis 2014
Salmonella parathyphi var.Java		MARAN				
Salmonella Typhimurium		MARAN				I.Zoonosis 2014
Salmonella Typhimurium monophasis						I.Zoonosis 2014
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet		RESAPATH	UKVARSS-clinical		
Vancomycin resistant *Enterococcus* sp.					NORM-VET	
Yersinia enterocolitica						
Turkey						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter coli	Germ-Vet / ZOMO					
Campylobacter jejuni	Germ-Vet / ZOMO			UK-VARSS-clinical / non-clinical		
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli	Germ-Vet	meat	RESAPATH	UK-VARSS-		

				clinical / non-clinical		
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA	ZOMO		RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Salmonella sp.	ZOMO (Skin and meat)			UK-VARSS-non clinical		I.Zoonosis 2014
Salmonella derby						I.Zoonosis 2014
Salmonella enterica						
Salmonella infantis						
Salmonella Kentucky						I.Zoonosis 2014
Staphylococcus sp.						
Staphylococcus aureus						
Yersinia enterocolitica						
Dogs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
Coagulase positive *Staphylococcus*			RESAPATH			
E. coli			RESAPATH			
E. coli carbapenemase-producing			RESAPATH			

Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella sp.			RESAPATH			
Pasteurella multocida						
Quinolone resistant *Escherichia coli*			RESAPATH			
Salmonella sp.				UKVARSS-clinical		
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet		RESAPATH			
Staphylococcus spp intermedius gruppe	Germ-Vet		RESAPATH			
Streptococcus sp.			RESAPATH			
Streptococcus agalactiae						
Yersinia enterocolitica						
Cats						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
Coagulase positive *Staphylococcus*			RESAPATH			
E. coli			RESAPATH			
E. coli carbapenemase-producing			RESAPATH			
Enterococcus sp.						

Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.	Germ-Vet					
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella sp.						
Pasteurella multocida						
Salmonella sp.						
Staphylococcus sp.			RESAPATH			
Staphylococcus aureus	Germ-Vet					
Yersinia enterocolitica						
Goat						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH			
Enterococcus sp.			RESAPATH			
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
Mycoplasma sp.						
Pasteurella sp.			RESAPATH			
Pasteurella multocida			RESAPATH			
Quinolone resistant			RESAPATH			

Escherichia coli						
Salmonella sp.						
Salmonella thyphimurium						
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Yersinia enterocolitica						
Sheep						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli		meat	RESAPATH	UKVARSS-clinical		
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						

Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Listeria monocytogenes						
Mannheimia haemolytica			RESAPATH	UKVARSS-clinical		
Mycoplasma sp.						
Pasteurella multocida				UKVARSS-clinical		
Salmonella sp.				UKVARSS-clinical		
Salmonella enterica						
Salmonella thyphimurium						
Staphylococcus sp.						
Staphylococcus aureus						
Streptococcus dysgalactiae						

VTEC						
Yersinia enterocolitica						
Hourses						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH			
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.			RESAPATH			
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli from horses*			RESAPATH			
Salmonella sp.				UKVARSS-clinical		
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Streptococcus sp.			RESAPATH			
Yersinia enterocolitica						

Annex B. Overview on AMU and AMR data available in ARDIG countries in 2015

2015						
Animal data sources	Germ-Vet 2014-2015 (Clinical isolates) and ZOMO 2015 (food)	MARAN 2016 (Poultry data in salmonella (non clinical) /Cattle and swine data in salmonella (clinical))	RESAPATH 2015 (Clinical isolates)	UK-VARSS 2015 (EU Harmonized surveillance->non clinical/Vet Pathogen->Clinical)	NORM-VET 2015 (Non-clinical samples)-> Salmonella-> clinical and nc cases joined)	Informe zoonosis 2015 (Healthy animals)
Human data sources (Clinical isolates)	ARS	NETHMAP 2016	ONERBA 2015	ESPAUR 2016. Only England data.	NORM 2015 (Clinical)	

	GE	NL	FR	UK	NO	SP
Humans						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						I.Zoonosis2015
Campylobacter coli						I.Zoonosis2015
Campylobacter jejuni					NORM	
Carbapenemase-producing *Enterobacteriaceae*						
E. coli sp.	ARS	NETHMAP	ONERBA	ESPAUR	NORM	
E. coli 0157		MARAN				
E. coli- ESBL producing						
Enterobaceae						
*Enterobacteriae*ESBL producing-ESBL producing						
Enterococcus sp.	ARS				NORM	
Enterococcus faecalis		NETHMAP			NORM	
Enterococcus faecium		NETHMAP			NORM	
Enterococcus faecium teicoplanin						

resistance						
Enterococcus faecium vancomycin resistance						
ESBL CARBA-producing *Enterobacteriaceae*					NORM (STUDY)	
Haemophilus influenzae		NETHMAP			NORM	
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.	ARS				NORM	
Klebsiella ESBL						
Klebsiella non ESBL						
Klebsiella oxytoca					NORM	
Klebsiella pneumoniae		NETHMAP	ONERBA	ESPAUR	NORM	
Mannheimia sp.						
MRSA			ONERBA		NORM	
Mycoplasma sp.						
Pasteurella sp.						
Salmonella sp.					NORM	I.Zoonosis2015
Salmonella 1,4,(5),12:I:-						
Salmonella derby						I.Zoonosis2015
Salmonella enterica					NORM	
Salmonella enteritidis		MARAN sick			NORM	
Salmonella flexneri					NORM	
Salmonella infantis						
Salmonella parathyphi						
Salmonella parathyphi var.Java						
Salmonella sonnei					NORM	
Salmonella thyphi						
Salmonella Typhimurium		MARAN sick			NORM	I.Zoonosis2015
Salmonella Typhimurium monophasis						I.Zoonosis2015
Shigela sp.						
Staphylococcus sp.	ARS					
Staphylococcus epidermidis						
Staphylococcus aureus		NETHMAP	ONERBA		NORM	

Staphylococcus cuagulase negative			ONERBA			
Staphylococcus haemolyticus						
Streptococcus sp.						
Streptococcus agalactiae					NORM sterile site	
Streptococcus pneumoniae	ARS	NETHMAP	ONERBA	ESPAUR	NORM	
Streptococcus pyogenes					NORM	
Yersinia enterocolitica					NORM	
Yersinia pseudotuberculosis					NORM	
Cattle						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli	ZOMO					I.Zoonosis2015
Campylobacter jejuni	ZOMO					I.Zoonosis2015
Carbapenemase producing *Escherichia coli*			RESAPATH		NORM-VET	
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH		NORM-VET	
E. coli	Germ-Vet / ZOMO	MARAN / MARAN(meat)	RESAPATH	UKVARSS-clinical	NORM-VET faecal/meat	I.Zoonosis2015
E. coli STEC non-0157		MARAN(meat)				
Enterococcus sp.			RESAPATH			
Enterococcus faecalis		MARAN / MARAN(meat)				
Enterococcus faecium		MARAN / MARAN(meat)				
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						

Histophilus somni				UKVARSS-clinical		
Klebsiella sp.	Germ-Vet		RESAPATH			
Klebsiella oxytoca						
Klebsiella pneumoniae			RESAPATH			
Listeria monocytogenes						
Mannheimia haemolytica			RESAPATH	UKVARSS-clinical		
MRSA					NORM-VET	
Mycoplasma sp.						
Pasteurella multocida			RESAPATH	UKVARSS-clinical		
Quinolone resistant *Escherichia coli*			RESAPATH		NORM-VET/meat	
Salmonella sp.				UKVARSS-clinical	NORM-VET	I.Zoonosis2015
Salmonella derby						I.Zoonosis2015
Salmonella enterica						
Salmonella enteritidis						
Salmonella Mbandaka			RESAPATH			
Salmonella Montevideo			RESAPATH			
Salmonella parathyphi						
Salmonella thyphi						
Salmonella Typhimurium		MARAN	RESAPATH			I.Zoonosis2015
Salmonella thyphimurium monophasis						I.Zoonosis2015 (nC)
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet		RESAPATH	UKVARSS-clinical		
Staphylococcus coagulase negative	Germ-Vet		RESAPATH			
Staphylococcus coagulase positive			RESAPATH			
Streptococcus agalactiae			RESAPATH			
Streptococcus dysgalactiae			RESAPATH	UKVARSS-clinical		
Streptococcus uberis			RESAPATH	UKVARSS-clinical		
VTEC	ZOMO					

Yersinia enterocolitica						
Pigs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica	Germ-Vet					
Campylobacter sp.						
Campylobacter coli	ZOMO				NORM-VET	I.Zoonosis2015
Campylobacter jejuni	ZOMO					
Carbapenemase producing *Escherichia coli*					NORM-VET	
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*					NORM-VET	
E. coli	Germ-Vet / ZOMO	MARAN / MARAN(meat)	RESAPATH	UKVARSS-clinical / non clinical	NORM-VET faecal/meat	I.Zoonosis2015
E. coli STECO157						
E. coli STEC/STEC/VTEC						
Enterococcus sp.						
Enterococcus faecalis		MARAN(meat)				
Enterococcus faecium		MARAN(meat)				
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA	ZOMO				NORM-VET(STUDY)	I.Zoonosis2015
Mycoplasma sp.						
Pasteurella multocida	Germ-Vet		RESAPATH	UKVARSS-clinical		
Quinolone resistant *Escherichia coli*					NORM-VET/meat	
Salmonella sp.	ZOMO (intestine, faeces, meat)			UKVARSS-clinical / non clinical		I.Zoonosis2015
Salmonella derby						I.Zoonos

						is2015
Salmonella enterica		MARAN(meat)				
Salmonella enteritidis						
Salmonella rissen						I.Zoonosis2015
Salmonella Typhimurium		MARAN				I.Zoonosis2015
Salmonella Typhimurium monophasis						I.Zoonosis2015
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet					
Staphilocuccus hyicus	Germ-Vet					
Streptococcus suis	Germ-Vet		RESAPATH	UKVARSS-clinical		
VTEC	ZOMO					
Yersinia enterocolitica						
Poultry						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli		MARAN / MARAN(meat)				
Campylobacter jejuni		MARAN / MARAN(meat)				
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli	Germ-Vet	MARAN / MARAN(meat)	RESAPATH	UKVARSS-clinical		
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
ESBL/AmpC-producing Escherichia coli			RESAPATH			

Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *E. coli*			RESAPATH			
Salmonella sp.				UKVARSS-clinical	NORM-VET	I.Zoonosis2015
Salmonella enterica		MARAN(meat)				
Salmonella enteritidis		MARAN / MARAN(meat)				I.Zoonosis2015
Salmonella infantis						
Salmonella Kentucky						I.Zoonosis2015
Salmonella parathyphi var.Java		MARAN / MARAN(meat)				
Salmonella Typhimurium		MARAN / MARAN(meat)				I.Zoonosis2015
Salmonella Typhimurium monophasis						I.Zoonosis2015
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet		RESAPATH	UKVARSS-clinical		
Vancomycin resistant *Enterococcus* sp.						
Yersinia enterocolitica						
Turkey						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						
Campylobacter jejuni						
Carbapenemase-producing			RESAPATH			

Enterobacteriaceae						
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli	Germ-Vet	MARAN(meat)	RESAPATH	UKVARSS-clinical		
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Salmonella sp.				UKVARSS-clinical		I.Zoonosis2015
Salmonella derby						I.Zoonosis2015
Salmonella enterica						
Salmonella infantis						
Salmoenlla Kentucky						I.Zoonosis2015
Staphylococcus sp.						
Staphylococcus aureus						
Yersinia enterocolitica						
Dogs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica	Germ-Vet					
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
Coagulase positive *Staphylococcus*			RESAPATH			
E. coli	Germ-Vet		RESAPATH			
E. coli carbapenemase-			RESAPATH			

producing						
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella sp.			RESAPATH			
Pasteurella multocida						
Quinolone resistant *Escherichia coli*			RESAPATH			
Salmonella sp.					NORM-VET	
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Staphylococcus spp intermedius gruppe	Germ-Vet		RESAPATH			
Streptococcus sp.			RESAPATH			
Streptococcus agalactiae						
Yersinia enterocolitica						
Cats						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica	Germ-Vet					
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
Coagulase positive *Staphylococcus*			RESAPATH			
E. coli	Germ-Vet		RESAPATH			
E. coli carbapenemase-producing			RESAPATH			
Enterococcus sp.						
Enterococcus faecalis						

Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella sp.						
Pasteurella multocida	Germ-Vet					
Salmonella sp.						
Staphylococcus sp.			RESAPATH			
Staphylococcus aureus						
Yersinia enterocolitica						
Goat						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH			
Enterococcus sp.			RESAPATH			
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
Mycoplasma sp.						
Pasteurella sp.			RESAPATH			
Pasteurella multocida			RESAPATH			
Quinolone resistant *Escherichia coli*			RESAPATH			
Salmonella sp.	ZOMO (Milk and					

	cheese)					
Salmonella thyphimurium						
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Yersinia enterocolitica						
Sheep						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli		MARAN(meat)	RESAPATH	UKVARSS-clinical		
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						

Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Listeria monocytogenes				UKVARSS-clinical		
Mannheimia haemolytica			RESAPATH	UKVARSS-clinical		
Mycoplasma sp.						
Pasteurella multocida				UKVARSS-clinical		
Salmonella sp.	ZOMO (Milk and cheese)			UKVARSS-clinical	NORM-VET	
Salmonella enterica						
Salmonella thyphimurium						
Staphylococcus sp.						
Staphylococcus aureus						
Streptococcus dysgalactiae				UKVARSS-clinical		
VTEC	ZOMO					

Yersinia enterocolitica						
Hourses						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH			
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.			RESAPATH			
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli from horses*			RESAPATH			
Salmonella sp.						
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Streptococcus sp.			RESAPATH			
Yersinia enterocolitica						

Annex C.Overview on AMU and AMR data available in ARDIG countries in 2016

2016						
Animal data sources	ZOMO 2016 (food) GERM-Vet 2016	MARAN 2017 (Poultry data in salmonella (non clinical)	RESAPATH 2016 (Clinical isolates)	UK-VARSS 2016 (EU Harmonized surveillance->non clinical/Vet Pathogen-	NORM-VET 2016 (Non-clinical samples) (Salmonella-> clinical and nc cases joined)	Informe zoonosis 2016 (Healthy animals)

		/Cattle and swine data in salmonella (clinical))		>Clinical)		
Human data sources (Clinical isolates)	ARS	NETHMAP 2017		ESPAUR 2017. Only England data.	NORM 2016	
	GE	NL	FR	UK	NO	SP
Humans						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						I.Zoonosis2016
Campylobacter jejuni					NORM (STUDY)	I.Zoonosis2016
Carbapenemase-producing *Enterobacteriaceae*				ESPAUR		
E. coli	ARS	NETHMAP		ESPAUR	NORM	
E. coli 0157		MARAN				
E. coli- ESBL producing						
Enterobaceae						
*Enterobacteriae*ESBL producing-ESBL producing						
Enterococcus sp.	ARS				NORM	
Enterococcus faecalis		NETHMAP			NORM	
Enterococcus faecium		NETHMAP			NORM	
Enterococcus faecium teicoplanin resistance						
Enterococcus faecium vancomycin resistance						
ESBL CARBA-producing *Enterobacteriaceae*					NORM (STUDY)	
Haemophilus influenzae		NETHMAP			NORM	
Histomonas sp.						

Histophilus sp.						
Klebsiella sp.	ARS				NORM	
Klebsiella ESBL						
Klebsiella non ESBL						
Klebsiella oxytoca				ESPAUR	NORM	
Klebsiella pneumoniae		NETHMAP		ESPAUR	NORM	
Mannheimia sp.						
MRSA					NORM	
Mycoplasma sp.						
Pasteurella sp.						
Salmonella sp.					NORM	I.Zoonosis2016
Salmonella 1,4,(5),12:I:-						
Salmonella derby						
Salmonella enterica					NORM	
Salmonella enteritidis		MARAN			NORM	I.Zoonosis2016
Salmonella flexneri					NORM	
Salmonella infantis						I.Zoonosis2016
Salmonella parathyphi						
Salmonella parathyphi var.Java		MARAN				
Salmonella sonnei					NORM	
Salmonella thyphi						
Salmonella Typhimurium		MARAN			NORM	I.Zoonosis2016
Salmonella Typhimurium monophasis						
Shigela sp.						
Staphylococcus sp.	ARS					
Staphylococcus epidermidis						
Staphylococcus aureus		NETHMAP			NORM	
Staphylococcus cuagulase negative						
Staphylococcus haemolyticus						
Streptococcus sp.						
Streptococcus agalactiae					NORM sterile site	
Streptococcus pneumoniae	ARS	NETHMAP			NORM	
Streptococcus					NORM	

pyogenes						
Yersinia enterocolitica					NORM	
Yersinia pseudotuberculosis						
Cattle						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						
Campylobacter jejuni						
Carbapenemase producing *Escherichia coli*			RESAPATH			
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli	Germ-Vet	MARAN	RESAPATH	UKVARSS-clinical	NORM-VET(feed)	
E. coli STEC non-0157						
Enterococcus sp.			RESAPATH			
Enterococcus faecalis	Germ-Vet					
Enterococcus faecium	Germ-Vet					
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Histophilus somni				UKVARSS-clinical		
Klebsiella sp.	Germ-Vet		RESAPATH			
Klebsiella oxytoca						
Klebsiella pneumoniae			RESAPATH			
Listeria monocytogenes						
Mannheimia haemolytica	Germ-Vet		RESAPATH			
MRSA						
Mycoplasma sp.						
Pasteurella multocida	Germ-Vet		RESAPATH	UKVARSS-clinical		
Quinolone resistant *Escherichia coli*			RESAPATH			
Salmonella sp.						

Salmonella derby						
Salmonella enterica						
Salmonella enteritidis		MARAN				
Salmonella Mbandaka			RESAPATH			
Salmonella Montevideo			RESAPATH			
Salmonella parathyphi						
Salmonella thyphi						
Salmonella Typhimurium		MARAN	RESAPATH			
Salmonella thyphimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH	UKVARSS-clinical		
Staphylococcus coagulase negative			RESAPATH			
Staphylococcus coagulase positive			RESAPATH			
Streptococcus agalactiae	Germ-Vet		RESAPATH			
Streptococcus dysgalactiae	Germ-Vet		RESAPATH	UKVARSS-clinical		
Streptococcus uberis	Germ-Vet		RESAPATH	UKVARSS-clinical		
VTEC						
Yersinia enterocolitica						
Pigs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Campylobacter coli						
Campylobacter jejuni						
Carbapenemase producing *Escherichia coli*						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin						

resistant *E. coli*						
E. coli	ZOMO->Wildpig Germ-Vet	MARAN	RESAPATH	UKVARSS-clinical	NORM-VET(feed)	
E. coli STECO157		MARAN				
E. coli STEC/STEC/VTEC						
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA					NORM-VET (STUDY)	
Mycoplasma sp.						
Pasteurella multocida			RESAPATH	UKVARSS-clinical		
Quinolone resistant *Escherichia coli*						
Salmonella sp.						
Salmonella derby						
Salmonella enterica		MARAN(meat)				
Salmonella enteritidis						
Salmonella rissen						
Salmonella Typhimurium		MARAN				
Salmonella Typhimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet					
Staphilocuccus hyicus	Germ-Vet					
Streptococcus suis			RESAPATH	UKVARSS-clinical		
VTEC	ZOMO->Wildpig					
Yersinia enterocolitica						
Poultry						
use data						
line data						
aggregated data						

Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli	ZOMO	MARAN / MARAN(meat)				I.Zoonosis2016
Campylobacter jejuni	ZOMO	MARAN / MARAN(meat)		UKVARSS-non clinical	NORM-VET caecal	I.Zoonosis2016
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH		NORM-VET faecal / NORM-VET (meat)-Study	
E. coli	ZOMO GERM-Vet	MARAN / MARAN(meat)	RESAPATH	UKVARSS-clinical / non-clinical	NORM-VET faecal	I.Zoonosis2016
Enterococcus sp.						
Enterococcus faecalis	Germ-Vet	MARAN(meat)				
Enterococcus faecium		MARAN(meat)				
ESBL/AmpC-producing Escherichia coli			RESAPATH			
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA	ZOMO		RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *E. coli*			RESAPATH			
Salmonella sp.	ZOMO			UKVARSS-non clinical	NORM-VET	I.Zoonosis2016
Salmonella enterica		MARAN(meat)				
Salmonella enteritidis		MARAN				
Salmonella infantis						
Salmonella Kentucky						
Salmonella parathyphi var.Java		MARAN				
Salmonella Typhimurium		MARAN				

Salmonella Typhimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet		RESAPATH			
Vancomycin resistant *Enterococcus* sp.						
Yersinia enterocolitica						
Turkey						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						I.Zoonosis2016
Campylobacter jejuni				UKVARSS-non clinical		I.Zoonosis2016
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH		NORM-VET / NORMVET(meat)	
Cephalosporin resistant *E. coli*			RESAPATH		NORM-VET faecal / NORMVET(meat) (STUDY)	
E. coli	ZOMO Germ-Vet	MARAN(meat)	RESAPATH	UKVARSS-non clinical	NORM-VET faecal	I.Zoonosis2016
Enterococcus sp.						
Enterococcus faecalis		MARAN(meat)				
Enterococcus faecium		MARAN(meat)				
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA	ZOMO		RESAPATH			
Mycoplasma sp.						
Pasteurella multocida						
Salmonella sp.	ZOMO			UKVARSS-non clinical		I.Zoonosis2016
Salmonella derby						
Salmonella enterica						

Salmonella infantis						I.Zoonosis2016
Salmonella Kentucky						I.Zoonosis2016
Staphylococcus sp.						
Staphylococcus aureus						
Yersinia enterocolitica						
Dogs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH		NORM-VET(feed)	
Cephalosporin resistant *E. coli*			RESAPATH		NORM-VET(feed)	
Coagulase positive *Staphylococcus*			RESAPATH			
E. coli	Germ-Vet		RESAPATH			
E. coli carbapenemase-producing			RESAPATH		NORM-VET(feed)	
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella sp.			RESAPATH			
Pasteurella multocida						
Quinolone resistant *Escherichia coli*			RESAPATH		NORM-VET(feed)	
Salmonella sp.	Germ-Vet				NORM-VET	
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Staphylococcus spp	Germ-Vet		RESAPATH			

intermedius gruppe						
Streptococcus sp.			RESAPATH			
Streptococcus agalactiae						
Yersinia enterocolitica						
Cats						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
Coagulase positive *Staphylococcus*			RESAPATH			
E. coli	Germ-Vet		RESAPATH			
E. coli carbapenemase-producing			RESAPATH			
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.						
Mannheimia haemolytica						
MRSA			RESAPATH			
Mycoplasma sp.						
Pasteurella sp.						
Pasteurella multocida	Germ-Vet					
Salmonella sp.	Germ-Vet				NORM-VET	
Staphylococcus sp.			RESAPATH			
Staphylococcus aureus						
Yersinia enterocolitica						
Goat						
use data						
line data						

aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH			
Enterococcus sp.			RESAPATH			
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica	Germ-Vet					
Mycoplasma sp.						
Pasteurella sp.			RESAPATH			
Pasteurella multocida			RESAPATH			
Quinolone resistant *Escherichia coli*			RESAPATH			
Salmonella sp.						
Salmonella thyphimurium		MARAN				
Staphylococcus sp.						
Staphylococcus aureus			RESAPATH			
Yersinia enterocolitica						
Sheep						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH	UKVARSS-clinical		
Enterococcus sp.						
Enterococcus faecalis						

Enterococcus faecium						

Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Listeria monocytogenes						
Mannheimia haemolytica	Germ-Vet		RESAPATH	UKVARSS-clinical		
Mycoplasma sp.						
Pasteurella multocida						
Salmonella sp.						
Salmonella enterica						
Salmonella thyphimurium						
Staphylococcus sp.						
Staphylococcus aureus						
Streptococcus dysgalactiae						
VTEC						
Yersinia enterocolitica						
Hourses						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*			RESAPATH			
Cephalosporin resistant *E. coli*			RESAPATH			
E. coli			RESAPATH			
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.			RESAPATH			
Mannheimia haemolytica						
MRSA			RESAPATH			

Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli from horses*			RESAPATH			
Salmonella sp.						
Staphylococcus sp.						
Staphylococcus aureus	Germ-Vet		RESAPATH			
Streptococcus sp.			RESAPATH			
Yersinia enterocolitica						

Annex D.Overview on AMU and AMR data available in ARDIG countries in 2017

2017						
Animal data sources	ZOMO 2017	MARAN 2018 (Poultry data in salmonella (non clinical) /Cattle and swine data in salmonella (clinical))			NORM-VET 2017 (Non-clinical samples) (Salmonella-> clinical and nc cases joined)	
Human data sources (Clinical isolates)	ARS	NETHMAP 2018			NORM 2017	
	GE	NL	FR	UK	NO	SP
Humans						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						
Campylobacter jejuni					NORM	
Carbapenemase-producing *Enterobacteriaceae*						
E. coli	ARS	NETHMAP			NORM	
E. coli 0157		MARAN				
E. coli- ESBL producing						
Enterobaceae		NETHMAP				
*Enterobacteriae*ESBL producing						
Enterococcus sp.	ARS				NORM	
Enterococcus faecalis		NETHMAP			NORM	
Enterococcus faecium		NETHMAP			NORM	
Enterococcus faecium teicoplanin resistance						
Enterococcus faecium vancomycin resistance						
ESBL CARBA-producing						

Enterobacteriaceae						
Haemophilus influenzae		NETHMAP			NORM	
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.	ARS				NORM	
Klebsiella ESBL						
Klebsiella non ESBL						
Klebsiella oxytoca					NORM	
Klebsiella pneumoniae		NETHMAP			NORM	
Mannheimia sp.						
MRSA					NORM	
Mycoplasma sp.						
Pasteurella sp.						
Salmonella sp.					NORM	
Salmonella 1,4,(5),12:I:-						
Salmonella derby						
Salmonella enterica					NORM	
Salmonella enteritidis		MARAN			NORM	
Salmonella flexneri					NORM	
Salmonella infantis						
Salmonella parathyphi						
Salmonella parathyphi var.Java		MARAN				
Salmonella sonnei					NORM	
Salmonella thyphi						
Salmonella Typhimurium		MARAN			NORM	
Salmonella Typhimurium monophasis						
Shigela sp.						
Staphylococcus sp.	ARS					
Staphylococcus epidermidis						
Staphylococcus aureus		NETHMAP			NORM	
Staphylococcus cuagulase negative						
Staphylococcus haemolyticus						
Streptococcus sp.						
Streptococcus agalactiae					NORM sterile site	
Streptococcus	ARS	NETHMAP			NORM	

pneumoniae						
Streptococcus pyogenes					NORM	
Yersinia enterocolitica					NORM	
Yersinia pseudotuberculosis						
Cattle						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli						
Campylobacter jejuni						
Carbapenemase producing *Escherichia coli*						
Carbapenemase-producing *Enterobacteriaceae*					NORM-VET / NORMVET(meat)	
Cephalosporin resistant *E. coli*					NORM-VET / NORMVET(meat)	
E. coli		MARAN / MARAN(meat)			NORM-VET	
E. coli STEC non-0157						
Enterococcus sp.	ZOMO					
E. coli STEC / VTEC	ZOMO					
Enterococcus faecalis	ZOMO					
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Histophilus						
Klebsiella sp						
Klebsiella oxytoca						
Klebsiella pneumoniae						
Listeria monocytogenes						
Mannheimia haemolytica						
MRSA	ZOMO					
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant						

Escherichia coli						
Salmonella sp.						
Salmonella derby						
Salmonella enterica		MARAN(meat)				
Salmonella enteritidis						
Salmonella Mbandaka						
Salmonella Montevideo						
Salmonella parathyphi						
Salmonella thyphi						
Salmonella Typhimurium		MARAN				
Salmonella thyphimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus						
Staphylococcus coagulase negative						
Staphylococcus coagulase positive						
Streptococcus agalactiae						
Streptococcus dysgalactiae						
Streptococcus uberis						
VTEC						
Yersinia enterocolitica						
Pigs						
use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Campylobacter coli	ZOMO				NORM-VET	
Campylobacter jejuni	ZOMO					
Carbapenemase producing *Escherichia coli*						
Carbapenemase-producing					NORM-VET / NORMVET(	

Enterobacteriaceae					meat)	
Cephalosporin resistant *E. coli*					NORM-VET / NORMVET(meat)	
E. coli	ZOMO	MARAN / MARAN(meat)			NORM-VET	
E. coli STECO157						
E. coli STEC/STEC/VTEC	ZOMO					
Enterococcus sp.						
Enterococcus faecalis	ZOMO					
Enterococcus faecium	ZOMO					
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA	ZOMO				NORM-VET(STUDY)	
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli*						
Salmonella sp.	ZOMO				NORM-VET	
Salmonella derby						
Salmonella enterica		MARAN(meat)				
Salmonella enteritidis						
Salmonella rissen						
Salmonella Typhimurium		MARAN				
Salmonella Typhimurium monophasis						
Staphylococcus sp.						
Staphylococcus aureus						
Staphilocuccus hyicus						
Streptococcus suis						
VTEC						
Yersinia enterocolitica						
Poultry						
use data						
line data						

aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Campylobacter coli		MARAN / MARAN(meat)				
Campylobacter jejuni		MARAN / MARAN(meat)				
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
E. coli		MARAN / MARAN(meat)			NORM-VET(STUDY)	
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
ESBL/AmpC-producing Escherichia coli						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA						
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *E. coli*						
Salmonella sp.						
Salmonella enterica						
Salmonella enteritidis		MARAN / MARAN(meat)				
Salmonella infantis						
Salmonella Kentucky						
Salmonella parathyphi var.Java		MARAN				
Salmonella Typhimurium		MARAN				
Salmonella Typhimurium						

monophasis						
Staphylococcus sp.						
Staphylococcus aureus						
Vancomycin resistant *Enterococcus* sp.						
Yersinia enterocolitica						
Turkey						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter coli						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
E. coli		MARAN(meat)			NORM-VET(STUDY)	
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA						
Mycoplasma sp.						
Pasteurella multocida						
Salmonella sp.						
Salmonella derby						
Salmonella enterica		MARAN(meat)				
Salmonella infantis						
Salmonella Kentucky						
Staphylococcus aureus						
Staphylococcus sp.						
Yersinia enterocolitica						
Dogs						

use data						
line data						
aggregated data						
Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
Coagulase positive *Staphylococcus*						
E. coli						
E. coli carbapenemase-producing						
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
MRSA						
Mycoplasma sp.						
Pasteurella sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli*						
Salmonella sp.					NORM-VET	
Staphylococcus sp.						
Staphylococcus aureus						
Staphylococcus spp intermedius gruppe						
Streptococcus sp.						
Streptococcus agalactiae						
Yersinia enterocolitica						
Cats						
use data						
line data						
aggregated data						

Resistance data						
Bordetella bronchiseptica						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
Coagulase positive *Staphylococcus*						
E. coli						
E. coli carbapenemase-producing						
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.						
Mannheimia haemolytica						
MRSA						
Mycoplasma sp.						
Pasteurella sp.						
Pasteurella multocida						
Salmonella sp.						
Staphylococcus sp.						
Staphylococcus aureus						
Yersinia enterocolitica						
Goat						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
E. coli						

Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Mannheimia haemolytica						
Mycoplasma sp.						
Pasteurella sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli*						
Salmonella sp.						
Salmonella thyphimurium		MARAN				
Staphylococcus sp.						
Staphylococcus aureus						
Yersinia enterocolitica						
Sheep						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*						
Cephalosporin resistant *E. coli*						
E. coli						
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						

Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Listeria monocytogenes						
Mannheimia haemolytica						
Mycoplasma sp.						

Pasteurella multocida						
Salmonella sp.					NORM-VET	
Salmonella enterica		MARAN (meat)				
Salmonella thyphimurium		MARAN				
Staphylococcus sp.						
Staphylococcus aureus						
Streptococcus dysgalactiae						
VTEC						
Yersinia enterocolitica						
Hourses						
use data						
line data						
aggregated data						
Resistance data						
Bordetella sp.						
Campylobacter sp.						
Carbapenemase-producing *Enterobacteriaceae*					NORM-VET	
Cephalosporin resistant *E. coli*					NORM-VET	
E. coli					NORM-VET	
Enterococcus sp.						
Enterococcus faecalis						
Enterococcus faecium						
Haemophilus sp.						
Histomonas sp.						
Histophilus sp.						
Klebsiella sp.						
Mannheimia haemolytica						
MRSA					NORM-VET	
Mycoplasma sp.						
Pasteurella multocida						
Quinolone resistant *Escherichia coli from horses*					NORM-VET	
Salmonella sp.						
Staphylococcus sp.						
Staphylococcus aureus						

Streptococcus sp.						
Yersinia enterocolitica						

In this report, published AMU data collected from national reports have been proposed as a data source. As it is unknown the type and characteristics of data which will be finally provided by ARDIG partners, no data have been filled in the AMU part of the annex A, B, C und D.

Annex E.Overview on the sample types collected to study AMR of Escherichia coli in humans and animals by the ARDIG countries.

E. coli						
	Clinical samples					
Human-AMR	SP	GE	NL	FR	UK	NO
E. coli strains from outpatient care, on general wards and ICU		ARS 2014-2015-2016-2017				
E. coli from outpatient care		ARS 2014-2015-2016-2017	2014-2015-2016 ISIS-AR			2014-2015-2016- 2017
E. coli from inpatient care		from several levels of care ARS 2014-2015-2016-2017	2014-2015-2016 ISIS-AR			2014-2015-2016-2017
E. coli from ICU			2014-2015-2016 ISIS-AR			
E. coli from urine samples			2014-2015-2016 ISIS-AR from GP	2014-2015 MedQual	2014: England from acute hospitals/ GPs/ other communities 2016: from acute hospital /community SGSS	2014-2015-2016-2017
E. coli from bloodstream isolates			2014-2015-2016 from inpatient care (ICU excluded) ISIS-AR		2015-2014-2016 SGSS	
	Non-clinical samples	Clinical samples	Non-clinical samples	Clinical samples	Clinical and non-clinical samples	Non-clinical samples
Animal-AMR	SP	GE	NL	FR	UK	NO
Dog		2014: Gastrointestinal/ urogenital infect 2015: Gastrointestinal/ urogenital infect		2014-2015-2016: Urinary tract/ skin and soft issues/ otitits		

Cat		2014: Gastrointestinal / urogenital infect 2015: Gastrointestinal / urogenital infect		2014-2015-2016:All pathologies/ urinary tract		
Poultry	2014 2016	2014: Septicemia laying hens/ diff sources:Cock and cock chicks 2015: Septicemia laying hens/diff sources: Cock and cock chicks	2014:Caecal samples from broilers/from laying hens 2015-2016 caecal samples from broilers	2014-2015-2016:Hens and broilers: All pathologies/laying hens: All pathologies/ broilers: Wll pathologies	2014: Broilers 2015: Clinical surveillance chicken 2016: Broilers / clinical surveillance	2014: Broiler 2016: Broiler
Turkey	2014 2016	2014: Different sources/ 2015: Different sources		2014-2015-2016: All pathologies	2014:Turkey 2016: Turkey	2016: Turkey
Cattle	2015 <1year, 2017<1year	2014:Enteritis veal/Mastitis dairy cow 2015:Enteritis veal/Enteritis beef	2014-2015-2016:caecal samples from dairy cows/from veal calves	2014-2015-2016:digestive/mastitis	2014: Clinical surveillance->mastitis/neonatal/preweaning/adult 2015: clinical surveillance: catlle 2016: Clinical surveillance	2015: Cattle 2017: Cattle<1year
Pig	2015, 2017	2015: Enteritis pigglets	2014-2015-2016: Caecal samples from pigs	2014-2015-2016:All pathologies/ piglets:digestive/sows:Urinary	2014: Clinical surveillance->neonatal/post-weaning/adult 2015: Pig-faeces-nc/clinical surveillance: pig 2016: clinical surveillance	2015-2017: Pig

Annex F. AMU data collected in humans in UK

Human AMU	Source :ESPAUR 2018 (England data only)			
Table 3.1 Total antibiotic consumption by antibiotic groups, expressed as DDDs per 1,000 inhabitants per day, 2013-2017				
Antibiotic Group	2014	2015	2016	2017
Penicillins (excluding inhibitors)	8.302	7.987	8.073	7.875
Penicillins (inhibitor combinations only)	1.815	1.708	1.614	1.561
First and secondgeneration cephalosporins	0.347	0.301	0.268	0.257
Third, fourth and fifthgeneration cephalosporins	0.057	0.057	0.063	0.074
Carbapenems	0.081	0.082	0.079	0.079
Tetracyclines	4.946	4.841	4.749	4.697
Macrolides, lincosamides and streptogramins	3.36	3.221	3.196	3.111
Sulfonamides and trimethoprim	1.438	1.354	1.265	1.055
Quinolone antibacterials	0.537	0.519	0.515	0.522
Anti-Clostridium difficile agents	0.381	0.359	0.336	0.332
Other antibacterials	1.135	1.197	1.272	1.445

Human AMU	Source :ESPAUR 2018 (England data only) and ESPAUR 2017 (England data only)				
Table 3.2 Total antibiotic consumption by antibiotic groups and prescriber settings, expressed as DDDs per 1,000 inhabitants per day, 2017 (ESPAUR 2018)					
Antibiotic Group	General Practice	Hospital Inpatient	Hospital Outpatient	Dentist	Other Community
Penicillins (excluding inhibitors)	5.552	0.727	0.334	0.872	0.390

Penicillins (inhibitor combinations only)	0.669	0.527	0.305	0.005	0.055
First and secondgeneration cephalosporins	0.173	0.054	0.022	0.002	0.007
Third, fourth and fifthgeneration cephalosporins	0.001	0.058	0.014	0	0
Carbapenems	0	0.068	0.011	0	0
Tetracyclines	4.181	0.209	0.233	0.005	0.070
Macrolides, lincosamides and streptogramins	2.411	0.283	0.224	0.084	0.108
Sulfonamides and trimethoprim	0.818	0.087	0.109	0	0.040
Quinolone antibacterials	0.290	0.097	0.121	0	0.013
Anti-Clostridium difficile agents	0.109	0	0	0.123	0.004
Other antibacterials	1.089	0.213	0.090	0	0.052
Aminoglycosides	0.007	0.089	0.03	0	0
Amphenicols	0	0.002	0	0	0

Figure 3.3 (Summary) Total antibiotic consumption by key antibiotic groups, expressed as DDD per 1000 inhabitants per day, England, 2012-2016 (ESPAUR 2017)

	DDD per 1000 inhabitants per day		
Key antibiotic group	2014	2015	2016
Anti Clostridium difficile agents	0,4	0,3	0,3
Quinolone antibacterials	0,5	0,5	0,5
Other β-lactam antibacterials*	0,5	0,4	0,4
Other antibacterials†	1,2	1,3	1,4
Sulfonamides and trimethoprim	1,4	1,3	1,3
Macrolides, lincosamides and streptogramins	3,3	3,2	3,2
Tetracyclines	4,9	4,8	4,7
Penicillins	10,0	9,6	9,6
Total	22,4	21,6	21,4

Figure 3.3a Total antibiotic consumption by key antibiotic groups, expressed as DDD per 1000 inhabitants per day, England, 2012-2016 (ESPAUR 2017)

		Location				
Key antibiotic group	Year	General Practice	Dentist	Hospital Inpatient	Hospital Outpatient	Other Community
Penicillins	2012	7,4	0,9	1,2	0,6	0,3
	2013	6,9	0,9	1,2	0,6	0,3
	2014	7,0	0,9	1,2	0,6	0,4
	2015	6,6	0,9	1,2	0,6	0,4
	2016	6,5	0,8	1,3	0,6	0,4
Tetracyclines	2012	4,3	0,0	0,2	0,2	0,0
	2013	4,4	0,0	0,2	0,2	0,0
	2014	4,5	0,0	0,2	0,2	0,1
	2015	4,4	0,0	0,2	0,2	0,1
	2016	4,3	0,0	0,2	0,2	0,1
Macrolides, lincosamides and streptogramins	2012	2,7	0,1	0,3	0,2	0,1
	2013	2,6	0,1	0,3	0,2	0,1
	2014	2,7	0,1	0,3	0,2	0,1
	2015	2,6	0,1	0,3	0,2	0,1
	2016	2,5	0,1	0,3	0,2	0,1
Sulfonamides and Trimethoprim	2012	1,2	0,0	0,1	0,1	0,0
	2013	1,2	0,0	0,1	0,1	0,1
	2014	1,2	0,0	0,1	0,1	0,1
	2015	1,1	0,0	0,1	0,1	0,1
	2016	1,0	0,0	0,1	0,1	0,0

Figure 3.3b Total antibiotic consumption by key antibiotic groups, expressed as DDD per 1000 inhabitants per day, England, 2012-2016 (ESPAUR 2017)

Key antibiotic group	Year	Location				
		General Practice	Dentist	Hospital Inpatient	Hospital Outpatient	Other Community
Other β-lactam antibacterials	2012	0,3	0,0	0,2	0,0	0,0
	2013	0,3	0,0	0,2	0,0	0,0
	2014	0,3	0,0	0,2	0,0	0,0
	2015	0,2	0,0	0,2	0,0	0,0
	2016	0,2	0,0	0,2	0,0	0,0
Quinolone antibacterials	2012	0,4	0,0	0,1	0,1	0,0
	2013	0,3	0,0	0,1	0,1	0,0
	2014	0,3	0,0	0,1	0,1	0,0
	2015	0,3	0,0	0,1	0,1	0,0
	2016	0,3	0,0	0,1	0,1	0,0
Anti-Clostridium difficile agents	2012	0,1	0,1	0,1	0,0	0,0
	2013	0,1	0,1	0,1	0,0	0,0
	2014	0,1	0,1	0,1	0,0	0,0
	2015	0,1	0,1	0,1	0,0	0,0
	2016	0,1	0,1	0,1	0,0	0,0
Other antibacterials	2012	0,8	0,0	0,2	0,1	0,0
	2013	0,9	0,0	0,2	0,1	0,0
	2014	0,9	0,0	0,3	0,1	0,0
	2015	0,9	0,0	0,3	0,1	0,0
	2016	1,0	0,0	0,3	0,1	0,0

Annex G. AMU data collected in animals in UK

Animal AMU	Source:UKVARSS2017			
BPC				
Table 2.3: Active ingredient (tonnes) of antibiotics used by all members of BPC Antibiotic Stewardship by antibiotic class, 2013–2017				
	2014	2015	2016	2017
Penicillins*	20 (31)	14 (30)	11 (45)	8.2 (57)
Tetracyclines	31 (48)	24 (52)	9.0 (38)	3.3 (23)
Lincomycins	7.1 (11)	4.8 (10)	1.4 (6)	1.2 (8)
Macrolides	2.7 (4)	1.1 (2)	0.5 (2)	0.6 (4)
Potentiated sulphonamides	1.2 (2)	1.0 (2)	1.6 (7)	0.9 (7)
Other**, including: Fluoroquinolones*** (kg) Colistin*** (kg)	2.1 (3) 1131 (2) 121 (0.2)	1.4 (3) 540 (1) 40 (0.1)	0.6 (3) 122 (0.5) 8 (0.03)	0.2 (1) 38 (0.3) 0 (0)
Total	46	46	24	14
* Amoxicillin and phenoxymethylpenicillin.				
** Aminoglycosides, pleuromutilins, fluoroquinolones, colistin and products under the cascade.				
*** Highest priority critically important antibiotics				

EMB (pigs)

Table 2.1: Usage recorded for active ingredient (mg/kg) of antibiotics in eMB Pigs by antibiotic class, 2015–2017

	Active ingredient in mg/kg (%)		
Antibiotic	2015	2016	2017
Tetracyclines	118 (42)	83 (45)	56 (43)
Penicillins	37 (13)	28 (15)	22 (17)
Trimethoprim/sulphonamides	66 (24)	29 (16)	21 (16)
Macrolides	31 (11)	29 (16)	16 (12)
Pleuromutilins	17 (6)	7.6 (4)	9.8 (7)
Other*	8.6 (3)	7.2 (4)	6.1 (5)

* Aminoglycosides, lincosamides, amphenicols, polymyxins, fluoroquinolones and 3rd and 4th generation cephalosporins.

Farmvet system (Dairy cattle)

Data on 2015-2017 pag 39 of UKVARSS2017

Table 2.7: Active ingredient (mg/kg) of antibiotics used by the dairy farms in the FarmVet Systems sample, 2015–2017

Antibiotic	2015	2016	2017
Penicillins and 1 st generation cephalosporins	7.2 (30)	9.1 (38)	5.0 (30)
Tetracyclines	4.5 (19)	4.8 (20)	3.5 (21)
Aminoglycosides	3.9 (16)	3.6 (15)	3.1 (18)
Macrolides	3.2 (13)	4.1 (17)	2.1 (13)
Trimethoprim/sulphonamides	2.1 (9)	2.7 (11)	1.6 (10)

Amphenicols	0.9 (4)	0.8 (3)	0.6 (4)
3 rd and 4th generation cephalosporins*	1.4 (6)	0.6 (3)	0.4 (2)
Fluoroquinolones*	0.5 (2)	0.3 (1)	0.2 (1)
Other**, including: Colistin*	0.2 (1) 0.005 (0.02)	0.2 (1) 0.011 (0.04)	0.1 (1) 0.007 (0.04)
Total 24 26 17	24	26	17
* Highest priority critically important antibiotics.			
** Aminocoumarins, lincosamides and polymyxins.			

Annex H. AMU data collected in humans in Norway

Human AMU		Source:NORM						
TABLE 8. Human usage of single antibacterial agents for systemic use in Norway 2012-2017. Sales are given in DDD/1,000 inhabitants/day. The methodology for collection of data on human usage of antibacterial agents is presented in Appendix 2.								
ATC	group	ATC	code	Substance	2014	2015	2016	2017
		J01A	A02	Doxycycline	1.99	1.97	1.82	1.69
		J01A	A04	Lymecycline	0.96	0.96	0.94	0.95
		J01A	A06*	Oxytetracycline	<0.001	<0.001	<0.001	<0.001
		J01A	A07	Tetracycline	0.5	0.45	0.4	0.36
J01A	Tetracyclines	J01A	A08*	Minocycline	0.003	0.002	0.002	0.001
J01B	Amphenicols	J01B	A01	Chloramphenicol	<0.001	<0.001	<0.001	<0.001
		J01C	A01	Ampicillin	0.12	0.11	0.13	0.13
		J01C	A04	Amoxicillin	1.46	1.39	1.31	1.3
		J01C	A08	Pivmecillinam	1.87	1.76	1.69	1.56
J01CA	Penicillins with extended spectrum	J01C	A11	Mecillinam	0.008	0.006	0.005	0.005
		J01C	E01	Benzylpenicillin	0.24	0.22	0.23	0.23
		J01C	E02	Phenoxymethylpenicillin	3.64	3.66	3.5	3.38
J01CE	Beta-lactamase sensitive penicillins	J01C	E08*	Benzathine benzylpenicillin	<0.001	<0.001	<0.001	<0.001
		J01C	F01	Dicloxacillin	0.72	0.73	0.74	0.7
		J01C	F02	Cloxacillin	0.19	0.16	0.17	0.13
J01CF	Beta-lactamase resistant penicillins	J01C	F05*	Flucloxacillin	<0.001	<0.001	<0.001	0.001
		J01C	R02	Amoxicillin and enzyme inhibitor	0.012	0.013	0.016	0.025
J01CR	Combination of penicillins, incl. betalactamase inhibitors	J01C	R05	Piperacillin and enzyme inhibitor	0.07	0.08	0.09	0.05

		J01D	B01	Cefalexin	0.14	0.12	0.1	0.09
		J01D	B03	Cefalotin	0.09	0.09	0.09	0.08
J01DB	1st gen. cephalosporins	J01D	B04	Cefazolin				0.009
J01DC	2nd gen. cephalosporins	J01D	C02	Cefuroxime	0.06	0.04	0.04	0.03
		J01D	D01	Cefotaxime	0.12	0.12	0.12	0.12
		J01D	D02	Ceftazidime	0.01	0.01	0.01	0.01
		J01D	D04	Ceftriaxone	0.02	0.02	0.02	0.02
		J01D	D08*	Cefixime			<0.001	<0.001
J01DD	3rd gen. cephalosporins	J01D	D52	Ceftazidime and avibactam				<0.001
J01DF	Monobactams	J01D	F01	Aztreonam	0.001	0.001	0.001	<0.001
		J01D	H02	Meropenem	0.05	0.04	0.04	0.04
		J01D	H03	Ertapenem	0.002	0.003	0.002	0.002
J01DH	Carbapenems	J01D	H51	Imipenem and enzyme inhibitor	0.002	0.002	0.002	0.002
		J01D	I02	Ceftaroline fosamil	<0.001	<0.001	<0.001	<0.001
J01DI	Other cephalosporins and penems	J01D	I54	Ceftolozane and enzyme inhibitor			<0.001	<0.001
		J01E	A01	Trimethoprim	0.46	0.42	0.38	0.35
		J01E	C02*	Sulfadiazine			0.001	0.001
J01E	Sulfonamides and trimethoprim	J01E	E01	Sulfamethoxazole and trimethoprim	0.4	0.44	0.44	0.49
		J01F	A01	Erythromycin	0.75	0.68	0.6	0.54
		J01F	A02	Spiramycin	0.005	0.004	0.003	0.003
		J01F	A06	Roxithromycin	<0.001	<0.001	<0.001	
		J01F	A09	Clarithromycin	0.23	0.18	0.14	0.13
J01F	Macrolides, lincosamides and streptogramins	J01F	A10	Azithromycin	0.35	0.33	0.3	0.26

		J01F	S15	Telithromycin	<0.001	<0.001	<0.001	
		J01F	F01	Clindamycin	0.34	0.31	0.28	0.25
J01G	Aminoglycosides	J01G	A01*	Streptomycin	<0.001	<0.001	<0.001	<0.001
		J01G	B01	Tobramycin	0.02	0.02	0.02	0.02
		J01G	B03	Gentamicin	0.05	0.06	0.06	0.07
		J01G	B06*	Amikacin	0.001	0.001	0.001	0.001
J01M	Quinolones	J01M	A01	Ofloxacin	0.01	0.01	0.01	0.01
		J01M	A02	Ciprofloxacin	0.65	0.59	0.52	0.43
		J01M	A12	Levofloxacin	0.002	0.002	0.003	0.003
		J01M	A14*	Moxifloxacin	0.007	0.008	0.009	0.01
J01X	Other antibacterials	J01X	A01	Vancomycin	0.02	0.02	0.02	0.02
		J01X	A02	Teicoplanin	<0.001	<0.001	<0.001	<0.001
		J01X	B01	Colistin	0.006	0.005	0.007	0.006
		J01X	C01	Fusidic acid	0.004	0.004	0.003	0.003
		J01X	D01	Metronidazole	0.05	0.04	0.03	0.04
		J01X	E01	Nitrofurantoin	0.35	0.34	0.31	0.28
		J01X	X01	Fosfomycin	<0.001	<0.001	<0.001	<0.001
		J01X	X05	Methenamine	3.86	3.99	4.09	4.11
		J01X	X08	Linezolid	0.007	0.009	0.01	0.009
		J01X	X09	Daptomycin	<0.001	0.001	0.001	<0.001
		J01X	X11	Tedizolid			<0.001	<0.001
Antibiotics in other ATC groups		J04A		Rifampicin**	0.13	0.12	0.12	0.11
		A07A	A09	Vancomycin	0.002	0.002	0.002	0.002

A07A	A11	Rifaximin	0.012	0.028	0.043	0.058
A07A	A12	Fidaxomicin	<0.001	<0.001	<0.001	<0.001
P01A	B01	Metronidazole	0.24	0.24	0.23	0.22
D06A X09 / R01A X06*		Mupirocin (grams)	174	225	185	213

Annex I. AMU data collected in animals in Norway

Animal AMU			

Annex J. AMU data collected in humans in The Netherlands

Human AMU	Source:NETHMAP				
Outpatient					
Table 3.1.1 10-years data on the use of antibiotics for systemic use (J01) in outpatients (DDD/1,000 inhabitant-days), 2014-2017 (source: SFK).					
ATC Group*	Therapeutic group	2014	2015	2016	2017
J01AA	Tetracyclines	2.23	2.25	2.1	1.98
J01CA	Penicillins_with_extended_spectrum	1.94	2.13	2.08	1.94

J01CE	Beta-lactamasesensitive	0.3	0.23	0.24	0.22
J01CF	Beta-lactamase_resistant_penicillins	0.44	0.43	0.46	0.46
J01CR	Penicillins+betalactamase_inhibitors	1.55	1.56	1.52	1.42
J01D	Cephalosporins_&_carbapenems	0.04	0.04	0.03	0.03
J01EA	Trimethoprimand_derivatives	0.16	0.14	0.14	0.13
J01EE	Sulphonamides+trimethoprim	0.28	0.28	0.28	0.29
J01FA	Macrolides	1.18	1.2	1.17	1.17
J01FF	Lincosamides	0.18	0.19	0.2	0.21
J01GB	Aminoglycosides	0.03	0.03	0.02	0.02
J01MA	Fluoroquinolones	0.79	0.77	0.75	0.73
J01XE	Nitrofuran-derivatives	1.4	1.4	1.39	1.36
J01XX01	Fosfomycin	0.03	0.04	0.05	0.05
J01EE	Sulphonamides+trimethoprim	0.04	0.04	0.02	0.05
J01	Antibiotics_for_systemic_use (total)	10.58	10.72	10.44	10.06
* From the 2017 edition of the Anatomical Therapeutic Chemical (ATC) classification system					
Inpatient					
Ten years use of antibiotics for systemic use (J01) in hospitals (DDD/100 patient-days), 2014-2016 (source: SWAB).					
ATC Group* -Therapeutic group	2014	2015	2016		
J01AA Tetracyclines	1.9	1.9	2		
J01CA Penicillins with extended spectrum	8.4	9.2	10.9		
J01CE Beta-lactamase sensitive penicillins	2.4	2.4	2.5		
J01CF Beta-lactamase resistant penicillins	8.7	7.7	8.7		

J01CR Combinations of penicillins, incl. beta-lactamase-inhibitors	14.5	14.3	14.6
J01DB First-generation cephalosporins	4.4	4.6	4.6
J01DC Second-generation cephalosporins	5	5.3	5.8
J01DD Third-generation cephalosporins	5.7	5.5	5.9
J01DH Carbapenems	1.6	1.7	1.8
J01EA Trimethoprim and derivatives	0.3	0.3	0.2
J01EE Combinations of sulfonamides and trimethoprim, including derivatives	1.9	1.8	2.1
J01FA Macrolides	2.9	2.7	3
J01FF Lincosamides	2.3	2.4	2.4
J01GB Aminoglycosides	3.6	3.7	3.7
J01MA Fluoroquinolones	9	8.4	9.1
J01XA Glycopeptides	1.6	1.6	1.6
J01XB Polymyxins	0.2	0.2	0.2
J01XD Imidazole derivatives	2.6	2.6	2.8
J01XE Nitrofuran derivatives	1.6	1.4	1.7
J01XX08 Linezolid	0.1	0.1	0.1
other antibacterials	78.5	77.8	84
J01 Antibiotics for systemic use (total)	326	330.1	326.1
* From the 2016 edition of the Anatomical Therapeutic Chemical (ATC) classification system			

Annex K. AMU data collected in animals in The Netherlands

Animal AMU	Source:SDa										
2017											
Table 5. Antibiotic use in kg (by livestock sector and for all livestock sectors combined) and sales figures for 2017, by pharmacotherapeutic group											
	According to delivery records									According to sales figures	
Pharmacotherapeutic group	Broiler farming sector	Turkey farming sector	Pig farming sector	Dairy cattle farming sector	Veal farming sector	Non-dairy cattle farming sector	Rabbit farming sector	Other poultry farming subsectors	All livestock sectors combined	Companion animal + horse sectors	Overall sales
1st-choice antibiotics	3,656	1,114	57,716	9,841	48,980	8,410	243	2,597	132,558	2,842	142,885
As a proportion of overall AB use / sales	40.94	63.86	81.59	85.6	84.11	84.88	75.61	84.37	80.6	67.14	78.9
Amphenicols	0	0	1,315	501	2,363	596	0	0	4,775	22	4,708
Fixed-dose combinations	0	0	0	0	0	0	0	0	0	389	389
Macrolides/lincosamides	452	316	7,175	352	13,720	2,173	17	829	25,033	109	24,201
Other	0	0	0	0	0	0	64	0	64	528	528
Penicillins	472	110	4,834	3,141	543	331	0	539	9,970	38	10,716
Pleuromutilins	0	13	660	0	0	0	25	17	716	0	770
Tetracyclines	917	555	30,598	1,731	25,121	3,972	102	708	63,705	606	67,708
Trimethoprim/sulfonamides	1,815	120	13,135	4,116	7,233	1,338	36	504	28,297	1,149	33,864
2nd-choice antibiotics	5,250	588	13,027	1,644	9,226	1,496	77	397	31,704	1,382	37,964
As a proportion of overall AB use/sales	58.78	33.68	18.41	14.3	15.84	15.1	23.96	12.9	19.28	32.64	20.96

Aminoglycosides	109	1	32	207	314	80	77	0	819	24	1,070
1st- and 2nd-gen. cephalosporins	0	0	0	26	0	0	0	0	27	452	484
Quinolones	832	11	223	9	1,689	214	0	64	3,040	0	3,160
Fixed-dose combinations	28	0	546	672	14	217	0	0	1,477	1	2,037
Macrolides/lincosamides	0	0	95	4	15	5	0	0	118	0	124
Penicillins	4,275	576	11,364	715	7,182	979	0	253	25,343	904	30,128
Polymyxins	5	0	767	12	13	2	0	80	880	1	962
3rd-choice antibiotics	25	43	0	11	26	2	1	84	193	9	248
As a proportion of overall AB use/sales	0.28	2.45	0	0.1	0.05	0.02	0.44	2.73	0.12	0.22	0.14
3rd- and 4th-gen. cephalosporins	0	0	0	0	0	0	0	0	0	0	1
Fluoroquinolones	25	43	0	11	26	2	1	84	193	9	247
Overall	8,932	1,745	70,743	11,497	58,232	9,907	322	3,077	164,456	4,233	181,097

* Although macrolides/lincosamides used in poultry are regarded as second-choice antibiotics, the amounts of macrolides/lincosamides used in the various poultry farming sectors have been recorded under first-choice antibiotics to facilitate comparison with sales figures, as sales figures cannot be categorized by livestock sector.

2016

Table 6. Distribution of antibiotic use in kg over the monitored livestock sectors, by pharmacotherapeutic group

	Broiler farming sector	Turkey farming sector	Pig farming sector	Dairy cattle farming sector	Veal farming sector	Non-dairy cattle farming sector	Rabbit farming sector	All livestock sectors combined
1st-choice antibiotics	3,846	1,649	60,823	10,887	51,948	9,263	310	138,725
As a proportion of overall AB	39.82%	66.92%	82.81%	86.12%	84.32%	85.96%	69.38%	81.10%

use/sales								
Amphenicols	0	0	1,214	618	2,624	680	0	5,136
Macrolides / lincosamides	584	458	6,787	431	13,541	2,227	10	24,038
Other	0	0	0	0	0	0	88	88
Penicillins	562	283	5,082	3,367	558	359	0	10,211
Pleuromutilins	0	0	498	0	0	0	21	519
Tetracyclines	957	783	31,560	2,101	26,489	4,407	138	66,435
Trimethoprim / sulfonamides	1,743	125	15,683	4,369	8,735	1,589	54	32,298
2nd-choice antibiotics	5,778	742	12,630	1,739	9,641	1,512	133	32,175
As a proportion of overall AB use/sales	59.83%	30.11%	17.19%	13.76%	15.65%	14.03%	29.82%	18.81%
Aminoglycosides	18	32	14	210	290	87	133	784
1st- and 2nd-gen. cephalosporins	0	0	0	28	0	0	0	29
Quinolones	729	1	211	2	1,966	351	0	3,258
Fixed-dose combinations	125	0	656	757	13	225	0	1,775
Macrolides/lincosamides	0	0	57	5	12	4	0	78
Penicillins	4,900	699	10,821	719	7,310	834	0	25,284
Polymyxins	7	10	872	19	50	10	0	968
3rd-choice antibiotics	34	73	0	15	19	1	4	146
As a proportion of overall AB use/sales	0.36%	2.97%	0.00%	0.12%	0.03%	0.01%	0.81%	0.09%
3rd- and 4th-gen. cephalosporins	0	0	0	0	0	0	0	0
Fluoroquinolones	34	73	0	15	19	1	4	146

Overall	9,658	2,464	73,453	12,641	61,608	10,776	447	171,047
2015								

Table 4. Distribution of use ofantibiotics in kg over the various livestock sectors, overall usage,and sales figures in 2015, by pharmacotherapeutic group

	According to delivery records						According to sales figures	
Pharmacotherapeutic group	Pig farming sector	Cattle farming sector	Veal farming sector	Broiler farming sector	Turkey farming sector	All livestock sectors	Companion animal sector	All sectors
1st-choice antibiotics	64,606	20,462	54,044	5,741	2,715	147,568	2,652	164,915
As a proportion of overall AB use/sales	83%	87%	85%	41%	72%	81%	64%	80%
Amphenicols	974	1,263	2,557	0	0	4,794	22	4,564
Fixed dose combinations	0	0	0	0	0	0	389	389
Macrolides / lincosamides	6,486	2,964	14,241	1,090	686	25,467	95	22,215
Other	0	0	0	0	0	0	383	475
Penicillins	5,127	3,376	463	988	388	10,341	49	12,671
Pleuromutilins	604	0	0	0	11	615	0	775
Tetracyclines	33,842	6,858	27,963	1,416	1,330	71,410	649	81,896
Trimethoprim/sulfonamides	17,572	6,001	8,822	2,247	300	34,941	1,064	41,930
2nd-choice antibiotics	13,057	3,105	9,558	8,112	1,000	34,832	1,471	40,351
As a proportion of overall AB use/sales	17%	13%	15%	58%	26%	19%	36%	20%
Aminoglycosides	39	193	214	73	26	544	27	1,210
1st- and 2nd-gen. cephalosporins	0	18	0	0	0	18	487	508

Quinolones	270	180	1,644	1,404	5	3,502	0	3,818
Fixed-dose combinations	755	938	17	269	0	1,979	1	2,534
Macrolides/lincosamides	56	8	15	0	0	79	0	50
Penicillins	10,741	1,728	7,533	6,356	957	27,316	955	30,296
Polymyxins	1,197	39	136	10	12	1,395	1	1,935
3rd-choice antibiotics	0	15	14	33	62	125	20	399
As a proportion of overall AB use / sales	0.00%	0.06%	0.02%	0.24%	1.65%	0.07%	0.47%	0.19%
3rd- and 4th-gen. cephalosporins	0	1	0	0	0	1	1	11
Fluoroquinolones	0	15	14	33	62	125	18	388
Overall	77,664	23,582	63,616	13,886	3,778	182,525	4,143	205,665

2014

Table 3. Distribution of the usage of antibiotics in kg over the various livestock sectors, overallusage and sales figures in 2014, by group of antibiotics.

Group	Pig farming sector	Veal farming sector	Cattle farming sector	Broiler farming sector	Turkey farming sector	Total	Sales figures
Amphenicols	907	2,417	1,280	0	0	4,604	4,354
Aminoglycosides	44	358	99	83	13	597	839
1st- and 2nd-gen. cephalosporins	0	0	19	0	0	19	545
3rd- and 4th-gen. Cephalosporins	0	0	19	0	0	19	545
Quinolones	485	1,393	327	1,003	1	3,208	3,379
Combinations of antibiotics	780	36	1,044	306	0	2,166	3,269

Fluoroquinolones	1	12	12	82	61	169	415
Macrolides/lincosamides	7,692	13,746	3,353	834	629	26,254	26,954
Other	0	0	0	0	0	0	502
Penicillins	15,680	7,325	5,416	9,576	1,170	39,168	46,406
Pleuromutilins	704	0	0	0	0	704	863
Polymyxins	1,079	116	52	9	1.32	1,257	1,416
Tetracyclines	35,679	28,737	8,208	1,526	901	75,050	69,052
Trimethoprim/sulphonamides	19,331	8,593	5,818	2,801	315	36,858	49,004
Total	82,380	62,733	25,629	16,220	3,092	190,055	207,012

Annex L. AMU data collected in humans in France

Human AMU		

Annex M. AMU data collected in animals in France

Animal AMU	Source: Sales survey of veterinary medicinal products containing antimicrobials in France												
DDDKg (oral and parental routes only)													
Cattle	AMINOGLYCOSIDES	CEPHALOSPORINES 3&4G	FLUOROQUINOLONES	LINCOSAMIDES	MACROLIDES	PENICILLINES	PHENICOLES	POLYPEPTIDES	QUINOLONES	SULFAMIDES	TETRACYCLINES	TRIMETHOPRIME	TOTAL
2014	0,060	0,027	0,020	0,002	0,074	0,077	0,013	0,028	0,003	0,018	0,095	0,012	0,354
2015	0,040	0,021	0,013	0,002	0,048	0,053	0,009	0,015	0,001	0,013	0,069	0,008	0,239
2016	0,059	0,006	0,004	0,002	0,056	0,071	0,011	0,012	0,002	0,018	0,070	0,015	0,248
Pig	AMINOGLYCOSIDES	CEPHALOSPORINES 3&4G	FLUOROQUINOLONES	LINCOSAMIDES	MACROLIDES	PENICILLINES	PHENICOLES	PLEUROMUTILINES	POLYPEPTIDES	QUINOLONES	SULFAMIDES	TETRACYCLINES	TRIMETHOPRIME	TOTAL
2014	0,040	0,003	0,028	0,019	0,091	0,171	0,009	0,010	0,268	0,005	0,098	0,311	0,098	1,017
2015	0,027	0,002	0,016	0,012	0,061	0,107	0,005	0,008	0,195	0,002	0,070	0,179	0,069	0,656
2016	0,051	0,001	0,008	0,012	0,063	0,169	0,014	0,005	0,112	0,003	0,064	0,187	0,064	0,645
Poultry	AMINOGLYCOSIDES	FLUOROQUINOLONES	LINCOSAMIDES	MACROLIDES	PENICILLINES	PHENICOLES	PLEUROMUTILINES	POLYPEPTIDES	QUINOLONES	SULFAMIDES	TETRACYCLINES	TRIMETHOPRIME	TOTAL
2014	0,005	0,020	0,001	0,028	0,213	0,000	0,005	0,431	0,011	0,046	0,317	0,041	1,073
2015	0,003	0,008	0,001	0,011	0,090	0,000	0,004	0,204	0,006	0,038	0,136	0,034	0,500
2016	0,007	0,009	0,001	0,013	0,129	0,000	0,004	0,232	0,007	0,047	0,127	0,042	0,574

Annex N. AMU data collected in humans in Spain

Human AMU		

Annex O. AMU data collected in animals in Spain

Animal AMU		

Annex P. AMU data collected in humans in Germany

Hospital data

Row description	2014	2015	2016	2017
Z-Root	17750465,7	26972194,2	32268789,5	35022505,8
A-Alimentary System and metabolism	66394,768	83320,21	86382,978	214888,439
Antibiotic profile 1	17407686,1	26517360,1	31700265	34426782,4
Other antibiotics*	321691,643	473725,211	635483,828	1009337,66
A07AA01-Neomycin	1460	1380	800	884
A07AA06-Paromomycin	2070,956	5298,271	5053,472	11776,07
A07AA09-Vancomycin, oral	4423,625	7573,05	6758,25	7196,75
A07AA10-Colistin, oral	3242,086	3419,044	2979,305	2234,694
A07AA11-Rifaximin	19788,5	29267,3	36106,1	158268,98
A07AA12-Fidaxomicin	704,6	1076,6	1394	1556,6
J01BA-Amphenicole		34	120	385
J01CG-Beta-Lactamase-Inhibitoren	5031	25277	22373,5	82704,5
J01DF-Monobactame	5949,45	7018,225	9709,75	10945,9
J01DI-Other Cephalosporine and Peneme	584,9	572	3200,965	6384,485

J01FG-Streptogramine				16
J01XB-Polymyxine	56,826	123,186	337,557	360,752
J01XC-Steroid-Antibiotic	9495	8532	7583	7792,5
J01XE-Nitrofuran-Derivate	4253,7	8167,28	10512,33	11786,55
J01XX01-Fosfomycin	230827,4	312161,38	447043,4	603636,44
J01XX07-Nitroxolin	20	90	196,6	850,5
J01XX11-Tedizolid			2,4	1,2
J04AB02-Rifampicin	33783,6	63735,875	81313,199	102556,741
J01A (without J01AA12)-Tetracycline (without Tigecyclin)	8728,04	16092,84	20054,45	22987,61
J01AA-Tetracycline	8728,04	16092,84	20054,45	22987,61
J01AA12-Tigecyclin	1603,5	2448,65	2982,7	3144,8
J01CA-Penicilline with extended spectrum of action	377917,224	551704,88	731512,069	884890,457
J01CA01-Ampicillin	132810,312	242857,016	315411,155	406963,167
J01CA04-Amoxicillin	113497,432	222546,023	303004,282	330846,979
J01CA08-Pivmecillinam	8707,2	10555,2	11568,803	14198,223
J01CA10-Mezlocillin	-4	360,012	60	
J01CA12-Piperacillin	122725,28	74989,629	101154,829	132863,088
J01CA17-Temocillin	181	397	313	19
J01CE, J01CF-Betalactamase-sensitive/resistente Penicilline	531210,221	840000,322	1238447,7	1655423,52
J01CE-Beta-Lactamase-sensitive Penicilline	353190,238	565033,674	725181,161	912380,663
J01CF-Beta-Lactamase-resistente Penicilline	178019,983	274966,648	513266,54	743042,861
J01CR- Combinations of penicillins, including beta-lactamase inhibitors	7280311,55	12217098,9	16715218	17823640,2
J01CR01-Ampicillin and Enzym-Inhibitoren	1996553,8	2731673,18	4044485,75	4947177,62
J01CR02-Amoxicillin and Enzym-Inhibitoren	371384,208	749015,082	998179,83	1313747,6
J01CR04-Sultamicillin	191473,05	339852,446	355837,901	328997,218
J01CR05-Piperacillin and Enzym-Inhibitoren	4720900,49	8396538,23	11316714,5	11233707,8
J01CR50- Combinations of penicillins		20,001		10,001
J01DB, J01DC-Cephalosporine of 1. and 2. Generation	2225350,87	3543393,69	4185310,08	4596480,07
J01DB-Cephalosporine of 1. Generation	518262,773	733452,803	932578,667	1030686,22

J01DB01-Cefalexin	41355	63043,09	69128	72909
J01DB04-Cefazolin	473185,79	665636,713	859923,667	947655,216
J01DB05-Cefadroxil	3721,983	4773	3527	10122
J01DC-Cephalosporine of 2. Generation	1707088,1	2809940,88	3252731,41	3565793,85
J01DC01-Cefoxitin	160		770	
J01DC02-Cefuroxim	1697729,18	2798196,63	3236228,97	3548796,85
J01DC04-Cefaclor	9198,916	11744,254	15732,437	16997,005
J01DD, J01DE-Cephalosporine of 3. and 4. Generation	866003,036	1478614,98	1849619,53	2291960,94
J01DD-Cephalosporine of 3. Generation	796245,036	1387932,73	1722507,53	2113953,44
J01DD01-Cefotaxim	100582,5	141340	184039	197339,5
J01DD02-Ceftazidim	198548	277625	333559	373299,5
J01DD04-Ceftriaxon	489799	949425	1182318	1502499
J01DD08-Cefixim	1564,8	4189,4	3989,2	7351,6
J01DD12-Cefoperazon			80	240
J01DD13-Cefpodoxim	5740,736	14966,486	17758,199	24639,905
J01DD14-Ceftibuten	10	386,844	260,128	
J01DD52-Ceftazidim, Combination			504	8583,938
J01DE-Cephalosporine of 4. Generation	69758	90682,25	127112	178007,5
J01DE01-Cefepim	69758	90682,25	127112	178007,5
J01DH-Carbapeneme	3877321,99	4248760,2	2349501,24	1850427,29
J01DH02-Meropenem	520347,687	854431,2	1163385,14	1319155,79
J01DH03-Ertapenem	8203	10114	10051	9762
J01DH04-Doripenem	53,5			
J01DH51-Imipenem and Enzym-Inhibitoren	3348717,8	3384215	1176065,1	521509,5
J01E-Sulfonamide and Trimethoprim	230104,966	372250,673	502314,977	528165,143
J01EA-Trimethoprim and Derivate	8869,046	8380,013	9012,697	9693,943
J01EC-Mittellang wirkende Sulfonamide	1720	3590,5	3275	1730
J01EE-Combination of Sulfonamide and Trimethoprim, incl. Derivate	219515,92	360280,16	490027,28	516741,2
J01FA-Macrolide	221103,162	392102,255	466402,627	498732,572

J01FA01-Erythromycin	49029,442	87210,35	114507,354	112842,505
J01FA02-Spiramycin		11,25	90	135
J01FA06-Roxithromycin	8637,3	18955,55	22775,251	22599,601
J01FA07-Josamycin	497,5	555	537	457
J01FA09-Clarithromycin	156361	276578,825	313584,532	342091,256
J01FA10-Azithromycin	6553,92	8791,28	14908,49	20607,21
J01FA15-Telithromycin	24			
J01FF-Lincosamide	362856,332	525164,842	639744,868	687409,132
J01FF01-Clindamycin	362856,332	525164,842	639744,868	687409,132
J01G-Aminoglycosid-Antibiotic	16025,297	26113,468	31599,322	33978,019
J01GA-Streptomycine	295	340	431	439
J01GB-Other Aminoglycoside	15730,297	25773,468	31168,322	33539,019
J01M-Chinolone	469220,321	784803,543	1001714,21	1055277,29
J01MA-Fluorchinolone	469220,321	784803,543	1001714,21	1055277,29
J01XA-Glycopeptid-Antibiotic	210207,904	321279,352	396324,646	415442,337
J01XA01-Vancomycin, parenteral	196506,504	308856,952	384787,346	404868,84
J01XA02-Teicoplanin	13701,4	12361,9	11166,8	9973,5
J01XA03-Telavancin				7,5
J01XA04-Dalbavancin		60,5	370,5	592,497
J01XD01, P01AB01-Metronidazol	347002,834	625536,433	782387,006	892935,333
J01XD01-Metronidazol, parenteral	199416,234	353970,633	459171,906	573213,183
P01AB01-Metronidazol, oral	147586,6	271565,8	323215,1	319722,15
J01XX08-Linezolid	55037,4	90659,72	141496,81	161932,202
J01XX09-Daptomycin	5989,779	7610,122	10151,009	14617,816

Human AMU	Source:Germap 2015	Only 2014 data

Tab. 2.1.5: Prescriptions, sales and daily doses (DDD) of the ten leading so-called second-line antimicrobials in 2014 (Sources:WIdO, SHI Drug Index)			
	Prescriptions in '000	Sales in million EUR	Daily doses in million DDD
Cefuroxime	4,695	92	55,1
Ciprofloxacin	3,947	60,2	20,1
Clarithromycin	1,597	24.4	15,9
Azithromycin	2,713	37.5	13,5
Cefaclor	1,651	31.7	12,4
Roxithromycin	1,380	21.3	11,8
Levofloxacin	1,212	18.6	8,1
Cefpodoxime	727	17.9	4,3
Moxifloxacin	439	20,2	3,1
Cefixime	366	8,7	2,6
Total	18,728	332.5	146,8
Total of all second-line antimicrobials	19,902	420.8	153.9

Annex Q. AMU data collected in animals in Germany (examples of available data)

German sales data of antimicrobials sold to veterinarians in Germany between 2014 and 2017

	Amount sold in t			
Substance/year	2014	2015	2016	2017
Aminoglycosides	38	25	26	29
Cephalosp., 1. Gen.	2.1	1.9	2	2
Cephalosp., 3. Gen.	2.3	2.3	2.3	2.3
Cephalosp., 4. Gen.	1.4	1.3	1.1	1.1
Fluoroquinolones	12.3	10.6	9.3	9.9
Folic Acid antagonists	19	10	9.8	7.8
Macrolides	109	52	55	55
Penicillins	450	299	279	269
Phenicoles	5.3	5	5.1	5.6
Pleuromutilins	13	11	9.9	13
Polymyxins	107	82	69	74
Sulfonamides	121	73	69	62
Tetracyclines	342	221	193	188
Others	15.6	10.9	11.5	14.3
Summe	1238	805	742	733

Table. Therapy frequency within the VetCAb project: pigs: Schaekel et al. 2017, also available for cattle populations and per substance group)

age group	half year	number of holdings	minimum	5%-percentile	median	upper quartile	95% - percentile
sucklers	**2013–2**	374	0	0	21,6	60,8	170,7
	2014–1	4,815	0	0	18,3	45,3	122,7
	2014–2	6,727	0	0	25	57,2	133
	2015–1	6,812	0	0.2	23	55,7	150,8
weaners	**2013–2**	522	0	0	5,8	14,3	55,7
	2014–1	6,048	0	0	9,7	26,2	74,6
	2014–2	8,577	0	0	11,3	29,7	76,9
	2015–1	8,293	0	0	9,4	22,1	56,8
fattening pigs	**2013–2**	9,588	0	0	4,3	11,6	30,4
	2014–1	16,96	0	0	3,4	10,6	29,4
	2014–2	20,374	0	0	3	9,6	26,1
	2015–1	19,324	0	0	2,1	6,7	19

Table. Median and 3.rd quartile of therapy frequency per semester in six animal populations in Germany2014/2 to 2018/1

Animal species	Subpopulation		Median	3. Quartile
Pigs	< 30kg	2014-2	4.793	21.398
		2015-1	5.93	14.681
		2015-2	3.49	10.08
		2016-1	3.35	8.897
		2016-2	3.06	8.017
		2017-1	3.023	7.743
		2017-2	2.968	7.326
		2018-1	2.708	6.919
	>30kg	2014-2	1.199	8.292
		2015-1	0.757	5.717
		2015-2	0.547	4.088
		2016-1	0.44	3.6
		2016-2	0.455	3.547
		2017-1	0.382	3.214
		2017-2	0.437	3.268
		2018-1	0.366	3.165
Broiler	fattening	2014-2	19.558	15.474
		2015-1	16.712	10.402
		2015-2	11.86	10.159
		2016-1	12.9	10
		2016-2	14.32	11.379
		2017-1	14.828	11.244
		2017-2	16.234	12.247

		2018-1	18.633	11.86
Turkey	fattening	2014-2	23.03	24.456
		2015-1	21.791	18.434
		2015-2	13.357	18.981
		2016-1	17.4	12.9
		2016-2	14.926	12.856
		2017-1	16.126	12.792
		2017-2	17.336	12.659
		2018-1	16.5	13.143
Cattle	Calves < 8 m	2014-2	0	5.058
		2015-1	0	2.676
		2015-2	0	2.707
		2016-1	0	2.251
		2016-2	0	2.904
		2017-1	0	2.211
		2017-2	0	3.165
		2018-1	0	2.363
	Beef >8mth	2014-2	0	0.015
		2015-1	0	0
		2015-2	0	0
		2016-1	0	0
		2016-2	0	0
		2017-1	0	0
		2017-2	0	0
		2018-1	0	0

List of abbreviations

ABDATA	**Pharma-Data service**
ABS	Antibiotic Stewardship
ADKA	Federal Association of German Hospital Pharmacists
AECOSAN	Spanish Agency for Consumer Affairs, Food Safety and Nutrition
AEMPS	Spanish agency of medicaments and sanitary products
AMR	Antimicrobial resistance
AMU	Antimicrobial consumption
ANMV	National Agency for Veterinary Medicines
ANSES	French Agency for Food, Environmental and Occupational Health & Safety
APHA	Food & Nutrition Section of the American Public Health Association
ARDIG	Antibiotic Resistance Dynamics
ARMIN	Antibiotic resistance monitoring in Lower Saxony
ARPEC	Antibiotic Resistance and Prescribing in European Children
ARS	Antibiotics Resistance Surveillance
AST	Antibotic Susceptibility Testing
ATB	Antibiotic Consumption Monitoring
ATC	Anatomic Therapeutic Chemical
AVS	Antibiotic Consumption Surveillance
BDCAP	Primary Care Clinical Database
BEIC	British Egg Industry Council
BIFAP	Database for Pharmacoepidemiological Research in Primary Care
BPC	British Poultry Council
BVL	Federal Office of Consumer Protection and Food Safety
CA-SFM	Antibiogram Committee of the French Society for Microbiology
CLSI	Clinical Laboratory Standard Institute

CPIAS	National Network for the Prevention of Care-Related Infections
DART	German antibiotic resistance strategy
DCD	Defined Course Dose
DDD	Defined Daily Dose
DGI	German society for infectious Diseases
DIMDI	German Institute for Medical Documentation and Information
DIN	G erman Institute for Standardization
DTU	University of Denmark
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European Center for Disease Prevention and Control
ECOFF	Epidemiological Cut-OFF
EFSA	European Food Safety Authority
EGB	Generalist sample of beneficiaries
EMA	European Medicines Agency
eMB	Electronic Medicine Book
ESAC-Net	European Surveillance of Antimicrobial Consumption Network
ESPAUR	English surveillance programme for antimicrobial utilisation and resistance
ESVAC	European Surveillance of Veterinary Antimicrobial
EU	Europe/European
EUCAST	The European Committee on Antimicrobial Susceptibility Testing
FACCO	Chamber of Trade Unions of Dog, Cat, Bird and Other Pet Food Manufacturers
FIDIN	Federation of the Dutch veterinary pharmaceutical industry
Fr	France
FSK	Foundation for Pharmaceutical Statistics, the Hague
FWD-Net	European Food and Waterborne Diseases and Zoonoses Network
GAmSi	Rapid Prescription Feedback System of SHI

GAP	Global Action Plan
Ge	Germany
GENARS	German Network for Antimicrobial Resistance Surveillance
GERMAP	Report on the consumption of antimicrobials and the spread of antimicrobial resistance in human and veterinary medicine in Germany
GERM-VET	Resistance situation in clinically important animal pathogenic bacteria
GP	General Practice
GRASP	Gonococcal Resistance to Antimicrobials Surveillance Programme
GS	Google sheet
HAI-Net	Healthcare-Associated Infections Surveillance Network
ICU	Intensive care unit
IGES	Institute for Health and Social Research
ISCIII	Carlos III Health Institute
ISIS-AR	Infectious Disease Surveillance Information System on Antibiotic Resistance
JIACRA	Joint Interagency Antimicrobial Consumption and Resistance Analysis
KISS	Hospital Infection Surveillance System
MABUSE	Medical Antimicrobial Use Surveillance and Evaluation
MAFF	Ministry of Agriculture, Fisheries and Food
MAGRAMA	Ministry of Agriculture, Fisheries and Food
MAPAMA	Ministry of Agriculture, Fisheries and Food
MARAN	Monitoring of Antimicrobial Resistance and Antibiotic Usage in Animals in the Netherlands
Medirund	Database Veterinary medicines cattle
MIC	Minimum Inhibitory Concentration
MOLIS	Modular Open Laboratory Information System
MRSA	Methicillin-Resistant Staphylococcus Aureus
MS	Member State

MSIS	Norwegian Surveillance System for Communicable Diseases
Ne	Netherlands
NethMap	Consumption of antimicrobial agents and antimicrobial resistance among medically important bacteria in the Netherlands
NFSA	Norwegian Food Safety Authority
NHS	National Health System
NIPH	Norwegian Institute of Public Health
NMR	National Milk Records
No	Norway
NOIS	Norwegian Surveillance System for Antibiotic Consumption and Healthcare-Associated Infections
NORM	surveillance programme for antimicrobial resistance in human pathogens
NORM-VET	monitoring programme for antimicrobial resistance in the veterinary and food proEEduction sectors
NorPD	Norwegian Prescription Database
NRC	National Reference Centre
NVI	Norwegian Veterinary Institute
NVMM	the Ministry of Health, Welfare and Sport and the Dutch Society of Medical Microbiology
NVWA	Netherlands Food and Consumer Product Safety Authority
ONERBA	National Observatory of the Epidemiology of Bacterial Antibiotic Resistance
PEG	Paul Ehrlich Society for Chemotherapy
PHE	Public Health England
PHW	Public Health Wales
PMSI	French hospital discharge database
PRAN	National Antibiotic Resistance Plan
PREZIES	Surveillance of healthcare associated infections (hospitals)
RAISIN	Alert, Investigation and Surveillance of Nosocomial Infection Network

RDD	Recommended Daily Dose
REGA	National Register for Livestock Holdings
RESAPATH	French surveillance network for antimicrobial resistance in pathogenic bacteria of animal origin
RKI	Robert Kock Institute
S,I,R	Sensible, Intermediate, Resistant
SARI	Surveillance of Antimicrobial Use and Bacterial Resistance in Intensive Care Units
SAVSNET	Practice Management Systems by the Small Animal Veterinary Surveillance Network
SDa	Netherlands Veterinary Medicines Institute
SGSS	Second Generation Surveillance System
SHI	Statutary Health Insurance
SIM	Microbiological Information System of ISCIII
SIR	Spread of nosocomial Infections and Resistant pathogens
SNDS	National Health Data System
SNIIRAM	National Health Data System
SNIV	National sentinel surveillance network for infectious diseases in nursing homes
SNS	National Health-Care System
SO-ZI/AMR	Hospital-acquired Infection and Antimicrobial Resistance Monitoring Group
SP	Spain
SWAB	Foundation Antibiotics Policy Working Group
UK	United Kingdom
UK	United Kingdom
VAV	Spanish Veterinary Antimicrobial Resistance Surveillance Network
VetReg	Veterinary Prescription Register
VMAF	veterinary medicine authority foundation
VMD	Veterinary Medicines Directorate
WHO	World Health Organisation

WIdO	Scientific Institute of the AOK
WP	Work Package
ZOMO	Zoonosis Monitoring

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