WHO Report on Surveillance of Antibiotic Consumption

2016-2018
Early implementation

World Health Organization

WHO Report on Surveillance of Antibiotic Consumption

2016 - 2018
Early implementation

WHO report on surveillance of antibiotic consumption: 2016-2018 early implementation

ISBN 978-92-4-151488-0

Suggested citation. WHO report on surveillance of antibiotic consumption: 2016-2018 early implementation. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Sales, rights and licensing. To purchase WHO publications, see http://apps.who.int/bookorders. To submit requests for commercial use and queries on rights and licensing, see http://www.who.int/about/licensing.

Printed in Switzerland

Table of contents

Annexes

Executive summary

Antimicrobial resistance is a major threat to health and human development, affecting our ability to treat a range of infections. Treatments for a growing number of infections have become less effective in many parts of the world due to resistance. The link between antimicrobial resistance and use of antimicrobials is well documented. However, little information is available on antimicrobial use in low-income countries. This report presents 2015 data on the consumption of systemic antibiotics from 65 countries and areas, contributing to our understanding of how antibiotics are used in these countries. In addition, the report documents early efforts of the World Health Organization (WHO) and participating countries to monitor antimicrobial consumption, describes the WHO global methodology for data collection, and highlights the challenges and future steps in monitoring antimicrobial consumption.

Need for a standardized approach to measuring antimicrobial consumption

In order to obtain a thorough and comprehensive picture of antimicrobial resistance and to be able to identify areas in which actions are needed, surveillance data are essential. This includes data on antimicrobial resistance and also antimicrobial consumption. Surveillance systems should provide data that can be easily compared, exchanged or used locally, nationally and globally. Unfortunately, many low- and middle-income countries lack the capacity to establish and maintain systems to collect and make use of data on antimicrobial consumption.

The WHO methodology for a global programme on surveillance of antimicrobial consumption provides a common technical basis for setting up a surveillance system on antimicrobial consumption and allows for standardized data collection at the national level. The approach has largely been adapted from the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) of the European Centre for Disease Prevention and Control (ECDC) and from the protocol developed by the WHO Regional Office for Europe for its Antimicrobial Medicines Consumption Network.

Overview of results

Since 2016, WHO has supported capacity building in monitoring antimicrobial consumption in 57 low- and middle-income countries through workshops, trainings and technical support. At this stage, 16 of these countries were able to share their national data with WHO. Other countries are currently in the process of data collection and validation. In total, 64 countries and Kosovo[1] contributed data on antibiotic consumption for this report, with the bulk of data coming from the European region and countries with pre-existing, mature surveillance systems.

The consumption data showed wide intra- and interregional variation in the total amount of antibiotics and the choice of antibiotics consumed. The overall consumption of antibiotics ranged from 4.4 to 64.4 Defined Daily Doses (DDD) per 1000 inhabitants per day. In most countries amoxicillin and amoxicillin/clavulanic acid were the most frequently consumed antibiotics. These substances belong to the Access category of the Model List of Essential Medicines, which includes antibiotics recommended as first- or second-line therapy for common infectious diseases and which should be available in all countries. In 49 countries, the Access category of antibiotics represented more than 50% of antibiotic consumption. Broad-spectrum antibiotics such as third generation cephalosporins, quinolones and carbapenems are categorized as Watch antibiotics and should be used with caution because of their high potential to cause the development of antimicrobial resistance and/or their side-effects. This report shows great diversity in the level of consumption of antibiotics in the Watch category, which accounted for less than 20% of total antibiotic consumption in some countries, but more than 50% in others. Reserve group antibiotics, which should only be used for specific indications such as infections with multidrug-resistant bacteria, accounted for less than 2% of total antibiotic consumption in most high-income countries and were not reported by most low- and middle-income countries. Antibiotics such as second generation cephalosporins and some tetracyclines, which have so far not been classified in the Access, Watch and

[1] In accordance with United Nations Security Council Resolution 1244 (1999).

Reserve (AWaRe) categories, accounted for a substantial proportion of total consumption, more than 10% in the majority of countries. Data interpretation should take the country context into account with respect to the data sources selected, burden of infectious diseases, access to medicines, structure of the health care systems, and antimicrobial resistance rates of the main pathogens.

Way forward

WHO aims to increase the number of countries participating in the global programme on surveillance of antimicrobial consumption and to continue supporting low- and middle-income countries in their efforts to build and improve surveillance systems on antimicrobial consumption adapted to the national context. Efforts to build national capacity will continue, including increasing knowledge on utilizing data on antimicrobial consumption to optimize antimicrobial use, to help ensure the sustainability of national antimicrobial consumption surveillance programmes in the long term. The AWaRe categorization provides a suitable framework for target setting, especially with respect to the use of Access antibiotics, and can be included as an indicator for monitoring and evaluation in the future. To improve coordination, the global monitoring of antimicrobial consumption will be included in the Global Antimicrobial Resistance Surveillance System (GLASS) IT platform in 2019. This will provide national antimicrobial resistance programmes and other users of GLASS access to data on both antimicrobial consumption and antimicrobial resistance.

The early implementation phase of the WHO global programme on surveillance of antimicrobial consumption revealed the challenges and impediments to establishing national surveillance of antimicrobial consumption in resource-limited countries. Nevertheless, the delivery of data from 16 low- and middle-income countries with newly implemented surveillance systems demonstrates the feasibility of the approach. The establishment of a global surveillance system can only be realized in a framework based on the engagement and contribution of each country and well-coordinated cooperation between countries, WHO regional offices and WHO headquarters. Continued commitment to expand and consolidate surveillance of antimicrobial consumption is essential.

Key messages

- Data on antimicrobial consumption provide an important basis for countries to better understand the patterns and amount of antibiotics used at the national level, which can inform policies, regulations and interventions to optimize the use of antibiotics.
- This report shows the great variation in quantity and type of antibiotics consumed between the included countries. While the observed variation may be due to the selection and coverage of data sources, it also reflects an actual difference in antibiotic use.
- The use of antibiotics appears to be very high in some parts of the world, suggesting their overuse, whereas it is low in others, which may indicate limited access to these life-saving medicines.
- Findings from this report confirm the need to take action to ensure that antibiotics are used appropriately, such as enforcing prescription-only policies and implementing antimicrobial stewardship programmes.
- Governments and the international community should also ensure equitable access to antibiotics, for example through strengthening of regulatory frameworks, procurement and supply chains.
- The process of implementing national surveillance of antimicrobial consumption has prompted countries to review national regulations, procurement and supply chains of medicines as a starting point to strengthen overall pharmaceutical systems.
- The lack of data from large parts of the world emphasizes the need for continued financial, technical and human resources support to further scale up the implementation of national surveillance of antimicrobial consumption, especially in low- and middle-income countries.
- Reporting and sharing data on antimicrobial consumption both nationally and internationally is an essential element of surveillance and provides important information in the global fight against antimicrobial resistance.

Acknowledgements

Data collectors and compilers

The World Health Organization, Department of Essential Medicines and Health Products warmly thanks all the national teams for collecting and sharing their data on antimicrobial consumption.

We would also like to thank the European Centre for Disease Prevention and Control (ECDC) for sharing the data on antimicrobial consumption from the European Antimicrobial Consumption Surveillance Network (ESAC-Net), which comprises the European Union and European Economic Area (EU/EEA) countries.

Reviewers

We would like to acknowledge the valuable feedback and comments received from the following WHO reviewers (in alphabetical order): Peter Beyer, Bernadette Capello, Sergey Eremin, Sarah Garner, Raniero Guerra, Suzanne Hill, Sarah Paulin, Carmem Pessoa da Silva, Ingrid Smith, Marc Sprenger, Barbara Tornimbene and Karin Weyer.

We would also like to acknowledge the valuable peer review contributions from (in alphabetical order): Hege Salvesen Blix, Sujith Chandy, Katherine Fleming-Dutra, Laura King, Dominique L. Monnet, Elizabeth Roughead, Thomas Van Boekel , Vera Vlahovic-Palcevski, Klaus Weist and Peter Zarb.

Developers and coauthors

We also gratefully acknowledge the valuable contribution of the following colleagues (in alphabetical order).

Core contributors: Verica Ivanovska, Arno Muller, Birgitta Schweickert, Prateek Sharma and Wenjing Tao.

Contributors of the regional sections: Jose Luis Castro, Emmanuel Eraly, Socorro Escalante, Albert Figueras, Kotoji Iwamoto, Ketevan Kandelaki, Adi Al Nuseirat, Hanne Bak Pedersen, Jane Robertson, Robin Rojas, Aissatou Sougou and Klara Tisocki.

Other contributors: Fiona Curlet (editing), and Deirdre Dimancesco.

Financial support

Funding for the production of this report was kindly provided by the governments of Canada and the United Kingdom of Great Britain and Northern Ireland (Fleming Fund).

Global implementation of surveillance activities on antimicrobial consumption was supported by funding from the governments of Canada, Germany, Netherlands, Norway and the United Kingdom of Great Britain and Northern Ireland (Fleming Fund), and from the European Commission.

Foreword

This publication is the first ever WHO global report that provides an overview of antibiotic consumption data based on a standardised global methodology that can be used by all countries, regardless of their level of development. It reports antibiotic consumption data from 65 countries and areas in 2015, including those with limited resources, where the growing use of antibiotics has not always translated into improved access and better patient care.

Since their discovery, antibiotics have played an essential role in the treatment of infections in humans and animals, and have significantly improved public health. Growing resistance to these crucial medicines is therefore extremely worrying; without effective antibiotics – and other antimicrobials – much of the progress made in fighting infectious disease and prolonging life will be lost. For that reason, World Health Assembly adopted a global action plan to fight antimicrobial resistance (AMR) in 2015.

AMR is driven by many complex factors, but overuse and misuse of antibiotics are among the leading causes. Measuring and analysing the consumption and use of antibiotics is therefore a critical step that will inform the development of appropriate strategies to improve our use of antibiotics. It will also allow us to identify areas where consumption is too low and therefore devise ways to increase access to antibiotics where needed.

As part of the WHO global programme on surveillance of antimicrobial consumption, WHO provided countries with two main tools: the global methodology for the measurement of antibiotic consumption, which builds on existing methodologies, and the AWaRe index of antibiotics – a classification of essential antibiotics to guide responsible prescription and use, expand access where needed, and preserve the most valuable and at-risk antibiotics.

This report includes 65 countries and areas that collected valuable information on the consumption of antibiotics. As a result, a clearer picture of antibiotic consumption at national, regional and global levels is emerging. In addition, middle-income and particularly low-income countries have so far lacked the capacity to collect solid surveillance data, so the WHO global programme is supporting them to build monitoring systems on antibiotic consumption adapted to their national contexts.

Collecting data on antibiotic use is of paramount importance to generate the evidence that will enable us to tackle AMR and protect human health. We trust more countries will join our efforts to measure antibiotic use and help us to be able to keep using these medicines as effective tools in fighting infectious disease.

Dr. Soumya Swaminathan

Deputy Director-General for Programmes

World Health Organization

List of acronyms

Acronym	Term
AIDS	Acquired Immune Deficiency Syndrome
AMC	Antimicrobial consumption
AMR	Antimicrobial resistance
ATC	Anatomical Therapeutic Chemical
AWaRe	Access, Watch and Reserve
CIPARS	Canadian Integrated Program for Antimicrobial Resistance
COIPARS	Colombian Integrated Surveillance Program for Antimicrobial Resistance
DANMAP	Danish Integrated Antimicrobial Resistance Monitoring and Research Programme
DDD	Defined Daily Dose
DU75	Drug Utilization 75%
ECDC	European Centre for Disease Prevention and Control
ESAC-Net	European Surveillance of Antimicrobial Consumption Network
EU/EEA	European Union and European Economic Area
FAO	Food and Agriculture Organization of the United Nations
GAP	Global action plan
GLASS	Global Antimicrobial Resistance Surveillance System
GNI	Gross national income
HIV	Human Immunodeficiency Virus
INRUD	International Network for Rational Use of Drugs
IQR	Interquartile range
JIACRA	Joint Interagency Antimicrobial Consumption and Resistance Analysis
KOICA	Korea International Cooperation Agency
NARMS	United States National Antimicrobial Resistance Monitoring System
OECD	Organisation for Economic Co-operation and Development
OIE	World Organisation for Animal Health
R&D	Research and development
TB	Tuberculosis
TESSy	The European Surveillance System
UN	United Nations
WHA	World Health Assembly
WHO	World Health Organization


SECTION
01

1 Introduction

1.1 Scope and aim of this report

The period since 2016 covers the early implementation activities of the WHO global programme on surveillance of antimicrobial consumption. During this time, WHO made its first attempt to gather accessible information on national antimicrobial consumption worldwide and test the feasibility of the WHO methodology for surveillance of antimicrobial consumption. The 2016–2018 round of data collection on antimicrobial consumption was a pilot phase and a capacity-building exercise for Member States in establishing national monitoring activities for antimicrobial consumption. The information collected in this round is expected to provide baseline knowledge for further development of monitoring activities and to support the addition of a module on antimicrobial consumption in the Global Antimicrobial Resistance Surveillance System (GLASS) platform.

This report aims to document WHO's early efforts to monitor antimicrobial consumption in the countries that participated in the programme, describe the WHO global methodology for data collection, provide the first overview of the results on antimicrobial consumption for 2015 with a focus on antibiotics, and highlight the challenges and future steps in monitoring antimicrobial consumption. The monitored antimicrobials in this report are aligned with the treatments for pathogens that are under GLASS surveillance and the suggested AWaRe categories recommended by the Model List of Essential Medicines in 2017 *(1)*.

1.2 Background

1.2.1 Global impact of antimicrobial resistance

Antimicrobial resistance (AMR) is a major threat to human development as it affects our ability to treat a range of infections caused by bacteria, parasites, viruses and fungi. Treatments for a growing list of infections, including urinary tract infections, tuberculosis (TB), sepsis, gonorrhoea and foodborne diseases, have become less effective in many parts of the world because of resistance. Modern medical procedures, such as major surgery, organ transplantation, treatment of preterm babies, diabetes management and cancer chemotherapy will become very high risk without effective antibiotics *(2,3)*.

The efficacy of commonly used antimicrobials is threatened because of AMR among pathogens; for example, *Acinetobacter* species, *Pseudomonas* species, *Escherichia coli, Klebsiella pneumoniae*, *Salmonella enterica, Staphylococcus aureus*, *Streptococcus pneumoniae* have become resistant to key antimicrobials *(4,5)*. Recently, failure of third-generation cephalosporins to treat *Neisseria gonorrhoeae* has been confirmed in at least 10 countries. Similarly, resistance to carbapenem antibiotics, a treatment of last resort for *K. pneumoniae*, has spread across the world *(2)*. Many other bacterial pathogens have evolved into multidrug-resistant forms, as in the case of *Mycobacterium tuberculosis (2)*.

The cost of health care for patients with resistant infections is higher than care for patients with non-resistant infections because of longer duration of illness, additional tests and the need for more expensive medicines. The rise in resistance not only impedes our ability to treat infections, but has broader societal and economic effects, and endangers the achievement of the Sustainable Development Goals *(2,6)*. The direct and indirect impact of AMR will mostly fall on low- and middle-income countries, which often lack the infrastructure, and human and financial resources to adequately counter drug resistance epidemics *(6)*. The consequences of AMR are aggravated in volatile situations such as civil unrest, violence, famine and natural disasters, as well as in settings with poor health care services or without access to health care *(2,7)*.

Antimicrobial-resistant organisms are everywhere in the environment, and can move between different ecosystems and facilitate the spread of mobile genetic elements that

can confer resistance to other organisms *(8,9)*. AMR is a complex public health problem that concerns the human, animal, agricultural and environmental sectors, and does not recognize human/animal or geographic borders. Therefore, no single strategy or intervention is sufficient to fully tackle the emergence and spread of infectious organisms that become resistant to the available antimicrobial drugs. Without a coordinated and multisectoral One Health approach and immediate action on a global scale, experts fear that the world is heading towards a post-antibiotic era *(2,8)*.

1.2.2 Link between antimicrobial resistance and use of antimicrobials

The development of AMR is a normal evolutionary process for microorganisms but it is accelerated by the selective pressure exerted by widespread use of antimicrobials *(2,10)*. The association between antimicrobial use and resistance has been well documented in individual health care facilities, communities and countries *(11–14)*. There is a strong association between AMR and levels of antimicrobial use, implying that a reduction in unnecessary consumption of antimicrobials could affect resistance *(11–14)*.

The available evidence suggests that the global consumption of antibiotics in humans has risen in the past two decades, primarily driven by an increased use in low- and middle-income countries *(15,16)*. At the same time, there has been a shift towards the use of broad-spectrum and last-resort antibiotics *(16)*. These trends are partly a result of improved access to medicines because of economic development in some parts of the world, but also because antibiotics are used inappropriately. The patterns of inappropriate use of antimicrobials include the use of antibiotics to treat conditions that are not caused by a bacterial infection, the use of the wrong type of antibiotic, the use of the wrong dosage or route of administration, and use for the wrong duration. Detailed global estimates are lacking but in countries of the Organisation for Economic Co-operation and Development (OECD), as many as half of all antimicrobials used in human health care can be considered inappropriate *(17)*.

Drug-resistant infections can also be a result of poor access to antimicrobials. Inequities in access to medicines persist and many low- and middle-income countries (or their subregions) still have high mortality rates from infectious diseases but low rates of use of antibiotics. In low- and middle-income countries where people have limited access to antimicrobials, individuals may not be able to afford a full course of treatment or may only be able to obtain substandard or falsified medicines or ones to which the organism is already resistant. In these countries and circumstances, increasing access to appropriate antimicrobials can reduce selection pressure *(18,19)*.

Historically, the development and use of each new antibiotic have been followed by the emergence of resistance. Until the 1970s, many new antibiotics were developed to which most common pathogens were initially fully susceptible. Unfortunately, their introduction in clinical practice has been accompanied by the rapid appearance of resistant strains in most parts of the world. Since the 1980s, only a few new classes of antibiotics have been successfully brought onto the market and most of them target Gram-positive bacteria. It has been a major challenge to find new antibiotics active against resistant *M. tuberculosis* strains and Gram-negative bacteria, which have been identified as priorities for research and development on new antibiotics by WHO *(20)*.

This complex picture of an almost empty antibiotic research and development pipeline, the diminishing effectiveness of existing antibiotics, the considerable misuse of these antibiotics, and insufficient access to adequate medicines in many resource-restricted settings indicates that while new treatments for infections need to be developed to counteract emerging AMR, antibiotics must also be used appropriately, made accessible to those who need them, and meet international standards of quality.

1.2.3 WHO response to antimicrobial resistance

The urgent need to improve antibiotic use and act collectively on AMR was acknowledged by world leaders at the United Nations General Assembly in 2016 *(21)*. They made a strong political commitment to fight AMR together, built on the WHO global action plan on antimicrobial resistance (GAP), which was adopted at the World Health Assembly (WHA68.7) in 2015 *(22)*. This WHA resolution urges Member States to align their national action plans on AMR with the GAP, and engaged the tripartite organizations-WHO, Food and Agriculture Organization of the United Nations (FAO) and World Organisation for Animal Health (OIE)-in responding to AMR *(22)*.

The goal of the GAP is to ensure the successful treatment and prevention of infectious diseases

with effective and safe medicines that are quality-assured, used in a responsible way and accessible to all who need them.

To achieve its goal, the GAP sets out five strategic objectives *(22)*.

1. Improve awareness and understanding of AMR through effective communication, education and training.
2. Strengthen the knowledge and evidence base through surveillance research.
3. Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures.
4. Optimize the use of antimicrobial medicines in human and animal health.
5. Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.

The GAP reflects the importance of effective actions to optimize antimicrobial use across sectors. Specifically related to objective four, Member States were asked to provide "stewardship programmes that monitor and promote optimization of antimicrobial use at national and local levels in accordance with international standards in order to ensure the correct choice of medicine at the right dose on the basis of evidence" *(22)*.

WHO has long recognized the problem of inappropriate use of medicines, including antimicrobials, and has been promoting a range of policies to optimize their use for many years, particularly in low- and middle-income countries. The importance of the topic was endorsed by the World Health Assembly resolution on the progress in the rational use of medicines (WHA60.16) in 2007 in the context of the threat of AMR to global health security and the adoption of the resolution on improving the containment of AMR (WHA58.27) in 2005 and the WHO global strategy for containment of AMR in 2001 *(23–25)*. To quantify medicines use, the International Network for Rational Use of Drugs (INRUD)/WHO indicators have been developed and widely used to measure patterns of primary care use of medicines, including antibiotics, and assess the effects of interventions in low- and middle-income countries *(26,27)*. More information can be found on the WHO website on surveillance of antimicrobial use *(28)*.

The GAP and the Global Framework for Development & Stewardship to Combat AMR, developed by WHO, OIE and FAO, provided strengthened guidance for global and national strategies with a focus on the appropriate use of antibiotics in the One Health context *(29)*.

In line with the GAP objectives, WHO updated its Model List of Essential Medicines in 2017 and grouped antibiotics into Access, Watch and Reserve (AWaRe) categories based on treatment profile and potential for development of resistance *(1,30)*. The AWaRe categorization is accompanied by recommendations on when each category should be used (see section 3.10). The updated Essential Medicines List and AWaRe categorization aim to ensure that antibiotics are available when needed and that the right antibiotics are prescribed for the right infections. This in turn should enhance treatment outcomes, reduce the development of drug-resistant bacteria and preserve the effectiveness of last-resort antibiotics that are needed when all others lose their efficacy.

Antimicrobial stewardship is another important part of AMR national action plans related to appropriate use of antibiotics. While guidance and tools for stewardship programmes adapted to limited-resource settings are being prepared in collaborations with partners, WHO is also working to improve the accessibility and use of diagnostics and laboratory services to reduce diagnostic uncertainty and inform treatment. In parallel, countries are being supported to strengthen the supply chain and ensure the quality of antimicrobials.

In the second GAP objective, surveillance and monitoring are acknowledged as critical components of the response to AMR. At a global level, long-standing disease-specific surveillance systems on AMR have been well established, such as for TB and HIV drug resistance since 1994 and 2007, respectively.

In 2015, WHO launched GLASS as a collaborative effort to standardize surveillance based on officially recognized data across countries, improve the understanding of AMR, inform effective national control strategies, and support national, regional and global efforts to tackle AMR using the multisectoral One Health approach. In its initial implementation phase, GLASS targeted surveillance of infections caused by selected bacterial pathogens of public health relevance. GLASS was designed to progressively expand to include other AMR-related surveillance data in order to provide a single system which will allow standardization of surveillance approaches both for AMR and

use and consumption of antibiotics as well as other data on AMR *(31)*.

In response to a lack of antimicrobial consumption data and standardized data collection in many low- and middle-income countries, WHO initiated the global programme on surveillance of antimicrobial consumption. The first aim of this programme is to support countries in developing national surveillance programmes. The second is to collect data on antimicrobial consumption at the national level using a standardized methodology (see Section 3). WHO developed a common methodology for the measurement of antibiotic consumption in 2016, using a number of existing international monitoring systems as reference, such as those of the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) and the WHO Regional Office for Europe (see section 4) *(32,33)*. Following the development of the methodology, WHO initiated data collection on antimicrobial consumption for 2014–2016 in selected countries across the world *(34)*.

1.2.4 Role of surveillance data on antimicrobial consumption

Data on antibiotic consumption have been collected and analysed in many high- and middle-income countries, and global monitoring of antibiotic use in animals is ongoing. However, data are often lacking on antibiotic use in humans at the point of care and from low-income countries.

All countries have some data related to the import, procurement, distribution, sales or clinical use of antimicrobials that can serve as a basis for stewardship and monitoring programmes. Aggregated data derived from such data sources can be used to measure antimicrobial consumption and act as a proxy for antimicrobial use at the patient level. This can be an important starting point for countries with limited experience in data collection and a lack of data sources for monitoring antimicrobial use at patient level. Data on antimicrobial consumption provide information on which antimicrobials are used and in what quantities and allow for the assessment of trends over time at global, country or health facility levels.

Data on antimicrobial consumption do not provide information on how antibiotics are used. For that information, data on the prescription, dispensing and use of antimicrobials at the patient level are required. Hence, WHO is developing tools to support countries to undertake point prevalence surveys on the use of antimicrobials in hospitals and the community to supplement national surveillance systems using data on antimicrobial consumption.

Data on the consumption of antimicrobial medicines can be used to:

- Identify and provide an early warning of problems related to changes in antimicrobial exposure and use, and develop interventions to address the problems identified;
- Monitor the outcomes of interventions;
- Assess the quality of prescribing in terms of adherence to practice guidelines;
- Raise awareness among health professionals, consumers and policy-makers about the problems of the inappropriate use of antimicrobials and its contribution to AMR;
- Link antimicrobial exposure to the development of AMR.

The development of national monitoring systems is an essential part of the national action plans for AMR. The GAP framework for action on antimicrobial resistance has specifically called for Member States to collect and report data on use of antimicrobials *(22)*. Over time, such data should provide a more complete picture of the trends in use of antimicrobials, and could guide patient treatment, identify populations at risk, inform policy-making and be used to assess the effect of interventions.

The One Health approach recommends that surveillance systems are integrated across sectors, and that they cover AMR and use/consumption of antimicrobials in human and animal populations, plant production and relevant environmental areas. These integrated surveillance systems can connect and build on existing systems, thereby facilitating analyses of trends in time and place, and in different sectors. Currently, several national and international projects and programmes address AMR surveillance in multiple sectors, including the Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP), Canadian Integrated Program for Antimicrobial Resistance (CIPARS), Colombian Integrated Surveillance Program for Antimicrobial Resistance (COIPARS), United States National Antimicrobial Resistance Monitoring System (NARMS), and the European Union Joint Interagency Antimicrobial Consumption and Resistance Analysis (JIACRA) *(35–39)*.

1.3 Medicines for tuberculosis

1.3.1 Burden of tuberculosis and global response

TB is an infectious disease caused by *M. tuberculosis*, and is one of the top 10 causes of death worldwide. In 2017, 10 million incident cases were estimated to have occurred worldwide and 1.6 million deaths were caused by TB (including 0.3 million deaths among people living with HIV), of which 95% were in low- and middle-income countries *(40)*.

Drug-resistant *M. tuberculosis* further threatens global TB care and prevention, and is a major public health concern in many countries. In 2017, there were 0.6 million new cases of TB with resistance to rifampicin, the most effective first-line medicine, of which 82% had multidrug-resistant TB, and did not respond to isoniazid and rifampicin. Around 10% of multidrug-resistant TB cases had the more serious extensively drug-resistant TB caused by bacteria that do not respond to the most effective first- and second-line anti-TB medicines *(40)*.

The WHO End TB Strategy and UN Sustainable Development Goals have set global targets and milestones for reductions in the burden of TB disease. Specific targets set in the End TB Strategy include a 90% reduction in TB deaths and an 80% reduction in TB incidence by 2030, compared with 2015. In September 2018, heads of states, and global health and business leaders attending the first-ever UN high-level meeting on TB committed to ending the global TB epidemic by 2030, to accelerate the TB response by detecting and treating 40 million TB cases by the end of 2022 and to urgently mobilize needed financial resources to improve TB prevention, care and research. They also committed to take firm action against drug-resistant forms of the disease *(41)*.

WHO has worked with the Global Fund to Fight AIDS, Tuberculosis and Malaria and the Stop TB Partnership to support countries with a high burden of TB or multidrug-resistant TB to review their priorities, and enable the financing and scaling up of efforts on TB or multidrug-resistant TB prevention, diagnosis, treatment and care activities for populations in need.

1.3.2 Consumption of tuberculosis medicines

WHO has published its annual global TB report since 1997 to provide information on the TB epidemic, and the progress in prevention, diagnosis and treatment of TB at global and national levels.

The latest report from 2018 included 10 new priority indicators to monitor the implementation of targets linked to the End TB Strategy. Three of the indicators are related to TB treatments, in particular: 1) treatment coverage for TB[1], 2) treatment coverage for latent TB infection[2] and 3) treatment coverage with new TB drugs[3]. The target level for all three indicators is at least 90% treatment coverage by 2025. Information on TB treatment coverage can be found in the 2018 global tuberculosis report *(42)*.

Within the Stop TB Partnership, the Global Drug Facility has become a global provider of quality-assured tuberculosis medicines, diagnostics and laboratory supplies to the public sector. By 2017, the Global Drug Facility had delivered more than 30 million treatment courses to 139 countries, which included 29 million first-line drug treatments for adult patients, 1.7 million first-line drug treatments for paediatric patients and 0.4 million second-line drug treatments *(43)*. More information on the activities of the Global Drug Facility can be found in the 2016 annual report of the Stop TB Partnership *(43)*.

[1] Number of new and relapse cases that were notified and treated divided by the estimated number of incident TB cases in the same year, expressed as a percentage.
[2] Number of people living with HIV newly enrolled in HIV care and the number of children aged <5 years who are household contacts of cases started on treatment for latent TB infection divided by the number eligible for treatment, expressed as a percentage (separately for each of the two groups).
[3] Number of TB patients treated with regimens that include new TB drugs divided by the number of notified patients eligible for treatment with new TB drugs, expressed as a percentage.

The WHO global programme on surveillance of antimicrobial consumption also collects data on the consumption of TB medicines (ATC group J04A, see section 3 on Methodology) directly from countries from both public and private health sectors. Because of the specific global supply arrangements for TB drugs compared with the supply chain for other antibiotics, further consideration of the differences is needed before WHO publishes these consumption data on TB medicines.

The consumption of TB medicines is not reported in this report. However, as the methodology of the WHO programme on surveillance of antimicrobial consumption does not capture information on indications, some of the reported consumption of antibiotics refers to treatments given for TB as well as for infections caused by other bacteria (e.g. fluoroquinolones, rifampicin).


SECTION
02

2 Early implementation

2.1 WHO global programme on surveillance of antimicrobial consumption

The GAP urges Member States to monitor their use of antimicrobials, as surveillance and monitoring are one of the GAP's five objectives. Explicitly, the second strategic objective is to strengthen the knowledge and evidence base through surveillance research. This means that it is necessary to design ways to monitor data on the use and consumption of antimicrobials. To achieve these objectives, surveillance systems should, as far as possible, provide data that can be easily compared, exchanged, used or aggregated locally, nationally and globally. However, many low- and middle-income countries lack the capacity to establish and maintain surveillance systems to collect and make use of data on antimicrobial consumption. In response, WHO launched the global programme on surveillance of antimicrobial consumption, which provides technical support to countries to develop national surveillance systems. To complement this, WHO developed a standardized global methodology for the measurement of antibiotic consumption in 2016, based on the Anatomical Therapeutic Chemical (ATC)/ Defined Daily Dose (DDD)-methodology of WHO and the methodologies established by ESAC-Net and the WHO Regional Office for Europe (see more in sections 3 and 4) *(32,33,44,45)*.

In the framework of the One Health approach, OIE has also built up its global database on the use of antimicrobial agents in food-producing animals. OIE published its first overview on the global use of antimicrobial agents in animals in 2016, based on data collected during 2010–2015 from 130 member countries *(46)*. The OIE methodology provides three options for reporting data with various levels of detail depending on the data available at the national level, including an option when quantitative data on antimicrobial agents used in animals are not available. The WHO global methodology was developed with the aim of providing data on human consumption comparable with OIE data.

After developing the WHO global methodology, WHO rolled out its first cycle of data collection (2016–2018) to gather consumption data for the 2014–2016 period in an initial set of countries enrolled in the programme. During this first round of data collection, WHO piloted the global methodology and its approach to supporting countries and establishing national monitoring systems in selected low-and middle-income countries. The list of selected countries was defined with WHO regional offices and WHO headquarters.

In the future, WHO will open participation to all its Member States. To reach this objective, WHO will continue to support countries in collecting data and will integrate monitoring of antimicrobial consumption into the GLASS platform as a separate module in 2019. In the short term, inclusion of this module in the GLASS platform will facilitate the exchange of antimicrobial consumption data between countries and WHO. In the longer term, the inclusion will support global efforts for integrated surveillance of AMR and antimicrobial consumption across sectors at local, regional and global levels.

2.2 Countries participating in the surveillance of antimicrobial consumption

Since 2016, WHO has provided training to 57 countries on the WHO methodology for surveillance of antimicrobial consumption. In addition, WHO informed 23 countries about the importance of monitoring antimicrobial consumption and the development of the WHO global methodology.

The countries that received training were requested to set up national systems and collect and report data on antimicrobial consumption. In addition to these countries, some other countries with existing surveillance systems were also requested to report data to WHO in line with the WHO global methodology. Data were provided directly by countries or,

in the case of the countries and areas of the European Union and European Economic Area (EU/EEA), through ESAC-Net.

In Europe, the importance of monitoring antimicrobial consumption at national and regional levels was recognized long before the GAP. This led to the establishment of the regional surveillance system ESAC-Net in 2001 in EU/EEA countries, which initially was coordinated by the University of Antwerp and transferred to ECDC in 2011 (ESAC-Net). In 2011, the WHO Regional Office for Europe established monitoring of antimicrobial consumption in the rest of Europe. This work was done jointly with external partners, including the European Centre for Disease Prevention and Control (ECDC) and the University of Antwerp. Therefore, the support in training was provided before the GAP was adopted in 2015. Since then, WHO Regional Office for Europe has been providing ongoing support to improve the WHO network on antimicrobial consumption, such as facilitating the appropriate analysis, and the sharing and use of data on antimicrobial consumption.

Fig. 2.1 shows the countries that took part in the initial phase of the WHO global programme on surveillance of antimicrobial consumption. Table 2.1 shows the number of countries that submitted data and are included in this report.

Fig. 2.1 Status of countries with regard to WHO activities on monitoring antimicrobial consumption

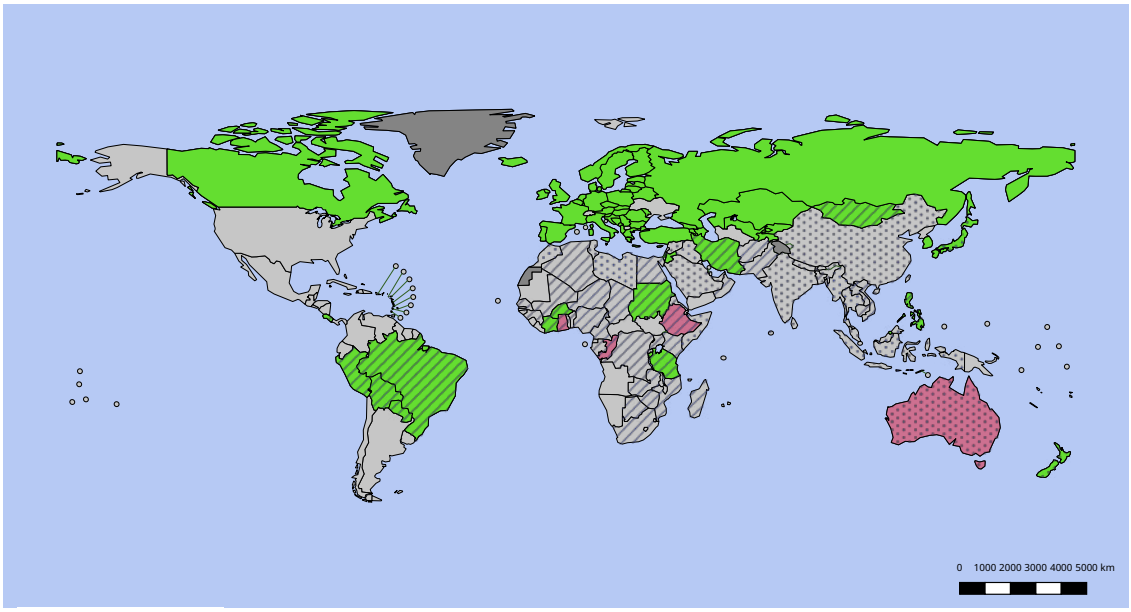


Table 2.1 Countries and areas submitting national data on antimicrobial consumption to WHO based on the WHO methodology or a comparable methodology[a]

WHO Region	Countries and areas in the region	Countries and areas submitting data	Countries and areas included in the report	
	No.	No.	No.	%
African Region	47	6	4	9
Region of the Americas	35	6	6	17
South-East Asia Region	11	0	0	0
European Region	54	46	46	85

(continue)

WHO Region	Countries and areas in the region	Countries and areas submitting data	Countries and areas included in the report	
	No.	No.	No.	%
Eastern Mediterranean Region	21	3	3	14
Western Pacific Region	27	7	6	22

[a] *Data for countries of the EU/EEA that participate in ESAC-Net were shared with WHO based on the European Surveillance System (TESSy) data request.*

This WHO report presents data on antimicrobial consumption from 65 countries. Table 2.1 shows that the proportion of countries included in the report by WHO region ranges from 0% to 85%. Two countries from the African Region, and one country from the Western Pacific Region submitted data to WHO but are not included in the report due to issues related to their data format, coverage or quality. In the South-East Asia Region, no country submitted data for this report. However, efforts are ongoing to set up national surveillance systems to collect and report data on antimicrobial consumption in several South-East Asia countries, for example Bangladesh, India and Thailand.

Furthermore, other countries may have national surveillance systems for antimicrobial consumption in place, but are yet to submit their data to WHO. More details on the types of national surveillance systems for antimicrobial consumption and use are presented in the results section.


SECTION
03

3 Methods

This report presents data on national consumption of antibiotics for systemic use from 65 countries and areas, and documents the current status of the implementation of the WHO global programme on surveillance of antimicrobial consumption.

3.1 Definition of consumption and use

In this report, the term *consumption* refers to estimates of aggregated data, mainly derived from import, sales or reimbursement databases. Aggregated data on antimicrobial consumption, often collected for administrative purposes, are usually easily accessible and can serve as a proxy for actual use of antibiotics, for which data collection is often more laborious.

The term antibiotic *use* refers to data on antibiotics taken by the individual patients. Data are collected at the patient level, which allows a more comprehensive set of data to be gathered, such as information on indication, treatment schemes and patient characteristics. In general, the collection of data on antibiotic use requires more resources but provides additional information on prescribing practices, which is important for guiding antimicrobial stewardship activities.

Data on consumption and use each serve specific purposes and complement rather than replace each other.

3.2 Data collection

The consumption data in this report were collated according to the *WHO methodology for a global programme on surveillance of antimicrobial consumption (34),* hereafter referred to as the WHO global methodology. Consumption data that were collected through a standardized protocol comparable with the WHO global methodology were also utilized, including data collected through ESAC-Net, the Antimicrobial Medicines Consumption Network managed by the WHO Regional Office for Europe, and the surveillance programmes on antimicrobial consumption in Canada, Japan, New Zealand and the Republic of Korea.

According to the WHO protocol, data are collected at the product level (proprietary and generic products) and comprise information on the active substance(s) of the product, route of administration, strength per unit, number of units per package and total number of packages consumed. Data collection is facilitated by means of a standard *Excel* template with functions to calculate volume and consumption for each product. The template was shared with all Member States submitting consumption data to the WHO, but some Member States and networks such as the ESAC-Net with long experience in monitoring antimicrobial consumption at the national level delivered data aggregated at the substance level. Data on antimicrobial consumption provided by ECDC from EU and EEA/EFTA countries participating in ESAC-Net has been extracted from the European Surveillance System (TESSy).

All datasets submitted to WHO were validated through functions in the WHO *Excel* template and through manual row-by-row review of the antibiotic products in order to detect inconsistencies. When necessary, country focal points were consulted to confirm the revisions.

In this initial round of data collection, countries were requested to provide data from 2014 to 2016. Several countries were collecting data on antimicrobial consumption for the first time and were not able to provide data for multiple years. This report, therefore, presents data on antimicrobial consumption for 2015. For countries that did not provide data for this year, 2016 estimates were used as a replacement.

3.3 Anatomical Therapeutic Chemical/Defined Daily Dose classification system

The WHO global methodology uses the Anatomical Therapeutic Chemical (ATC) classification system to distinguish between pharmacological subgroups and substances of antimicrobials. The ATC system classifies active pharmacological substances based on the organ or system on which they act, and their therapeutic, pharmacological and chemical properties.

To measure the consumption of antimicrobials, the methodology uses the number of defined daily doses (DDDs). The DDD is the assumed average maintenance dose per day of an antimicrobial substance(s) used for its main indication in adults, and is assigned to active ingredients with an existing ATC code. As a rule, the DDDs for antimicrobials are based on treatment for infections of moderate severity. To adjust for population size, the consumption is usually presented as number of DDDs per 1000 inhabitants per day. This metric can be roughly interpreted as the number of individuals per 1000 inhabitants on antibiotic treatment per day.

The ATC/DDD system is maintained by the WHO Collaborating Centre for Drug Statistics Methodology, which updates the system continuously to account for new pharmaceutical substances entering the market or existing substances that are not yet captured by the system *(46)*. Because of the continuous revisions, it is essential to report the version of the ATC/DDD used to calculate consumption when comparisons are made over time and between countries.

This report uses the ATC/DDD version for 2018, including changes planned for the 2019 version since a comprehensive revision of DDD values for common antimicrobials will be made in the next version of the ATC/DDD *(47)*. Consequently, comparisons with estimates from other publications on antimicrobial consumption should be interpreted with caution. Annex 1 summarizes the ATC and DDD values used in this report.

3.4 Antimicrobials monitored

The WHO global programme on surveillance of antimicrobial consumption monitors antimicrobials for systemic use and includes a core set of antimicrobial classes to be monitored in all national surveillance programmes. Additionally, countries may choose to include additional antimicrobials according to need and resources. Table 3.1 lists the mandatory (core) and optional antimicrobial classes to monitor.

Table 3.1 Core and optional classes of antimicrobials in the WHO global surveillance programme of antimicrobial consumption

Class of antimicrobials	ATC	Monitoring
Antibacterials for systemic use	J01	
Antibiotics for intestinal tract	A07AA	**Core**
Nitroimidazole derivates	P01AB	
Antimycotics for systemic use	J02	
Antifungals for systemic use (dermatologicals)	D01BA	
Antivirals for systemic use	J05	**Optional**
Antimycobacterials for treatment of tuberculosis	J04A	
Antimalarials	P01B	

Antimicrobials that are administered topically or for other localized use are excluded from the surveillance programme. These include, amongst others, antimicrobials in the ATC classes starting with D (topical), S (opthalmological, otological) and G (gynaecological).

This report presents consumption data of the core antimicrobial classes monitored, specifically J01 (systemic antibiotics), P01AB (oral nitroimidazoles) and A07AA09, A07AA11 and A07AA12 (oral vancomycin, rifaximin and fidaxomicin). Some countries also submitted data from other classes of antimicrobials, but they are not included in this report.

3.5 Data sources

Consumption data can be retrieved from a number of sources. The most common data sources are:

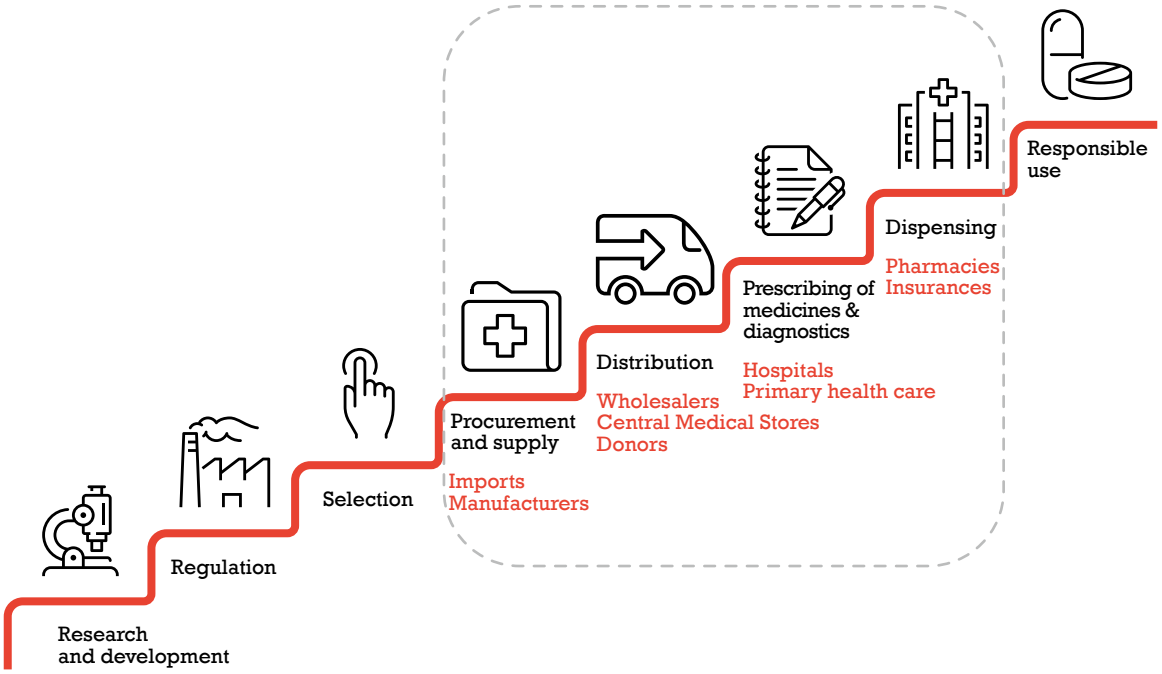
- Import records: for example from custom records and declaration forms;
- Production records from domestic manufacturers;
- Wholesaler records: both procurement data by the wholesaler or sales data from wholesaler to health care facilities and pharmacies;
- Public sector procurement: from centralized or decentralized purchasing of medicines for the public sector, e.g. records from central medical stores;
- Donation records: usually related to specific programmes (e.g. HIV, TB and malaria) or specific populations (e.g. migrants and refugees). This may be captured by public sector procurement, if donated medicines go through the central medical stores;
- Dispensing records: for example records from community and hospital pharmacies and licensed drug stores;
- Insurance and reimbursement records: data from health insurance schemes based on reimbursement of medicines;
- Prescribing data: from either physician records or patient-based dispensing data from pharmacies;
- Commercial data sources: for example IQVIA (previously IMS). Data from commercial sources are included in this report, if data was purchased and endorsed by countries for national surveillance purposes.

In order to reach complete coverage at the national level, it may be necessary to combine different data sources. For example, import records can be coupled with production records from domestic manufacturers, and records from public sector procurement can be combined with those from private wholesalers.

Fig. 3.1 illustrates potential data sources along the life cycle of medicines. The closer the data source is to the end user, the more accurate is the estimate but the more laborious it may be to achieve complete national coverage because data often have to be obtained from many different stakeholders and data sources. For example, while import data can often be retrieved from one or a few administrative registers maintained by government institutions, dispensing data may require contact with individual pharmacies and health facilities if no national system is in place that automatically captures the information. The strengths and limitations of common data sources are given in Annex 2.

For this report, data are collected from official channels and no data explicitly capturing antimicrobials circulating on the informal market have been obtained. Consequently, for countries in which the informal market is significant, only an incomplete picture of antibiotic consumption can be presented.

Fig. 3.1 **Potential data sources along the life cycle of medicines**



3.6 Health care sectors monitored

This report presents antibiotic consumption data at the national level. Depending on the data sources underlying the national surveillance system on antimicrobial consumption, the estimates may be disaggregated by health care sector (community/hospital), health care provider (public/private) or geographical location. In cases where countries only reported consumption data from one of the sectors (mostly community sector or public sector alone), it has been highlighted through footnotes in the figures and tables of the report.

3.7 Other surveillance networks contributing data to WHO on antibiotic consumption

Before the WHO global programme, other national and regional monitoring systems of antimicrobial consumption were in place. Data from some of these networks and national surveillance programmes are included in the report (Table 3.2).

Table 3.2 **National and regional monitoring systems of antimicrobial consumption**

Organization/country	Network/surveillance system	Description
European Centre for Disease Prevention and Control	European Surveillance of Antimicrobial Consumption Network	Collects and reports data on consumption of systemic antimicrobials in the community and hospital sector from 30 EU and EEA countries (Norway and Iceland) *(32)*
WHO Regional Office for Europe	Antimicrobial Medicines Consumption Network	Collects and reports data from 18 non-EU countries and predates the WHO global surveillance programme *(33)*
Canada	Canadian Antimicrobial Resistance Surveillance System	Monitors antimicrobial consumption and antimicrobial resistance in humans and food-producing animals *(48)*. Only antibiotics from the ATC group J01 are included.
Japan	Japanese Antimicrobial Consumption Surveillance	Collects nationwide data on antimicrobial consumption *(49)*. Only antibiotics from the ATC group J01 are included.

(continue)

Organization/country	Network/surveillance system	Description
New Zealand	Antibiotic consumption in New Zealand (Institute of Environmental Science and Research Ltd)	Monitors antibiotic consumption in the community *(50)*. Only antibiotics from the ATC group J01 are included.
Republic of Korea	Antimicrobial consumption in the Republic of Korea	Monitors antibiotic consumption in the community and hospital sector *(51)*.

EU = European Union, EEA = European Economic Area, ATC = Anatomical Therapeutic Chemical.

3.8 Metrics and indicators reported

The report presents the volume of antibiotics consumed using two metrics: DDD and the weight of the antibiotic substances in metric tonnes (t). The second metric can be used for comparison with antimicrobial consumption in the animal sector.

Antibiotic consumption is presented using the following key indicators:

- Quantity of antibiotics as DDD per 1000 inhabitants per day for total consumption and by pharmacological subgroup (ATC3);
- Quantity of antibiotics as weight in tonnes for total consumption;
- Relative consumption of antibiotics as a percentage of total consumption by route of administration (oral, parenteral, rectal and inhaled) and AWaRe categories (Access, Watch and Reserve) *(1)*;
- List of the most frequently used antibiotic substances comprising 75% of the total consumption, stratified by route of administration-Drug Utilization 75 (DU75).

Absolute and relative consumption figures are presented separately by region in graphs and tables (Section 4 and Annexes 4-8) .

3.9 Calculation of metrics and indicators

The number of DDDs consumed for each antibiotic substance was calculated by dividing the amount consumed in grams of the substance by the DDD value assigned to that substance:

Number of DDDs = grams of active substance / substance-specific DDD

Annex 1 summarizes all the ATC and DDD values used in this report.

The total amount in grams is obtained by multiplying the strength of each tablet or vial by the number of units per package and the number of packages consumed. The DDD value is mostly specified in grams, but can also be defined as MU (million units) for certain substances.

For combinations of antibiotics with two or more active ingredients, the DDD value is specified as UD (unit dose). One tablet of a combination product with a specific strength is defined as one UD. To obtain the DDD consumed of a specific combination product, the total number of UDs is divided by the assigned DDD value. A list of combination products with specified strengths and their assigned DDD values are compiled by the WHO Collaborating Centre for Drug Statistics Methodology *(46)*.

For countries that delivered data at the substance level and by DDD, a reverse calculation was done using DDD values to obtain the total number of tonnes.

The denominator (population size) for each country was obtained from the 2017 version of the World Population Prospects database for all countries but Member States of the ESAC-Net where specific populations specified by the data provider (European Centre for Disease Prevention and Control) was used *(52)*. The population denominator of Serbia does not include Kosovo, as this is presented separately. The World Bank population database was used for the the other countries and areas of the WHO European region, as these denominators have been approved since previously by the countries and areas through the WHO European Regional Office *(53)*. In most cases, the World Bank population database and the World Population Prospects database presents the same population denominator, with the exception of three countries: Georgia, Republic of Moldova, and Serbia. For these

countries, the population denominators referenced in the report are derived from the World Bank population database. For countries with incomplete data coverage, no adjustment of the population denominator has been performed when calculating consumption with the exception of the Plurinational State of Bolivia, Paraguay and Peru.

To obtain the DU75 by region, antibiotic substances accounting for 75% of the consumption measured in DDD were listed by route of administration for each country. All substances that appeared on the DU75 lists in countries within a region were compiled into a region-specific list for oral substances and parenteral substances, respectively. For each antibiotic substance on the regional DU75 list, the report presents the number of countries for which the specific substance appears on the country-specific DU75 list, as well as the percentage of the total consumption it accounts for in those specific countries (as median and interquartile range (IQR)).

3.10 AWaRe categorization

In the 2017 revision of the WHO Model List of Essential Medicines, antibiotics in the list were grouped into three AWaRe categories: Access, Watch and Reserve *(1)*. The Access category includes first and second choice antibiotics for the empirical treatment of common infectious syndromes and they should be widely available in health care settings. Antibiotics in the Watch category have a higher potential for resistance to develop and their use as first and second choice treatment should be limited. Finally, the Reserve category includes "last resort" antibiotics whose use should be reserved for specialized settings and specific cases where alternative treatments have failed.

This report presents the consumption data grouped according to AWaRe categorization. Antibiotics that are not included in the WHO Model List of Essential Medicines have not yet been categorized, and are reported as "Other". This should not be confused with antibiotic substances in the ATC group J01X (Other Antibacterials). Annex 3 presents the antibiotic subgroups and substances and their respective ATC codes according to the AWaRe categorization.

3.11 Socioeconomic and health contexts

Additional information describing the broader socioeconomic and health context in the regions that are of relevance to interpretation of antimicrobial consumption data has also been included *(54)*. The list of indicators for the contextual information, along with their definitions and data sources, are presented in Table 3.3. In addition, information on the status of implementation of national action plans on AMR and the progress of surveillance efforts on AMR and antibiotic consumption in each region are reported.

Table 3.3 **Characteristics and indicators related to the broader context for antimicrobial consumption**

Demographic and socio economic characteristics *(52,55)*
Indicator: gross national income per capita • Low-income country: gross national income (GNI) per capita < US$ 1025 • Middle-income country: GNI per capita US$ 1026-$ 12 475 • High-income country: GNI per capita > US$ 12 476
Regional health status *(56)*
Indicator: infectious diseases among the 10 leading causes of death
Regional health system - Health expenditure *(57,58)*
Indicator: average domestic general government health expenditure per capita (US$)
Indicator: average of current health expenditure as % of gross domestic product
Indicator: average of domestic general government health expenditure as % of current health expenditure
Indicator: average out of pocket expenditure as % of current health expenditure
Indicator: total population with household expenditure on health greater than 10% of total household expenditure or income (%)
Indicator of health spending: total population with household expenditure on health greater than 25% of total household expenditure or income (%)
Country progress in implementing a national action plan for AMR – AMC component *(59)*
• Country progress with development of a national action plan on AMR • National Monitoring System for Antimicrobials Use/Consumption - Human Health


SECTION
04

4 Results

4.1 Overview

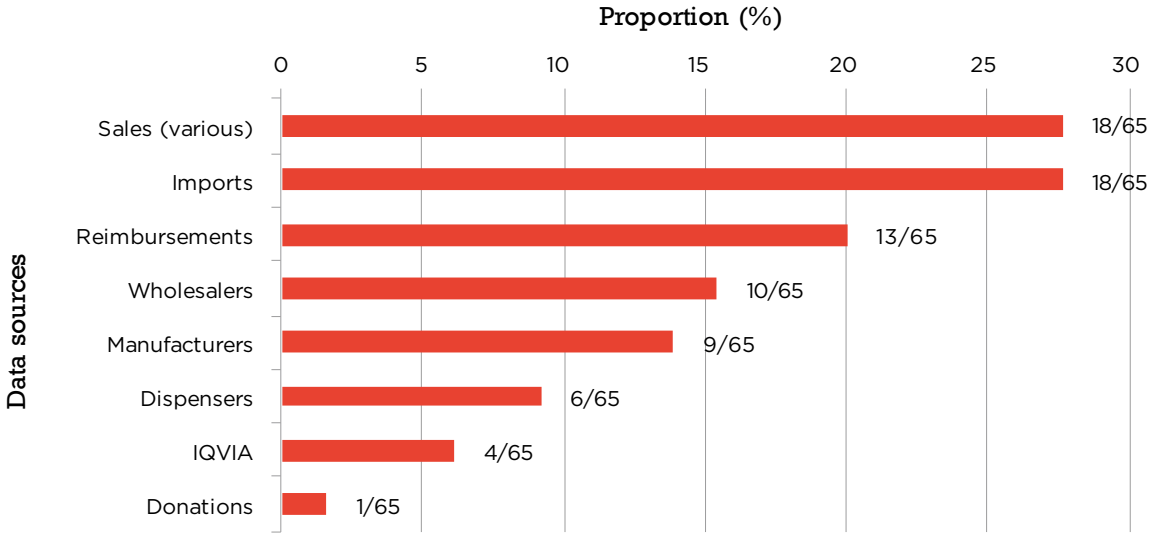
This report includes estimates of antibiotic consumption from 65 countries and areas: four from the African Region, six from the Region of the Americas, 46 from the European Region: three from the Eastern Mediterranian Region and six from the Western Pacific Region. All of these countries provided data for 2015, with the exception of Plurinational State of Bolivia, Brazil, Costa Rica, Paraguay, Peru and the United Republic of Tanzania which contributed data for 2016. Sections 4.2 to 4.7 present the results for each WHO region.

4.1.1 Data sources and health care sectors

Sales of antibiotics and import records were the most common sources of the data (Fig. 4.1). Sixteen countries combined different data sources in order to obtain a more comprehensive coverage. A combination of import and manufacturing data was the most common approach and especially important in countries with substantial local manufacturing of medicines. Six countries used dispensing data and 14 used reimbursement data, either as the sole data source or in combination with sales data, mostly from the European Region (Table 4.1).

Countries chose to provide either total consumption of antibiotics at the national level or separated by health care sector: public versus private sector, or hospital versus community consumption. Where available, this report presents total consumption of antibiotics at the national level. Six countries (Austria, Czech Republic, Germany, Iceland, Spain, New Zealand) provided data from the community sector alone and six countries (Plurinational State of Bolivia, Brunei Darussalam, Burundi, Costa Rica, Paraguay and Peru) provided only public sector data. For these countries, the estimates represent antimicrobial consumption in the community or public sector only. Table 4.1 summarizes by country the available data sources and health care sectors from where data were retrieved.

Fig. 4.1 Data sources used for national estimates of antimicrobial consumption in 65 countries and areas*



*Multiple entries are possible

Table 4.1 Countries and areas that submitted data on national consumption of antimicrobials, including data sources and the health care sectors by which data can be disaggregated

Country or area	Year	Data source	Sector			Method/ programme
			Total	Hospital	Community	
African Region						
Burkina Faso	2015	Wholesalers	X	–	–	WHO
Burundi[a]	2015	Wholesalers (central medical store)	X	–	–	WHO
Côte d'Ivoire	2015	Wholesalers (central medical store and private wholesalers) and donations	X	–	–	WHO
United Republic of Tanzania	2016	Imports	X	–	–	WHO
Region of the Americas						
Bolivia (Plurinational State of)[a,b]	2016	Dispensers	X	–	–	WHO
Brazil	2016	Manufacturers	X	X	X	WHO
Canada	2015	Dispensers and hospital procurement	X	X	X	CARSS
Costa Rica[a]	2016	Wholesalers	X	–	–	WHO
Paraguay[a,b]	2016	Wholesalers	X	X	X	WHO
Peru[a,b]	2016	Dispensers	X	–	–	WHO
European Region						
Albania	2015	Imports	X	–	–	WHO
Armenia	2015	Imports and local manufacturers	X	–	–	WHO
Austria[d]	2015	Reimbursements	–	–	X	ECDC
Azerbaijan	2015	Imports	X	–	–	WHO
Belarus	2015	Imports and local manufacturers	X	–	–	WHO
Belgium	2015	Reimbursements	X	X	X	ECDC
Bosnia and Herzegovina	2015	Wholesalers and local manufacturers	X	–	–	WHO
Bulgaria	2015	Sales	X	X	X	ECDC
Croatia	2015	Reimbursements	X	X	X	ECDC
Cyprus	2015	Sales	X	X	X	ECDC
Czech Republic[d]	2015	Reimbursements	–	–	X	ECDC
Denmark	2015	Sales	X	X	X	ECDC
Estonia	2015	Sales	X	X	X	ECDC
Finland	2015	Sales	X	X	X	ECDC
France	2015	Sales	X	X	X	ECDC
Georgia	2015	Imports	X	–	–	WHO
Germany[d]	2015	Reimbursements	–	–	X	ECDC
Greece	2015	Sales	X	X	X	ECDC
Hungary	2015	Sales	X	X	X	ECDC
Iceland[d]	2015	Sales	–	–	X	ECDC
Ireland	2015	Reimbursements and sales	X	X	X	ECDC
Italy	2015	Reimbursements and sales	X	X	X	ECDC
Kazakhstan	2015	Dispensers and hospital procurement	X	X	X	WHO
Kosovo[e]	2015	Imports	X	–	–	WHO
Kyrgyzstan	2015	Imports and local manufacturers	X	–	–	WHO

(continue)

Country or area	Year	Data source	Sector			Method/ programme
			Total	Hospital	Community	
Latvia	2015	Sales	X	X	X	ECDC
Lithuania	2015	Sales	X	X	X	ECDC
Luxembourg	2015	Reimbursements and sales	X	X	X	ECDC
Malta	2015	Sales	X	X	X	ECDC
Montenegro	2015	Imports	X	X	X	WHO
Netherlands	2015	Sales	X	X	X	ECDC
Norway	2015	Sales	X	X	X	ECDC
Poland	2015	Sales	X	X	X	ECDC
Portugal	2015	Reimbursements	X	X	X	ECDC
Republic of Moldova	2015	Imports and local manufacturers	X	–	–	WHO
Romania	2015	Sales	X	X	X	ECDC
Russian Federation	2015	IQVIA MIDAS	X	X	X	WHO
Serbia	2015	Wholesalers (marketing authorization holders)	X	–	–	WHO
Slovakia	2015	Sales	X	X	X	ECDC
Slovenia	2015	Reimbursements	X	X	X	ECDC
Spain[d]	2015	Reimbursements	–	–	X	ECDC
Sweden	2015	Sales	X	X	X	ECDC
Tajikistan	2015	Imports and certification records	X	–	–	WHO
Turkey	2015	IQVIA MIDAS and wholesalers	X	–	–	WHO
United Kingdom (The)	2015	Reimbursements	X	X	X	ECDC
Uzbekistan	2015	Manufacturers	X	–	–	WHO
Eastern Mediterranean Region						
Iran (Islamic Republic of)	2015	Wholesalers	X	–	–	WHO
Jordan[c]	2015	Imports	X	–	–	WHO
Sudan	2015	Imports and local manufacturers	X	–	–	WHO
Western Pacific Region						
Brunei Darussalam[a]	2015	Dispensers	X	–	–	WHO
Japan	2015	IQVIA MIDAS	X	–	–	JACS
Mongolia	2015	Imports and local manufacturers	X	–	–	WHO
New Zealand[d]	2015	Dispensers (reimbursements)	–	–	X	ESR
Philippines	2015	IQVIA MIDAS and imports	X	–	–	WHO
Republic of Korea	2015	Reimbursements (insurance) and wholesalers	X	–	–	HIRA

CARSS = Canadian Antimicrobial Resistance Surveillance System, ECDC = European Centre for Disease Prevention and Control, ESR = Institute of Environmental Science and Research, HIRA = Health Insurance Review & Assessment Service, JACS = Japanese Antimicrobial Consumption Surveillance, WHO = World Health Organization.

[a] *Only public sector reported.*

[b] *Coverage of antimicrobial consumption estimated to be 70% or less, population-adjusted.*

[c] *Coverage of antimicrobial consumption estimated to be 70% or less, not population-adjusted.*

[d] *Only community consumption reported.*

[e] *In accordance with Security Council Resolution 1244 (1999).*

4.1.2 Total consumption of antibiotics

The consumption of total antibiotics in Defined Daily Doses, in DDD per 1000 inhabitants per day and in metric tonnes for the 65 countries and areas included in this report are presented in Table 4.2. Overall consumption of antibiotics in these 65 countries and areas ranged from 4.4 to 64.4 DDD per 1000 inhabitants per day. The overall absolute weight (not adjusted by population size) varied from 1 tonne to 2225 tonnes per year.

Table 4.2 Total consumption of antibiotics, including J01, P01AB, A07AA09, A07AA11-12 according to the ATC/DDD classification system, in 65 countries and areas

Country or area	Year	DDD	DDD/1000 inhabitants per day	Metric tonnes
African Region				
Burkina Faso	2015	91 114 955	**13.78**	136.4
Burundi[a]	2015	16 533 614	**4.44**	56.39
Côte d'Ivoire	2015	90 050 956	**10.68**	134.82
United Republic of Tanzania[b]	2016	553 622 340	**27.29**	712.46
Region of the Americas				
Bolivia (Plurinational State of)[a,b,c]	2016	15 400 592	**19.57**	22.14
Brazil[b]	2016	1 724 124 919	**22.75**	2225.47
Canada	2015	223 101 184	**17.05**	242.69
Costa Rica[a,b]	2016	25 143 759	**14.18**	30.17
Paraguay[a,b,c]	2016	31 825 441	**19.38**	36.45
Peru[a,b,c]	2016	71 432 278	**10.26**	94.63
European Region				
Albania	2015	17 251 602	**16.41**	18.17
Armenia	2015	10 981 069	**10.31**	14.39
Austria[e]	2015	38 081 745	**12.17**	38.84
Azerbaijan	2015	26 995 944	**7.66**	36.45
Belarus	2015	60 556 399	**17.48**	68.88
Belgium	2015	104 860 173	**25.57**	112.95
Bosnia and Herzegovina	2015	23 033 283	**17.85**	28.66
Bulgaria	2015	53 233 312	**20.25**	52.18
Croatia	2015	31 280 578	**20.28**	35.27
Cyprus	2015	8 389 248	**27.14**	8.10
Czech Republic[e]	2015	66 073 164	**17.18**	67.87
Denmark	2015	36 848 791	**17.84**	53.25
Estonia	2015	5 822 060	**12.13**	6.30
Finland	2015	36 983 121	**18.52**	47.21
France	2015	628 986 424	**25.92**	764.02
Georgia	2015	33 152 652	**24.44**	33.04
Germany[e]	2015	340 449 193	**11.49**	290.85
Greece	2015	134 139 320	**33.85**	139.18
Hungary	2015	58 664 563	**16.31**	57.27
Iceland[e]	2015	2 146 458	**17.87**	2.18
Ireland	2015	39 318 933	**23.27**	50.22
Italy	2015	590 686 917	**26.62**	662.47
Kazakhstan	2015	114 558 903	**17.89**	162.22
Kosovo[f]	2015	13 271 382	**20.18**	16.62
Kyrgyzstan	2015	39 013 935	**17.94**	77.30

(continue)

Country or area	Year	DDD	DDD/1000 inhabitants per day	Metric tonnes
Latvia	2015	9 644 074	**13.3**	10.93
Lithuania	2015	16 877 454	**15.83**	19.87
Luxembourg	2015	4 583 651	**22.31**	4.92
Malta	2015	3 428 658	**21.88**	3.55
Montenegro	2015	6 660 880	**29.33**	7.97
Netherlands	2015	60 338 150	**9.78**	55.66
Norway	2015	31 998 795	**16.97**	46.35
Poland	2015	337 067 701	**24.3**	306.61
Portugal	2015	67 089 554	**17.72**	79.84
Republic of Moldova	2015	17 411 914	**13.42**	20.87
Romania	2015	206 717 694	**28.5**	253.28
Russian Federation	2015	779 270 524	**14.82**	915.65
Serbia	2015	81 762 868	**31.57**	98.34
Slovakia	2015	48 154 016	**24.34**	49.55
Slovenia	2015	10 152 289	**13.48**	14.07
Spain[e]	2015	304 475 774	**17.96**	343.91
Sweden	2015	48 834 144	**13.73**	72.70
Tajikistan	2015	68 493 070	**21.95**	121.12
Turkey	2015	1 090 722 974	**38.18**	1195.69
United Kingdom (The)	2015	484 761 369	**20.47**	535.37
Uzbekistan	2015	97 762 994	**8.56**	185.90
Eastern Mediterranean Region				
Iran (Islamic Republic of)	2015	1 123 329 829	**38.78**	1178.61
Jordan[d]	2015	29 836 359	**8.92**	21.23
Sudan	2015	497 782 564	**35.29**	675.75
Western Pacific Region				
Brunei Darussalam[a]	2015	901 761	**5.92**	1.13
Japan	2015	658 400 748	**14.19**	524.9
Mongolia	2015	69 986 355	**64.41**	133.24
New Zealand[e]	2015	38 036 523	**22.68**	36.85
Philippines	2015	304 852 740	**8.21**	260.55
Republic of Korea	2015	515 342 775	**27.68**	546.37

[a] *Only public sector reported.*
[b] *Data from 2016.*
[c] *Coverage of antimicrobial consumption estimated to be 70% or less, population-adjusted.*
[d] *Coverage of antimicrobial consumption estimated to be 70% or less, not population-adjusted.*
[e] *Only community consumption reported.*
[f] *In accordance with Security Council Resolution 1244 (1999).*

4.2 WHO African Region

4.2.1 Contextual indicators and activities

Demography and socioeconomic characteristics

The size of the population (in thousands) living in the WHO African Region in 2015 was 993 163 *(52)*. Of the 47 Member States of the African Region, 26 are low-income countries, 20 are middle-income and one is a high-income country *(55)*.

Regional health status

Table 4.3 Causes of death from infectious diseases among the top 10 causes of death in the African Region, 2015 *(56)*

Rank	Cause	Deaths (000s)	% of total deaths	Crude death rate per 100 000 population
	All causes	8 843	100.0	890.4
1	Lower respiratory infections	991	11.2	92
2	HIV/AIDS	759	8.6	76
3	Diarrhoeal diseases	664	7.5	67
5	Malaria	419	4.7	42
6	Tuberculosis	408	4.6	41
	Sum of above listed infections	**3 248**	**36.6**	**318**

Regional health systems – health expenditure

Table 4.4 Health financing indicators (aggregated average and range) in *the* African Region 2015 *(57)*

Indicator	Average	Range
Domestic general government health expenditure per capita (US$)	55.8	2.1–477.0
Current health expenditure as % of gross domestic product	6.2	2.5–18.3
Domestic general government health expenditure as % of current health expenditure	33.8	7.4–97.0
Out-of-pocket expenditure as % of current health expenditure	34.9	2.5–74.8

Out-of-pocket spending

In 2010, 10.3% of the total population of the region reported health expenditure exceeding 10% of total household expenditure, and 2.6% reported health spending (exceeding 25% of total household expenditure) *(58)*.

Progress in implementing national action plans – antimicrobial consumption component

In 2016–2017, 14 countries of the African Region reported to have a national action plan for AMR *(59)*. Additionally, nine countries reported that they were monitoring antibiotic consumption or use in some manner (Table 4.5).

Table 4.5 Types of national monitoring system of human antimicrobial use in the African Region, 2016 (Question 7.1 in the country self-assessment questionnaire) *(59)*

Survey response	Number of countries
No national plan or system for monitoring the use of antimicrobials	16
System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics and rational use of antibiotics in health services	6
Total sales of antimicrobials are monitored at the national level and/or some monitoring of antibiotic use at a subnational level	3

(continue)

Survey response	Number of countries
Prescribing practices and antibiotic use are monitored in a national sample of health care settings	0
On a regular basis (every year/2 years) data are collected and reported on: a) antimicrobial sales or consumption at the national level for human use b) antibiotic prescribing and appropriate use in a representative sample of health facilities, public and private	0
Non-response to question 7.1	2
Non-response to country self-assessment questionnaire	20

Regional and national activities to measure antimicrobial consumption and use

Between 2016 and 2018, the Regional Office for Africa conducted trainings on the preparation and follow-up of national action plans on AMR and 295 regional experts were trained during this period. At the same time, four regional courses on monitoring antimicrobial consumption were held in Mozambique, Burkina Faso and Côte d'Ivoire. This coincided with the period when countries were taking action to establish their stewardship programmes, and monitor and promote optimal antimicrobial use at the national level in accordance with international standards. These training activities promote shared understanding amongst important stakeholders in countries and enable WHO staff to provide adequate technical support to adopt and adapt the national action plan for AMR in countries, including activities on antimicrobial consumption.

In addition, two point prevalence surveys on antimicrobial use in hospitals were carried out in Botswana and Zimbabwe between 2016 and 2017. In 2018, three countries - Côte d'Ivoire, Mauritius and the United Republic of Tanzania - piloted the *WHO Methodology for Point Prevalence Surveys on Antibiotic Use in Hospitals*. The data are now being analysed, and these will inform decision-makers and stakeholders on strategies to promote the appropriate use of antibiotics and access to these medicines.

In September 2018 two regional trainings on the WHO methodology for surveillance of antimicrobial consumption and WHO methodology for point prevalence surveys on antibiotic use in hospitals were conducted in Zimbabwe.

The training on WHO global methodology on monitoring antimicrobial consumption involved 22 English- and French-speaking African countries (Algeria, Benin, Burkina Faso, Cameroon, Chad, Comoros, Democratic Republic of the Congo, Eritrea, Gabon, Guinea, Kenya, Madagascar, Mali, Mauritius, Niger, Nigeria, Rwanda, Sierra Leone, South Africa, Togo, Uganda and Zambia). During the workshop, most countries developed an operational plan for implementing national consumption monitoring of antimicrobials in their countries. Some countries also considered the monitoring of antimicrobial consumption in hospitals.

The training on the WHO methodology for point prevalence surveys involved 11 English- and French-speaking African countries (Botswana, Burkina Faso, Burundi, Cameroon, Côte d'Ivoire, Kenya, Madagascar, Mozambique, Nigeria, United Republic of Tanzania, Zimbabwe). During the training, all countries developed an operational plan for conducting national surveys in five to ten hospitals, with activities starting by the end of 2018 or beginning of 2019, and final data submission and reporting finishing by September 2019.

WHO offices across the African Region have also participated in the World Awareness Antibiotics Week since its inception in 2016, through dissemination of harmonized messages and organization of campaigns to raise awareness among communities and health practitioners, notably in Burundi, Congo and Mali. High-level commitment to combat AMR was confirmed at the launch of Ghana's national action plan by the president of Ghana, and the endorsement and launch of the Korea International Cooperation Agency (KOICA) project by the Minister of Health and Public Hygiene in Mali.

These regional efforts are, however, hampered by various challenges: inequity in access and outcomes within and between countries, fragmented and poorly sustained health investments that do not take account of needs and contexts, and the huge cost of ill health for African countries.

4.2.2 Data on antibiotic consumption in the African Region

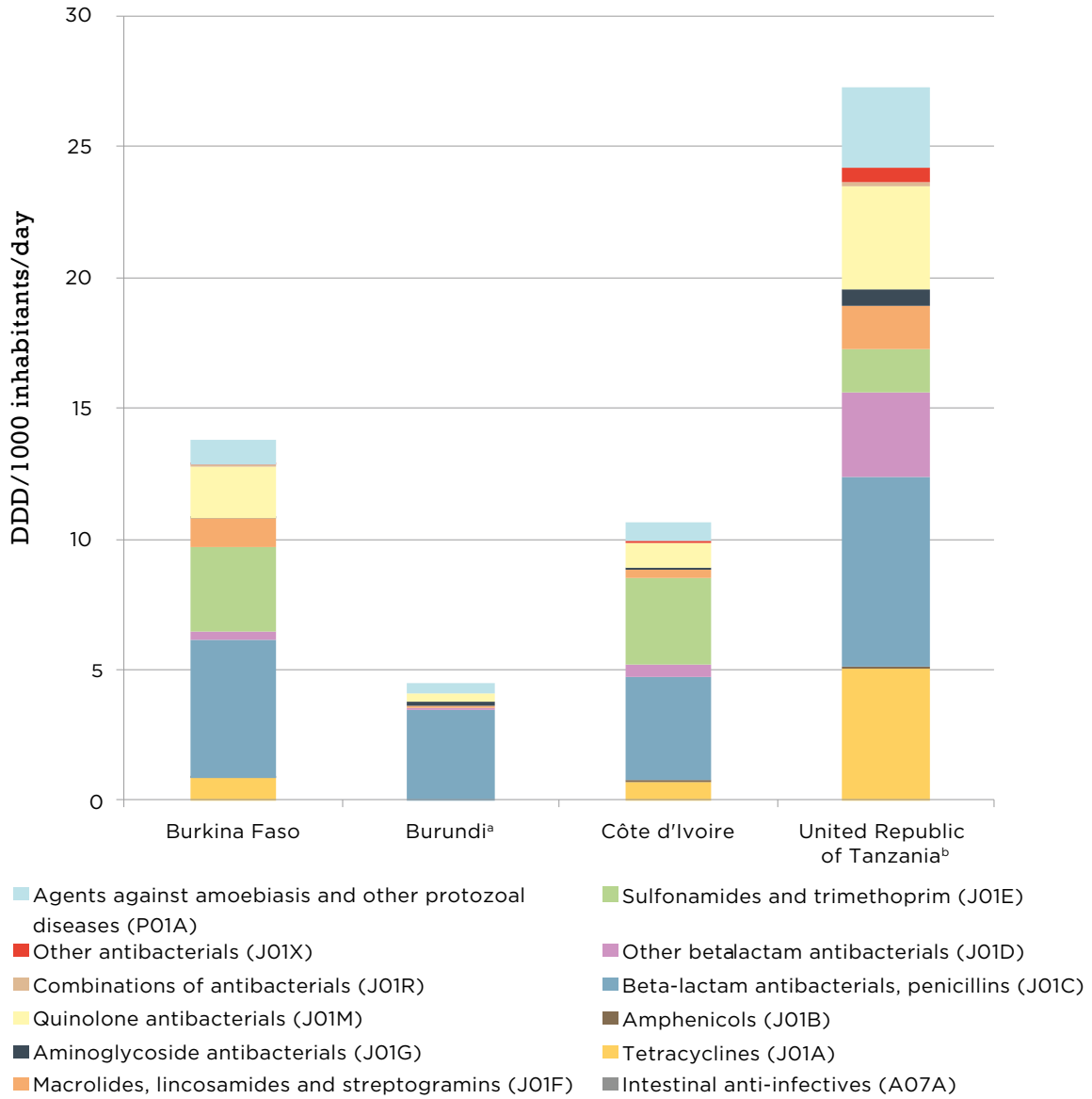
Data on antibiotic consumption are presented for four countries of the African Region: Burkina Faso, Burundi, Côte d'Ivoire and the

United Republic of Tanzania. The countries submitted sales data from wholesalers for 2015, except for the United Republic of Tanzania that provided data from 2016 based on imports.

The total antibiotic consumption was highest for the United Republic of Tanzania (27.3 DDD per 1000 inhabitants per day) followed by Burkina Faso (13.8 DDD per 1000 inhabitants per day), Côte d'Ivoire (10.7 DDD per 1000 inhabitants per day) and Burundi (4.4 DDD per 1000 inhabitants per day). The low consumption in Burundi can be partially explained by the limited data coverage as at this stage data were only retrieved from the central medical store mainly providing medicines to the public sector, including many hospitals. Therefore, the results from Burundi represent mostly consumption in the hospital sector.

Consumption according to pharmacological subgroup for the four countries is presented in Figure 4.2. The patterns of antibiotic consumption were largely similar for Burkina Faso and Côte d'Ivoire, where penicillins (J01C) accounted for nearly 40% of all consumption, followed by sulfonamides and trimethoprim (J01E) (24% in Burkina Faso and 31% in Côte d'Ivoire). In the United Republic of Tanzania, penicillins (J01C) accounted for 27% of total consumption followed by tetracyclines (J01A) (18%) and quinolones (J01M) (14%). In Burundi, where mainly the hospital sector is represented, penicillins (J01C) were by far the most frequently consumed antibiotic subgroup (78%). Detailed data on the consumption of total antibiotics and pharmaceutical subgroups by country can be found in Annex 4 (Table A4.1).

Fig. 4.2 Consumption of antibiotics (DDD per 1000 inhabitants per day) by pharmacological subgroup in four countries of the African Region (2015)



[a] *Only public sector reported.*

[b] *Data from 2016.*

In all countries but Burundi, oral formulations accounted for the vast majority of antibiotics consumed (96–98%). In Burundi, 24% of antibiotics consumed were oral and 76% were parenteral. The high proportion of parenteral formulations is probably because of the overrepresentation of hospital consumption. In three countries, amoxicillin, sulfamethoxazole/trimethoprim and ciprofloxacin were among the antibiotics that contributed to 75% of the total oral antibiotic consumption accounting for a median proportional consumption of 25%, 24% and 14% in these countries, respectively. For antibiotics given parenterally, ceftriaxone was the most commonly consumed in Burkina Faso and Côte d'Ivoire, accounting for an average proportional consumption of 41%, while in the United Republic of Tanzania and Burundi, gentamicin and benzylpenicillin, respectively, were the most consumed antibiotics. The substances accounting for 75% of total antibiotic consumption in the region, and the number of countries in which they were part of the country-specific DU75 list and the median proportional consumption in these countries is provided in Table 4.6.

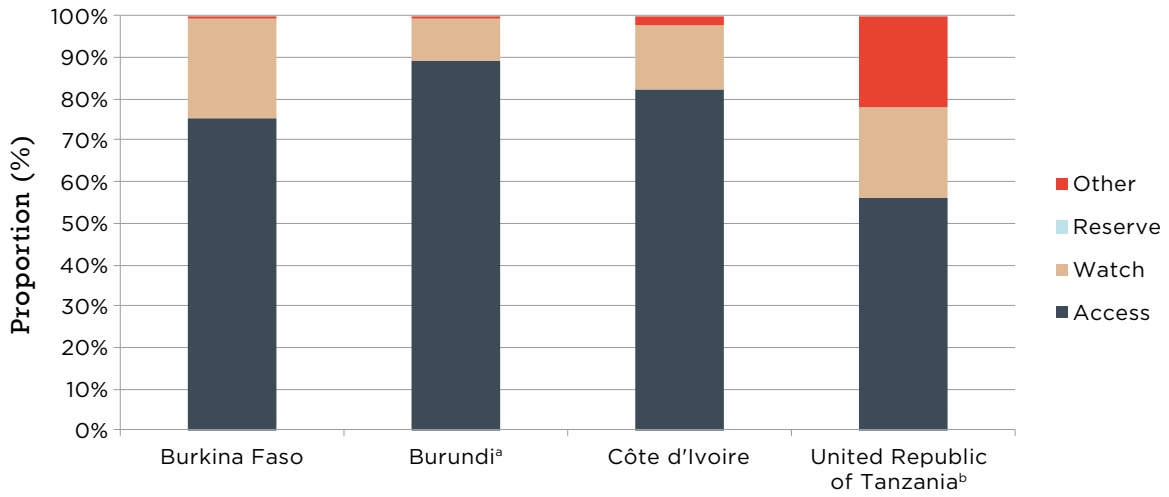
Table 4.6 Oral and parenteral antibiotic substances that made up 75% of all antibiotic consumption in the African Region, number of countries in which they were part of the country-specific DU75 list and the median proportional consumption (% of total DDD) in these countries

Oral			Parenteral		
Antibiotic	Appears in country's DU75	Median proportion[a] (IQR)	Antibiotic	Appears in country's DU75	Median proportion[a] (IQR)
Amoxicillin	3/4	25.1 (22.3–29.3)	Ceftriaxone	2/4	40.7 (34.9–46.5)
Ciprofloxacin	3/4	14.4 (14.2–22.9)	Amoxicillin	1/4	11.8
Sulfamethoxazole and trimethoprim	3/4	24.2 (15.1–27.9)	Ampicillin	1/4	18.6
Metronidazole	2/4	18.6 (12.8–24.4)	Benzathine benzylpenicillin	1/4	23.2
Amoxicillin and beta-lactamase inhibitor	1/4	9	Benzylpenicillin	1/4	50.8
Cefalexin	1/4	8.2	Gentamicin	1/4	67.8
Doxycycline	1/4	9.6	Metronidazole	1/4	9.4
Tetracycline	1/4	9.4	-	-	-
Tinidazole	1/4	4.7	-	-	-

[a] *Median of the total proportional consumption of the countries in which the respective substance is part of the DU75 list.*

Classification of antibiotic consumption according to the AWaRe categories showed that the proportion of antibiotics in the Access category relative to the total consumption in Burkina Faso, Burundi and Côte d'Ivoire was 75%, 90% and 82%, respectively, while the Watch group accounted for 24%, 10% and 16%, respectively. The United Republic of Tanzania showed a different pattern with antibiotics in the Access and Watch groups making up 56% and 22%, respectively, of the total consumption, while 22% of the antibiotic substances consumed (mostly tetracyclines and nitroimidazoles) were not classified into any of the AWaRe categories and have been allocated to the Other group (Fig. 4.3). Reserve group antibiotics were not identified in any of the four countries. Detailed data on the consumption by AWaRe categories can be found in Annex 4 (Table A4.2).

Fig. 4.3 Proportional consumption of antibiotics (%) by AWaRe categorization in four countries of the African Region (2015)



[a] *Only public sector reported.*
[b] *Data from 2016.*

4.3 WHO Region of the Americas

4.3.1 Contextual indicators and activities

Demography and socioeconomic characteristics

The size of the population (in thousands) living in the Region of the Americas in 2015 was 982 776 *(52)*. Of the 35 Member States of the region, one is a low-income country, 24 are middle-income countries and 10 are high-income countries *(55)*.

Regional health status

Table 4.7 Causes of death from infectious diseases among the top 10 causes of death in the Region of the Americas, 2015 *(56)*

Rank	Cause	Deaths (000s)	% of total deaths	Crude death rate per 100 000 population
	All causes	6 749	100.0	686.9
6	Lower respiratory infections	307	4.5	31
	Sum of above listed infections	**307**	**4.5**	**31**

Regional health systems – health expenditure

Table 4.8 Health financing indicators (aggregated average and range) in the Region of the Americas, 2015 *(57)*

Indicator	Average	Range
Domestic general government health expenditure per capita (US$)	549.6	5.7–4801.9
Current health expenditure as % of gross domestic product	6.9	3.2–16.8
General government health expenditure as % of current health expenditure	54.3	10.7–76.0
Out-of-pocket expenditure as % of current health expenditure	32.5	10.1–57.0

Out-of-pocket spending

In 2010, 11.1% of the total population of the region reported expenditure on health exceeding 10% of total household expenditure, and 1.9% reported health spending (exceeding 25% of total household expenditure) *(58)*.

Progress in implementing national action plans – antimicrobial consumption component

In 2016–2017, 23 countries of the Region of the Americas reported they were developing or had developed a national action plan for AMR *(59)*. At the same time, 11 countries reported they were monitoring antibiotic consumption or use in some manner (Table 4.9).

Table 4.9 Types of national monitoring system of human antimicrobial use in the Region of the Americas, 2016 (Question 7.1 in the country self-assessment questionnaire) *(59)*

Survey response	Number of countries
No national plan or system for monitoring the use of antimicrobials	13
System designed for surveillance of antimicrobial use, that includes monitoring sales or consumption of antibiotics at the national level and rational use of antibiotics in health services	4
Total sales of antimicrobials are monitored at the national level and/or some monitoring of antibiotic use at a subnational level	1
Prescribing practices and antibiotic use are monitored in a national sample of health care settings	3
On a regular basis (every year/2 years) data are collected and reported on: a) antimicrobial sales or consumption for human use at the national level b) antibiotic prescribing and appropriate use, in a representative sample of health facilities, public and private	3
Non-response to question 7.1	1
Non-response to country self-assessment questionnaire	10

Regional and national activities to measure antimicrobial consumption and use

In the Region of the Americas, countries have started to conduct self-evaluations of antimicrobial sales, based on the WHO methodology for surveillance of antimicrobial consumption. The aim was to promote the adoption of a uniform methodology in the region that takes into account the WHO AWaRe (Access, Watch and Reserve) categorization of antibiotics, and also to enable independent estimates of national sales or consumption, and strengthen capacity for implementing policies and decision-making.

Antibiotic consumption was also estimated using data from IQVIA. Data from Argentina, Brazil, Chile, Colombia, the Dominican Republic, Ecuador, Peru and countries in Central America were analysed and transformed into DDD/1000 inhabitants per day. The IQVIA database mostly covered only a portion of the national sales - data coverage ranged from 67% in Peru to 100% in Brazil.

In addition, surveys on antibiotic use in hospitals were carried out in South and Central America and the Caribbean. The WHO methodology used for these surveys allows the collection of hospital prescriptions of antimicrobials, including information on products, indications, patient categories, specialties, wards and types of health service. The objective of carrying out the surveys was to provide support to policy-makers and health professionals in implementing strategies that improve the rational use of antimicrobials.

In the initial phase in 2017, the surveys were undertaken in 10 hospitals in Costa Rica, Nicaragua and Peru, supported by their respective Ministries of Health. The overall prevalence of antibiotic use in patients in the hospitals was 56%. Adherence to clinical practice guidelines was 74% for treatments and 37% for prophylaxis practices. In 2018, hospitals in Barbados, Cuba, El Salvador, Guyana, Mexico, Paraguay and Saint Lucia are expected to start their surveys.

The WHO Regional Office for the Americas has supported the development of antimicrobial stewardship programmes in the region, with a focus on the following capacity-building components: human resources, health services, training, use of clinical treatment guidelines, optimization of the use of antimicrobials, and periodic monitoring of antimicrobial consumption.

In 2017, the need to implement antimicrobial stewardship programmes was expressed by a number of hospitals in Costa Rica, El Salvador, Nicaragua and Peru. Currently, Cuba, Mexico and Paraguay are working to implement such programmes in their referral hospitals.

4.3.2 Data on antibiotic consumption in the Region of the Americas

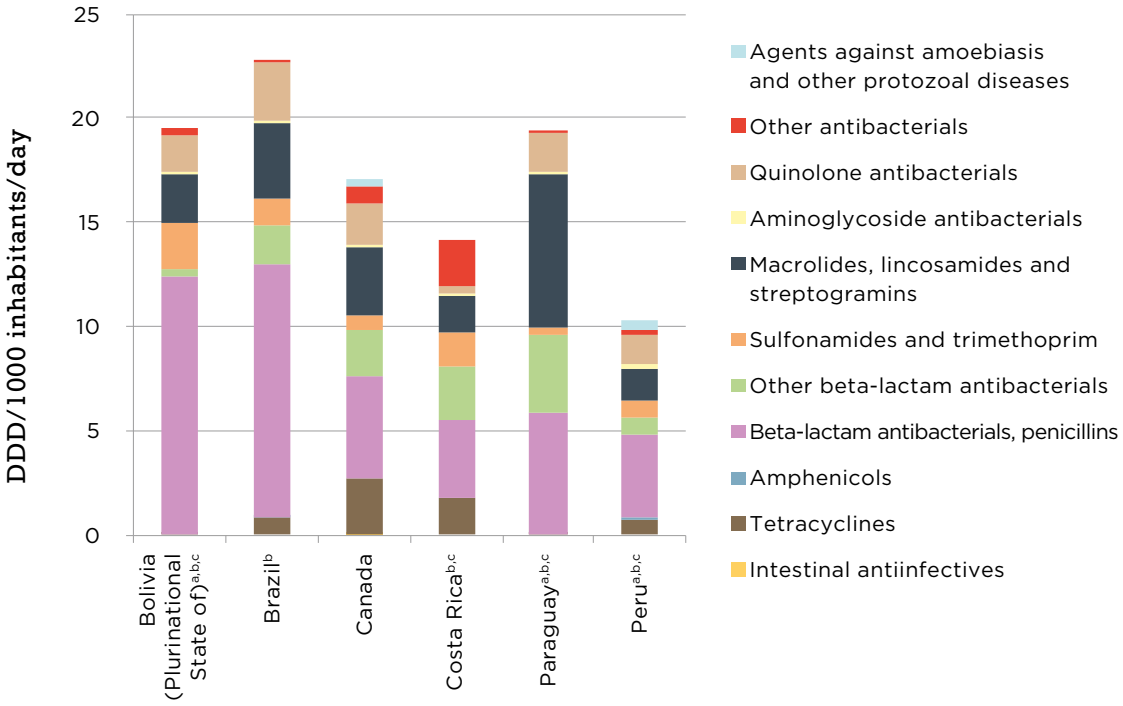
Data on antibiotic consumption are presented for six countries of the Region of the Americas: Canada (North America), Costa Rica (Central America) and Brazil, Plurinational State of Bolivia, Paraguay and Peru (South America). The countries used different data sources including dispensers, local manufacturers, wholesalers and hospital procurement. So far, data from the Plurinational State of Bolivia, Costa Rica, Paraguay and Peru are from the public sector only. For the Plurinational state of Bolivia, Paraguay and Peru the population coverage is about 20%, 67% and 60%, respectively, which has been considered in the calculations by adjusting the population denominator accordingly. The countries of the American Region provided data for 2016 with the exception of Canada, which submitted data for 2015.

The total antibiotic consumption varied between 10.3 DDD per 1000 inhabitants per day in Peru and 22.8 DDD per 1000 inhabitants per day in Brazil. The relatively low estimates of Peru may be because the data did not cover all health care sectors.

The consumption of the pharmacological subgroups is presented by country in Fig. 4.4. Penicillins were the most frequently consumed antibiotic group in all countries, with the exception of Paraguay. In the Plurinational State of Bolivia and Brazil, penicillins (J01C) accounted for more than 50% of total consumption (63% and 53%, respectively) followed by macrolides/lincosamides/streptogramins (J01F), 13% and 16%, respectively. Compared with the other countries, the Plurinational State of Bolivia had a low consumption of other beta-lactam antibacterials (J01D) (1.4% of total consumption). However, this has to be considered in light of the currently incomplete coverage of the data. Canada showed a more even distribution of the antibiotic groups: 29% of the total consumption was penicillins (J01C), 19% was macrolides/lincosamides/streptogramins (J01F) and 16% tetracyclines (J01A). In the public sector of Peru, penicillins (J01C) also dominated (40% of total consumption) followed by macrolides/lincosamides/streptogramins (J01F) (14%) and then quinolones (J01M) (13%). Paraguay had a different pattern with macrolides/lincosamides/streptogramins (J01F) as the most frequently consumed antibiotic group (38% of total consumption), followed by penicillins (J01C) (30%) and other beta-lactam antibacterials (J01D) (20%). In Costa Rica, penicillins (J01C) and other beta-lactam antibacterials (J01D) were the most frequently consumed accounting for 27% and 18%, respectively, of total consumption followed by other antibacterials (J01X) (16% of total consumption), which was mostly consumption of nitrofurantoin. Detailed data on the consumption of total antibiotics and pharmacological subgroups by country can be found in Annex 5 (Table A5.1).

With regard to route of administration, more than 90% were orally administered antibiotics in all countries, ranging from 92% in Peru to 97% in the Plurinational State of Bolivia. Amoxicillin was the most commonly consumed oral antibiotic followed by azithromycin accounting for a median proportional use of 29% and 11%, respectively, in the countries, where these substances are included in their DU75 list. For parentally administered antibiotics, ceftriaxone was the most frequently consumed and was on the DU75 list of five countries with a median proportional use of 13%. The substances accounting for 75% of total use, and the number of countries in which they were part of the country-specific DU75 list and the median proportional consumption in these countries is provided in Table 4.10.

Fig. 4.4 Consumption of antibiotics (DDD per 1000 inhabitants per day) by pharmacological subgroup in six countries of the Region of the Americas (2015)



[a] *Coverage of antimicrobial consumption estimated to be 70% or less, population-adjusted.*
[b] *Data from 2016.*
[c] *Only public sector reported.*

Table 4.10 Oral and parenteral antibiotic substances that made up 75% of all antibiotic consumption in the Region of the Americas, number of countries in which they were part of the country-specific DU75 list and the median proportional consumption (% of total DDD) in these countries

Oral			Parenteral		
Antibiotic	Appears in country's DU75	Median proportion[a] (IQR)	Antibiotic	Appears in country's DU75	Median proportion[a] (IQR)
Amoxicillin	6/6	29.4 (22.2–40.9)	Ceftriaxone	5/6	13.0 (12.4–14.3)
Azithromycin	4/6	10.8 (6.2–19.8)	Benzylpenicillin	3/6	7.9 (7.6–13.4)
Cefalexin	3/6	14.3 (10.4–15.6)	Cefazolin	3/6	5.9 (5.8–12.4)
Doxycycline	3/6	11.0 (9.4–12.0)	Clindamycin	3/6	8.5 (6.0–10.9)
Amoxicillin and beta-lactamase inhibitor	2/6	7.6 (6.5–8.6)	Gentamicin	3/6	10.4 (9.4–13.6)
Ciprofloxacin	2/6	9.8 (8.8–10.9)	Oxacillin	3/6	10.7 (8.0–15.8)
Nitrofurantoin	2/6	10.6 (7.9–13.2)	Benzathine benzylpenicillin	2/6	23.2 (16.6–29.9)
Sulfamethoxazole and trimethoprim	2/6	10.5 (10.0–11.0)	Cefalotin	2/6	6.4 (5.3–7.6)
Clarithromycin	1/6	10.9	Cefotaxime	2/6	11.3 (8.1–14.5)
Dicloxacillin	1/6	7.3	Amikacin	1/6	13.1
-	-	-	Amoxicillin and beta-lactamase inhibitor	1/6	51
-	-	-	Cefepime	1/6	4.1

(continue)

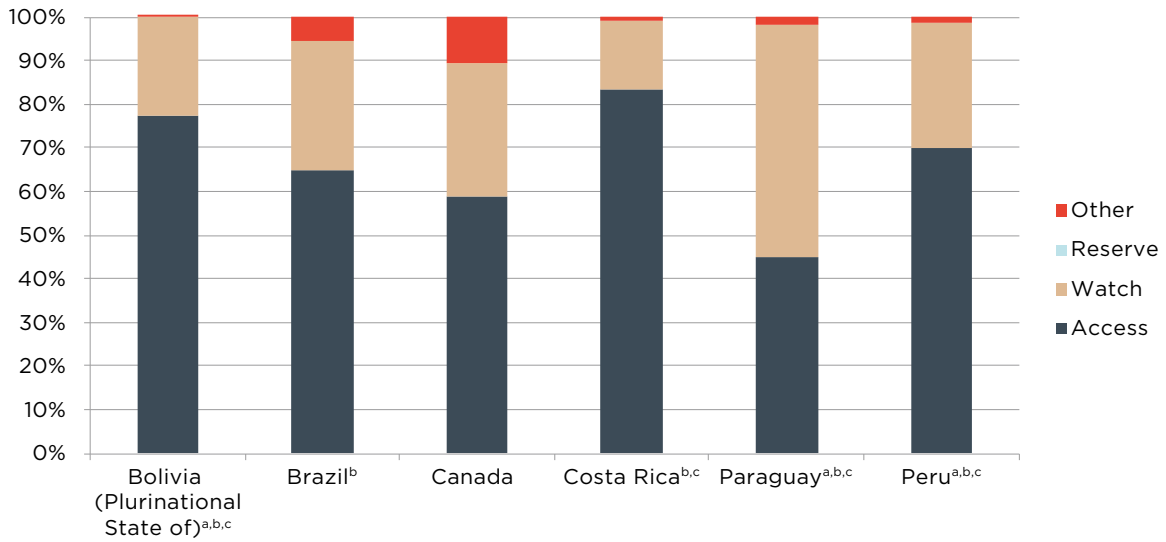
Oral		
Antibiotic	Appears in country's DU75	Median proportion[a] (IQR)
-	-	-
-	-	-
-	-	-
-	-	-

Parenteral		
Antibiotic	Appears in country's DU75	Median proportion[a] (IQR)
Ciprofloxacin	1/6	5
Cloxacillin	1/6	10.2
Meropenem	1/6	5.8
Piperacillin and beta-lactamase inhibitor	1/6	9.8

[a] *Median of the total proportional consumption of the countries in which the respective substance is part of the DU75 list.*

Distribution of antibiotic consumption according to the AWaRe categories showed that for most countries (Plurinational State of Bolivia, Brazil, Canada, Costa Rica and Peru) the Access group antibiotics accounted for more than 50% of total consumption, ranging from 59% in Canada to 83% in Costa Rica (Fig. 4.5). In these countries, the proportional consumption of the Watch group antibiotics ranged between 16% in Costa Rica and 31% in Canada. Paraguay showed an inverse pattern with the Watch and Access group antibiotics accounting for 53% and 45%, respectively, of total consumption, which is mainly caused by the relatively high proportional consumption of macrolides/lincosamides/streptogramins (J01F) in this country. Reserve group antibiotics generally were not or only rarely consumed with a share of < 0.5%. The percentage of antibiotics in the Other group ranged from 0.2% in the Plurinational State of Bolivia to 11% in Canada. Detailed data on the consumption by AWaRe categories can be found in Annex 5 (Table A5.2)

Fig. 4.5 Proportional consumption (%) of antibiotics by AWaRe categorization in six countries of the Region of the Americas (2015)



[a] *Coverage of antimicrobial consumption estimated to be 70% or less, population-adjusted.*

[b] *Data from 2016.*

[c] *Only public sector reported.*

4.4 WHO South-East Asian Region

4.4.1 Contextual indicators and activities

Demography and socioeconomic characteristics

The size of the population (in thousands) living in the South-East Asia Region in 2015 was 1 926 539 *(52)*. Of the 11 Member States of the region, two are low-income countries, nine are middle-income and none is a high-income country *(55)*.

Regional health status

Table 4.11 **Causes of death from infectious diseases among the top 10 causes of death in the South-East Asia Region, 2015** *(56)*

Rank	Cause	Deaths (000s)	% of total deaths	Crude death rate per 100 000 population
	All causes	13 633	100.0	707.6
4	Lower respiratory infections	779	5.6	40
5	Tuberculosis	668	4.8	35
6	Diarrhoeal diseases	539	3.9	28
	Sum of above listed infections	**1 986**	**14.3**	**103**

Regional health systems – health expenditure

Table 4.12 **Health financing indicators (aggregated average and range) in the South-East Asia Region, 2015** *(57)*

Indicator	Average	Range
Domestic general government health expenditure per capita (US$)	119.1	4.7–770.2
Current health expenditure as % of gross domestic product	4.6	2.6–11.5
General government health expenditure as % of current health expenditure	46.1	14.7–81.6
Out-of-pocket expenditure as % of current health expenditure	41.8	10.2–73.9

Out-of-pocket spending

During 2007–2015, 12.8% of the total population reported health expenditure exceeding 10% of total household expenditure, and 2.9% reported health spending (exceeding 25% of total household expenditure) *(58)*.

Progress in implementing national action plans – antimicrobial consumption component

In 2016–2017, 10 countries of the region reported that they had an intersectoral national action plan for AMR *(59)*. At the same time, seven countries reported they were monitoring antibiotic consumption or use in some manner (Table 4.13).

Table 4.13 **Types of national monitoring system of human antimicrobial use in the South-East Asian Region, 2016 (Question 7.1 in the country self-assessment questionnaire)** *(59)*

Survey response	Number of countries
No national plan or system for monitoring the use of antimicrobials	4
System designed for surveillance of antimicrobial use that includes monitoring sales or consumption of antibiotics at the national level and rational use of antibiotics in health services	5
Total sales of antimicrobials are monitored at the national level and/or some monitoring of antibiotic use at a subnational level	2

(continue)

Survey response	Number of countries
Prescribing practices and antibiotic use are monitored in a national sample of health care settings	0
On a regular basis (every year/2 years) data are collected and reported on: a) antimicrobial sales or consumption at the national level for human use b) antibiotic prescribing and appropriate use, in a representative sample of health facilities, public and private	0
Non-response to question 7.1	0
Non-response to country self-assessment questionnaire	0

Regional and national activities to measure antimicrobial consumption and use

In 2017 all countries in the WHO South-East Asia Region participated in an introductory training on how to conduct monitoring of antimicrobial consumption using the WHO global methodology and the ATC/DDD metric.

Several countries, including Bangladesh, Sri Lanka and Thailand, have adopted a multisectoral approach to the development of an integrated antimicrobial consumption monitoring system. To understand how antibiotics are imported, manufactured and sold in Thailand, all antibiotic distribution channels across all sectors were mapped to ensure full data capture *(60)*. The Thai Working Group on the Surveillance of antimicrobial consumption has developed an integrated method to collect consumption data and validated the methodology through an external peer-review mechanism *(61)*.

Bangladesh has established the Antimicrobial Consumption Monitoring Taskforce with support of the FAO /OIE/WHO. As over 95% of pharmaceuticals are produced by the domestic pharmaceutical sector in Bangladesh, most of the antimicrobial production and sales information can be collected at the regulator level - Directorate General of Drug Administration under the Ministry of Health & Family Welfare. Most of the information from distribution (distributor and wholesaler) and retail sale (pharmacies and medicine stores) was not yet digitalized, therefore it was necessary first to apply ATC coding and build a database of antimicrobials to be monitored. The Antimicrobial Consumption Monitoring Taskforce developed the database and the methodology for data collection and is progressing with implementation of the antimicrobial consumption monitoring system. Similar efforts are being initiated or are in progress in Bhutan, Maldives, Myanmar and Sri Lanka.

4.4.2 Antimicrobial consumption in the South-East Asia Region

As mentioned above, some countries have initiated surveillance of antimicrobial consumption. However, they were not at a stage to share data with WHO. It is expected that the data will be shared in the near future. Therefore, no results section is included in this report.

Regional initiative on collection of sales of antimicrobials

In parallel, the WHO Regional Office for South-East Asia is conducting an ongoing project to estimate the consumption of antibiotics using IQVIA databases. Sales data from five countries (Bangladesh, India, Indonesia, Sri Lanka and Thailand) were analysed but data were not ready to be shared before the finalization of the global report.

Summary of initial results

The analysis of the different classes of antibiotics, when applying the WHO AWaRe categorization, found a high level of consumption of cephalosporins and quinolones in some of the countries, and a very high level of consumption of third-generation cephalosporins in all states in India.

Regulation of antimicrobials

The South Asia Regulatory Network has discussed key roles of national regulatory authorities to fight AMR in its meetings.

These national regulatory authorities can**:**

- Raise awareness and promote responsible use of antimicrobials in human and animal/ agriculture sectors;
- Ensure quality and supply chain security;
- Generate data (antimicrobial consumption data) to support policy development;

- Facilitate the early introduction of new diagnostics and antimicrobials through an efficient approval system.

Several national regulatory authorities have taken action to tackle AMR:

- Bhutan strictly enforces antibiotic dispensing with prescription only.
- Bangladesh has banned future registration of irrational, fixed-dose combinations of multiple antibiotics that promote the development of AMR.
- India uses red strip labelling of packages to reduce dispensing without prescription.
- India conducted the largest ever drug quality survey and the Central Drugs Standard Control Organization/state food and drug agencies are taking regulatory action to reduce the availability of antibiotics whose quality is non-standard or substandard
- Myanmar is conducting a drug quality survey of tuberculosis medicines to detect and reduce poor-quality tuberculosis drugs that may contribute to multidrug resistance.
- Thailand plans to revise dispensing of antibiotics to reduce over-the-counter dispensing, which is still legal in the country.
- National regulatory authorities in many countries (Bangladesh, Indonesia, Maldives and Timor-Leste) have conducted awareness campaigns to educate the public and professionals about AMR.
- The South Asia Regulatory Network is planning further collaborative actions.

4.5 WHO European Region

4.5.1 Contextual indicators and activities

Demography and socioeconomic characteristics

The size of the population (in thousands) living in the European Region in 2015 was 912 984 *(52)*. Of the 53 Member States of the region, none is a low-income country, 20 are middle-income countries and 33 are high-income countries *(55)*.

Regional health status

Table 4.14 **Causes of death from infectious diseases among the top 10 causes of death in the European Region, 2015** *(56)*

Rank	Cause	Deaths (000s)	% of total deaths	Crude death rate per 100 000 population
	All causes	9 249	100.0	1 013
7	Lower respiratory infections	252	2.7	28
	Sum of above listed infections	**252**	**2.7**	**28**

Regional health systems – health expenditure

Table 4.15 **Health financing indicators (aggregated average and range) in the European Region, 2015** *(57)*

Indicator	Average	Range
Domestic general government health expenditure per capita (US$)	1634.3	17.7–6943.9
Current health expenditure as % of gross domestic product	7.9	2.0–12.1
General government health expenditure as % of current health expenditure	64.7	15.9–85.4
Out-of-pocket expenditure as % of current health expenditure	30.8	6.1–81.6

Out-of-pocket spending

In 2010, 7% of the total population reported health expenditure exceeding 10% of total household expenditure, and 1% reported health spending (exceeding 25% of total household expenditure) *(58)*.

Progress in implementing national action plans – antimicrobial consumption component

In 2016–2017, 49 countries of the region reported they had developed or had started developing a national action plan for AMR *(59)*. At the same time, 41 countries reported that they were monitoring antibiotic consumption or use in some manner (Table 4.16).

Table 4.16 Types of national monitoring systems for human antimicrobial use in the European Region, 2016 (Question 7.1 in the country self-assessment of questionnaire) *(59)*

Survey response	Number of countries
No national plan or system for monitoring use of antimicrobials	4
System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics and rational use of antibiotics in health services	4
Total sales of antimicrobials are monitored at the national level and/or some monitoring of antibiotic use at a subnational level	19
Prescribing practices and antibiotic use are monitored in a national sample of health care settings	8
On a regular basis (every year/2 years) data are collected and reported on: a) antimicrobial sales or consumption at the national level for human use b) antibiotic prescribing and appropriate use in a representative sample of health facilities, public and private	14
Non-response to question 7.1	3
Non-response to country self-assessment questionnaire	1

Regional and national activities to measure antimicrobial consumption and use

Data on antimicrobial consumption in the European Region are collected using two separate networks that share common methods of data collection and analysis in order to provide a pan-European perspective on consumption of antimicrobial medicines.

European Surveillance of Antimicrobial Consumption Network

The ESAC-Net is a network of national surveillance systems that provides reference data on antimicrobial consumption *(32)*. Data on consumption of antimicrobials are collected from 28 Member States of the European Union and two countries in the European Economic Area, namely Iceland and Norway, using the European Surveillance System TESSy. The coordination of ESAC-Net was transferred from the University of Antwerp, Belgium to the ECDC in July 2011. Nominated national focal points provide the antimicrobial consumption data.

ESAC-Net publishes annual reports of antimicrobial consumption data based on a standard reporting framework from the community and hospital sectors, using medicines sales or reimbursement data. Antimicrobial consumption data are collected using the ATC classification system and DDD methodology. The data are presented up to the fourth level of ATC coding (pharmacological subgroup). Three main categories of antimicrobials are under surveillance: antibacterials for systemic use, antifungals and antimycotics for systemic use, and antivirals for systemic use *(62)*. In addition to annual reports, there are downloadable files showing trends in consumption of antimicrobials and an interactive database that can provide overviews of country data, data sources, geographical distribution of antibiotic consumption, rates and trends by country, as well as a number of quality indicators for antibiotic consumption in the community *(63)*. Data are available from 1997 onwards. Antimicrobial consumption data of the previous year are first published through the interactive database on the occasion of the European Antibiotic Awareness Day on 18 November.

In addition to participating in the ESAC-Net, countries participate in the Disease Programme on Antimicrobial Resistance and Healthcare-associated Infections. The programme focuses on four areas of public health: surveillance, response and scientific advice, training, and communication to address the threat of AMR and health care-associated infections.

In 2009, the ECDC adopted a plan to conduct a point prevalence survey across the European Union of health care-associated infections and antimicrobial use in European acute care hospitals based on the recommendations of the external evaluation of the IPSE (Improving Patient Safety in Europe) network. The first ECDC point prevalence survey was conducted in 2011–2012, and the second, using a modified protocol, in 2016–2017. The objectives of the surveys were to:

estimate the total burden (prevalence) of health care-associated infections and antimicrobial use in acute care hospitals in the European Union/European Economic Area; describe patients, invasive procedures, and antimicrobials prescribed; describe key structures and processes for the prevention of health care-associated infections and antimicrobial resistance at the hospital and ward level in hospitals in the European Union; disseminate results to those who need to know at local, regional, national and European Union levels; and provide a standardized tool for hospitals to identify targets for quality improvement *(64)*. Similarly, the ECDC is performing repeated point prevalence surveys of health care-associated infections and antimicrobial use in long-term care facilities in Europe. Three point prevalence surveys in long-term care facilities were conducted, in 2010, 2013 and 2017 *(65)*.

Most countries have been conducting national antibiotic awareness campaigns, and on the occasion of the European Antibiotic Awareness Day, carry out various public and professional activities *(66)*.

In recent years countries have recognized the importance of introducing antimicrobial stewardship programmes in order to preserve the effectiveness of antimicrobial agents. A broad range of antimicrobial stewardship activities have been implemented in the countries. Some countries have formalized antimicrobial stewardship programmes while others have introduced individual basic structure, process and outcome elements.

Although the countries that participate in ESAC-Net have long experience in collecting data on antimicrobial consumption, there is still room for improvement: complete data reporting on antimicrobial consumption for the hospital sector among all participating countries needs to be achieved as well as for data validation processes.

The ECDC started the external evaluation of the European Union/European Economic Area public health surveillance systems, a four-year project to strengthen efficiency and public health usefulness of surveillance systems, including ESAC-Net, at the European Union level.

Within the perspective of One Health approach, a set of primary and secondary outcome indicators for antimicrobial consumption in the community and the hospital sector have been developed for humans and for the veterinary sector by the ECDC, the European Food and Safety Authority and the European Medicines Agency to monitor antimicrobial consumption and tailor interventions for antimicrobial stewardship programmes *(67)*. A third Joint Interagency Antimicrobial Consumption and Resistance Analysis Report is planned using ESAC-Net data for human consumption *(39)*.

Surveillance of antimicrobial consumption has a growing importance as a process element in antimicrobial stewardship programmes and ESAC-Net will continue to contribute to global efforts on appropriate antibiotic use.

WHO Europe Antimicrobial Medicines Consumption Network

The WHO Europe Antimicrobial Medicines Consumption Network is an initiative of the WHO Regional Office for Europe that follows from a pilot project on data collection in 2011 involving the University of Antwerp (Belgium), the ECDC and the WHO Collaborating Centre for Drug Statistics Methodology (Norway). It aims to support countries and areas in the WHO European Region that are not part of ESAC-Net; it currently comprises 17 Member States and Kosovo[1]. The methodology used by the WHO Europe Antimicrobial Medicines Consumption Network is closely aligned with that used by the ECDC in order to facilitate comparisons between European Union and non-European Union member states in the region. Data collected at the country and area level are shared with stakeholders and can be used to inform programmes and proposals for national policy actions to improve the use of antimicrobials, as well as for cross-national comparisons. Data collection predates the formation of the WHO Europe Antimicrobial Medicines Consumption Network in a number of the member countries.

Various data sources are available for estimating antimicrobial consumption. Most network members use import records, sometimes supplemented with sales records from market authorization holders, local manufacturing estimates, wholesaler records and health insurance data. Data collection follows a standardized protocol, using a common *Excel* template based on a complete national register of antimicrobial medicines with marketing authorization. The ATC classification system is used with data presented up to the fifth level of coding (individual medicine). Nominated national

[1] In accordance with United Nations Security Council Resolution 1244 (1999).

focal points for antimicrobial consumption provide the consumption data. The 2011 data from 11 countries of this network and Kosovo[2] were published in 2014 *(68)* and an analysis of data on antimicrobial consumption for 2011–2014 from 12 members of the network was published in 2017 *(33)*.

As a relatively newly established network, there are varying levels of analysis capacity at the country level and the network uses a model of peer support and learning. Annual meetings of network members are held to review data collected, share experiences and introduce topics of importance to AMR through contributions from international and WHO experts. The focus in data collection and analysis is on maximizing the information value of the data available. As far as possible, the data should be actionable and highlight areas for further study and investigation.

In addition to reporting reference data to the WHO Regional Office for Europe, many of the countries in WHO Europe Antimicrobial Medicines Consumption Network are actively engaged in other studies, activities and interventions to address AMR at the community and hospital level. Nine network countries and Kosovo[2] participated in the 2015 Global Point Prevalence Survey of Antimicrobial Consumption and Resistance (Global-Point prevalence survey), a point prevalence study of antimicrobial consumption and resistance in adult hospital patients, and a number also took part in the 2017 Global-Point prevalence survey *(69)*. Turkish health authorities have implemented an electronic prescription system to track prescription data and provide feedback to physicians, and adopted a rational drug use national action plan for 2014–2017 that prioritizes the appropriate use of antibiotics, which is supported by staff working on advocacy initiatives in 81 provinces *(70)*. A number of countries in the network have conducted qualitative investigations to better understand what influences the use of antibiotics from the doctor, pharmacist and patient perspectives *(71)*. Consumption data have been disseminated at the local level to stimulate discussion on the findings and next steps to tackle potential problems in antibiotic use, as well as presented at international conferences and forums.

Limitations to the use of import records alone to provide data on antibiotic consumption are well known. Network members are working to review data sources available to try to ensure the completeness and reliability of the estimates being derived. Work also needs to be undertaken to better understand the influence of different data sources, including commercial sources, on consumption estimates. Many countries are in the process of developing or implementing e-health, including e-prescription, and it will be important to link these data information systems with drug utilization monitoring. In many of the network countries, antibiotics are freely available over the counter without prescription. This is an important area of discussion and future activity for the network to support more appropriate use of antibiotics.

4.5.2 Data on antibiotic consumption in the European Region

Data on antibiotic consumption are presented for 46 countries and areas of the WHO European Region: 28 member states of the European Union, two countries of the European Economic Area (Iceland and Norway) and 15 non-European Union countries and Kosovo[2].

A wide variety of data sources was used, mostly sales data as well as import and reimbursement data. Some countries combined different data sources in order to obtain full coverage. Five countries (Austria, Czech Republic, Germany, Iceland and Spain) delivered data only for the community sector.

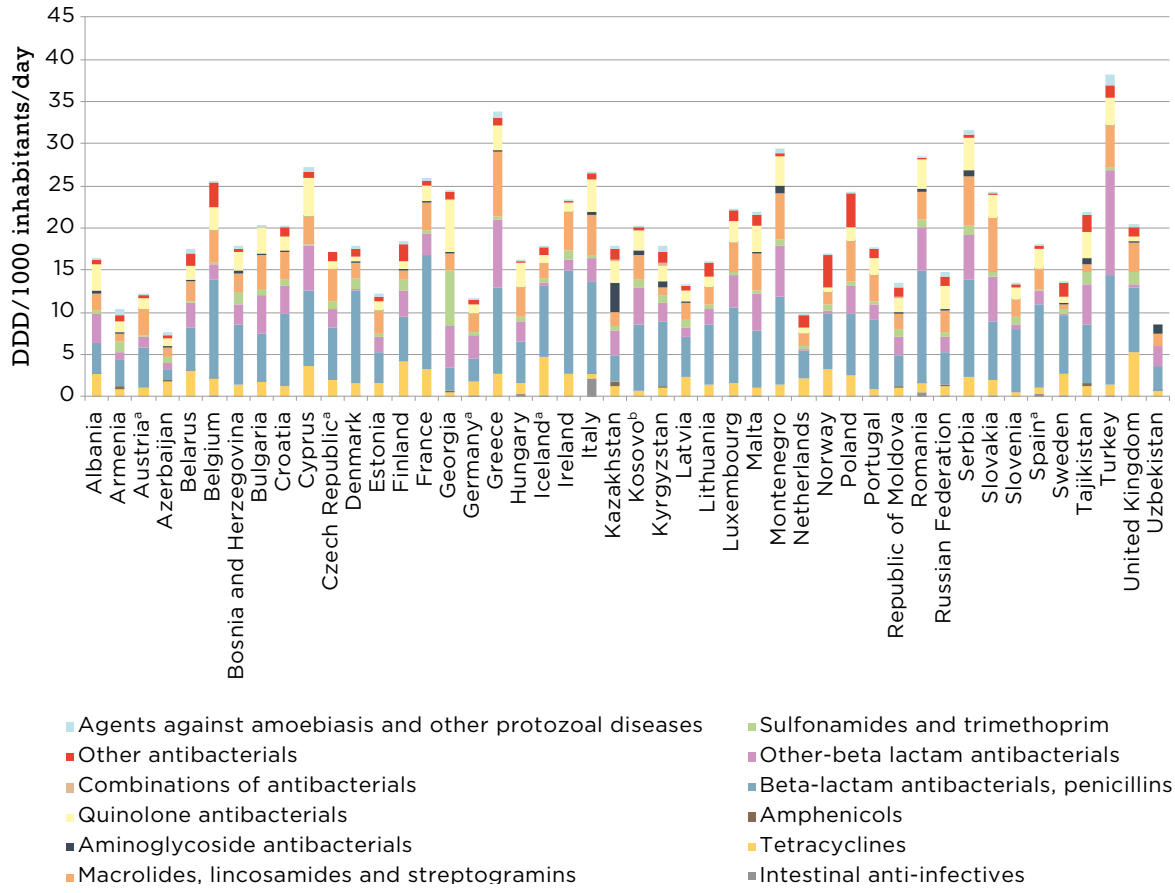
Consumption of total antibiotics and pharmacological subgroups for the 45 countries and Kosovo[2] is presented in Fig. 4.6. The median consumption of antibiotics was 17.9 (IQR: 14.5–24.3) DDD per 1000 inhabitants per day, ranging from 7.7 DDD per 1000 inhabitants per day in Azerbaijan to 38.2 DDD per 1000 inhabitants per day in Turkey.

Penicillins (J01C) were the most frequently consumed antibiotic subgroup with a median consumption of 7.1 (IQR: 4.5–9.2) DDD per 1000 inhabitants per day, representing 37% of total consumption and ranging from 12% in Georgia to 61% in Denmark. The consumption of macrolides/lincosamides/streptogramins (J01F) (2.6 DDD per 1000 inhabitants per day; IQR: 1.8–3.8) and other beta-lactam antibacterials (J01D) (2.3 DDD per 1000 inhabitants per day; IQR: 1.4–4.4) was in a similar range, both subgroups accounting for around 15% of total consumption. Consumption of macrolides/lincosamides/streptogramins (J01F) was lowest in

[2] In accordance with United Nations Security Council Resolution 1244 (1999).

Sweden (0.7 DDD per 1000 inhabitants per day) and highest in Greece (7.7 DDD per 1000 inhabitants per day), accounting for 5% and 23%, respectively, of total consumption. In Azerbaijan, Denmark, Iceland, the Netherlands, Norway, Slovenia, Sweden and the United Kingdom, consumption of the subgroup other beta-lactam antibacterials (J01D) was < 1.0 DDD per 1000 inhabitants per day. In contrast, consumption density of this subgroup was greatest in Greece and Turkey: 8.0 DDD per 1000 inhabitants per day and 12.4 DDD per 1000 inhabitants per day corresponding to a proportional use of 24% and 33%, respectively. Consumption of quinolones (J01M) and tetracyclines (J01A) was similar with median consumption of 1.8 (IQR: 1.1–2.9) DDD per 1000 inhabitants per day and 1.6 (IQR: 1.1–2.5) DDD per 1000 inhabitants per day, corresponding to a proportional use of 11% and 9%, respectively. The values ranged from 0% for quinolones (J01M) and 2% for tetracyclines (J01A) to 26% of total consumption for both. For the subgroup of sulfonamides and trimethoprim (J01E), the median consumption was 0.6 (IQR: 0.4–0.9) DDD per 1000 inhabitants per day. Detailed data on the consumption of total antibiotics and pharmaceutical subgroups by country can be found in Annex 6 (Table A6.1).

Fig. 4.6 **Consumption of antibiotics (DDD per 1000 inhabitants per day) by pharmacological subgroup in 45 countries and Kosovo[3] of the European Region, 2015**



[a] *Only community consumption reported.*

[b] *In accordance with Security Council Resolution 1244 (1999).*

With regard to route of administration, the percentage of orally administered antibiotics in the different countries and areas ranged from 50% to nearly 100% in countries and areas providing only community data. Amoxicillin and amoxicillin/beta-lactamase inhibitor were the most frequently consumed oral antibiotics and accounted for a median proportional use of 16% and 15%, respectively, in the countries and areas where these substances were part of the DU75 list (about 85% of countries and areas). For antibiotic substances administered parenterally, ceftriaxone was on the DU75 list for 36 out

[3] In accordance with United Nations Security Council Resolution 1244 (1999).

of the 45 countries and Kosovo[3] in the region, accounting for 26.3% (median) of parenteral use. Antibiotic substances that accounted for 75% of total use in the region, and the number of countries and areas in which they were part of the country- or area-specific DU75 list as well as the median proportional consumption in these countries and areas are provided in Table 4.17.

Table 4.17 Oral and parenteral antibiotic substances that made up 75% of all antibiotic consumption in the European Region, number of countries and areas in which they were part of the DU75 list and their median proportional consumption (% of total DDD) in these countries and areas

Oral			Parenteral		
Antibiotic	Number of countries and areas where it appears in the country's DU75	Median proportion[a] (IQR)	Antibiotic	Number of countries and areas where it appears in the country's DU75	Median proportion[a] (IQR)
Amoxicillin	40/46	16.2 (11.9–21.1)	Ceftriaxone	36/46	26.3 (13.7–35.5)
Amoxicillin and beta-lactamase inhibitor	39/46	15.4 (10.7–24.9)	Gentamicin	25/46	7.9 (5.5–14.0)
Doxycycline	34/46	8.8 (7.3–12.1)	Cefazolin	24/46	10.1 (7.0–14.1)
Clarithromycin	28/46	8.2 (6.1–11.5)	Metronidazole	22/46	6.6 (5.8–8.2)
Ciprofloxacin	26/46	7.0 (6.0–8.7)	Amoxicillin and beta-lactamase inhibitor	19/46	13.7 (10.2–17.2)
Azithromycin	24/46	8.1 (6.7–9.6)	Cefuroxime	17/46	9.6 (6.9–17.6)
Cefuroxime	20/46	11.0 (7.0–14.5)	Piperacillin and beta-lactamase inhibitor	15/46	7.8 (7.2–13.8)
Sulfamethoxazole and trimethoprim	11/46	7.3 (6.1–9.1)	Benzylpenicillin	11/46	10.1 (4.5–15.6)
Phe-noxymethylpe-nicillin	9/46	9.7 (5.0–20.5)	Ciprofloxacin	11/46	6.1 (5.2–7.1)
Levofloxacin	8/46	6.0 (5.5–6.6)	Meropenem	9/46	5.9 (4.6–6.0)
Nitrofurantoin	7/46	6.8 (6.3–12.4)	Cefotaxime	6/46	11.1 (6.1–12.3)
Ampicillin	6/46	6.6 (5.7–9.1)	Flucloxacillin	6/46	13.4 (7.6–16.0)
Cefalexin	5/46	9.7 (6.1–12.3)	Vancomycin	6/46	5.1 (4.2–5.9)
Metronidazole	5/46	4.7 (4.1–6.3)	Ampicillin and beta-lactamase inhibitor	5/46	5.5 (5.4–6.5)
Tetracycline	5/46	5.0 (5.0–10.8)	Cloxacillin	5/46	13.8 (7.7–20.8)
Lymecycline	4/46	7.8 (5.7–9.7)	Teicoplanin	5/46	4.8 (3.3–6.0)
Trimethoprim	4/46	5.9 (4.7–15.8)	Amikacin	4/46	5.9 (5.5–16.4)
Cefixime	3/46	5.4 (5.2–6.4)	Streptomycin	4/46	10.9 (7.8–14.2)
Flucloxacillin	3/46	10.4 (9.4–11.6)	Ceftazidime	3/46	5.6 (5.1–6.6)
Methenamine	3/46	9.2 (8.8–15.4)	Clindamycin	3/46	4.3 (3.7–4.3)
Pivmecillinam	3/46	9.5 (7.4–12.a4)	Doxycycline	3/46	5.3 (4.9–8.2)
Clindamycin	2/46	5.3 (5.1–5.5)	Amoxicillin	2/46	5.1 (4.8–5.4)
Erythromycin	2/46	6.6 (5.6–7.5)	Ampicillin	2/46	12.4 (10.4–14.4)
Benza-thine phe-noxymethylpe-nicillin	1/46	9.4	Imipenem and cilastatin	2/46	4.2 (3.9–4.6)
Cefaclor	1/46	4.1	Levofloxacin	2/46	4.9 (4.6–5.2)
Cefdinir	1/46	6	Oxacillin	2/46	9.2 (7.4–10.9)
Cefpodoxime	1/46	3.4	Azithromycin	1/46	4

(continue)

Oral		
Antibiotic	Number of countries and areas where it appears in the country's DU75	Median proportion[a] (IQR)
Chloramphenicol	1/46	4.5
Dicloxacillin	1/46	6.4
Furazidin	1/46	4.8
Ofloxacin	1/46	4.7
Pristinamycin	1/46	3.9
Rifaximin	1/46	8.3
Roxithromycin	1/46	4.3
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

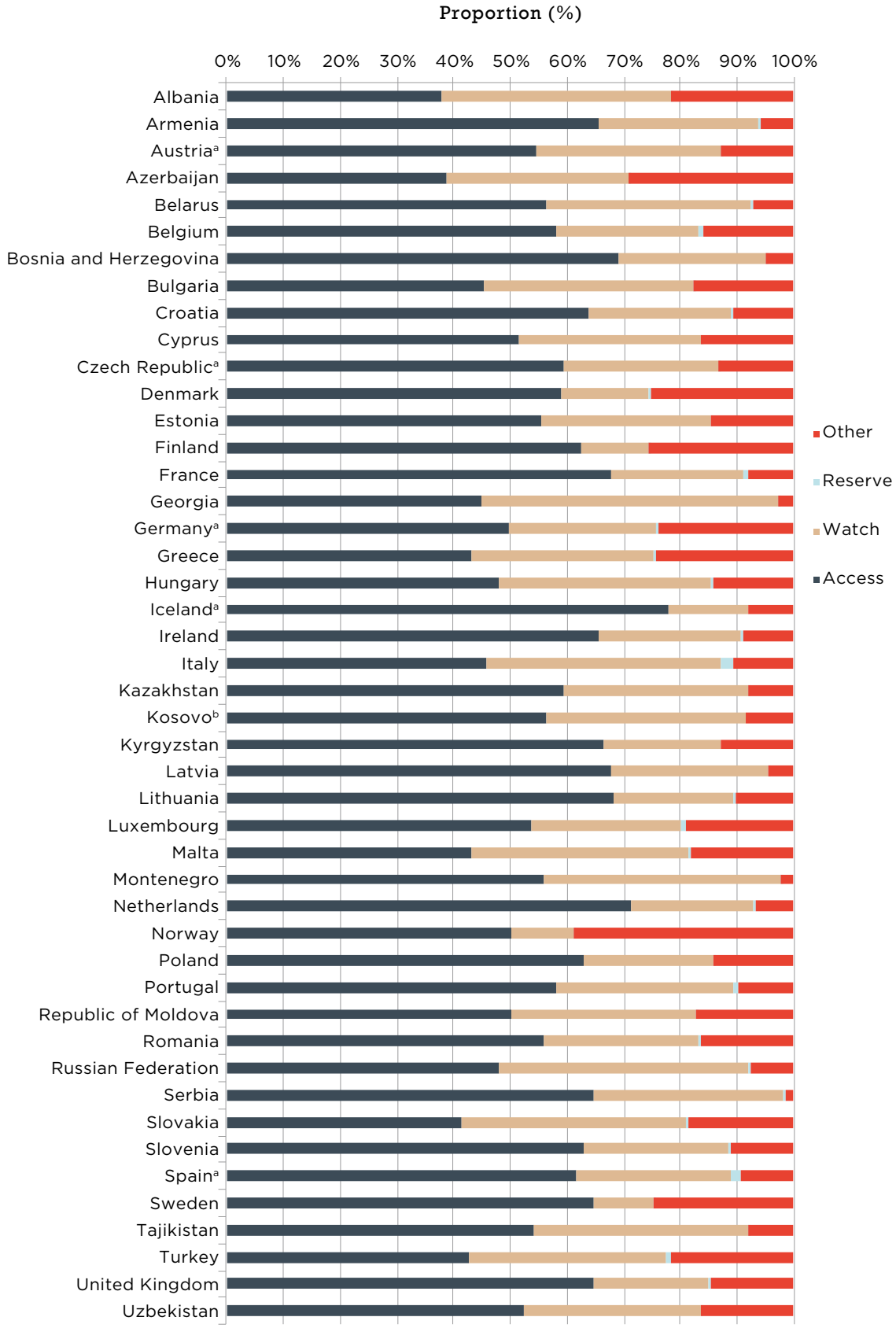
Parenteral		
Antibiotic	Number of countries and areas where it appears in the country's DU75	Median proportion[a] (IQR)
Cefalotin	1/46	8.6
Cefonicid	1/46	55.1
Cefoxitin	1/46	3.9
Ceftizoxime	1/46	4.5
Colistin	1/46	8.5
Combinations	1/46	6.7
Dicloxacillin	1/46	11
Procaine benzylpenicillin	1/46	6.7
Sulfamethoxazole and trimethoprim	1/46	3.9
Temocillin	1/46	3.2
Thiamphenicol	1/46	3.7
Tobramycin	1/46	16.1

[a] *Median of the total proportional consumption of the countries and areas in which the respective substance is part of the DU75 list.*

The classification according to the WHO AWaRe categories showed that the Access group antibiotics accounted for > 50% of total consumption in 34 out of the 45 countries and Kosovo[4] in the region. The median proportional consumption of the Access group was 56% (IQR: 49–64%) and the values ranged from 38% in Albania to 78% in Iceland. The median proportion of Watch group antibiotics related to total consumption was 29% (IQR: 25–36%) with values ranging from less than 20% in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) to 52% in Georgia. Reserve group antibiotics were only rarely used in most countries and areas with a median proportional use of 0.2% (IQR: 0.1–0.5%). The most widely used Reserve group antibiotics were intravenous fosfomycin, followed by cefepime, colistin, linezolid and daptomycin. The antibiotics assigned to the Other group made up 13% (IQR: 8–18%) of total consumption and varied from 1.5% in Serbia to 39% in Norway (Fig. 4.7). Second-generation cephalosporins were the most frequently consumed antibiotic class in this group. The high percentage in Norway is primarily due to the consumption of methenamine, pivmecillinam and tetracyclines. Detailed data on the consumption by AWaRe categories can be found in Annex 6 (Table A6.2).

[4] In accordance with United Nations Security Council Resolution 1244 (1999).

Fig. 4.7 Proportional consumption (%) of antibiotics by AWaRe categorization in 45 countries and Kosovo[5] of the European Region (2015)



[a] *Only community consumption reported.*

[b] *In accordance with Security Council Resolution 1244 (1999).*

5 In accordance with United Nations Security Council Resolution 1244 (1999).

4.6 WHO Eastern Mediterranean Region

4.6.1 Contextual indicators and activities

Demography and socioeconomic characteristics

The size of the population (in thousands) living in the Eastern Mediterranean Region in 2015 was 651 529 *(52)*. Of the 21 Member States of the region and Palestine (West Bank and Gaza Strip), two are low-income countries, 13 are middle-income countries and six are high-income countries *(55)*.

Regional health status

Table 4.18 Causes of death from infectious diseases among the top 10 causes of death in the Eastern Mediterranean Region, 2015 *(56)*

Rank	Cause	Deaths (000s)	% of total deaths	Crude death rate per 100 000 population
	All causes	4099	100.0	629.1
3	Lower respiratory infections	221	5.4	34
9	Diarrhoeal diseases	119	2.9	18
	Sum of above listed infections	**340**	**8.3**	**52**

Regional health systems – health expenditure

Table 4.19 Health financing indicators (aggregated average and range) in the Eastern Mediterranean Region 2015 *(57)*

Indicator	Average	Range
Domestic general government health expenditure per capita (US$)	388.6	3.1–1733.5
Current health expenditure on health as % of gross domestic product	5.3	2.7–10.3
General government health expenditure as % of current health expenditure	50.5	5.2–88.3
Out-of-pocket expenditure as % of current health expenditure	40.1	6.2–81.0

Out-of-pocket spending

In 2010, 9.5% of the total population reported health expenditure exceeding 10% of total household expenditure, and 1.4% reported health spending (exceeding 25% of total household expenditure) *(58)*.

Progress in implementing national action plans – antimicrobial consumption component

In 2016–2017, 13 countries of the region reported they had developed or were starting to develop a national action plan *(59)*. In addition, seven countries reported monitoring antibiotic consumption or use in some manner (Table 4.20).

Table 4.20 Types of national monitoring system of human antimicrobial use in the Eastern Mediterranean Region, 2016 (Question 7.1 in country self-assessment questionnaire) *(58)*

Survey response	Number of countries
No national plan or system for monitoring use of antimicrobials	5
System designed for surveillance of antimicrobial use, that includes monitoring sales or consumption of antibiotics at the national level and rational use of antibiotics in health services	3
Total sales of antimicrobials are monitored at national level and/or some monitoring of antibiotic use at a subnational level	3

(continue)

Survey response	Number of countries
Prescribing practices and antibiotic use are monitored in a national sample of health care settings	1
On a regular basis (every year/2 years) data are collected and reported on: a) antimicrobial sales or consumption for human use at the national level b) antibiotic prescribing and appropriate use in a representative sample of health facilities, public and private	0
Non-response to question 7.1	2
Non-response to country self-assessment questionnaire	7

Regional and national activities to measure antimicrobial consumption and use

The Regional Office for the Eastern Mediterranean developed a regional operational framework for implementation of the GAP on AMR. This provides an operational basis for planning and implementing the national action plans on AMR in the regional context and a stepwise approach to doing this. A total of 16 countries in the region have established national AMR committees: Afghanistan, Bahrain, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Libya, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Sudan, Tunisia and United Arab Emirates. There are variations in the structure, membership, and roles and responsibilities of the national AMR committees across countries of the region.

The regional office supported three additional countries (Libya, Islamic Republic of Iran, Sudan) who have recently endorsed and submitted their AMR national action plans to WHO. Five countries (Bahrain, Egypt, Iraq, Qatar and Tunisia) have completed their national action plans and are awaiting official endorsement by the relevant authorities. In each country, detailed interventions and activities were developed to support the second strategic objective of the GAP to establish/improve their national surveillance systems. At present, eight countries of the Eastern Mediterranean Region have shared their national action plans with WHO.

The regional office carried out situation or capacity assessments on AMR and antimicrobial consumption in seven countries: Islamic Republic of Iran, Jordan, Lebanon, Morocco, Oman, Pakistan and Sudan. Between 2016 and 2018, the regional office conducted national workshops in Egypt, Iraq, Jordan, Libya, Pakistan, Qatar, Sudan and Tunisia to support Member States in developing comprehensive national action plans on AMR, including activities related to antimicrobial use.

Two training workshops on the WHO methodology for surveillance of antimicrobial consumption were conducted in Pakistan and Sudan in 2017 to enable countries to provide reliable data on national consumption of antimicrobials: national representatives from Afghanistan, Egypt, Islamic Republic of Iran, Jordan, Lebanon, Oman, Pakistan and Sudan participated. The aim was for the countries to initiate national surveillance following the workshop. Until now, three countries (Islamic Republic of Iran, Jordan and Sudan) have provided WHO with their data on national consumption of antimicrobials for the years 2014–2016. In addition, the WHO global methodology was also introduced to the participants from 17 Member States during the 2018 Eastern Mediterranean Drug Regulatory Authorities Conference.

A point prevalence survey of health care-associated infections and antimicrobial use was conducted in Iraq in the first half of 2018. Egypt, Morocco, Pakistan and Sudan are planning to conduct the survey at the end of 2018.

A programme for behaviour change on antimicrobial resistance "Tailoring Antimicrobial Resistance Programs (TAP)" has been developed in collaboration with experts from different countries of the region. It is currently piloted in Egypt, Qatar and Sudan. Other countries (Iraq, Jordan and Pakistan) agreed to implement the intervention in their health care facilities.

WHO offices across the Eastern Mediterranean Region participate in the World Awareness Antibiotics Week by disseminating harmonized messages and carrying out campaigns to raise awareness among communities and health practitioners. The regional office developed an AMR e-card on the occasion of Eid al-Fitr (at the end of Ramadan) that was widely used on social media.

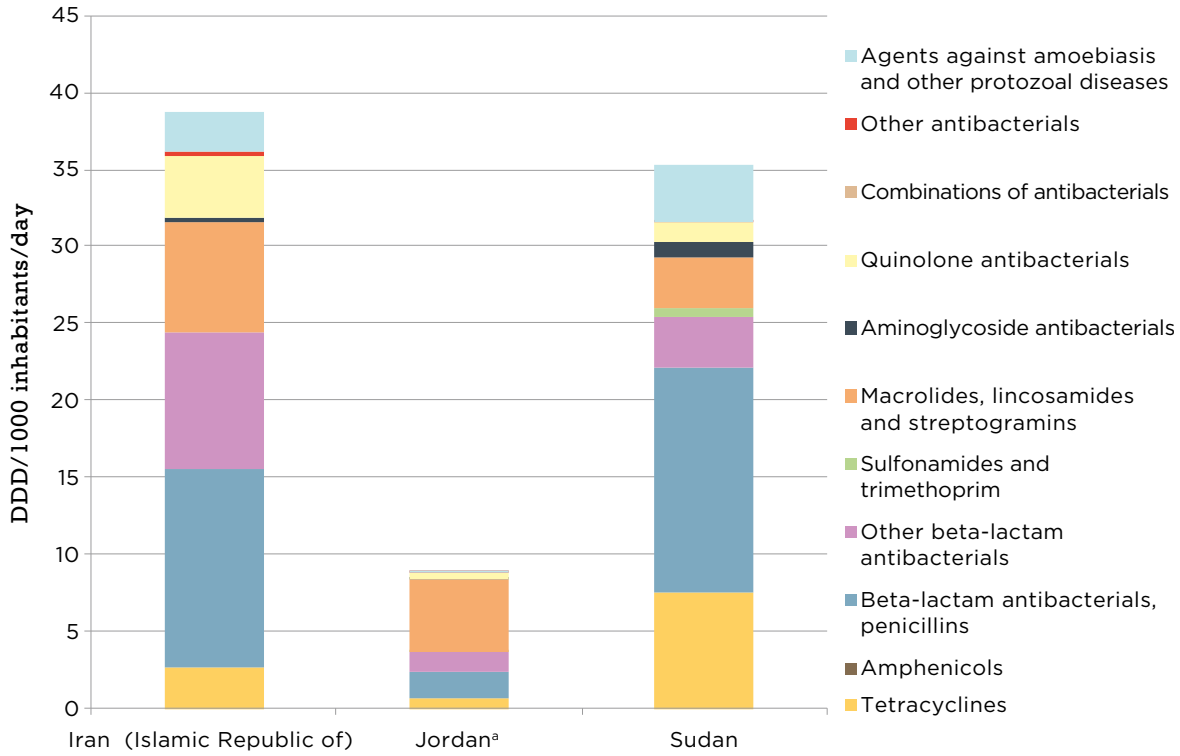
4.6.2 Data on antibiotic consumption in the Eastern Mediterranean Region

Data on antibiotic consumption are presented for three countries of the Eastern Mediterranean Region: Islamic Republic of Iran, Jordan and Sudan. The Islamic Republic of Iran submitted data from wholesalers, Jordan provided import data (although locally produced medicines are estimated to account for a significant portion of antibiotic consumption, data were not available at this stage) and Sudan provided combined data from two data sources: import and local manufacturers.

The total consumption for Islamic Republic of Iran, Jordan and Sudan was 38.8 DDD per 1000 inhabitants per day, 8.9 DDD per 1000 inhabitants per day and 35.3 DDD per 1000 inhabitants per day, respectively.

The consumption according to pharmacological subgroups for the three countries is presented in Fig. 4.8. In the Islamic Republic of Iran and Sudan, penicillins (J01C) represented the most frequently used antibiotic subgroup, accounting for 33% and 41%, respectively, of total consumption. In the Islamic Republic of Iran, other frequently used antibiotic groups were other beta-lactam antibacterials (J01D) (23%) and macrolides/lincosamides/streptogramins (J01F) (19%) followed by quinolones (J01M) (11%). In Sudan, tetracyclines (J01A) were the second most consumed antibiotic subgroup (21%) followed by nitroimidazoles (P01A), macrolides/lincosamides/streptogramins (J01F) and other beta-lactam antibacterials (J01D), each accounting for a similar share of total consumption (10–11%). The import data provided by Jordan showed that macrolides/lincosamides/streptogramins (J01F) accounted for more than 50% of the antibiotics consumed followed by penicillins (J01C) and other beta-lactam antibacterials (J01D). Detailed data on the consumption of total antibiotics and pharmaceutical subgroups by country can be found in Annex 7 (Table A7.1).

Fig. 4.8 **Consumption of antibiotics (DDD per 1000 inhabitants per day) by pharmacological subgroup in three countries of the Eastern Mediterranean Region, 2015**



[a] *Coverage of antimicrobial consumption estimated to be 70% or less, not population-adjusted.*

Categorization by route of administration showed that oral antibiotics accounted for 95% and 87% of total antibiotic consumption in the Islamic Republic of Iran and Sudan, respectively. In the Islamic Republic of Iran, the most commonly consumed orally administered antibiotic substances were amoxicillin, azithromycin and cefixime, while in Sudan, doxycycline, amoxicillin and combinations of penicillins (ATC code J01CR50) were the three most commonly consumed. Narrow-spectrum penicillins (benzathine benzylpenicillin, procaine benzylpenicillin) were the most frequently consumed parenteral antibiotics in

both countries. The substances accounting for 75% of total use in the region, and the number of countries in which they were part of the country-specific DU75 list and the median proportional consumption in these countries is provided in Table 4.21.

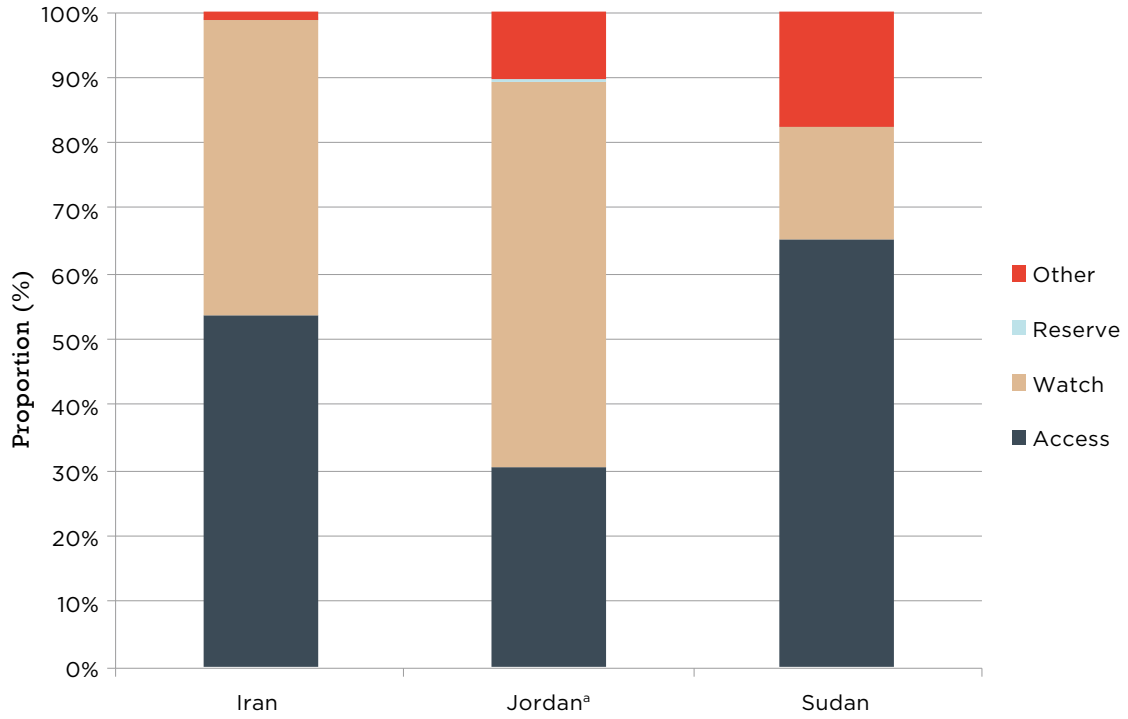
Table 4.21 Oral and parenteral antibiotic substances that made up 75% of all antibiotic consumption in the Eastern Mediterranean Region, number of countries in which they were part of the country-specific DU75 list and the median proportional consumption (% of total DDD) in these countries

Oral			Parenteral		
Antibiotic	Number of countries where it appears in country's DU75	Median proportion[a] (IQR)	Antibiotic	Number of countries where it appears in country's DU75	Median proportion[a] (IQR)
Amoxicillin	2/3	20.6 (18.0–23.1)	Ceftriaxone	2/3	28.1 (26.2–30.1)
Amoxicillin and beta-lactamase inhibitor	2/3	10.9 (9.8–12.0)	Benzathine benzylpenicillin	1/3	68.3
Azithromycin	2/3	31.9 (24.1–39.7)	Cefazolin	1/3	17.9
Metronidazole	2/3	9.4 (8.2–10.6)	Ceftazidime	1/3	5.8
Cefixime	1/3	15.6	Gentamicin	1/3	5.4
Cefuroxime	1/3	9.6	Lincomycin	1/3	16
Ciprofloxacin	1/3	8.4	Metronidazole	1/3	12.1
Combinations of penicillins	1/3	13.1	Procaine benzylpenicillin	1/3	26.6
Doxycycline	1/3	21.6	-	-	-

[a] *Median of the total proportional consumption of the countries in which the respective substance is part of the DU75 list.*

Categorization according to the AWaRe categories showed that, for the Islamic Republic of Iran and Sudan, > 50% of the antibiotics were in the Access group. Watch group antibiotics accounted for 45% of total consumption in the Islamic Republic of Iran, but only 17% in Sudan. Almost a fifth (18%) of the antibiotic consumption in Sudan belonged to the Other group mainly because of the large consumption of combination penicillins (Fig. 4.9). In Jordan, the Watch group antibiotics accounted for 59% due to a high percentage of macrolides (import data). Detailed data on the consumption by AWaRe categories can be found in Annex 7 (Table A7.2)

Fig. 4.9 Proportional consumption of antibiotics (%) by AWaRe categorization in three countries of the Eastern Mediterranean Region, 2015



[a] *Coverage of antimicrobial consumption estimated to be 70% or less, not population-adjusted.*

4.7 WHO Western Pacific Region

4.7.1 Contextual indicators and activities

Demography and socioeconomic characteristics

The size of the population (in thousands) living in the WHO Western Pacific Region in 2015 was 1 879 161 *(52)*. Of the 27 Member States of the region, none is a low-income country, 20 are middle-income and seven are high-income countries *(55)*.

Regional health status

Table 4.22 Causes of death from infectious diseases among the top 10 causes of death in the Western Pacific Region, 2015 *(56)*

Rank	Cause	Deaths (000s)	% of total deaths	Crude death rate per 100 000 population
	All causes	13 486	100.0	717.6
7	Lower respiratory infections	460	3.4	24
	Sum of above listed infections	**460**	**3.4**	**24**

Regional health systems – health expenditure

Table 4.23 Health financing indicators (aggregated average and range) in the Western Pacific Region *(57)*

Indicator	Average	Range
Domestic general government health expenditure per capita (US$)*	300.5	15.6–1182.9

(continue)

Indicator	Average	Range
Current health expenditure as % of gross domestic product	6.9	2.6–22.1
General government health expenditure as % of current health expenditure*	58.5	22.1–96.3
Out-of-pocket expenditure as % of current health expenditure	20.1	0.2–58.4

**Note: high income OECD countries are not included*

Out-of-pocket spending

In 2010, 14.8% of the total population reported health expenditures exceeding 10% of total household expenditure, and 3.9% reported health spending (exceeding 25% of total household expenditure) *(58)*.

Progress in implementing national action plans – antimicrobial consumption component

In 2016–2017, 15 countries reported they had a national action plan for AMR or were in the process of development *(59)*. At the same time, 15 countries reported they were monitoring antibiotic consumption or use in some manner (Table 4.24).

Table 4.24 Types of national monitoring systems of human antimicrobial use in the Western Pacific Region, 2016 (Question 7.1 in the country self-assessment questionnaire) *(59)*

Survey response	Number of countries
No national plan or system for monitoring use of antimicrobials	9
System designed for surveillance of antimicrobial use, that includes monitoring national level sales or consumption of antibiotics and rational use of antibiotics in health services	7
Total sales of antimicrobials are monitored at the national level and/or some monitoring of antibiotic use at a subnational level	1
Prescribing practices and antibiotic use are monitored in a national sample of health care settings	3
On a regular basis (every year/2 years) data are collected and reported on: a) antimicrobial sales or consumption at the national level for human use b) antibiotic prescribing and appropriate use, in a representative sample of health facilities, public and private	4
Non-response to question 7.1	0
Non-response to country self-assessment questionnaire	3

Regional and national activities to measure antimicrobial consumption and use

In 2014, the WHO Regional Committee for the Western Pacific endorsed the Action agenda for antimicrobial resistance in the Western Pacific Region, which provided guidance on priority actions to combat AMR in three key areas: 1) strengthen development and implementation of national plans and raise awareness in multiple sectors; 2) improve surveillance of AMR and monitoring of antimicrobial use; 3) strengthen health system capacity to contain AMR.

All Member States in the Western Pacific Region, in various ways, have developed policies, implemented actions and strengthened systems to combat AMR. WHO addresses AMR in the region more broadly in the context of: achieving universal health coverage; accelerating the elimination and eradication of high-impact communicable diseases, including malaria, tuberculosis and HIV/AIDS; and ensuring public health security.

The WHO Regional Office for the Western Pacific has undertaken a multipronged approach to AMR that covers regional coordination and governance of AMR work and support to countries to develop and implement national action plans. This includes: strengthening systems for AMR surveillance to contribute to the regional and global surveillance systems; monitoring antimicrobial consumption and use; implementing stewardship programmes; coordinating multisectoral action across

human health, animal and agriculture sectors; and conducting advocacy and campaigns for behaviour change.

To date, 15 Member States/areas have developed their national action plans: Australia, Cambodia, China, China, Hong Kong SAR, Cook Islands, Fiji, Japan, Malaysia, Mongolia, New Zealand, Papua New Guinea, the Philippines, the Republic of Korea, Singapore and Viet Nam. The Lao People's Democratic Republic, the Federated States of Micronesia and Palau are in the process of developing their national action plans.

WHO is providing coordinated support to implement the action plans through its technical working group on AMR based in the regional office and the tripartite collaboration of WHO, FAO and OIE.

A substantial number of countries have established surveillance systems for AMR, including Australia, Japan, Malaysia, New Zealand, the Philippines, the Republic of Korea and Singapore. WHO is providing support for the establishment and strengthening of national surveillance systems in Cambodia, Lao People's Democratic Republic and the Philippines. Two countries, Japan and the Philippines, have contributed surveillance data to the GLASS.

WHO has provided training to selected countries on the WHO methodology for surveillance of antimicrobial consumption: Brunei Darussalam, Cambodia, Lao Democratic People's Republic, Mongolia, the Philippines and Viet Nam. Seven countries - Australia, Brunei, Japan, Mongolia, New Zealand, the Philippines and the Republic of Korea - have submitted data for the global monitoring of antimicrobial consumption.

Efforts are focused on strengthening health system capacity to combat of AMR and strengthening pharmaceutical systems to ensure rational use of and access to good quality, safe and effective antimicrobials. Seven countries - Australia, Brunei Darussalam, Malaysia, Mongolia, the Philippines, Singapore and Viet Nam - have established antimicrobial stewardship programmes. To support countries, the regional office has developed training modules and monitoring tools for antimicrobial stewardship.

Since 2015, the WHO regional office has been supporting Member States to organize the annual World Antibiotic Awareness Week. A 5-year plan for advocacy and campaigns for behavioural change has been developed and is being implemented at the regional and country level. In 2017, the regional office, Member States and the tripartite collaboration have worked together to implement an action-oriented campaign to stop the overuse and misuse of antibiotics.

4.7.2 Data on antibiotic consumption in the Western Pacific Region

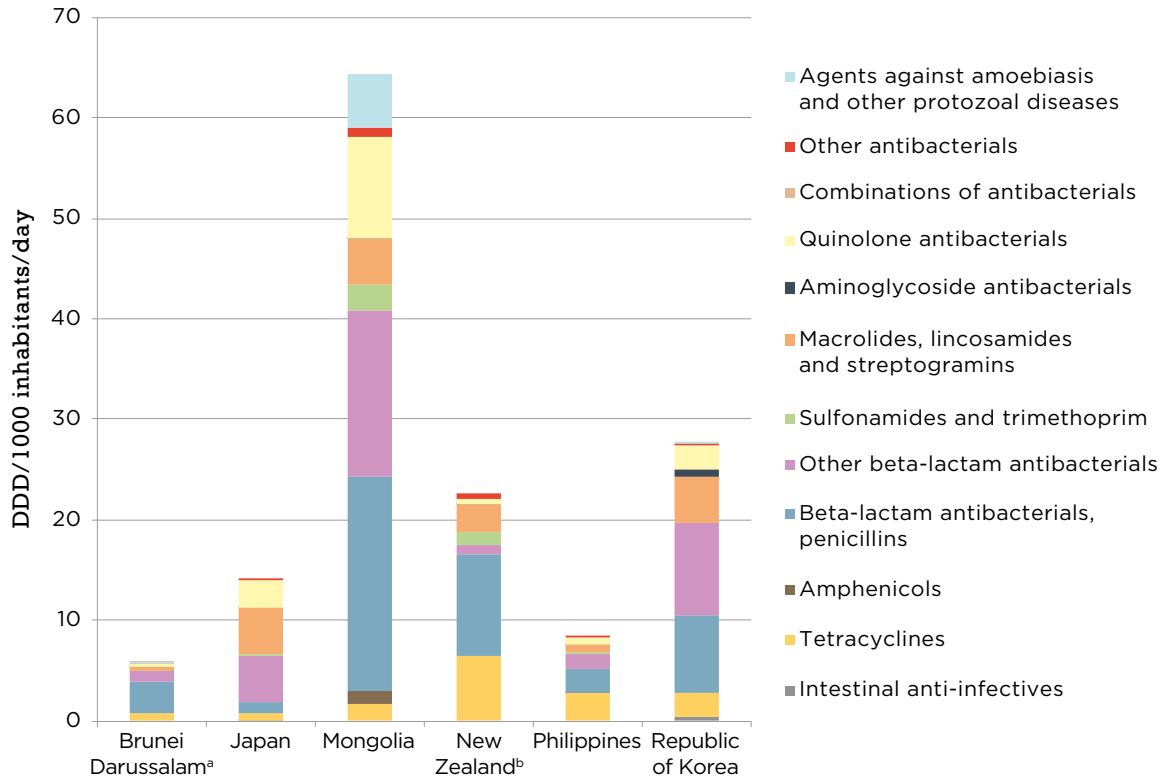
Data on antibiotic consumption are presented for six countries of the Western Pacific Region: Brunei Darussalam, Japan, Mongolia, New Zealand, the Philippines and the Republic of Korea. The countries used different data sources including dispensers, local manufacturers, wholesalers, import records, IQVIA and reimbursement records. At this stage, two countries have provided data with partial coverage: Brunei Darussalam submitted data for the public health sector only and New Zealand submitted data for the community sector only.

The total consumption varied from 5.9 DDD per 1000 inhabitants per day in Brunei Darussalam to 64.4 DDD per 1000 inhabitants per day in Mongolia. The relatively low figure from Brunei Darussalam is due to the incomplete coverage and represents the amount of antibiotics used in the public health care sector only. Total antibiotic consumption for the other countries was 14.2 DDD per 1000 inhabitants per day for Japan, 27.7 DDD per 1000 inhabitants per day for the Republic of Korea, 22.7 DDD per 1000 inhabitants per day for New Zealand and 8.2 DDD per 1000 inhabitants per day for the Philippines.

Consumption according to the pharmacological subgroup for the six countries is presented in Fig. 4.10. There was notable variation in the use across the countries. In most of the countries, about one third to one half of the consumption of antibiotics belonged to the group of penicillins (J01C). In the Republic of Korea, the most frequently used antibiotic group was other beta-lactam antibacterials (J01D) followed by penicillins (J01C) and macrolides/lincosamides/streptogramins (J01F), accounting for 33%, 28% and 17%, respectively, of total consumption. New Zealand had a different pattern with penicillins (J01C) ranking first (44% of total consumption) followed by tetracyclines (J01A) and macrolides/lincosamides/streptogramins (J01F) (29% and 13% of total consumption). Tetracyclines (J01A) and penicillins (J01C) were the most frequently consumed antibiotics in the Philippines, each contributing to about 30% of total consumption. In contrast to most other countries, the consumption of penicillins (J01C)

was low in Japan (7% of total consumption), while macrolides/lincosamides/streptogramins (J01F) and other beta-lactam antibacterials (J01D), both accounting for 32% of total use, were the most consumed antibiotic groups followed by quinolones (19%). In the public sector of Brunei Darussalam, beta-lactam antibiotics (J01C, J01D) represented 70% of total consumption. The most frequently used antibiotic subgroups in Mongolia were penicillins (J01C), other beta-lactam antibacterials (J01D) and quinolones (J01M) accounting for 33%, 26% and 16%, respectively, of total consumption. Detailed data on the consumption of total antibiotics and pharmacological subgroups by country can be found in Annex 8 (Table A8.1).

Fig. 4.10 **Consumption of antibiotics (DDD per 1000 inhabitants per day) by pharmacological subgroup in six countries of the Western Pacific Region, 2015**



[a] *Only public sector reported.*

[a] *Only community consumption reported.*

With regard to route of administration, oral antibiotics accounted for more than 90% of all antibiotic consumption, with the exception of Mongolia where 66% were oral antibiotics. The most common oral antibiotic substances included in the DU75 list of four to six countries were amoxicillin, amoxicillin/beta-lactamase inhibitor and doxycycline accounting for a median proportional consumption of 19%, 17% and 21%, respectively. Cephalosporins were by far the most commonly consumed parenteral antibiotic agents, of which cefazolin and/or ceftriaxone or cefuroxime were part the DU75 list of all countries, with a median proportional consumption of 16%, 14% and 22%, respectively. Of note is that meropenem was included in the DU75 list of three countries. The substances accounting for 75% of total use in the region, and the number of countries in which they were part of the country-specific DU75 list and the median proportional consumption in these countries is provided in Table 4.25.

Table 4.25 Oral and parenteral antibiotic substances that made up 75% of all antibiotic consumption in the Western Pacific Region, number of countries in which they were part of the country-specific DU75 list and the median proportional consumption (% of total DDD) in these countries

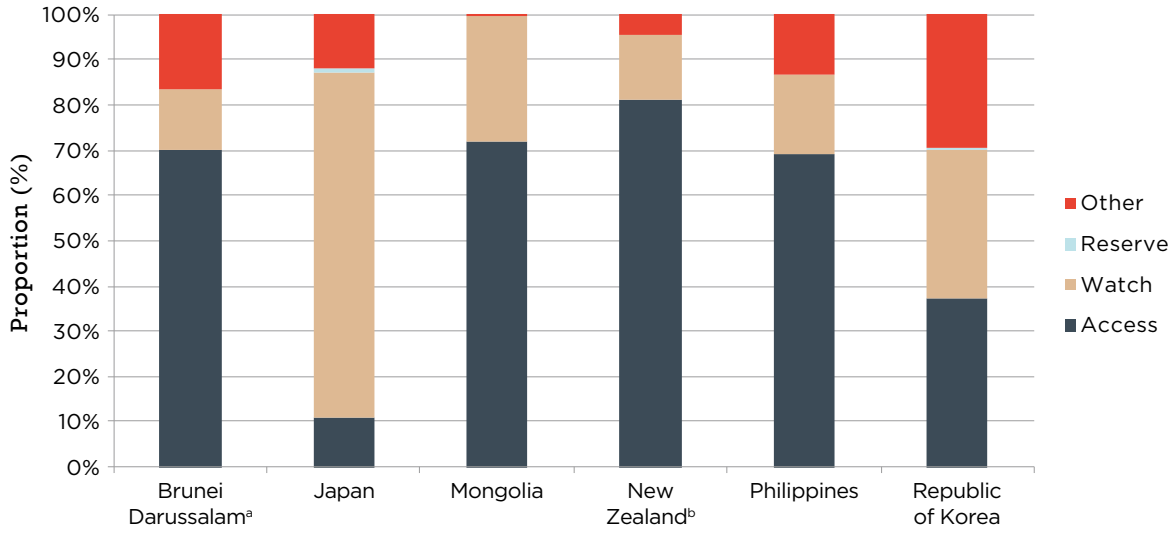
Oral			Parenteral		
Antibiotic	Number of countries where it appears in country's DU75	Median proportion[a] (IQR)	Antibiotic	Number of countries where it appears in country's DU75	Median proportion[a] (IQR)
Amoxicillin	6/6	18.5 (12.5–22.0)	Cefazolin	5/6	15.7 (14.5–26.4)
Amoxicillin and beta-lactamase inhibitor	4/6	16.8 (13.4–20.6)	Ceftriaxone	4/6	14.1 (11.6–16.1)
Doxycycline	4/6	20.8 (12.4–29.3)	Meropenem	3/6	5.6 (5.2–7.0)
Clarithromycin	2/6	17.8 (14.2–21.4)	Metronidazole	3/6	4.5 (4.1–9.3)
Azithromycin	1/6	4.8	Piperacillin and beta-lactamase inhibitor	3/6	7.2 (5.7–7.6)
Cefaclor	1/6	17	Cefuroxime	2/6	21.6 (19.0–24.3)
Cefcapene	1/6	11.8	Flomoxef	2/6	3.2 (2.8–3.6)
Cefditoren	1/6	9	Gentamicin	2/6	12.2 (8.4–16.0)
Cefuroxime	1/6	11.5	Levofloxacin	2/6	3.6 (3.1–4.2)
Ciprofloxacin	1/6	22.9	Amikacin	1/6	3.8
Erythromycin	1/6	6.9	Ampicillin	1/6	2.7
Flucloxacillin	1/6	7.5	Ampicillin and beta-lactamase inhibitor	1/6	9.5
Garenoxacin	1/6	4.2	Benzylpenicillin	1/6	4.7
Levofloxacin	1/6	10.8	Cefazedone	1/6	8.2
Metronidazole	1/6	12.7	Cefmetazole	1/6	4.1
Minocycline	1/6	3.8	Cefotaxime	1/6	2.8
Roxithromycin	1/6	6.1	Cefotiam	1/6	2.8
-	-	-	Ceftazidime	1/6	15.3
-	-	-	Ceftezole	1/6	3.8
-	-	-	Ciprofloxacin	1/6	2.8
-	-	-	Lincomycin	1/6	4.1
-	-	-	Minocycline	1/6	2.3
-	-	-	Netilmicin	1/6	3.7
-	-	-	Procaine benzylpenicillin	1/6	17.4
-	-	-	Ribostamycin	1/6	9.7
-	-	-	Streptomycin	1/6	3.4
-	-	-	Tobramycin	1/6	15.7
-	-	-	Vancomycin	1/6	2.5

[a] *Median of the total proportional consumption of the countries in which the respective substance is part of the DU75 list.*

The classification according to the AWaRe categories showed that the Access group antibiotics accounted for more than 65% of antibiotic consumption in Brunei Darussalam, Mongolia, New Zealand and the Philippines, while the proportion of Watch group antibiotics in these countries ranged from 13% to 28% (Fig. 4.11). The Reserve group antibiotics accounted for no more than 0.2%. In Japan, Watch group antibiotics accounted for 76% of antibiotic consumption and the Reserve group about 1%. The Republic of Korea showed a similar distribution with respect to Access and Watch group antibiotics and the Other group, each representing around a third of the total antibiotic consumption.

The most common antibiotics in the Reserve group were intravenous fosfomycin and cefepime. Within the Other group, most of the consumption consisted of second-generation cephalosporins (cefuroxime, cefaclor) and minocycline. Detailed data on the consumption by AWaRe categories can be referred to in Annex 8 (Table A8.2)

Fig. 4.11 Proportional consumption (%) of antibiotics by AWaRe categorization in six countries of the Western Pacific Region, 2015



[a] *Only public sector reported.*

[b] *Only community consumption reported.*

SECTION

05

5 Discussion

In 2015, WHO initiated the global programme on surveillance of antimicrobial consumption in response to the lack of quality antimicrobial consumption data and standardized methodology for data collection in many low- and middle-income countries. The programme includes the development of global tools for managing the global surveillance systems (i.e. methodology for monitoring antimicrobial consumption at national level), and the provision of technical support to countries in establishing national surveillance systems.

Many low- and middle-income countries may lack the capacity on how to establish and run a national surveillance system on antibiotic consumption, which generally goes hand in hand with insufficient human and financial resources. Therefore country capacity building is a crucial component of the work of the WHO. During the first cycle of the global programme on surveillance of antimicrobial consumption (2016–2018), WHO supported 57 low- and middle-income countries through trainings and workshops. Fifteen of these countries were able to report their first national data on antimicrobial consumption using aggregated data sources. This report presents data on antibiotic consumption in 2015 from 65 countries, including countries with pre-existing national surveillance of antimicrobial consumption.

5.1 Data interpretation and data limitations

Results from this report showed wide intra- and interregional variation in the quantity and types of antibiotics consumed. This variation likely reflects actual differences in antibiotic consumption, but might also be partially attributed to differences in data coverage.

The WHO methodology on antimicrobial consumption monitoring allows for data to be collected on an aggregated level and does not rely on the availability of person-level data. There is also flexibility in the choice of data sources, ranging from import- and production records to prescription data, enabling countries with limited resources to use pre-existing data sources to build sustainable programmes for surveillance of antimicrobial consumption. However, the choice of data sources has implications for the interpretation of results, as different data sources have inherent advantages and limitations.

Depending on the source(s) selected, data coverage or population coverage may be incomplete in some countries, thus not showing the full picture of antibiotic consumption. It is important to take this into consideration when interpreting the results, and consequently it is best to refrain from cross-regional and cross-country comparisons. More importantly, the data on antibiotic consumption should be interpreted within the context of the specific countries, considering other aspects such as the burden of infectious diseases, national or local treatment guidelines and broader health systems issues.

The main data limitations noted from this report include:

5.1.1 Incomplete data and population coverage

Some countries in the report only reported on public sector data due to the selected data source (e.g. central medical stores, public procurement). If a substantial portion of the antibiotics are sold and dispensed in the private sector, the estimates derived from the public sector alone will underestimate the consumption of antibiotics. Additionally, the public sector may cover hospital care to a greater extent than primary health care, which affects the types of antibiotics used. Thus, this may lead to misinterpretation of the observed pattern of antibiotic consumption in this report.

In order to achieve full data coverage it might be necessary to combine different data sources, for example records on import and domestic manufacturing of antimicrobials. Seven countries in the report obtained only import data. Where local manufactured antibiotics are a substantial portion of the sold and dispensed antibiotics, import data alone will substantially underestimate the consumption of antibiotics as well as skew the patterns of the observed antibiotic consumption.

5.1.2 Informal market

As data for this report have been collected through the official channels, mainly national regulatory authorities, antibiotics that are potentially sold through the informal market may not be captured in the surveillance system. The size of the informal market, where substandard or falsified medicines may be circulating, might be substantial in low- and middle-income countries, resulting in underestimation of antibiotic consumption. Other types of surveillance methods, for instance surveys, would be more suitable to capture such information.

5.1.3 ATC/DDD methodology

The WHO methodology on antimicrobial consumption monitoring relies on the ATC/DDD classification, which is a global standard for the drug utilization research. This standardization allows comparisons of data across health care facilities, countries and regions but it is not suitable for quantifying consumption of antibiotics in children. This limits the direct comparability of consumption between countries with different age distributions, but it has less impact on the comparisons of consumption over time in a single country. Another limitation is that some antibiotic substances have not been assigned ATC codes or DDD values, which prevents the calculation of consumption for these products. This limitation applies to many combination products that are more common in some countries and regions than others. It is important to note that the report uses the 2019 ATC/DDD version, where the DDD value has been changed for some commonly used antibiotics such as amoxicillin. Thus, results from this report will differ from prior consumption estimates that have been calculated with the previous ATC/DDD versions.

5.2 Opportunities for using antimicrobial consumption data

Data on antimicrobial consumption collected by means of routine surveillance can be used for several purposes, for example to raise awareness of appropriate antimicrobial use, to inform policy and regulatory changes to optimize use, to identify areas for improvement and monitor the impact of interventions, and to improve the procurement and supply of medicines. Some of these areas are described in further detail below.

5.2.1 Pharmaceutical systems strengthening

The implementation of a national surveillance system on antimicrobial consumption has prompted countries to review their pharmaceutical supply chain systems in order to identify available data sources. This process has identified existing gaps and challenges associated with the regulation, procurement and distribution of medicines within countries. This has served as a good starting point for overall pharmaceutical systems strengthening and in some instances, has encouraged countries to address their regulatory and supply chain deficits.

One area of pharmaceutical systems strengthening relates to the supply of quality-assured antimicrobials. For example, the health authority of Côte d'Ivoire detected a high number of authorized antimicrobial products on the market as well as a weak information management system for medicines after collecting data for monitoring purposes. As a result, the country introduced a system to assign unique codes to each authorized medical product in order to improve the tracking of medicines. Other countries, such as Bangladesh, plan to use consumption data to improve quality assurance of medicines by prioritizing quality controls for the most sold products and packages.

The ATC/DDD classification and the WHO methodology on antimicrobial consumption monitoring can be transferable to other medicines and become a part of a standardized national health information system. Some countries have expressed interest in expanding their surveillance systems to also incorporate medicines in other areas such as noncommunicable diseases.

5.2.2 Access to medicines

While excess use of antibiotics is a challenge in many high- and middle-income countries, poor access to affordable and quality-assured antibiotics is a problem in countries with limited resources, and particularly for some population groups. This can be reflected in their low antibiotic consumption, as well as in the specific patterns of antibiotic use. For example, the Reserve group of antibiotics

were rarely observed in many of the countries included in this report, which may suggest limited access. To improve the procurement of medicines that are frequently out of stock in health facilities, some countries in West Africa are now collecting data at the national, regional and facility levels throughout the public procurement systems to understand the flow of antimicrobials in the public sector.

It is important to note that national consumption estimates can mask considerable inequalities in access to and consumption of antibiotics within a country. To better understand intra-country variations, national estimates should be disaggregated where possible; for example by rural and urban areas, health care sector (private/public sector or hospital/primary care) or socioeconomic strata.

5.2.3 Antimicrobial stewardship

Monitoring antimicrobial consumption is a key element of national and local antimicrobial stewardship programmes. Linked to surveillance data on antimicrobial resistance, information on the volume and pattern of antimicrobial consumption helps to identify areas of improvement, develop targeted stewardship interventions, and monitor and evaluate the impact of such interventions.

This report presents a few selected indicators for antibiotic consumption, including the total volume of consumption of antibiotics, relative consumption by subgroups and by the AWaRe categories, and lists the most consumed antibiotic substances. However, other indicators not included in this report are also helpful to support antimicrobial stewardship programs. Recently, the European Centre for Disease Prevention and Control (ECDC), European Food Safety Authority (EFSA) and European Medicines Agency (EMA) published a list of indicators for surveillance of antimicrobial consumption *(67)*. For example, the ratio of broad-spectrum to narrow-spectrum antibiotics is useful for outpatient settings.

In addition to the ATC/DDD classification, other metrics can also be used to quantify antibiotic consumption. Some countries, such as Norway, Sweden and the United States of America (USA), apply the number of prescriptions per population as a metric to monitor antibiotic consumption over time *(72-75)*. During the first cycle of the global programme, data from countries using other metrics than ATC/DDD were not included in the report, but WHO intends to expand the scope of the global programme on surveillance of antimicrobial consumption and use in the upcoming cycles.

Aggregated data on antimicrobial consumption should, ideally, be combined with more granular data at the patient level to better understand prescribing behaviours. Such data can be collected through surveys. For example, surveys conducted by national health care or administrative/claims data are used in the USA to characterize antibiotic prescribing related to health care visits or episodes, and also provide additional information on payment, patient demographics and diagnosis, prescriptions, and diagnostic testing (72, 76–78). The *WHO Protocol for Point Prevalence Survey on Antibiotic Use in Hospitals* to be published in 2018 will complement the WHO methodology on antimicrobial consumption monitoring. The survey supports collection of patient data at the facility level, which is of importance for the implementation, monitoring and evaluation of antimicrobial stewardship programmes in hospitals.

5.2.4 Links to other surveillance programmes

Data on antibiotic consumption can be linked to other relevant surveillance data in humans and animals. The European Union has compared antimicrobial consumption data in human and animals to resistance rates through integrated data analysis *(39)*.

To allow for the comparison of antimicrobial consumption across the human and animal sectors through a One Health approach, the volume of antibiotic consumption is also presented as tonnes in this report. Due to the lack of a standardized approach to estimate body mass in humans (denominator), this metric is not population-adjusted and should not be used for direct comparisons between countries. However, with the expansion of the global programme on surveillance of antimicrobial consumption to additional countries over time, efforts to link consumption data from the human sector to corresponding data in the animal sector and antimicrobial resistance rates will be undertaken.

5.3 Recommendations and future steps

This report shows the progress in establishing surveillance of antimicrobial consumption in countries. Depending on the state of implementation, countries are recommended to take any of the following actions:

- Countries without national surveillance of antimicrobial consumption should explore means to establish such a system using the WHO methodology on antimicrobial consumption monitoring or a comparable methodology.
- Countries that have recently implemented national surveillance of antimicrobial consumption should undertake data validation, expand data coverage when applicable, and have in place dedicated human and financial resources to ensure sustainability of the surveillance system.
- Countries with mature surveillance systems should explore possibilities of linking their data to other relevant surveillance programmes (antimicrobial consumption and antimicrobial resistance) across the human and animal sectors through a One Health approach, and are encouraged to share their experiences with other countries.
- All countries collecting or planning to collect national data on antimicrobial consumption are encouraged to submit their data to the WHO as part of the global programme on surveillance of antimicrobial consumption.

The WHO will continue to work closely with countries, donors and development agencies to strengthen the global programme on surveillance of antimicrobial consumption. This includes providing technical and financial support to low- and middle-income countries without existing surveillance systems on antimicrobial consumption, as well as continued support to countries with recently implemented surveillance systems to sustain their programmes and expand their population coverage where applicable. Country experiences and lessons learned from the early implementation phase will inform the continued roll-out of the global programme.

To support capacity building, online training courses on the WHO methodology on antimicrobial consumption monitoring are being developed. To integrate surveillance of antimicrobial consumption with antimicrobial resistance, the WHO global programme on surveillance of antimicrobial consumption will be integrated into the WHO GLASS platform and launch its first official call for data in 2019.

REFERENCES

References

1. WHO model list of essential medicines. 20th list (March 2017). Geneva: World Health Organization; 2017 (http://www.who.int/medicines/publications/essentialmedicines/20th_EML2017.pdf?ua=1, accessed 25 September 2018).
2. WHO. Antimicrobial resistance (WHO Fact sheet). Geneva: World Health Organization; February 2018 (http://www.who.int/en/news-room/fact-sheets/detail/antimicrobial-resistance, accessed 25 September 2018).
3. Laxminarayan R, Duse A, Wattal C, Zaidi AK, Wertheim HF, Sumpradit N, et al. Antibiotic resistance-the need for global solutions. Lancet Infect Dis. 2013;13:1057–98. doi:10.1016/S1473-3099*(13)*70318-9
4. WHO. Prioritization of pathogens to guide discovery, research and development of new antibiotics for drug-resistant bacterial infections including tuberculosis. Geneva: World Health Organization; 2017 (http://www.who.int/medicines/areas/rational_use/PPLreport_2017_09_19.pdf?ua=1, accessed 25 September 2018).
5. Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, Monnet DL, et al. Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet Infect Dis. 2018;18:318-27. doi:10.1016/S1473-3099*(17)*30753-3
6. The World Bank. Drug resistant infections: a threat to our economic future. Washington D.C: The World Bank; 2017 (http://documents.worldbank.org/curated/en/323311493396993758/pdf/114679-REVISED-v2-Drug-Resistant-Infections-Final-Report.pdf, accessed 25 September 2018).
7. Ayukekbong JA, Ntemgwa M, Atabe AN. The threat of antimicrobial resistance in developing countries: causes and control strategies. Antimicrob Resist Infect Control. 2017;6:47. doi:10.1186/s13756-017-0208-x
8. Davies J, Davies D. Origins and evolution of antibiotic resistance. Microbiol Mol Biol Rev. 2010;74:417–33. doi:10.1128/MMBR.00016-10
9. González-Zorn B, Escudero JA. Ecology of antimicrobial resistance: humans, animals, food and environment. Int Microbiol. 2012;15:101–9. doi:10.2436/20.1501.01.163
10. WHO, FAO, and OIE unite in the fight against Antimicrobial Resistance. World Health Organization, Food and Agriculture Organization and World Organisation for Animal Health. (Flyer); 2015 (http://www.who.int/foodsafety/areas_work/antimicrobial-resistance/amr_tripartite_flyer.pdf?ua=1, accessed 25 September 2018).
11. Goossens H, Ferech M, Vander Stichele R, Elseviers M; ESAC Project Group. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. Lancet 2005;365:579–87. doi:10.1016/S0140-6736*(05)*17907-0
12. Malhotra-Kumar S, Lammens C, Coenen S, Van Herck K, Goossens H. Effect of azithromycin and clarithromycin therapy on pharyngeal carriage of macrolide-resistant streptococci in healthy volunteers: a randomised, double-blind, placebo controlled study. Lancet 2007;369:482–90. doi:10.1016/S0140-6736*(07)*60235-9
13. Fridkin SK, Edwards JR, Courval JM, Hill H, Tenover FC, Lawton R, et al.; Intensive Care Antimicrobial Resistance Epidemiology (ICARE) Project and the National Nosocomial Infections Surveillance (NNIS) System Hospitals. The effect of vancomycin and third-generation cephalosporins on prevalence of vancomycin-resistant enterococci in 126 U.S. adult intensive care units. Ann Intern Med 2001;135:175–83. doi: 10.7326/0003-4819-135-3-200108070-00009
14. Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. BMJ. 2010;340:c2096. doi:10.1136/bmj.c2096

15. Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, et al. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. Lancet Infect Dis. 2014;14:742–50. doi:10.1016/S1473-3099*(14)*70780-7

16. Klein EY, Van Boeckel TP, Martinez EM, Pant S, Gandra S, Levin SA, et al. Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. Proc Natl Acad Sci USA. 2018;15:E3463–70. doi:10.1073/pnas.1717295115

17. Cecchini M, Langer J, Slawomirski L. Antimicrobial resistance in G7 countries and beyond—Economic issues, policies and options for action. Paris: Organisation for Economic Co-operation and Development; 2015 (https://www.oecd.org/els/health-systems/Antimicrobial-Resistance-in-G7-Countries-and-Beyond.pdf, accessed 25 September 2018).

18. Laxminarayan R, Matsoso P, Pant S, Brower C, Røttingen JA, Klugman K, et al. Access to effective antimicrobials: a worldwide challenge. Lancet. 2016;387:168–75. doi:10.1016/S0140-6736*(15)*00474-2

19. Mendelson M, Røttingen JA, Gopinathan U, Hamer DH, Wertheim H, Basnyat B, et al. Maximising access to achieve appropriate human antimicrobial use in low-income and middle-income countries. Lancet 2016;387:188–98. doi:10.1016/S0140-6736*(15)*00547-4

20. WHO. Antibiotic agents in clinical development: an analysis of the antibiotic clinical development pipeline, including tuberculosis. Geneva: World Health Organization; 2017 (http://apps.who.int/iris/bitstream/handle/10665/258965/WHO-EMP-IAU-2017.11-eng.pdf?sequence=1, accessed 25 September 2018).

21. United Nations. Draft political declaration of the high-level meeting of the General Assembly on antimicrobial resistance. New York: United Nations; 2016 (https://www.un.org/pga/71/wp-content/uploads/sites/40/2016/09/DGACM_GAEAD_ESCAB-AMR-Draft-Political-Declaration-1616108E.pdf, accessed 25 September 2018).

22. WHO. Global action plan on antimicrobial resistance. Geneva: World Health Organization; 2015 (www.who.int/antimicrobial-resistance/publications/global-action-plan/en/, accessed 25 September 2018).

23. WHA60.16 Progress in the rational use of medicines. Geneva: World Health Assembly; 2007 (http://apps.who.int/gb/ebwha/pdf_files/WHASSA_WHA60-Rec1/E/reso-60-en.pdf?ua=1#page=27, accessed 25 September 2018).

24. WHA58.27 Improving the containment of antimicrobial resistance. Geneva: World Health Assembly; 2005 (http://apps.who.int/medicinedocs/documents/s16340e/s16340e.pdf, accessed 25 September 2018).

25. WHO global strategy for containment of antimicrobial resistance. Geneva: World Health Organization; 2001 (http://www.who.int/drugresistance/WHO_Global_Strategy_English.pdf, accessed 25 September 2018).

26. WHO. How to investigate drug use in health facilities: selected drug use indicators. Geneva: World Health Organization; 1993 (EDM Research Series No. 007) (http://apps.who.int/medicinedocs/en/d/Js2289e/#Js2289e, accessed 25 September 2018).

27. WHO. Medicines use in primary care in developing and transitional countries. Fact Book summarizing results from studies reported between 1990 and 2006. Geneva: World Health Organization; 2009 (http://www.who.int/medicines/publications/who_emp_2009.3/en/, accessed 25 September 2018).

28. WHO. Antimicrobial resistance. Surveillance of antimicrobial use. Geneva: World Health Organization (http://www.who.int/antimicrobial-resistance/global-action-plan/optimise-use/surveillance/en/, accessed 25 September 2018).

29. WHO, FAO, OIE. Global Framework for Development & Stewardship to Combat Antimicrobial Resistance. Draft Roadmap. World Health Organization, Food and Agriculture Organization of the United Nations and World Organization for Animal Health; 2017 (http://www.who.int/phi/implementation/research/UpdatedRoadmap-Global-Framework-for-Development-Stewardship-to-combatAMR_2017_11_03.pdf?ua=1, accessed 25 September 2018).

30. Sharland M, Pulcini C, Harbarth S, Zeng M, Gandra S, Mathur S et al.; 21st WHO Expert Committee on Selection and Use of Essential Medicines. Classifying antibiotics in the WHO Essential Medicines List for optimal use-be AWaRe. Lancet Infect Dis. 2018;18(1):18-20. doi: 10.1016/S1473-3099*(17)*30724-7.

31. WHO. Global antimicrobial resistance surveillance system (GLASS) report: early implementation 2016–2017. Geneva: World Health Organization; 2017 (http://apps.who.int/iris/bitstream/handle/10665/259744/9789241513449-eng.pdf?sequence=1, accessed 25 September 2018).

32. ECDC. European Surveillance of Antimicrobial Consumption Network (ESAC-Net). European Centre for Disease Prevention and Control (https://ecdc.europa.eu/en/about-us/partnerships-and-networks/disease-and-laboratory-networks/esac-net, accessed 25 September 2018).

33. WHO Regional Office for Europe Antimicrobial Medicines Consumption (AMC) Network. AMC data 2011–2014. Copenhagen: World Health Organization Regional Office for Europe; 2017 (http://www.euro.who.int/__data/assets/pdf_file/0007/337984/51020-WHO-AMC-report-web.pdf?ua=1, accessed 25 September 2018).

34. WHO methodology for a global programme on surveillance of antimicrobial consumption. Geneva: World Health Organization; 2017 (http://www.who.int/medicines/areas/rational_use/WHO_AMCsurveillance_1.0.pdf?ua=1, accessed 25 September 2018).

35. Statens Serum Institute, National Veterinary Institute, National Food Institute. DANMAP (Danish Integrated Antimicrobial Resistance Monitoring and Research Programme). (https://www.danmap.org/, accessed 25 September 2018).

36. Public Health Agency of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS). Government of Canada. Public Health Agency of Canada (https://www.canada.ca/en/public-health/services/surveillance/canadian-integrated-program-antimicrobial-resistance-surveillance-cipars.html, accessed 25 September 2018).

37. Donado-Godoy P, Castellanos R, León M, Arevalo A, Clavijo V, Bernal J, et al. The establishment of the Colombian Integrated Program for Antimicrobial Resistance Surveillance (COIPARS): a pilot project on poultry farms, slaughterhouses and retail market. Zoonoses Public Health. 2015;62(Suppl 1):58–69. doi:10.1111/zph.12192

38. CDC. National Antimicrobial Resistance Monitoring System (NARMS). Centers for Disease Control and Prevention; 2018 (http://www.cdc.gov/narms/, accessed 25 September 2018).

39. 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. EFSA J. 2017;15:e4872. doi:10.2903/j.efsa.2017.4872

40. WHO. Tuberculosis (WHO Fact sheet). Geneva: World Health Organization; 2018 (http://www.who.int/news-room/fact-sheets/detail/tuberculosis, accessed 25 September 2018).

41. United Nations. Meetings coverage and press releases. World leaders reaffirm commitment to end tuberculosis by 2030, as General Assembly adopts declaration outlining actions for increased financing, treatment access. 26 September 2018 (https://www.un.org/press/en/2018/ga12067.doc.htm, accessed 9 October 2018).

42. WHO. Global tuberculosis report 2018. Geneva: World Health Organization; 2018 (http://apps.who.int/iris/bitstream/handle/10665/274453/9789241565646-eng.pdf?ua=1, accessed 12 October 2018).

43. Stop TB Partnership. Annual report 2016. Geneva: Stop TB Partnership; 2017 (http://www.stoptb.org/assets/documents/resources/publications/annualreports/ANNUAL_REPORT_2016.pdf, accessed 25 September 2018).

44. Versporten A, Bolokhovets G, Ghazaryan I, Abilova V, Pyshnik G, Spasojewic T, et al. Antibiotic use in eastern Europe: a cross-national database study in cooerdination with the WHO Regional Office for Europe. Lancet Infect Dis. 2014;14:381

45. WHO Collaborating Centre for Drug Statistics Methodology (https://www.whocc.no/, accessed 25 Oktober 2018).

46. OIE Annual report on antimicrobial agents intended for use in animals: better understanding of the global situation. Second report. Paris: World Organisation for Animal Health; 2017 (http://www.oie.int/fileadmin/Home/fr/Our_scientific_expertise/docs/pdf/AMR/Survey_on_monitoring_antimicrobial_agents_Dec2016.pdf, accessed 05 November 2018)

47. WHO Collaborating Centre for Drug Statistics Methodology. ATC/DDD-Index 2018. WHO Collaborating Centre for Drug Statistics Methodology; 2018 (https://www.whocc.no/atc_ddd_index/, accessed 25 September 2018).

48. Public Health Agency of Canada. Canadian Antimicrobial Resistance Surveillance System. 2017 report. Ottawa: Public Health Agency of Canada; 2017 (https://www.wormsandgermsblog.com/files/2017/11/CARSS-Report-2017-EN.pdf, accessed 25 September 2018).

49. Muraki Y, Yagi T, Tsuji Y, Nishimura N, Tanabe M, Niwa T, et al. Japanese antimicrobial consumption surveillance: first report on oral and parenteral antimicrobial consumption in Japan (2009-2013). J Glob Antimicrob Resist. 2016;7:19–23. doi: 10.1016/j.jgar.2016.07.002

50. Williamson DA, Roos RF, Verrall A. Antibiotic consumption in New Zealand, 2006–2014. Porirua: The Institute of Environmental Science and Research Ltd.; 2016 (https://surv.esr.cri.nz/PDF_surveillance/AntibioticConsumption/2014/Antibiotic_Consumption_Report_Final.pdf, accessed 25 September 2018).

51. OECD Health Statistics 2016. Definitions, sources and methods – pharmaceutical consumption by DDDs. Paris: Organisation for Economic Co-operation and Development; 2016 (https://www.oecd.org/els/health-systems/Table-of-Content-Metadata-OECD-Health-Statistics-2016.pdf, accessed 25 September 2018).

52. United Nations. Population Division. The World Population Prospects - the 2017 revision. New York: United Nations; 2017 (https://www.un.org/development/desa/publications/world-population-prospects-the-2017-revision.html, accessed 05 November 2018)

53. The World Bank. Population, total. The World Bank; 2017 (https://data.worldbank.org/indicator/SP.POP.TOTL, accessed 25 September 2018).

54. Harbarth S, Monnet DL. Cultural and socioeconomic determinants of antibiotic use. In: Gould I, van der Meer JW, editors. Antibiotic policies: fighting resistance. Boston, MA: Springer; 2008.

55. The World Bank. World Development Indicators. The World Bank Data Bank; 2018 (http://databank.worldbank.org/data/GNI-per-capita-2008-2015/id/d25dac07, accessed 25 September 2018).

56. WHO. Top 10 causes of death, 2015. Global Health Observatory data repository. Geneva: World Health Organization; 2018 (http://www.who.int/gho/mortality_burden_disease/causes_death/top_10/en/ accessed 25 September 2018).

57. WHO. Global Health Expenditures Database. Table of regional averages for key indicators. Geneva: World Health Organization; 2018 (http://apps.who.int/nha/database/Regional_Averages/Index/en, accessed 25 September 2018).

58. WHO. The Global Health Observatory. Universal Health Coverage2017. Geneva: World Health Organization; 2017 (http://www.who.int/gho/en/, accessed 25 September 2018).

59. WHO, FAO, OIE. Global database for antimicrobial resistance country self assessment 2016. World Health Organization, Food and Agriculture Organization of the United Nations and World Organization for Animal Health; 2016 (http://amrcountryprogress.org/, accessed 25 September 2018).

60. Sommanustweechai A, Chanvatik S, Sermsinsiri V, Sivilaikul S, Patcharanarumol W, Yeung S, et al. Antibiotic distribution channels in Thailand: results of key-informant interviews, reviews of drug regulations and database searches. Bull World Health Organ. 2018; 96:101–9. doi: 10.2471/BLT.17.199679

61. Tangcharoensathien V, Sommanustweechai A, Chanthong B, SumpraditN,SakulbumrungsilR,SasiJaroenpoj S, et al. on behalf of the Thai SAC Working Group. Surveillance of antimicrobial consumption: methodological review for systems development in Thailand. J Glob Health. 2017;7:010307. doi: 10.7189/jogh.07.010307

62. ECDC. ESAC-Net Reporting Protocol 2018. European Centre for Disease Prevention and Control; 2018 (https://ecdc.europa.eu/en/publications-data/esac-net-reporting-protocol-2018, accessed 25 September 2018).

63. ECDC. European Surveillance of Antimicrobial Consumption Network (ESAC-Net). European Centre for Disease Prevention and Control (https://ecdc.europa.eu/en/antimicrobial-consumption/surveillance-and-disease-data/database, accessed 25 September 2018).

64. ECDC. Healthcare-associated infections in acute care hospitals. Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals, 2011–2012. European Centre for Disease Prevention and Control (https://ecdc.europa.eu/en/healthcare-associated-infections-acute-care-hospitals, accessed 25 September 2018).

65. ECDC. Point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities, April–May 2013. European Centre for Disease Prevention and Control (https://ecdc.europa.eu/en/healthcare-associated-infections-long-term-care-facilities, accessed 25 September 2018).

66. ECDC. European Antibiotic Awareness Day. A European Health Initiative. European Centre for Disease Prevention and Control (https://antibiotic.ecdc.europa.eu/en, accessed 25 September 2018).

67. ECDC, EFSA and EMA. Joint Scientific Opinion on a list of outcome indicators as regards surveillance of antimicrobial resistance and antimicrobial consumption in humans and food-producing animals. European Centre for Disease Prevention and Control, European Food Safety Authority, European Medicines Agency; 2017 (https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2017.5017, accessed 25 September 2018)

68. Versporten A, Bolokhovets G, Ghazaryan L, Abilova V, Pyshnik G, Spasojevic T, et al. Antibiotic use in eastern Europe: a cross-national database study in coordination with the WHO Regional Office for Europe. Lancet Infect Dis. 2014;14:381–7. doi: 10.1016/S1473-3099*(14)*70071-4

69. Versporten A, Zarb P, Caniaux I, Gros M-F, Drapier N, Miller M, et al. Antimicrobial consumption and resistance in adult hospital inpatients in 53 countries: results of an internet-based global point prevalence survey. Lancet Glob Health. 2018;6:e619–29. doi: 10.1016/S2214-109X*(18)*30186-4

70. WHO Regional Office for Europe. Turkey takes strong action to reduce antibiotic consumption and resistance. Copenhagen: World Health Organization Regional Office for Europe; 2017 (http://www.euro.who.int/en/health-topics/disease-prevention/antimicrobial-resistance/news/news/2017/11/turkey-takes-strong-action-to-reduce-antibiotic-consumption-and-resistance, accessed 25 September 2018).

71. Kaae S, Sporrong SK, Traulsen JM, Wallach Kildemoes H, Nørgaard LS, Jakupi A, et al. Experiences from a pilot study on how to conduct a qualitative multi-country research project regarding use of antibiotics in Southeast Europe. J Pharm Policy Pract. 2016;9:20. doi: 10.1186/s40545-016-0069-3

72. Public Health Agency Canada. Canadian Antimicrobial Resistance Surveillance System 2017 Report. Public Health Agency Canada; 2017 (https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-2017-report-executive-summary.html, accessed 18 October 2018)

73. Health Protection Scotland, NHS, ISD. Scottish Antimicrobial Prescribing Group. Primary Care Prescribing Indicators, Annual Report 2013-14. Health Protection Scotland, National Health Service Scotland, Information Services Division Scotland; 2014 (https://www.isdscotland.org/Health-Topics/Prescribing-and-Medicines/Publications/2014-10-14/2014-10-14-SAPG-Primary-Care-PI-2013-14-Report.pdf, accessed 18 October 2018)

74. CDC. Outpatient Antibiotic Prescriptions – United States, 2015. Centers for Disease Control and Prevention (https://www.cdc.gov/antibiotic-use/community/programs-measurement/state-local-activities/outpatient-antibiotic-prescriptions-US-2015.html, accessed 18 October 2018)

75. Hicks LA, Bartoces MG, Roberts RM, Suda KJ, Hunkler RJ, Taylor TH Jr et al. US outpatient antibiotic prescribing variation according to geography, patient population, and provider specialty in 2011. Clin Infect Dis. 2015;60(9):1308-16.

76. Agence nationale de securité du medicament et des produits de santé. La consummation d'antibiotiques en France en 2016. (https://ansm.sante.fr/var/ansm_site/storage/original/application/188a6b5cf9cde90848ae9e3419bc-3d3f.pdf, accessed 18 October 2018)

77. CDC. Ambulatory health care data. Centers for Disease Control and Prevention (https://www.cdc.gov/nchs/ahcd/about_ahcd.htm, accessed 18 October 2018)

78. Fleming-Dutra KE, Hersh AL, Shapiro DJ, Bartoces M, Enns EA, File TM Jr, et al. Prevalence of inappropriate antibiotic prescriptions among US ambulatory visits, 2010-2011. JAMA. 2016 May 3; 315*(17)*:1864-73.

ANNEX 01

Annex 1: 2019 ATC/DDD version

Anatomical Therapeutic Chemical (ATC) and defined daily dose (DDD) values underlying the calculation of antimicrobial consumption (2019 ATC/DDD version)

ATC5	Route of administration	DDD value	ATC5
A07AA01	O	5	G
A07AA02	O	1.5	MU
A07AA03	O	0.3	G
A07AA05	O	3	MU
A07AA06	O	3	G
A07AA07	O	0.4	G
A07AA08	O	3	G
A07AA09	O	2	G
A07AA10	O	9	MU
A07AA11	O	0.6	G
A07AA12	O	0.4	G
D01BA01	O	0.5	G
D01BA02	O	0.25	G
J01AA01	O	0.6	G
J01AA02	O	0.1	G
J01AA02	P	0.1	G
J01AA03	O	1	G
J01AA04	O	0.6	G
J01AA04	P	0.6	G
J01AA05	O	0.6	G
J01AA06	O	1	G
J01AA06	P	1	G
J01AA07	O	1	G
J01AA07	P	1	G
J01AA08	O	0.2	G
J01AA08	P	0.2	G
J01AA09	P	0.35	G
J01AA11	O	1	G
J01AA12	P	0.1	G
J01BA01	O	3	G
J01BA01	P	3	G
J01BA02	O	1.5	G
J01BA02	P	1.5	G
J01CA01	O	2	G
J01CA01	P	6	G
J01CA01	R	2	G
J01CA02	O	1.05	G
J01CA03	P	12	G
J01CA04	O	1.5	G
J01CA04	P	3	G

ATC5	Route of administration	DDD value	ATC5
J01CA05	O	4	G
J01CA06	O	1.2	G
J01CA07	O	2	G
J01CA07	P	2	G
J01CA08	O	0.6	G
J01CA09	P	12	G
J01CA10	P	6	G
J01CA11	P	1.2	G
J01CA12	P	14	G
J01CA13	P	15	G
J01CA14	O	1.5	G
J01CA14	P	1.5	G
J01CA15	O	2	G
J01CA16	P	15	G
J01CA17	P	2	G
J01CA18	O	2	G
J01CA19	P	4	G
J01CE01	P	3.6	G
J01CE02	O	2	G
J01CE03	O	0.9	G
J01CE04	O	1.5	G
J01CE05	O	1	G
J01CE06	O	1.05	G
J01CE07	O	1	G
J01CE08	P	3.6	G
J01CE09	P	0.6	G
J01CE10	O	2	G
J01CF01	O	2	G
J01CF01	P	2	G
J01CF02	O	2	G
J01CF02	P	2	G
J01CF03	P	4	G
J01CF04	O	2	G
J01CF04	P	2	G
J01CF05	O	2	G
J01CF05	P	2	G
J01CF06	P	3	G
J01CG01	P	1	G
J01CR01	P	6	G
J01CR02	O	1.5	G
J01CR02	P	3	G
J01CR03	P	15	G
J01CR04	O	1.5	G
J01CR05	P	14	G
J01DB01	O	2	G
J01DB02	P	3	G
J01DB03	P	4	G
J01DB04	P	3	G

ATC5	Route of administration	DDD value	ATC5
J01DB05	O	2	G
J01DB06	P	3	G
J01DB07	O	1	G
J01DB08	P	4	G
J01DB09	O	2	G
J01DB09	P	2	G
J01DB11	O	2.1	G
J01DB12	P	3	G
J01DC01	P	6	G
J01DC02	O	0.5	G
J01DC02	P	3	G
J01DC03	P	6	G
J01DC04	O	1	G
J01DC05	P	4	G
J01DC06	P	1	G
J01DC07	O	1.2	G
J01DC07	P	4	G
J01DC08	O	0.6	G
J01DC09	P	4	G
J01DC10	O	1	G
J01DC11	P	4	G
J01DC12	P	4	G
J01DC13	P	2	G
J01DC14	P	2	G
J01DD01	P	4	G
J01DD02	P	4	G
J01DD03	P	4	G
J01DD04	P	2	G
J01DD05	P	2	G
J01DD06	P	4	G
J01DD07	P	4	G
J01DD08	O	0.4	G
J01DD09	P	2	G
J01DD10	O	1	G
J01DD11	P	2	G
J01DD12	P	4	G
J01DD13	O	0.4	G
J01DD14	O	0.4	G
J01DD15	O	0.6	G
J01DD16	O	0.4	G
J01DD17	O	0.45	G
J01DD18	O	0.4	G
J01DD52	P	6	G
J01DD62	P	4	G
J01DD63	P	2	G
J01DE01	P	4	G
J01DE02	P	4	G
J01DE03	P	4	G

ATC5	Route of administration	DDD value	ATC5
J01DF01	IS	0.225	G
J01DF01	P	4	G
J01DF02	P	2	G
J01DH02	P	3	G
J01DH03	P	1	G
J01DH04	P	1.5	G
J01DH05	P	1.2	G
J01DH06	O	0.56	G
J01DH51	P	2	G
J01DH55	P	2	G
J01DI01	P	1.5	G
J01DI02	P	1.2	G
J01DI03	O	0.75	G
J01DI54	P	3	G
J01EA01	O	0.4	G
J01EA01	P	0.4	G
J01EA02	O	0.2	G
J01EB01	O	4	G
J01EB01	P	4	G
J01EB02	O	4	G
J01EB03	O	4	G
J01EB04	O	1	G
J01EB05	O	4	G
J01EB05	P	4	G
J01EB08	O	6	G
J01EC01	O	2	G
J01EC02	O	0.6	G
J01EC03	O	1	G
J01EC03	P	1	G
J01ED01	O	0.5	G
J01ED02	O	0.1	G
J01ED04	O	0.5	G
J01ED05	O	0.5	G
J01ED06	O	0.5	G
J01ED07	O	3	G
J01ED08	O	1	G
J01ED09	O	1.5	G
J01ED09	R	1.5	G
J01FA01	O	1	G
J01FA01	O (Ethylsuccinate)	2	G
J01FA01	P	1	G
J01FA02	O	3	G
J01FA03	P	1	G
J01FA03	O	1.2	G
J01FA05	O	1	G
J01FA06	O	0.3	G
J01FA07	O	2	G
J01FA08	O	1	G

ATC5	Route of administration	DDD value	ATC5
J01FA09	O	0.5	G
J01FA09	P	1	G
J01FA10	O	0.3	G
J01FA10	P	0.5	G
J01FA11	O	1.2	G
J01FA12	O	0.8	G
J01FA13	O	0.5	G
J01FA14	O	0.75	G
J01FA15	O	0.8	G
J01FF01	O	1.2	G
J01FF01	P	1.8	G
J01FF02	O	1.8	G
J01FF02	P	1.8	G
J01FG01	O	2	G
J01FG02	P	1.5	G
J01GA01	P	1	G
J01GA02	P	1	G
J01GB01	IP	0.112	G
J01GB01	IS	0.3	G
J01GB01	P	0.24	G
J01GB03	P	0.24	G
J01GB04	P	1	G
J01GB05	O	1	G
J01GB06	P	1	G
J01GB07	O	0.35	G
J01GB07	P	0.35	G
J01GB08	P	0.24	G
J01GB09	P	0.14	G
J01GB10	P	1	G
J01GB11	P	0.4	G
J01GB12	P	0.2	G
J01GB13	P	0.6	G
J01MA01	O	0.4	G
J01MA01	P	0.4	G
J01MA02	O	1	G
J01MA02	P	0.8	G
J01MA03	O	0.8	G
J01MA03	P	0.8	G
J01MA04	O	0.8	G
J01MA05	O	0.8	G
J01MA06	O	0.8	G
J01MA07	O	0.4	G
J01MA08	O	0.4	G
J01MA08	P	0.4	G
J01MA09	O	0.2	G
J01MA10	O	0.2	G
J01MA11	O	0.4	G
J01MA12	O	0.5	G

ATC5	Route of administration	DDD value	ATC5
J01MA12	P	0.5	G
J01MA13	O	0.2	G
J01MA13	P	0.2	G
J01MA14	O	0.4	G
J01MA14	P	0.4	G
J01MA15	O	0.32	G
J01MA16	O	0.4	G
J01MA16	P	0.4	G
J01MA17	O	0.6	G
J01MA18	P	1	G
J01MA19	O	0.4	G
J01MA21	O	0.1	G
J01MA22	O	0.45	G
J01MA23	O	0.9	G
J01MA23	P	0.6	G
J01MB01	O	0.3	G
J01MB02	O	4	G
J01MB03	O	2	G
J01MB04	O	0.8	G
J01MB05	O	1	G
J01MB06	O	1	G
J01MB07		1.2	G
J01XA01	P	2	G
J01XA02	P	0.4	G
J01XA04	P	1.5	G
J01XB01	IP	3	MU
J01XB01	IS	3	MU
J01XB01	P	9	MU
J01XB02	P	0.15	G
J01XC01	O	1.5	G
J01XC01	P	1.5	G
J01XD01	P	1.5	G
J01XD02	P	1.5	G
J01XD03	P	1	G
J01XE01	O	0.2	G
J01XE02	O	0.16	G
J01XE03	O	0.3	G
J01XX01	O	3	G
J01XX01	P	8	G
J01XX03	R	1.5	G
J01XX04	P	3	G
J01XX05	O (Hippurate)	2	G
J01XX05	O (Mandelate)	3	G
J01XX06	O	12	G
J01XX07	O	1	G
J01XX08	O	1.2	G
J01XX08	P	1.2	G
J01XX09	P	0.28	G

ATC5	Route of administration	DDD value	ATC5
J01XX11	O	0.2	G
J01XX11	P	0.2	G
P01AB01	O	2	G
P01AB01	R	2	G
P01AB02	O	2	G
P01AB02	R	2	G
P01AB03	O	1.5	G
P01AB06	O	2	G
P01AB07	O	2	G


ANNEX
02

Annex 2: Strengths and limitations of data sources

Common data sources containing aggregated information on antimicrobial consumption and their respective strengths and limitations

Data source	Strengths	Limitations
Import records	Few and centralized data sources Information system to collect import data for administrative purposes are usually already established in countries Reporting is standardized, e.g. through customs declaration form Includes over-the-counter medicines	Volumes and types of medicines reflect import cycles rather than consumption patterns Does not capture re-export of medicines Does not capture the informal market May not be possible to separate human and agricultural/veterinary use
Domestic manufacturers	Licensed domestic manufacturers should be easy to identify Can separate production for local use versus export Can request data in a format suitable for analysis	Data may be difficult to obtain from private companies Volumes reflect production rather than consumption patterns May be few or many manufacturers
Public sector procurement	Usually few procurement agencies Can disaggregate by, for example, health care facility and geographical location	Provides only data for the public sector and may not cover public health facilities (e.g. hospitals) that procure independently Procured medicines may not reflect consumption, e.g. when in stock but not dispensed
Wholesalers	Can provide both procurement and supply data, with supply data being preferred as they are closer to actual use Possible to disaggregate by, for example, health care facility and geographical location	May be few or many wholesalers In some countries, health facilities and practitioners may be allowed to import medicines
Donations	May cover a significant proportion of antimicrobials dispensed for specific disease areas	Usually programme- or disease-specific May not be possible to distinguish between medicines distributed to the local population and to special populations
Prescriber records	May contain information on diagnoses, dose and duration of medicine use May be possible to obtain patient-level information	Cumbersome data collection if no (electronic) system is in place to capture the information
Dispensing records	Data source is closer to the end-user than other aggregated data sources Can distinguish between use in the community and hospital sector, and potentially between use in the public and private sector May include over-the-counter medicines	Often many facilities exist making data collection resource intensive Cumbersome data collection if no (electronic) system is in place to capture the information May be difficult to obtain information from the private sector
Insurance/ reimbursement records	Can obtain patient-level information May be possible to disaggregate by community and hospital sector Often number of data providers are limited	May be difficult to obtain information from the private sector Includes only reimbursed medicines Usually covers a selected population May not include all necessary information for consumption monitoring
Commercial data sources (e.g. IQVIA)	Standardized data collection Combines data from many sources	Have to purchase May not be possible to disaggregate by sector, facility and geographical location May be limited data collection in some countries and does not cover all countries Extrapolation methods are unknown May not use the ATC/DDD classification system

ATC = Anatomical Therapeutic Chemical, DDD = defined daily dose.

ANNEX 03

Annex 3: AWaRe categories

Antibacterial subgroups and substances within each AWaRe (Access, Watch and Reserve) category, including ATC codes

AWaRe	Substance	ATC code
Access		
Access	Amikacin	J01GB06
Access	Amoxicillin	J01CA04
Access	Amoxicillin + clavulanic acid	J01CR02
Access	Ampicillin	J01CA01
Access	Benzathine benzylpenicillin	J01CE08
Access	Benzylpenicillin	J01CE01
Access	Cefazolin	J01DB04
Access	Cephalexin	J01DB01
Access	Chloramphenicol	J01BA01
Access	Clindamycin	J01FF01
Access	Cloxacillin	J01CF02
Access	Dicloxacillin	J01CF01
Access	Doxycycline	J01AA02
Access	Flucloxacillin	J01CF05
Access	Gentamicin	J01GB03
Access	Meticillin	J01CF03
Access	Metronidazole (oral, rectal)	P01AB01
Access	Metronidazole (parenteral)	J01XD01
Access	Nafcillin	J01CF06
Access	Nitrofurantoin	J01XE01
Access	Oxacillin	J01CF04
Access	Phenoxymethylpenicillin	J01CE02
Access	Procaine benzylpenicillin	J01CE09
Access	Spectinomycin	J01XX04
Access	Sulfamethoxazole + trimethoprim	J01EE01
Access	Trimethoprim	J01EA01
Watch		
Quinolones and fluoroquinolones		
Watch	Cinoxacin	J01MB06
Watch	Ciprofloxacin	J01MA02
Watch	Enoxacin	J01MA04
Watch	Fleroxacin	J01MA08
Watch	Flumequine	J01MB07
Watch	Garenoxacin	J01MA19
Watch	Gatifloxacin	J01MA16
Watch	Gemifloxacin	J01MA15
Watch	Grepafloxacin	J01MA11
Watch	Levofloxacin	J01MA12
Watch	Lomefloxacin	J01MA07
Watch	Moxifloxacin	J01MA14
Watch	Nalidixic acid	J01MB02

AWaRe	Substance	ATC code
Watch	Nemonoxacin	J01MB08
Watch	Norfloxacin	J01MA06
Watch	Ofloxacin	J01MA01
Watch	Ofloxacin	J01MA01
Watch	Oxolinic acid	J01MB05
Watch	Pazufloxacin	J01MA18
Watch	Pelfloxacin	J01MA03
Watch	Pipemidic acid	J01MB04
Watch	Piromidic acid	J01MB03
Watch	Prulifloxacin	J01MA17
Watch	Rosoxacin	J01MB01
Watch	Rufloxacin	J01MA10
Watch	Sitafloxacin	J01MA21
Watch	Sparfloxacin	J01MA09
Watch	Temafloxacin	J01MA05
Watch	Trovafloxacin	J01MA13
Glycopeptides		
Watch	Dalbavancin	J01XA04
Watch	Oritavancin	J01XA05
Watch	Teicoplanin	J01XA02
Watch	Telavancin	J01XA03
Watch	Vancomycin (intravenous)	J01XA01
Watch	Vancomycin (oral)	A07AA09
Carbapenems and penems		
Watch	Biapenem	J01DH05
Watch	Doripenem	J01DH04
Watch	Ertapenem	J01DH03
Watch	Faropenem	J01DI03
Watch	Imipenem + cilastatin	J01DH51
Watch	Meropenem	J01DH02
Watch	Panipenem + betamipron	J01DH55
Third-generation cephalosporins		
Watch	Cefcapene	J01DD17
Watch	Cefdinir	J01DD15
Watch	Cefditoren	J01DD16
Watch	Cefetamet	J01DD10
Watch	Cefixime	J01DD08
Watch	Cefmenoxime	J01DD05
Watch	Cefodizime	J01DD09
Watch	Cefoperazone	J01DD12
Watch	Cefoperazone + beta-lactamase inhibitor	J01DD62
Watch	Cefotaxime	J01DD01
Watch	Cefotaxime + beta-lactamase inhibitor	J01DD51
Watch	Cefpiramide	J01DD11
Watch	Cefpodoxime	J01DD13
Watch	Cefsulodin	J01DD03
Watch	Ceftazidime	J01DD02

AWaRe	Substance	ATC code
Watch	Ceftazidime + beta-lactamase inhibitor	J01DD52
Watch	Ceftibuten	J01DD14
Watch	Ceftizoxime	J01DD07
Watch	Ceftriaxone	J01DD04
Watch	Ceftriaxone + beta-lactamase inhibitor	J01DD63
Watch	Ceftriaxone, combinations	J01DD54
Watch	Latamoxef	J01DD06
Macrolides		
Watch	Azithromycin	J01FA10
Watch	Clarithromycin	J01FA09
Watch	Dirithromycin	J01FA13
Watch	Erythromycin	J01FA01
Watch	Flurithromycin	J01FA14
Watch	Josamycin	J01FA07
Watch	Midecamycin	J01FA03
Watch	Miocamycin	J01FA11
Watch	Oleandomycin	J01FA05
Watch	Rokitamycin	J01FA12
Watch	Roxithromycin	J01FA06
Watch	Solithromycin	J01FA16
Watch	Spiramycin	J01FA02
Watch	Telithromycin	J01FA15
Watch	Troleandomycin	J01FA08
Antipseudomonal penicillins + beta-lactamase inhibitor		
Watch	Piperacillin + beta-lactamase inhibitor	J01CR05
Watch	Ticarcillin + beta-lactamase inhibitor	J01CR03
Reserve		
Monobactams		
Reserve	Aztreonam	J01DF01
Reserve	Carumonam	J01DF02
Fourth-generation cephalosporins		
Reserve	Cefepime	J01DE01
Reserve	Cefozopran	J01DE03
Reserve	Cefpirome	J01DE02
Fifth-generation cephalosporins		
Reserve	Ceftaroline fosamil	J01DI02
Reserve	Ceftobiprole medocaril	J01DI01
Reserve	Ceftolozane + beta-lactamase inhibitor	J01DI43
Polymyxins		
Reserve	Colistin (intravenous)	J01XB01
Reserve	Colistin (oral)	A07AA10
Reserve	Polymyxin B (intravenous)	J01XB02
Reserve	Polymyxin B (oral)	A07AA05
Lipopeptides		
Reserve	Daptomycin	J01XX09

AWaRe	Substance	ATC code
Oxazolidinones		
Reserve	Linezolid	J01XX08
Reserve	Tedizolid	J01XX11
Glycylcyclines		
Reserve	Tigecycline	J01AA12
Phosphonic acid derivatives		
Reserve	Fosfomycin (intravenous)	J01XX01


ANNEX
04

Annex 4: Results – African Region

Table A4.1 Antibiotic consumption (DDD per 1000 inhabitants per day) and proportion (%) of total antibiotics by pharmacological subgroup (ATC code) in four countries of the African Region (2015)

Country	DDD per 1000 inhabitants per day (% of total)												
	Agents against amoebiasis and other protozoal diseases (P01A)	Other antibacterials (J01X)	Combinations of antibacterials (J01R)	Quinolone antibacterials (J01M)	Aminoglycoside antibacterials (J01G)	Macrolides, lincosamides and streptogramins (J01F)	Sulfonamides and trimethoprim (J01E)	Other beta-lactam antibacterials (J01D)	Beta-lactam antibacterials, penicillins (J01C)	Amphenicols (J01B)	Tetracyclines (J01A)	Intestinal anti-infectives (A07A)	**Total**
Burkina Faso	0.94 (6.8%)	0.03 (0.2%)	0.07 (0.5%)	1.95 (14.1%)	0.03 (0.2%)	1.10 (8.0%)	3.24 (23.5%)	0.25 (1.8%)	5.34 (38.7%)	0.02 (0.2%)	0.82 (6.0%)	0.00 (0.0%)	**13.79 (100.0%)**
Burundi[a]	0.32 (7.1%)	0.00 (0.0%)	0.00 (0.0%)	0.33 (7.4%)	0.21 (4.8%)	0.03 (0.6%)	0.00 (0.0%)	0.11 (2.5%)	3.45 (77.6%)	0.00 (0.0%)	0.00 (0.1%)	0.00 (0.0%)	**4.45 (100.0%)**
Côte d'Ivoire	0.76 (7.1%)	0.02 (0.2%)	0.00 (0.0%)	1.01 (9.5%)	0.02 (0.2%)	0.38 (3.6%)	3.30 (30.9%)	0.45 (4.2%)	3.98 (37.3%)	0.06 (0.5%)	0.69 (6.4%)	0.00 (0.0%)	**10.67 (100.0%)**
United Republic of Tanzania[b]	3.11 (11.4%)	0.57 (2.1%)	0.15 (0.5%)	3.89 (14.3%)	0.67 (2.5%)	1.65 (6.0%)	1.61 (5.9%)	3.26 (11.9%)	7.31 (26.8%)	0.06 (0.2%)	5.02 (18.4%)	0.00 (0.0%)	**27.3 (100.0%)**

[a] *Only public sector reported.*

[b] *Data from 2016.*

Table A4.2 Consumption of antibiotics (DDD per 1000 inhabitants per day) and proportion (%) of total consumption by AWaRe categorization in four countries of the African Region (2015)

Country	DDD per 1000 inhabitants per day (% of total)				
	Access	Watch	Reserve	Other	**Total**
Burkina Faso	10.39 (75.4%)	3.27 (23.7%)	0.00 (0.0%)	0.12 (0.9%)	**13.78 (100.0%)**
Burundi[a]	3.97 (89.5%)	0.45 (10.2%)	0.00 (0.0%)	0.02 (0.4%)	**4.44 (100.0%)**
Côte d'Ivoire	8.75 (82.0%)	1.70 (15.9%)	0.00 (0.0%)	0.22 (2.1%)	**10.68 (100.0%)**
United Republic of Tanzania[b]	15.26 (55.9%)	6.08 (22.3%)	0.00 (0.0%)	5.95 (21.8%)	**27.29 (100.0%)**

[a] *Only public sector reported.*

[b] *Data from 2016.*


ANNEX
05

Annex 5: Results – Region of the Americas

Table A5.1 Antibiotic consumption (DDD per 1000 inhabitants per day of total antibiotics) and proportion (%) of total consumption by pharmacological subgroup (ATC code) in six countries of the Region of the Americas (2015)

Country	DDD per 1000 inhabitants per day (% of total)											
	Agents against amoebiasis and other protozoal diseases (P01A)	Other antibacterials (J01X)	Quinolone antibacterials (J01M)	Aminoglycoside antibacterials (J01G)	Macrolides, lincosamides and streptogramins (J01F)	Sulfonamides and trimethoprim (J01E)	Other beta-lactam antibacterials (J01D)	Beta-lactam antibacterials, penicillins (J01C)	Amphenicols (J01B)	Tetracyclines (J01A)	Intestinal anti-infectives (A07A)	**Total**
Bolivia (Plurinational State of) [a,b,c]	0.00 (0.0%)	0.39 (2.0%)	1.73 (8.9%)	0.10 (0.5%)	2.44 (12.5%)	2.22 (11.3%)	0.27 (1.4%)	12.36 (63.2%)	0.00 (0.0%)	0.07 (0.3%)	0.00 (0.0%)	**19.57 (100.0%)**
Brazil [b]	0.00 (0.0%)	0.11 (0.5%)	2.83 (12.4%)	0.06 (0.2%)	3.69 (16.2%)	1.22 (5.3%)	1.92 (8.4%)	12.15 (53.4%)	0.01 (0.0%)	0.78 (3.4%)	0.00 (0.0%)	**22.75 (100.0%)**
Canada	0.30 (1.8%)	0.90 (5.3%)	1.99 (11.7%)	0.05 (0.3%)	3.29 (19.3%)	0.65 (3.8%)	2.26 (13.2%)	4.88 (28.6%)	0.00 (0.0%)	2.73 (16.0%)	0.01 (0.1%)	**17.05 (100.0%)**
Costa Rica [b,c]	0.00 (0.0%)	2.22 (15.7%)	0.35 (2.4%)	0.12 (0.9%)	1.75 (12.3%)	1.65 (11.6%)	2.55 (18.0%)	3.80 (26.8%)	0.00 (0.0%)	1.74 (12.2%)	0.00 (0.0%)	**14.18 (100.0%)**
Paraguay [a,b,c]	0.00 (0.0%)	0.08 (0.4%)	1.92 (9.9%)	0.09 (0.5%)	7.31 (37.7%)	0.35 (1.8%)	3.77 (19.5%)	5.81 (30.0%)	0.00 (0.0%)	0.04 (0.2%)	0.00 (0.0%)	**19.38 (100.0%)**
Peru [a,b,c]	0.46 (4.5%)	0.25 (2.4%)	1.38 (13.4%)	0.20 (1.9%)	1.48 (14.4%)	0.88 (8.6%)	0.76 (7.4%)	4.06 (39.5%)	0.05 (0.5%)	0.75 (7.3%)	0.00 (0.0%)	**10.26 (100.0%)**

[a] *Coverage of antimicrobial consumption estimated to be 70% or less, population-adjusted.*

[b] *Data from 2016.*

[c] *Only public sector reported.*

Table A5.2 Consumption of antibiotics (DDD per 1000 inhabitants per day) and proportion (%) of total consumption by AWaRe categorization in six countries of the Region of the Americas (2015)

Country	DDD per 1000 inhabitants per day (% of total)				
	Access	Watch	Reserve	Other	**Total**
Bolivia (Plurinational State of)[a,b,c]	15.12 (77.3%)	4.41 (22.5%)	0.00 (0.0%)	0.03 (0.2%)	**19.57 (100.0%)**
Brazil[b]	14.72 (64.7%)	6.72 (29.5%)	0.08 (0.4%)	1.23 (5.4%)	**22.75 (100.0%)**
Canada	10.02 (58.7%)	5.21 (30.5%)	0.02 (0.1%)	1.80 (10.6%)	**17.05 (100.0%)**
Costa Rica[b,c]	11.82 (83.3%)	2.25 (15.9%)	0.00 (0.0%)	0.11 (0.8%)	**14.18 (100.0%)**
Paraguay[a,b,c]	8.69 (44.8%)	10.29 (53.1%)	0.00 (0.0%)	0.39 (2.0%)	**19.38 (100.0%)**
Peru[a,b,c]	7.19 (70.1%)	2.95 (28.7%)	0.00 (0.0%)	0.12 (1.1%)	**10.26 (100.0%)**

[a] *Coverage of antimicrobial consumption estimated to be 70% or less, population-adjusted.*

[b] *Data from 2016.*

[c] *Only public sector reported.*


ANNEX
06

Annex 6 : Results – European Region

Table A6.1 Antibiotic consumption (DDD per 1000 inhabitants per day) and proportion (%) of total antibiotics by pharmacological subgroup in 46 countries and areas of the European Region, 2015

Country or area	DDD per 1000 inhabitants per day (% of total)												
	Intestinal anti-infectives (A07A)	Tetracyclines (J01A)	Amphenicols (J01B)	Beta-lactam antibacterials, penicillins (J01C)	Other beta-lactam antibacterials (J01D)	Sulfonamides and trimethoprim (J01E)	Macrolides, lincosamides and streptogramins (J01F)	Aminoglycoside antibacterials (J01G)	Quinolone antibacterials (J01M)	Combinations of antibacterials (J01R)	Other antibacterials (J01X)	Agents against amoebiasis and other protozoal diseases (P01A)	**Total**
Albania	0.00 (0.0%)	2.64 (16.1%)	0.05 (0.3%)	3.69 (22.5%)	3.52 (21.5%)	0.26 (1.6%)	2.06 (12.6%)	0.28 (1.7%)	3.26 (19.9%)	0.00 (0.0%)	0.56 (3.4%)	0.09 (0.6%)	**16.41 (100.0%)**
Armenia	0.00 (0.0%)	0.88 (8.5%)	0.34 (3.3%)	3.07 (29.8%)	1.04 (10.1%)	1.19 (11.5%)	0.88 (8.5%)	0.21 (2.0%)	1.34 (13.0%)	0.00 (0.0%)	0.74 (7.2%)	0.63 (6.1%)	**10.31 (100.0%)**
Austria[a]	0.00 (0.0%)	0.99 (8.1%)	0.00 (0.0%)	4.72 (38.8%)	1.44 (11.9%)	0.19 (1.6%)	3.06 (25.2%)	0.02 (0.1%)	1.32 (10.8%)	0.00 (0.0%)	0.33 (2.7%)	0.09 (0.8%)	**12.17 (100.0%)**
Azerbaijan	0.00 (0.0%)	1.80 (23.5%)	0.16 (2.1%)	1.35 (17.7%)	0.73 (9.5%)	0.70 (9.1%)	1.00 (13.1%)	0.31 (4.1%)	0.84 (10.9%)	0.00 (0.0%)	0.45 (5.9%)	0.32 (4.1%)	**7.66 (100.0%)**
Belarus	0.00 (0.0%)	3.02 (17.3%)	0.08 (0.4%)	5.13 (29.4%)	2.91 (16.7%)	0.12 (0.7%)	2.43 (13.9%)	0.24 (1.4%)	1.64 (9.4%)	0.00 (0.0%)	1.48 (8.5%)	0.42 (2.4%)	**17.48 (100.0%)**
Belgium	0.06 (0.2%)	2.05 (8.0%)	0.03 (0.1%)	11.77 (46.0%)	1.78 (7.0%)	0.24 (1.0%)	3.77 (14.8%)	0.04 (0.1%)	2.78 (10.9%)	0.00 (0.0%)	2.90 (11.3%)	0.14 (0.5%)	**25.57 (100.0%)**
Bosnia and Herzegovina	0.00 (0.0%)	1.35 (7.6%)	0.00 (0.0%)	7.22 (40.5%)	2.27 (12.7%)	1.57 (8.8%)	2.22 (12.4%)	0.32 (1.8%)	2.14 (12.0%)	0.00 (0.0%)	0.39 (2.2%)	0.38 (2.1%)	**17.85 (100.0%)**
Bulgaria	0.00 (0.0%)	1.72 (8.5%)	0.04 (0.2%)	5.62 (27.8%)	4.64 (22.9%)	0.80 (3.9%)	3.92 (19.4%)	0.28 (1.4%)	2.97 (14.7%)	0.00 (0.0%)	0.10 (0.5%)	0.17 (0.8%)	**20.25 (100.0%)**
Croatia	0.00 (0.0%)	1.20 (5.9%)	0.00 (0.0%)	8.67 (42.7%)	3.33 (16.4%)	0.68 (3.3%)	3.29 (16.2%)	0.10 (0.5%)	1.73 (8.5%)	0.00 (0.0%)	1.01 (5.0%)	0.27 (1.4%)	**20.28 (100.0%)**
Cyprus	0.00 (0.0%)	3.61 (13.3%)	0.00 (0.0%)	8.95 (33.0%)	5.25 (19.3%)	0.22 (0.8%)	3.27 (12.0%)	0.06 (0.2%)	4.56 (16.8%)	0.00 (0.0%)	0.69 (2.5%)	0.54 (2.0%)	**27.14 (100.0%)**
Czech Republic[a]	0.00 (0.0%)	1.96 (11.4%)	0.00 (0.0%)	6.19 (36.0%)	2.19 (12.7%)	0.87 (5.1%)	3.94 (22.9%)	0.07 (0.4%)	0.87 (5.0%)	0.00 (0.0%)	1.10 (6.4%)	0.00 (0.0%)	**17.18 (100.0%)**
Denmark	0.01 (0.1%)	1.64 (9.2%)	0.00 (0.0%)	10.87 (61.0%)	0.32 (1.8%)	1.15 (6.5%)	1.94 (10.9%)	0.04 (0.2%)	0.66 (3.7%)	0.00 (0.0%)	0.86 (4.8%)	0.33 (1.8%)	**17.84 (100.0%)**
Estonia	0.00 (0.0%)	1.50 (12.3%)	0.00 (0.0%)	3.74 (30.8%)	1.78 (14.7%)	0.48 (3.9%)	2.60 (21.5%)	0.04 (0.4%)	1.08 (8.9%)	0.00 (0.0%)	0.65 (5.3%)	0.27 (2.2%)	**12.13 (100.0%)**
Finland	0.01 (0.0%)	4.12 (22.3%)	0.00 (0.0%)	5.39 (29.1%)	2.99 (16.1%)	1.35 (7.3%)	1.17 (6.3%)	0.02 (0.1%)	0.99 (5.3%)	0.00 (0.0%)	2.09 (11.3%)	0.39 (2.1%)	**18.52 (100.0%)**
France	0.00 (0.0%)	3.28 (12.7%)	0.00 (0.0%)	13.55 (52.3%)	2.44 (9.4%)	0.45 (1.7%)	3.34 (12.9%)	0.09 (0.3%)	1.83 (7.0%)	0.00 (0.0%)	0.59 (2.3%)	0.36 (1.4%)	**25.92 (100.0%)**
Georgia	0.00 (0.0%)	0.44 (1.8%)	0.15 (0.6%)	2.88 (11.8%)	4.84 (19.8%)	6.73 (27.5%)	1.93 (7.9%)	0.18 (0.7%)	6.28 (25.7%)	0.00 (0.0%)	0.80 (3.3%)	0.20 (0.8%)	**24.44 (100.0%)**
Germany[a]	0.03 (0.3%)	1.68 (14.7%)	0.00 (0.0%)	2.88 (25.0%)	2.71 (23.6%)	0.41 (3.6%)	2.09 (18.2%)	0.01 (0.1%)	1.15 (10.0%)	0.00 (0.0%)	0.45 (3.9%)	0.07 (0.6%)	**11.49 (100.0%)**
Greece	0.00 (0.0%)	2.63 (7.8%)	0.00 (0.0%)	10.32 (30.5%)	8.04 (23.8%)	0.43 (1.3%)	7.68 (22.7%)	0.12 (0.3%)	2.90 (8.6%)	0.00 (0.0%)	1.04 (3.1%)	0.69 (2.0%)	**33.85 (100.0%)**
Hungary	0.29 (1.8%)	1.24 (7.6%)	0.00 (0.0%)	5.06 (31.0%)	2.31 (14.1%)	0.55 (3.3%)	3.43 (21.0%)	0.04 (0.2%)	2.92 (17.9%)	0.00 (0.0%)	0.27 (1.7%)	0.21 (1.3%)	**16.31 (100.0%)**
Iceland[a]	0.03 (0.2%)	4.62 (25.9%)	0.00 (0.0%)	8.38 (46.9%)	0.46 (2.6%)	0.58 (3.3%)	1.72 (9.6%)	0.00 (0.0%)	0.93 (5.2%)	0.00 (0.0%)	0.99 (5.5%)	0.16 (0.9%)	**17.87 (100.0%)**
Ireland	0.00 (0.0%)	2.64 (11.3%)	0.00 (0.0%)	12.27 (52.7%)	1.35 (5.8%)	1.11 (4.8%)	4.51 (19.4%)	0.09 (0.4%)	1.04 (4.5%)	0.00 (0.0%)	0.23 (1.0%)	0.03 (0.1%)	**23.27 (100.0%)**

Country or area	DDD per 1000 inhabitants per day (% of total)												
	Intestinal anti-infectives (A07A)	Tetracyclines (J01A)	Amphenicols (J01B)	Beta-lactam antibacterials, penicillins (J01C)	Other beta-lactam antibacterials (J01D)	Sulfonamides and trimethoprim (J01E)	Macrolides, lincosamides and streptogramins (J01F)	Aminoglycoside antibacterials (J01G)	Quinolone antibacterials (J01M)	Combinations of antibacterials (J01R)	Other antibacterials (J01X)	Agents against amoebiasis and other protozoal diseases (P01A)	**Total**
Italy	2.08 (7.8%)	0.58 (2.2%)	0.06 (0.2%)	11.00 (41.3%)	2.69 (10.1%)	0.38 (1.4%)	4.80 (18.0%)	0.29 (1.1%)	3.80 (14.3%)	0.00 (0.0%)	0.85 (3.2%)	0.09 (0.3%)	**26.62 (100.0%)**
Kazakhstan	0.00 (0.0%)	1.31 (7.3%)	0.51 (2.8%)	3.10 (17.3%)	2.80 (15.6%)	0.63 (3.5%)	1.60 (9.0%)	3.45 (19.3%)	2.72 (15.2%)	0.18 (1.0%)	1.14 (6.4%)	0.44 (2.5%)	**17.89 (100.0%)**
Kosovo[b]	0.00 (0.0%)	0.61 (3.0%)	0.00 (0.0%)	8.02 (39.7%)	4.36 (21.6%)	0.95 (4.7%)	2.76 (13.7%)	0.72 (3.6%)	2.36 (11.7%)	0.00 (0.0%)	0.22 (1.1%)	0.18 (0.9%)	**20.18 (100.0%)**
Kyrgyzstan	0.00 (0.0%)	1.09 (6.1%)	0.13 (0.7%)	7.74 (43.1%)	2.18 (12.2%)	0.81 (4.5%)	0.91 (5.0%)	0.82 (4.6%)	1.76 (9.8%)	0.50 (2.8%)	1.25 (7.0%)	0.75 (4.2%)	**17.94 (100.0%)**
Latvia	0.00 (0.0%)	2.29 (17.2%)	0.00 (0.0%)	4.78 (35.9%)	1.19 (8.9%)	0.92 (6.9%)	1.99 (15.0%)	0.09 (0.7%)	1.32 (9.9%)	0.00 (0.0%)	0.50 (3.7%)	0.23 (1.7%)	**13.30 (100.0%)**
Lithuania	0.00 (0.0%)	1.39 (8.8%)	0.00 (0.0%)	7.18 (45.3%)	1.89 (11.9%)	0.42 (2.7%)	1.98 (12.5%)	0.11 (0.7%)	1.19 (7.5%)	0.00 (0.0%)	1.63 (10.3%)	0.04 (0.3%)	**15.83 (100.0%)**
Luxembourg	0.06 (0.2%)	1.59 (7.1%)	0.00 (0.0%)	8.97 (40.2%)	3.77 (16.9%)	0.29 (1.3%)	3.56 (15.9%)	0.06 (0.2%)	2.52 (11.3%)	0.00 (0.0%)	1.30 (5.8%)	0.21 (0.9%)	**22.31 (100.0%)**
Malta	0.05 (0.2%)	0.94 (4.3%)	0.00 (0.0%)	6.78 (31.0%)	4.44 (20.3%)	0.35 (1.6%)	4.46 (20.4%)	0.11 (0.5%)	3.19 (14.6%)	0.00 (0.0%)	1.23 (5.6%)	0.32 (1.5%)	**21.88 (100.0%)**
Montenegro	0.00 (0.0%)	1.32 (4.5%)	0.00 (0.0%)	10.53 (35.9%)	5.96 (20.3%)	0.88 (3.0%)	5.47 (18.6%)	0.89 (3.0%)	3.53 (12.0%)	0.00 (0.0%)	0.27 (0.9%)	0.48 (1.6%)	**29.33 (100.0%)**
Netherlands	0.01 (0.1%)	2.12 (21.7%)	0.00 (0.0%)	3.24 (33.1%)	0.23 (2.4%)	0.42 (4.3%)	1.35 (13.9%)	0.06 (0.6%)	0.82 (8.3%)	0.00 (0.0%)	1.44 (14.7%)	0.09 (0.9%)	**9.78 (100.0%)**
Norway	0.04 (0.3%)	3.15 (18.6%)	0.00 (0.0%)	6.69 (39.4%)	0.35 (2.1%)	0.73 (4.3%)	1.38 (8.1%)	0.07 (0.4%)	0.51 (3.0%)	0.00 (0.0%)	3.84 (22.6%)	0.21 (1.2%)	**16.97 (100.0%)**
Poland	0.00 (0.0%)	2.46 (10.1%)	0.00 (0.0%)	7.40 (30.5%)	3.20 (13.2%)	0.65 (2.7%)	4.69 (19.3%)	0.09 (0.4%)	1.54 (6.3%)	0.00 (0.0%)	4.06 (16.7%)	0.21 (0.9%)	**24.30 (100.0%)**
Portugal	0.05 (0.3%)	0.80 (4.5%)	0.00 (0.0%)	8.21 (46.4%)	1.78 (10.1%)	0.46 (2.6%)	3.03 (17.1%)	0.05 (0.3%)	2.04 (11.5%)	0.00 (0.0%)	1.16 (6.6%)	0.13 (0.7%)	**17.72 (100.0%)**
Republic of Moldova	0.00 (0.0%)	1.06 (7.9%)	0.07 (0.5%)	3.78 (28.1%)	2.18 (16.2%)	0.86 (6.4%)	1.83 (13.6%)	0.21 (1.6%)	1.73 (12.9%)	0.08 (0.6%)	1.09 (8.1%)	0.53 (4.0%)	**13.42 (100.0%)**
Romania	0.51 (1.8%)	1.10 (3.9%)	0.01 (0.0%)	13.26 (46.5%)	5.27 (18.5%)	0.89 (3.1%)	3.18 (11.2%)	0.36 (1.3%)	3.50 (12.3%)	0.00 (0.0%)	0.19 (0.7%)	0.23 (0.8%)	**28.50 (100.0%)**
Russian Federation	0.03 (0.2%)	1.28 (8.7%)	0.15 (1.0%)	3.79 (25.6%)	1.74 (11.8%)	0.60 (4.1%)	2.57 (17.3%)	0.26 (1.7%)	2.64 (17.8%)	0.11 (0.7%)	0.98 (6.6%)	0.65 (4.4%)	**14.82 (100.0%)**
Serbia	0.00 (0.0%)	2.28 (7.2%)	0.00 (0.0%)	11.63 (36.8%)	5.27 (16.7%)	1.10 (3.5%)	5.90 (18.7%)	0.67 (2.1%)	3.84 (12.2%)	0.00 (0.0%)	0.34 (1.1%)	0.55 (1.7%)	**31.57 (100.0%)**
Slovakia	0.09 (0.4%)	1.77 (7.3%)	0.00 (0.0%)	6.97 (28.6%)	5.45 (22.4%)	0.49 (2.0%)	6.36 (26.1%)	0.09 (0.4%)	2.71 (11.1%)	0.00 (0.0%)	0.24 (1.0%)	0.18 (0.7%)	**24.34 (100.0%)**
Slovenia	0.00 (0.0%)	0.43 (3.2%)	0.00 (0.0%)	7.57 (56.1%)	0.61 (4.6%)	0.84 (6.3%)	2.00 (14.8%)	0.06 (0.5%)	1.38 (10.2%)	0.00 (0.0%)	0.47 (3.5%)	0.12 (0.9%)	**13.48 (100.0%)**
Spain[a]	0.34 (1.9%)	0.74 (4.1%)	0.00 (0.0%)	9.80 (54.6%)	1.65 (9.2%)	0.27 (1.5%)	2.26 (12.6%)	0.01 (0.0%)	2.36 (13.1%)	0.00 (0.0%)	0.47 (2.6%)	0.06 (0.3%)	**17.96 (100.0%)**
Sweden	0.03 (0.2%)	2.74 (20.0%)	0.00 (0.0%)	6.80 (49.6%)	0.30 (2.2%)	0.46 (3.4%)	0.67 (4.9%)	0.02 (0.1%)	0.84 (6.1%)	0.00 (0.0%)	1.68 (12.2%)	0.18 (1.3%)	**13.73 (100.0%)**
Tajikistan	0.00 (0.0%)	1.20 (5.5%)	0.34 (1.6%)	6.96 (31.7%)	4.75 (21.6%)	1.57 (7.2%)	0.86 (3.9%)	0.65 (3.0%)	3.14 (14.3%)	0.09 (0.4%)	1.90 (8.6%)	0.49 (2.2%)	**21.95 (100.0%)**
Turkey	0.05 (0.1%)	1.30 (3.4%)	0.00 (0.0%)	13.04 (34.2%)	12.39 (32.5%)	0.37 (1.0%)	4.98 (13.0%)	0.10 (0.3%)	3.23 (8.5%)	0.00 (0.0%)	1.48 (3.9%)	1.23 (3.2%)	**38.18 (100.0%)**
United Kingdom (The)	0.02 (0.1%)	5.18 (25.3%)	0.00 (0.0%)	7.76 (37.9%)	0.43 (2.1%)	1.45 (7.1%)	3.39 (16.6%)	0.12 (0.6%)	0.56 (2.8%)	0.00 (0.0%)	1.19 (5.8%)	0.37 (1.8%)	**20.47 (100.0%)**
Uzbekistan	0.00 (0.0%)	0.60 (7.0%)	0.13 (1.6%)	2.94 (34.4%)	2.37 (27.7%)	0.00 (0.0%)	1.45 (16.9%)	1.07 (12.5%)	0.00 (0.0%)	0.00 (0.0%)	0.00 (0.0%)	0.00 (0.0%)	**8.56 (100.0%)**

[a] *Only community consumption reported.*

[b] *In accordance with Security Council Resolution 1244 (1999).*

Table A6.2 Consumption of antibiotics (DDD/1000 inhabitants/day) and proportion (%) of total consumption by AWaRe categorization in 46 countries and areas of the European Region, 2015

Country or area	DDD/1000 inhabitants per day (% of total)				
	Access	Watch	Reserve	Other	**Total**
Albania	6.22 (37.9%)	6.63 (40.4%)	0.04 (0.3%)	3.52 (21.4%)	**16.41 (100.0%)**
Armenia	6.75 (65.4%)	2.94 (28.5%)	0.02 (0.2%)	0.61 (5.9%)	**10.31 (100.0%)**
Austria[a]	6.66 (54.7%)	3.92 (32.2%)	0.04 (0.4%)	1.54 (12.7%)	**12.17 (100.0%)**
Azerbaijan	2.99 (39.0%)	2.43 (31.7%)	0.02 (0.2%)	2.23 (29.1%)	**7.66 (100.0%)**
Belarus	9.82 (56.2%)	6.33 (36.2%)	0.09 (0.5%)	1.24 (7.1%)	**17.48 (100.0%)**
Belgium	14.90 (58.3%)	6.39 (25.0%)	0.20 (0.8%)	4.08 (15.9%)	**25.57 (100.0%)**
Bosnia and Herzegovina	12.35 (69.2%)	4.64 (26.0%)	0.01 (0.1%)	0.85 (4.8%)	**17.85 (100.0%)**
Bulgaria	9.15 (45.2%)	7.48 (36.9%)	0.01 (0.0%)	3.61 (17.8%)	**20.25 (100.0%)**
Croatia	12.91 (63.6%)	5.17 (25.5%)	0.03 (0.1%)	2.18 (10.7%)	**20.28 (100.0%)**
Cyprus	13.92 (51.3%)	8.81 (32.5%)	0.01 (0.0%)	4.39 (16.2%)	**27.14 (100.0%)**
Czech Republic[a]	10.24 (59.6%)	4.65 (27.1%)	0.02 (0.1%)	2.27 (13.2%)	**17.18 (100.0%)**
Denmark	10.49 (58.8%)	2.82 (15.8%)	0.04 (0.2%)	4.49 (25.1%)	**17.84 (100.0%)**
Estonia	6.71 (55.3%)	3.64 (30.0%)	0.02 (0.2%)	1.76 (14.5%)	**12.13 (100.0%)**
Finland	11.61 (62.7%)	2.13 (11.5%)	0.02 (0.1%)	4.76 (25.7%)	**18.52 (100.0%)**
France	17.58 (67.8%)	6.00 (23.2%)	0.23 (0.9%)	2.11 (8.1%)	**25.92 (100.0%)**
Georgia	11.03 (45.1%)	12.70 (52.0%)	0.04 (0.2%)	0.67 (2.8%)	**24.44 (100.0%)**
Germany[a]	5.71 (49.7%)	2.98 (25.9%)	0.06 (0.5%)	2.74 (23.8%)	**11.49 (100.0%)**
Greece	14.66 (43.3%)	10.80 (31.9%)	0.21 (0.6%)	8.18 (24.2%)	**33.85 (100.0%)**
Hungary	7.80 (47.8%)	6.14 (37.6%)	0.09 (0.5%)	2.28 (14.0%)	**16.31 (100.0%)**
Iceland[a]	13.93 (78.0%)	2.51 (14.1%)	0.00 (0.0%)	1.42 (8.0%)	**17.87 (100.0%)**
Ireland	15.27 (65.6%)	5.86 (25.2%)	0.07 (0.3%)	2.07 (8.9%)	**23.27 (100.0%)**
Italy	12.25 (46.0%)	10.96 (41.2%)	0.53 (2.0%)	2.88 (10.8%)	**26.62 (100.0%)**
Kazakhstan	10.64 (59.4%)	5.81 (32.5%)	0.02 (0.1%)	1.43 (8.0%)	**17.89 (100.0%)**
Kosovo[b]	11.33 (56.2%)	7.15 (35.4%)	0.00 (0.0%)	1.70 (8.4%)	**20.18 (100.0%)**
Kyrgyzstan	11.91 (66.4%)	3.70 (20.6%)	0.00 (0.0%)	2.33 (13.0%)	**17.94 (100.0%)**
Latvia	9.01 (67.7%)	3.69 (27.8%)	0.01 (0.1%)	0.59 (4.4%)	**13.30 (100.0%)**
Lithuania	10.78 (68.1%)	3.39 (21.4%)	0.03 (0.2%)	1.63 (10.3%)	**15.83 (100.0%)**

Country or area	DDD/1000 inhabitants per day (% of total)				
Luxembourg	11.96 (53.6%)	5.93 (26.6%)	0.13 (0.6%)	4.28 (19.2%)	**22.31 (100.0%)**
Malta	9.41 (43.0%)	8.44 (38.6%)	0.04 (0.2%)	4.00 (18.3%)	**21.88 (100.0%)**
Montenegro	16.46 (56.1%)	12.15 (41.4%)	0.02 (0.1%)	0.71 (2.4%)	**29.33 (100.0%)**
Netherlands	6.98 (71.4%)	2.09 (21.4%)	0.05 (0.5%)	0.66 (6.8%)	**9.78 (100.0%)**
Norway	8.54 (50.3%)	1.86 (11.0%)	0.01 (0.1%)	6.56 (38.6%)	**16.97 (100.0%)**
Poland	15.27 (62.8%)	5.55 (22.9%)	0.04 (0.1%)	3.44 (14.2%)	**24.30 (100.0%)**
Portugal	10.27 (58.0%)	5.53 (31.2%)	0.21 (1.2%)	1.70 (9.6%)	**17.72 (100.0%)**
Republic of Moldova	6.76 (50.4%)	4.33 (32.3%)	0.02 (0.2%)	2.31 (17.2%)	**13.42 (100.0%)**
Romania	15.88 (55.7%)	7.88 (27.6%)	0.04 (0.1%)	4.70 (16.5%)	**28.50 (100.0%)**
Russian Federation	7.14 (48.2%)	6.47 (43.7%)	0.06 (0.4%)	1.15 (7.7%)	**14.82 (100.0%)**
Serbia	20.37 (64.5%)	10.65 (33.7%)	0.07 (0.2%)	0.49 (1.5%)	**31.57 (100.0%)**
Slovakia	10.08 (41.4%)	9.67 (39.7%)	0.06 (0.3%)	4.53 (18.6%)	**24.34 (100.0%)**
Slovenia	8.52 (63.2%)	3.42 (25.4%)	0.03 (0.2%)	1.52 (11.3%)	**13.48 (100.0%)**
Spain[a]	11.05 (61.5%)	4.91 (27.3%)	0.33 (1.8%)	1.67 (9.3%)	**17.96 (100.0%)**
Sweden	8.88 (64.7%)	1.44 (10.5%)	0.01 (0.1%)	3.39 (24.7%)	**13.73 (100.0%)**
Tajikistan	11.93 (54.3%)	8.24 (37.5%)	0.01 (0.0%)	1.77 (8.1%)	**21.95 (100.0%)**
Turkey	16.32 (42.7%)	13.31 (34.9%)	0.21 (0.5%)	8.34 (21.9%)	**38.18 (100.0%)**
United Kingdom (The)	13.23 (64.6%)	4.17 (20.4%)	0.06 (0.3%)	3.02 (14.7%)	**20.47 (100.0%)**
Uzbekistan	4.47 (52.3%)	2.68 (31.3%)	0.01 (0.1%)	1.40 (16.3%)	**8.56 (100.0%)**

[a] *Only community consumption reported.*

[b] *In accordance with Security Council Resolution 1244 (1999).*

ANNEX 07

Annex 7 : Results – Eastern Mediterranean Region

Table A7.1 Antibiotic consumption (DDD per 1000 inhabitants per day) and proportion (%) of total antibiotics by pharmacological subgroup in three countries of the Eastern Mediterranean Region, 2015

Country	DDD per 1000 inhabitants per day (% of total)											
	Agents against amoebiasis and other protozoal diseases (P01A)	Other antibacterials (J01X)	Combinations of antibacterials (J01R)	Quinolone antibacterials (J01M)	Aminoglycoside antibacterials (J01G)	Macrolides, lincosamides and streptogramins (J01F)	Sulfonamides and trimethoprim (J01E)	Other beta-lactam antibacterials (J01D)	Beta-lactam antibacterials, penicillins (J01C)	Amphenicols (J01B)	Tetracyclines (J01A)	**Total**
Iran (Islamic Republic of)	2.59 (6.7%)	0.33 (0.9%)	0.00 (0.0%)	4.06 (10.5%)	0.19 (0.5%)	7.19 (18.5%)	0.00 (0.0%)	8.86 (22.8%)	12.81 (33.0%)	0.00 (0.0%)	2.74 (7.1%)	**38.78 (100.0%)**
Jordan[a]	0.03 (0.3%)	0.09 (1.1%)	0.00 (0.0%)	0.39 (4.4%)	0.05 (0.6%)	4.66 (52.2%)	0.06 (0.7%)	1.32 (14.7%)	1.71 (19.2%)	0.00 (0.0%)	0.61 (6.9%)	**8.92 (100.0%)**
Sudan	3.69 (10.5%)	0.03 (0.1%)	0.00 (0.0%)	1.33 (3.8%)	0.92 (2.6%)	3.36 (9.5%)	0.48 (1.4%)	3.37 (9.6%)	14.58 (41.3%)	0.00 (0.0%)	7.53 (21.3%)	**35.29 (100.0%)**

[a] *Coverage of antimicrobial consumption estimated to be 70% or less, not population-adjusted.*

Table A7.2 Consumption of antibiotics (DDD per 1000 inhabitants per day) and proportion (%) of total consumption by AWaRe categorization in three countries of the Eastern Mediterranean Region, 2015

Country	DDD per 1000 inhabitants per day (% of total)				
	Access	Watch	Reserve	Other	**Total**
Iran (Islamic Republic of)	20.86 (53.8%)	17.46 (45.0%)	0.01 (0.0%)	0.46 (1.2%)	**38.78 (100.0%)**
Jordan[a]	2.72 (30.5%)	5.27 (59.0%)	0.01 (0.1%)	0.93 (10.4%)	**8.92 (100.0%)**
Sudan	23.05 (65.3%)	6.05 (17.1%)	0.01 (0.0%)	6.18 (17.5%)	**35.29 (100.0%)**

[a] *Coverage of antimicrobial consumption estimated to be 70% or less, not population-adjusted.*

ANNEX 08

Annex 8 : Results – Western Pacific Region

Table A8.1 Antibiotic consumption (DDD per 1000 inhabitants per day) and proportion (%) of total antibiotics by pharmacological subgroup in six countries of the Western Pacific Region (2015)

Country	DDD per 1000 inhabitants per day (% of total)												
	Agents against amoebiasis and other protozoal diseases (P01A)	Other antibacterials (J01X)	Combinations of antibacterials (J01R)	Quinolone antibacterials (J01M)	Aminoglycoside antibacterials (J01G)	Macrolides, lincosamides and streptogramins (J01F)	Sulfonamides and trimethoprim (J01E)	Other beta-lactam antibacterials (J01D)	Beta-lactam antibacterials, penicillins (J01C)	Amphenicols (J01B)	Tetracyclines (J01A)	Intestinal anti-infectives (A07A)	**Total**
Brunei Darussalam[a]	0.15 (2.5%)	0.07 (1.2%)	0.00 (0.0%)	0.28 (4.8%)	0.03 (0.4%)	0.36 (6.1%)	0.12 (2.0%)	1.07 (18.1%)	3.07 (51.9%)	0.00 (0.0%)	0.77 (13.0%)	0.00 (0.0%)	**5.92 (100.0%)**
Japan	0.00 (0.0%)	0.15 (1.0%)	0.00 (0.0%)	2.74 (19.3%)	0.05 (0.3%)	4.59 (32.3%)	0.29 (2.0%)	4.53 (32.0%)	1.04 (7.4%)	0.00 (0.0%)	0.79 (5.6%)	0.01 (0.0%)	**14.19 (100.0%)**
Mongolia	5.38 (8.3%)	0.86 (1.3%)	0.00 (0.0%)	10.14 (15.7%)	0.11 (0.2%)	4.43 (6.9%)	2.67 (4.1%)	16.47 (25.6%)	21.43 (33.3%)	1.25 (1.9%)	1.67 (2.6%)	0.00 (0.0%)	**64.41 (100.0%)**
New Zealand[b]	0.00 (0.0%)	0.60 (2.6%)	0.00 (0.0%)	0.51 (2.2%)	0.01 (0.0%)	2.83 (12.5%)	1.26 (5.5%)	1.01 (4.4%)	9.99 (44.1%)	0.00 (0.0%)	6.48 (28.6%)	0.00 (0.0%)	**22.68 (100.0%)**
Philippines	0.00 (0.0%)	0.01 (0.1%)	0.00 (0.0%)	0.66 (8.0%)	0.01 (0.1%)	0.68 (8.3%)	0.28 (3.4%)	1.46 (17.7%)	2.40 (29.2%)	0.01 (0.1%)	2.72 (33.1%)	0.00 (0.0%)	**8.21 (100.0%)**
Republic of Korea	0.03 (0.1%)	0.18 (0.7%)	0.00 (0.0%)	2.47 (8.9%)	0.61 (2.2%)	4.69 (17.0%)	0.00 (0.0%)	9.21 (33.3%)	7.63 (27.6%)	0.00 (0.0%)	2.52 (9.1%)	0.32 (1.2%)	**27.68 (100.0%)**

[a] *Only public sector reported.*

[b] *Only community consumption reported.*

Table A8.2 Consumption of antibiotics (DDD per 1000 inhabitants per day) and proportion (%) of total consumption by AWaRe categorization in six countries of the Western Pacific Region, 2015

Country	DDD per 1000 inhabitants per day (% of total)				
	Access	Watch	Reserve	Other	**Total**
Brunei Darussalam[a]	4.15 (70.2%)	0.78 (13.1%)	0.00 (0.1%)	0.98 (16.6%)	**5.92 (100.0%)**
Japan	1.56 (11.0%)	10.82 (76.2%)	0.15 (1.1%)	1.66 (11.7%)	**14.19 (100.0%)**
Mongolia	46.20 (71.7%)	18.08 (28.1%)	0.00 (0.0%)	0.14 (0.2%)	**64.41 (100.0%)**
New Zealand[b]	18.41 (81.2%)	3.29 (14.5%)	0.00 (0.0%)	0.97 (4.3%)	**22.68 (100.0%)**
Philippines	5.67 (69.1%)	1.44 (17.5%)	0.00 (0.0%)	1.10 (13.3%)	**8.21 (100.0%)**
Republic of Korea	10.30 (37.2%)	9.14 (33.0%)	0.05 (0.2%)	8.18 (29.6%)	**27.68 (100.0%)**

[a] *Only public sector reported.*

[b] *Only community consumption reported.*

ISBN 978-92-4-151488-0

Department of Essential Medicines and Health Products
Innovation, Access and Use
20 Avenue Appia
1211 Geneva 27
Switzerland
http://www.who.int/medicines