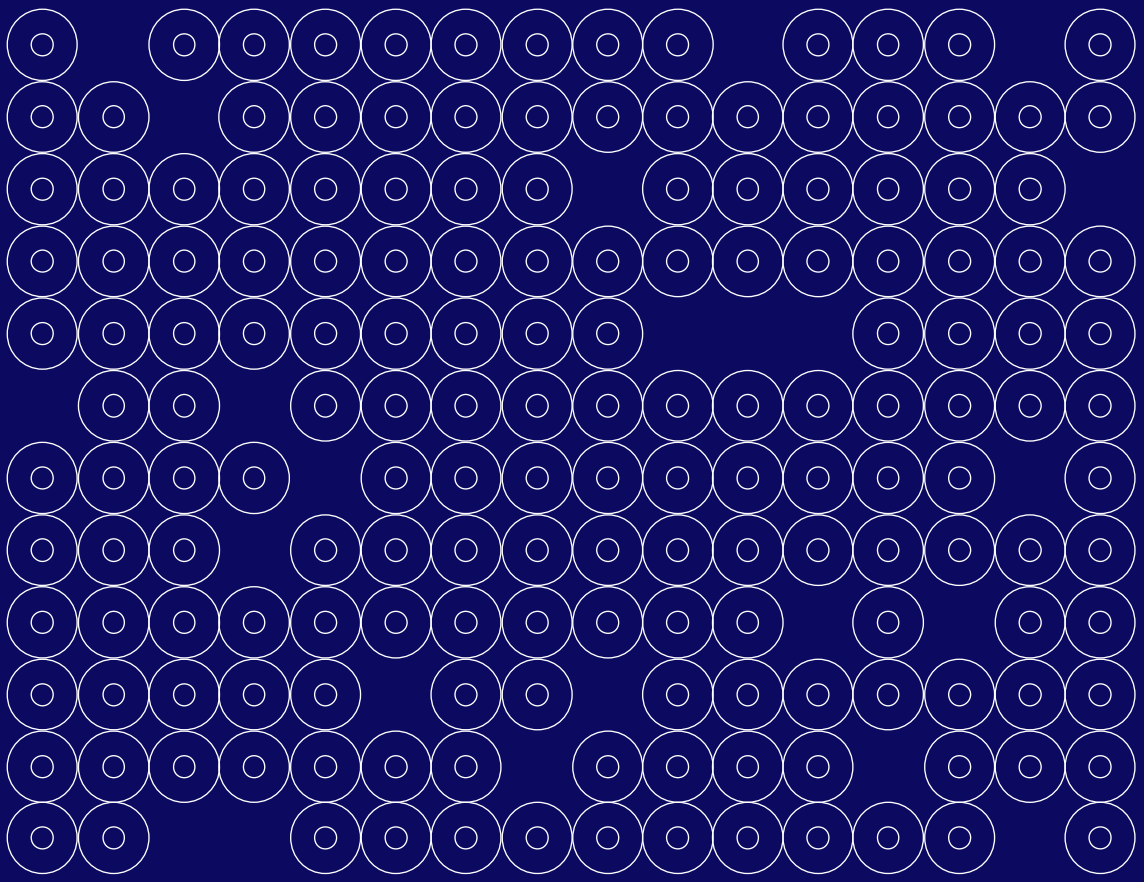
Mapping of AMR Research Funding

A comprehensive overview of the 2017 antimicrobial resistance research landscape in the JPIAMR member countries.



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Joint Programming Initiative on Antimicrobial Resistance

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Executive Summary

Background

Antimicrobial resistance (AMR) is a major threat to global health. The effectiveness of many of the valuable medical and public health advances are depending on the use of antibiotics are jeopardised due to the spread of AMR. Countries need to put in place policies and strategies to counteract the rising challenges of AMR. The Joint Programming Initiative on Antimicrobial Resistance (JPIAMR) provides the collaborative platform for its member countries to coordinate, align and support R&D efforts to prevent the consequences of AMR in a One Health framework. Key to this is the identification of knowledge gaps and duplication for better coordination and research prioritisation. In this report, JPIAMR presents its continuing effort to monitor the scale and scope of research investments in AMR across JPIAMR member countries through mapping the research funding landscape in 2017.

Methods

In 2017 JPIAMR performed systematic analyses on public investments in AMR research from 22 JPIAMR member countries, the European Commission (EC) and the Wellcome Trust. This mapping was similar to the JPIAMR mapping conducted in 2014. The data includes information on national competitive grants for research projects (institutional funding not included) that were active or where funding was committed on 1st January 2017. Each project was assigned as addressing either antibacterial, antifungal or anti-parasitic resistance, or a combination of them. Each project was categorised also within the six priority areas of the JPIAMR Strategic Research Agenda – therapeutics, diagnostics, surveillance, transmission, environment and interventions. Investment analyses were performed on different resistance areas (antibacterial, antifungal or anti-parasitic) and the JPIAMR priority research areas.

Findings

This mapping exercise recorded a total investment of 1 794 M€ in AMR research from 1 939 projects. Of the 1 939 projects reported, 76.2% of the total investment was recorded for research projects in antibiotic resistance followed by 20.6% in anti-parasitic and 3.2% in anti-fungal resistance research. Analyses on total investments in JPIAMR priority areas indicated that majority of the grants (57.6%) were dedicated to the priority area therapeutics, followed by diagnostics (13.1%), interventions (11.3%), transmission (7.5%), surveillance (6.7%) and environment (3.8%).

Interpretation

The JPIAMR 2017 mapping shows that JPIAMR member countries are continuing to increase funding of AMR as a national priority. However, the analyses and interpretation depends on the accuracy and the nature of the data available at national levels, which has improved compared to the 2014 mapping but may still vary between member countries. Although the majority of funding is still directed towards therapeutics as a solution of combatting AMR, increased investments were also observed for the other priority areas. Nevertheless, investments in research on AMR in the environment at national levels are still low. Further national commitments to support funding for detection and prevention of the spread of AMR in a truly “One Health” framework are needed. The mapped data is now available as a dynamic dashboard with self-guided visual analytics on the JPIAMR webpage. The dashboard allows users to explore data on competitive grants by funding agency, country, resistance area and JPIAMR research priority and individual research projects with interactive analyses on distribution of projects within different areas of resistance and JPIAMR research priorities.

Background

The World Health Organization (WHO) has declared AMR to be one of the ten threats to global health in 2019[1]. In 2016, the high-level meeting of United Nation's General Assembly also acknowledged AMR as a fundamental threat to the health of populations, the global economy and society as a whole. The UN General Assembly also highlighted the urgent need for countries to put policies in place to tackle AMR[2]. Apart from the need for the countries to develop and implement action plans to prevent the emergence and spread of AMR, it is also necessary is to provide increased national support for R&D to address the challenge. The national research investments need to be fully aligned through international coordination efforts such as the JPIAMR and in line with global health priorities to prevent AMR.

In 2017, JPIAMR undertook a mapping exercise to obtain a comprehensive picture of the AMR research funding landscape in different JPIAMR member countries. This work is an extension of a similar mapping exercise performed in 2014[3].

The aim of the mappings is to enable researchers, funders and policy makers to:

- obtain an overview of the national investments in AMR research funding in the JPIAMR member countries;
- provide an outline of the ongoing research projects in the area of AMR;
- determine what has already been funded across the different areas of AMR research in order to avoid duplication and identify potential partnering opportunities, and
- set strategic priorities towards investments in AMR research.

JPIAMR coordinates national public funding to support transnational AMR research and activities within six priority areas defined in the JPIAMR Strategic Research Agenda[4] – therapeutics, diagnostics, surveillance, transmission, environment and interventions that cover all relevant aspects of AMR.

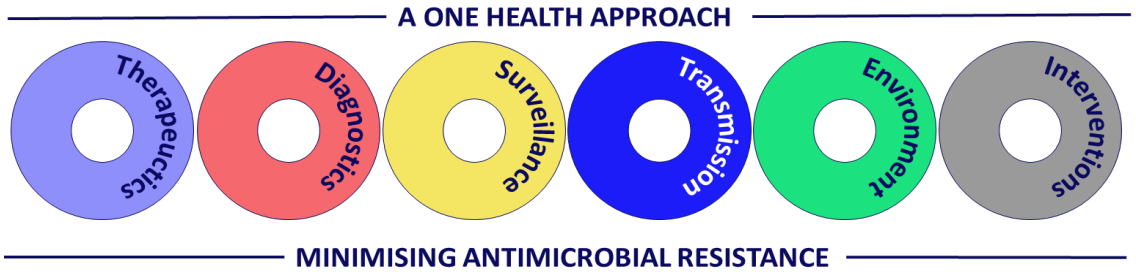

Figure 1. The six prioirty areas of the shared JPIAMR Strategic Research Agenda.

[1] https://www.who.int/emergencies/ten-threats-to-global-health-in-2019
[2] https://www.globalhealthnow.org/2016-09/just-beginning-un-adopts-amr-declaration
[3] https://www.jpiamr.eu/activities/mapping-activities/mapping-exercise-2/
[4] https://www.jpiamr.eu/activities/strategicresearchagenda/

As a global collaborative platform, the JPIAMR has engaged 27 nations in the effort to curb AMR with a One Health approach[5]. This report presents the findings of publicly funded research investments in 2017 at national level in JPIAMR member countries. Researchers, developers, innovators, funders and policymakers need to act in synergy in developing solutions in order to curb the rising trend of AMR [6]. Mapping of AMR research investments will guide both the JPIAMR and national funding agencies in defining and prioritising AMR research programming decisions.

Participating countries and other agencies

Funders from 22 countries provided data on national investments, in addition to information supplied by the EU commission and the Wellcome Trust (for full list of organisations, national point of contacts see *Annexes 1 and 2*). Detailed information on research investments at national level by agency, JPIAMR research priority and individual research projects are available in the AMR Research Funding Dashboard[7] published in the JPIAMR webpage.

[5] *https://www.jpiamr.eu/about/participating-members/*
[6] *Research, Innovation, and Policy: An Alliance Combating Antimicrobial Resistance*
[7] *https://www.jpiamr.eu/amr-research-funding-dashboard/*

Total grant investments for AMR research

A total number of 1939 projects, relating to an investment of 1794 M€, were included in the 2017 JPIAMR mapping. The results presented in Table 1 shows a comparison of the total number of projects and total public sector investment in AMR research from the participating JPIAMR member countries, the EC and the Wellcome Trsut for the 2017 and 2014 mapping. The EC provided data on EU-funded projects that were not only from framework programs but also from ERC grants related to AMR research. Increased investment towards AMR research at the national and EC levels was evident in the 2017 mapping. However, it should be highlighted that investment in basic bacteriology research, and antifungal and anti-parasitic resistance was included in the 2017 data, in contrast to the 2014 data. This difference could also be reflected in the increased investment in 2017.

Table 1. Total number of projects and grant investments in the JPIAMR 2014 and 2017 mapping.

	2017		**2014**	
Contributions from	**Project No.***	**Investment (M€) ***	**Project No****	**Investment (M€) ****
JPIAMR member countries	1 578	1 013	1 088	633
European Commission	178	500	105	314
Wellcome Trust	183	281	101	47
Overall	1 939	1794	1 294	994

* Totals include all committed public funds in AMR research in 2017, including national data from 22 participating countries out of the 27 member countries, data from the EC and the Wellcome Trust. The number of projects reported are not absolute, and may include some duplication of projects. Basic bacteriology research as well as other areas of resistance including anti-parasitic and antifungal in addition to antibiotic resistance has been included in the 2017 data.

** Totals include all committed public funds in antibacterial research from 2007-2013, including national data from 21 participating countries and EC level data (excluding the DG Research contribution to IMI-1). Information on investment in few of the projects funded by the Wellcome Trust were confidential. Investments in basic bacteriology research and parasitic and fungal resistance were not included in the 2014 data.

Distribution of total investment in different areas of resistance

In addition to data on antibiotic resistance, the 2017 mapping included information on grant investments in antifungal and anti-parasite resistance. Of the 1939 projects reported, 1710 projects addressed research on antibiotic resistance with an investment of 1395.5M€ (76.2%, Figure 1 and 2). However, 20.6% of the total funding was directed towards anti-parasitic resistance research with an investment of around 377.9 M€ in 184 projects. Only 3.2% of the total funding was recorded for research activities on anti-fungal resistance with an investment of 58.5M€ for 60 projects. The total investment per resistance area of research is highlighted in Figure 2.

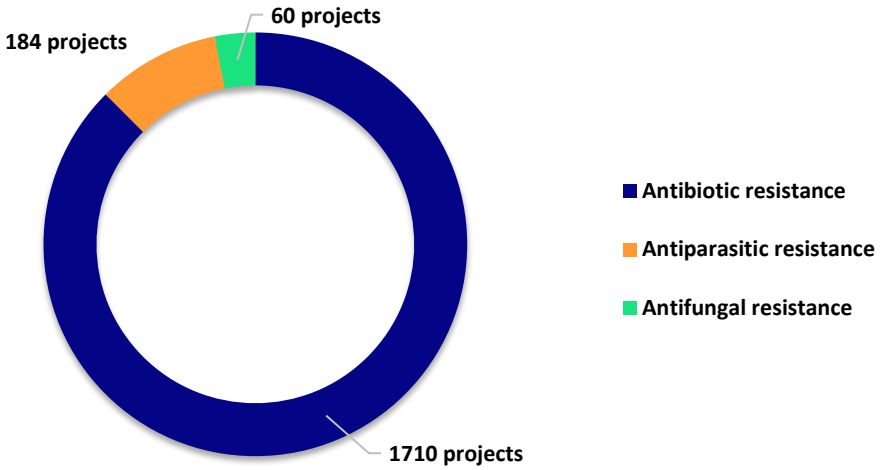

Figure 1. Distribution of projects per resistance area *

*The number of projects reported are not absolute, and may include some duplication of projects.

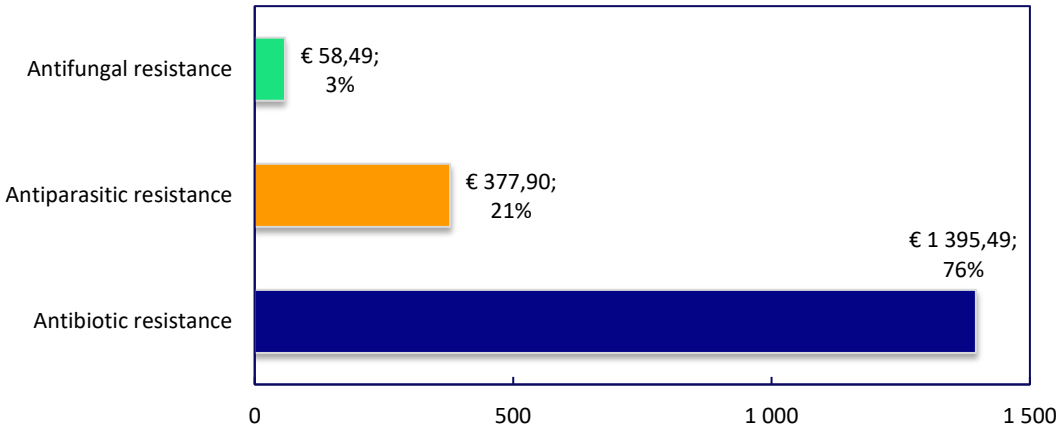

Figure 2. Total investment per resistance area (M€).

*Investment data from Japan is not represented in the graph as the as specific funding of each project could not be obtained.

Total Investment by JPIAMR-SRA priority topics

Of the 1939 projects funded across all participating countries and EC, the majority of awards 1182 projects (57.6%; 1000.3M€) were classified under the priority topic therapeutics (Figure 3 and 4). This was followed by the areas of diagnostics with 267 projects (13.1%; 235.86M€), transmission 260 projects (7.5%; 133.97M€), interventions 233 projects (11.3%; 202.95M€), surveillance 148 projects (6.7%; 119.7M€) and environment 147 projects (3.8%; 68.3M€) as shown in Figure 4. The corresponding investments of each different priority areas are listed in Figure 5.

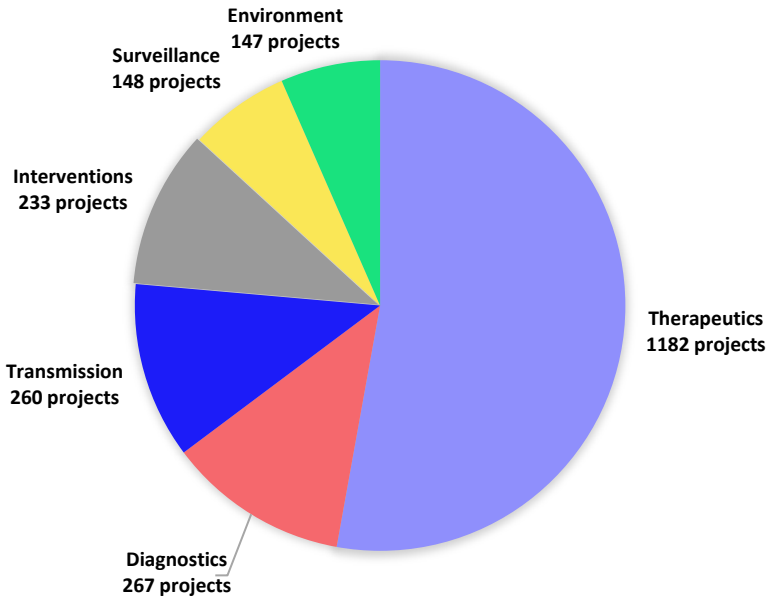

Figure 3. Distribution of projects per priority area of research.

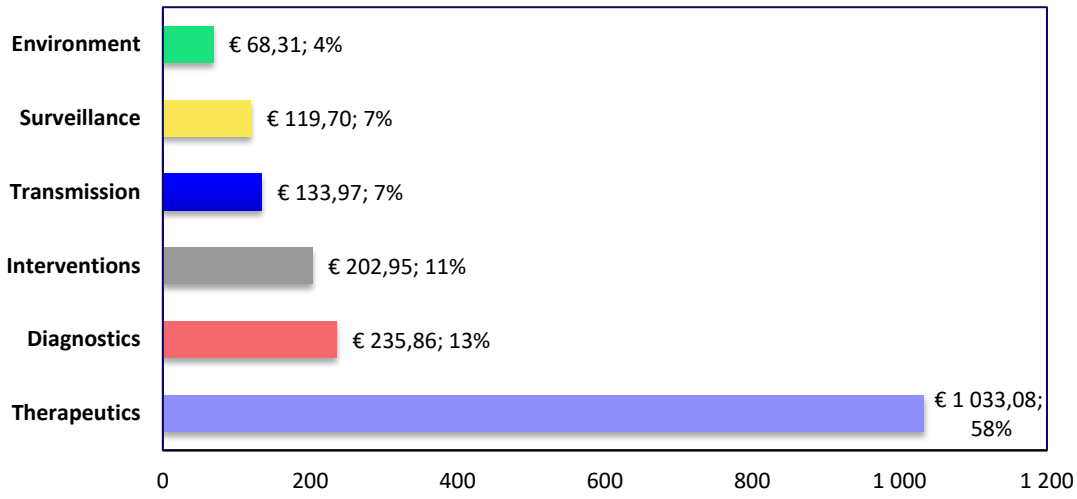

Figure 4. Total investment per priority area of research (M€).

A more even overall distribution of investment into the different priority areas categorised under the JPIAMR-SRA was observed in the 2017 JPIAMR mapping, as seen in Table 2. When compared to the 2014 mapping the majority of the investment was also in the priority topic therapeutics with 65% (441.1M€). This was followed by 16% in diagnostics (106.5M€), 8% in transmission (58.3M€), 5% in interventions (35.5M€), 4% in surveillance (25.1M€), and finally 2% in environment (13.0M€), as seen in Table 2. A large gap for investments in environment at national levels still exists.

Table 2. Comparison of investment by priority topic at the national level from 2017 and 2014.

JPIAMR-SRA priority areas	Investment (M€) 2017*	Investment (M€) 2014**
Therapeutics	1033.1	441.1
Diagnostics	235.9	106.5
Interventions	203.0	35.5
Transmission	134.0	58.3
Surveillance	119.7	25.1
Environment	68.3	13.0

* Totals include all committed public funds in AMR research in 2017, including national data from 22 participating countries out of the 27 member countries and EU level data. Basic bacteriology research as well as other areas of resistance including anti- parasitic and antifungal in addition to antibiotic resistance has been included in the 2017 mapping.

** Totals include all committed public funds in antibacterial research from 2007-2013, including national data from 21 participating countries and EU level data (excluding DG Research contribution to IMI-1). Investments in basic bacteriology research along with parasitic and fungal resistance were not included in the 2014 mapping.

Methods

Coordination

The JPIAMR secretariat coordinated the mapping exercise. A senior research officer and an analyst developed the questionnaire and the analyst was responsible for the coordination of different aspects of the mapping exercise including: data collection, data cleaning and validation, data classification and analyses and report writing with significant inputs from the senior research officer. Progress into the mapping exercise were presented and discussed at the JPIAMR Management Board meetings and areas of concern, if any, were addressed.

Data collection

A questionnaire was sent to all the national representative(s) of the JPIAMR member countries for coordinating national mapping activities and contacts with all public funding organisations for information on AMR research. The questionnaire was also sent to representatives at EC and the Wellcome Trust to obtain their data. All representatives were given detailed guidelines on the questionnaire through presentations and discussions at JPIAMR Management Board meetings and also through personal communications with the secretariat contact throughout the mapping exercise. Follow-up and support were provided through e-mail, skype meetings and over phone throughout the data collection and validation process by the analyst.

Inclusion criteria

Information on research funded by public funding organisations only were collected. Information on institutional funding was not accessible from all countries and hence was not included. Additional details related to the data are provided below:

- Grant investments by different organisations of JPIAMR member countries for awards and resources that were live (active) or where funding had been committed on 1st January 2017 were collected. Investments in both major programmes and individual research project grants for AMR research were included.

- Basic bacteriology and infectious disease research with no reference to resistance were included since such research contributes to the overall AMR research effort in the long term.

- Information on grant investments in fungal and parasite resistance were included.

Exclusion criteria

Information was not collected on:

- Projects pertaining to only viral infection or resistance (with the exception of projects that involve co-infection models where bacterial colonisation precedes, is concomitant or follows viral infection, for example: projects involving influenza and Streptococcus co-infection; or HIV and *Mycobacterium tuberculosis* co-infection).
- Project grants from other international agencies.

The collected information included: project title, project ID (if any), funding organisation name, host institution, summary or abstract, project start and end dates, and the total investment (in Euro). The respective funders provided all financial information in the report. Projects awarded in a currency other than Euro were converted to Euro by the funding organisations at the time of data collection.

Data validation

Data validation was performed in a two-stage process. Both the data provider (respective national representative(s) within each participating country) and the mapping coordinator validated the data. First, the data provider checked the data and the data was then validated by the mapping coordinator. In case of any discrepancy, the mapping coordinator contacted the data provider for revalidation.

Research project classification

Classification of the projects as per the six priority areas of the JPIAMR SRA were performed using the project title and summary or abstract provided. The projects were classified into different research categories as per JPIAMR SRA outlined below:

Therapeutics Research

- To develop new antimicrobials and therapeutic alternatives to antimicrobials (from basic research to market).
- To improve the use of current and new antimicrobials.
- To optimise treatment regimens.

Diagnostics Research

- To identify antimicrobial resistant pathogenic microorganisms and their resistance profile.

- To develop novel (rapid) diagnostics to effectively distinguish between viral, bacterial and parasitic infection.

- To stimulate better use of current antimicrobials and support the development and use of new antimicrobials and alternatives to antimicrobials.

Surveillance Research

- To standardise, improve, and extend international surveillance programmes for antimicrobial resistance and antimicrobial use in human, food, agricultural and environmental settings.

Transmission Research

- To have a comprehensive, multi-disciplinary understanding of the transmission mechanisms by which antimicrobial resistance can spread between pathogenic microorganisms populations and between different (animal, human, and environmental) reservoirs, and to translate this knowledge into the development of evidence-based strategies to minimise the spread of resistance.

Environment Research

- To assess the contribution of pollution of the environment (e.g. surface water, soil, sewage, air) with antimicrobials, antimicrobials residues and resistant pathogenic microorganisms on the spread of antimicrobial resistance.

- To develop strategies to minimise environmental contamination by antimicrobials and resistant pathogenic microorganisms.

Interventions Research

- To design and test cost effective interventions to prevent acquisition, transmission, and infection caused by antimicrobials-resistant pathogenic microorganisms.

- To determine and improve their efficacy in different settings (healthcare, community, agriculture).

Many research projects covered more than one priority topic. The funding of those projects was distributed equally to all the priority topics associated with the project. This was done on a case-by-case basis.

Data analyses and representation

Data collection was pursued in excel spreadsheets where data owners provided detailed data related to projects, funding, project duration, funding amount, and field of research. After data cleaning and validation, the data integration was performed using

the Spoon-Pentaho Data integration platform. The integrated data was then loaded on a visual analytics platform called Qlik Sense with self-guided data visualisation and embedded data analytics. JPIAMR has utilised this organised dataset and published a searchable dashboard with tools allowing visual analysis of the dataset collected. It will serve as a resource for the scientific community, funders and other interested policy makers to gain insight into the scale and scope of publicly funded AMR research in member countries of JPIAMR.

Limitations to the dataset

The following limitations of the data were identified:

1. The data provided by the members is incomplete as it includes information on competitive grants only. Information on institutional funding of respective countries were difficult to collect. Moreover, data could not be collected from many other national agencies investing in AMR research. Increased efforts at the national level are needed to provide complete and extensive data in order to fully map the AMR research landscape.

2. Basic bacteriology and infectious disease research with no reference to resistance was not included in 2014 mapping data. However, it was recognised that supporting basic bacteriology research will likely contribute to the overall AMR research effort in the long term and as such these projects were included in the 2017 mapping. This may influence the reflection that a general trend in increased investment towards AMR research is observed in the 2017 mapping at national levels. Hence, any interpretation (or comparison) should be made cautiously.

3. Projects funded under joint calls/actions (such as ERA-Nets and JPIAMR joint transnational calls) involving individual national sub-grants are counted independently and hence may result in duplication of the number of projects. However, information on the total investments remain unaffected.

Conclusions

Prioritised scientific studies through a joint strategic research agenda are essential to guide and support policies to curb AMR. JPIAMR has provided the platform to national public funders to offer their scientists opportunities to establish transnational collaborative research projects to address the threat of AMR. The JPIAMR 2017 research funding mapping reflects the fact that countries have embraced robust actions to address the threat of AMR. However, from the data available it appears that public funding has been majorly directed towards the area of therapeutics. Despite large investments observed in therapeutics, the discovery pipeline is quite empty and the void still persists. The challenge remains to discover and develop new antibiotics[8]. Hence, a more strengthened collaborative approach needs to be developed by countries to counteract this challenge and investments should be made into alternative and other novel strategies to combat AMR. JPIAMR has put many efforts to avoid any duplication of such activities to advance research on similar targets or approaches and help to swiftly develop novel alternatives.

Management and control of AMR is multi-sectorial. The environment is an important dimension to the complex context of AMR and plays a vital role in the transmission of AMR, as well as in the evolution of antimicrobial resistant strains. Knowledge gaps still exist that need to be filled to more efficiently manage the emergence and spread of AMR in the environment[9]. Investments from the national agencies are necessary to increase the scientific critical mass to fill these knowledge gaps and counteract AMR in the environmental context. Policymakers, funders and researchers need to act synergistically through boosting investments in developing solutions across all sectors through a "One-Health" approach to restrain AMR.

The EU and the Wellcome Trust, through investments in innovation, have contributed to an increased momentum in AMR research and have been instrumental in shaping the new framework for the One Health Action plan against AMR. This momentum now needs to be sustained at the national level through increased investment and coordination of national funds for transnational collaborations in AMR research.

Analyses of investments as provided through this mapping report for individual countries will enable the respective national funding agencies to identify and prioritise the national investments in specific sectors of research that are necessary to limit the emergence and spread of AMR. This will aid funders to streamline future investments and funding strategies in order to fill the key knowledge gaps in and provide the resources needed to combat AMR. The fact that the countries are continuing to invest in the AMR R&D pipeline as a national priority is promising, but commitments to invest and support a truly "One Health" framework is needed through new funding or coordination instruments at national levels.

[8] *Silver LL. Challenges of antibacterial discovery. Clin Microbiol Rev. 2011 Jan;24(1):71–109.*
[9] *Critical knowledge gaps and research needs related to the environmental dimensions of antibiotic resistance*

Annex I. Public Funding Organisations provided information to the mapping exercise

Country	Agencies reported in 2017 mapping
Argentina	ANPCYT, Agencia Nacional de Promoción Científica y Tecnológica
Belgium	FWO, Research Foundation Flanders; IWT-Flanders, Institute for Innovation by Science and Technology, Belgium; WIV-ISP, Belgian Scientific Institute of Public Health
Canada	CIHR, Canadian Institutes of Health Research
Czech Republic	Ministry of Health; CZ Science Foundation; Technology Agency; Ministry of Agriculture
Egypt	ASRT, Academy of Scientific Research and Technology
Estonia	Estonian Research Council; Enterprise Estonia; Ministry of Rural Affairs
Finland	Academy of Finland
France	ANR, National French Research Agency
Germany	BMBF, Federal Ministry of Education and Research; BMG, Federal Ministry of Health; BMEL, BMEL, Federal Ministry of Food and Agriculture; DZIF, German Center for Infection Research
Ireland	HRB, Health Research Board; Dept. of Agriculture Food and the Marine, Environmental Protection Agency; Science Foundation Ireland
Israel	CSO-MOH, Chief Scientist Office - Ministry of Health, The Israel Science Foundation
Italy	Ministry of Health
Japan	AMED, Japan Agency for Medical Research and Development
Korea	Animal And Plant Quarantine Agency; Advanced Institute of Science and Technology; Centers for Disease Control & Prevention; Drug Development Fund; Environmental Industry & Technology Institute; Evaluation Institute of Industrial Technology; Health Industry Development Institute; Institute of Marine Science & Technology Promotion; Institute of Planning and Evaluation for Technology in Food, Agriculture and Forestry; Research Institute of Bioscience and Biotechnology; Technology and Information Promotion Agency for SMEs; Ministry of Health and Welfare; Nano-Convergence Foundation; National Research Foundation; Rural Development Administration
Norway	RCN, Research Council of Norway; Helse Vest RHF (samarbeidsorganet); Matfondavtalen; BIONÆR; Northern Norway Regional Health Authority
South Africa	SAMRC, South African Medical Research Council
Spain	AEI-MINECO, La Agencia Estatal de Investigación ; ISCIII, Instituto de Salud Carlos III
Sweden	SRC, Swedish Research Council; Vinnova; The Swedish Research Council Formas; SSF, Swedish Foundation for Strategic Research; Statens energimyndighet

Switzerland	AGS, Agroscope; SNSF, Swiss National Science Foundation; FOAG, Federal Office for Agriculture; FSVO, Federal Food Safety and Veterinary Office; Innosuisse; SFOPH, Swiss Federal Office of Public Health
The Netherlands	Ministry of Health; ZonMw, The Netherlands Organisation for Health Research and Development
Turkey	TUBITAK, The Scientific and Technological Research Council of Turkey
UK	Arts and Humanites Research Council; BBSRC, Biotechnology and Biological Sciences Research Council; Chief Scientist Office-Scotland; DFID, Department for International Development; MoD, Ministry of Defence; VMD, Veterinary Medicines Directorate; NERC, Natural Environment Research Council; ESRC, Economic and Social Research Council; NIHR, National Institute for Health Research; EPSRC, Engineering and Physical Sciences Research Council; MRC, Medical Research Council; Food Standards Agency; Health and Care Research-Wales; Healthcare Infection Society; HEE, Health Education England; HSC R&D Division, Northern Ireland; PHE, Public Health England; Scottish Government; SIRN, Sustainable Intensification Research Network

Annex II. National, EU and Wellcome Trust respresentatives

Country	National representatives for the mapping exercise	Affiliation
Argentina	Alejandra Davidziuk	MINCyT, Ministry of Science, Technology and Productive Innovation
Belgium	Kathleen D'Hondt	Flanders, Dep. Economy, Science and Innovation - Flemish Government
Canada	Edith Brochu	CIHR, Canadian Institute of Health Research
Czech Republic	Lenka Krafkova	Ministry of Health
Egypt	Amr Radwan	ASRT, Academy of Scientific Research and Technology
Estonia	Kärt Söber	Ministry of Social Affairs
European Commission	Arjon Van Hengel	DG Research & Innovation, EC
Finland	Sirpa Nuotio	Academy of Finland
France	Virginie Mouchel	ANR, The French National Research Agency
Germany	Timo Jäger	German Center for Infection Research
	Akin Akkoyun	DLR, German Aerospace Center
	Barbara Junker	DLR, German Aerospace Center
Ireland	Kay Duggan-Walls	HRB, Health Research Board
Israel	Ayelet Zamir	CSO-MOH, The Chief Scientist Office-Ministry of Health
Italy	Maria Jose Ruiz Alvarez	Italian Ministry of Health
Japan	Yumiko Miyashita	Amed, Japan Agency for Medical Research and Development
Korea	Kyeong Kyu Kim	Sungkyunkwan University
Norway	Sonja Prehn	RCN, Research Council of Norway
South Africa	Richard Gordon	SAMRC, South African Medical Research Council
Spain	Estrella Fernández Rafael de Andres Medina	MINECO-AEI, Ministry of Economy and Competitiveness ISC III, Instituto de Saludo Carlos III
Sweden	Patriq Fagerstedt	Swedish Research Council
Switzerland	Barbara Flückiger Schwarzenbach	Swiss National Science Foundation
The Netherlands	Linda van Gaalen	ZonMw, The Netherlands Organisation of Health, Research and Development

Turkey	Ayse Özge Gözay Burak Barut	TUBITAK, The Scientific and Technological Research Council of Turkey TUBITAK, The Scientific and Technological Research Council of Turkey
UK	Jessica Boname	UKRI Medical Research Council
Wellcome Trust	Francesca Chiara	Wellcome Trust