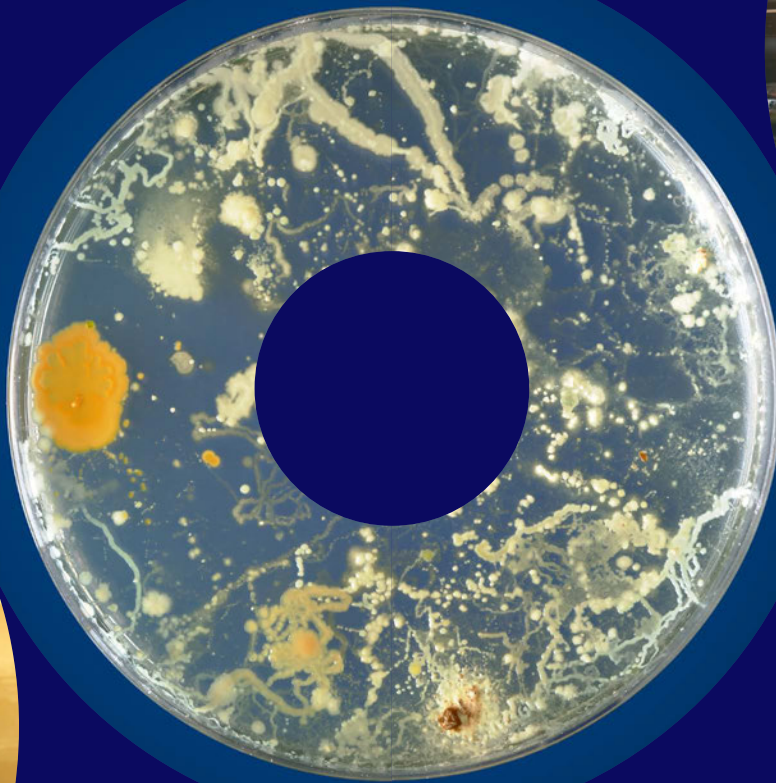


Strategic Research and Innovation Agenda

European Partnership on One Health Antimicrobial Resistance



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OH  AMR

The current SRIA has been developed by the Coordination and Support Action (CSA) DESIGN OH AMR, funded by the European Commission (Grant agreement ID: 101057036), in close collaboration with the JPIAMR Scientific Advisory Board and other experts, the JPIAMR member states and the European Partnership on One Health Antimicrobial Resistance partners (OHAMR). More information on the SRIA development process can be found in Annex 1.

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Executive summary

Antimicrobial resistance (AMR) is a global health challenge that affects human and animal health, food security and the environment. The World Health Organization (WHO) has recognised AMR to be one of the top 10 global public health threats facing humanity¹. The European Commission (EC) has also identified AMR as one of the top three priority health threats². Immediate action is needed to boost AMR research and innovation (R&I) to better understand the biological mechanisms of resistance and evolution in microorganisms, as well as transmission routes and drivers, including social human factors. R&I is also needed to develop new treatments and rapid and affordable diagnostics, improve current treatment solutions, improve surveillance methods and design innovative AMR preventing and mitigating interventions.

The European partnership on One Health AMR (the OHAMR) is one of the key European partnerships that has been identified by the EC within the framework of the Horizon Europe programme³ to support R&I to respond to the challenges of AMR. By deploying a joint research programme, co-funded by the OHAMR partners and the EC, the OHAMR will contribute to the objectives of the European Union (EU) One Health Action Plan against Antimicrobial Resistance⁴, to the European Parliament resolution on EU action to combat antimicrobial resistance⁵ and to the Council Recommendation on Stepping up EU actions to combat antimicrobial resistance in a One Health approach⁶. The OHAMR aims to align and coordinate strategic AMR R&I policies by attracting partners from EU and beyond, providing jointly support to R&I and mobilising knowledge in the fight against AMR. It will deploy an integrated One Health approach, recognising that human, animal and plant health are interdependent and interlinked with the environment. The OHAMR builds the work of the Joint Programming Initiative on AMR (JPIAMR), but aims at a bigger ambition, as well as a stronger integration of social sciences and humanities, support of innovation, and international engagement. Through this approach, the OHAMR will contribute to reduce the existing fragmentation of the R&I landscape, thus enabling the different One Health sectors and scientific disciplines to tackle the complex challenge of AMR with joint forces. The OHAMR will engage with different national and international stakeholders to seek synergy and avoid duplication of efforts.

¹ WHO (2019): [Ten threats to global health in 2019](#)

² Health Emergency Preparedness and Response Authority (2022): HERA factsheet- [HEALTH UNION: Identifying top 3 priority health threats](#)

³ [Horizon Europe Work Programme 2023-2024, Health](#)

⁴ [EU One Health Action Plan against AMR \(2017\)](#)

⁵ [Resolution on EU action to combat antimicrobial resistance \(1 June 2023\)](#)

⁶ [Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach \(13 June 2023\)](#)

The European Partnership on One Health Antimicrobial Resistance (OHAMR) will contribute to the objectives of the EU Action Plan on antimicrobial resistance (AMR), to combat the critical societal challenge of AMR and reduce the burden of AMR by:

- Enhancing European and global synergy, multi-sectoral and multidisciplinary collaboration, and alignment of strategic OH AMR R&I and policies to break silos;
- Boosting AMR research & innovation to generate knowledge and develop solutions to prevent and tackle AMR;
- Facilitating knowledge valorisation of research and innovation into products, policy and practice.

The OHAMR is structured around three focus areas which will be executed through four programmes. The three focus areas encompass: (i) prevent the emergence and spread of AMR, (ii) strengthen appropriate use of antimicrobials and infection prevention and control and (iii) provide innovative and cost-effective treatment options. Each of the three focus areas covers various aspects relative to therapeutics, diagnostics, surveillance, transmission & evolution, and interventions.

To ensure its mission, the OHAMR will deploy a wide range of activities organized under four programmes: (i) the R&I Funding programme, to provide a financial support to AMR R&I; (ii) the Capacity Strengthening Programme, to support training, networking and collaboration across disciplines, sectors, countries and career stages; (iii) the Data Exploitation Programme, to facilitate and promote access, sharing and (re) use of data and research infrastructures; and (iii) the Impact Programme for knowledge mobilization, to facilitate uptake of research results into products, practice and policy for maximum societal impact.

The current Strategic Research and Innovation Agenda (SRIA) presents the vision, mission, objectives, scientific focus, and implementation plan of the OHAMR, and serves as the strategic foundation of the partnership to guide its future actions. The OHAMR SRIA is the outcome of the efforts of the scientific community, member countries as well a broad range of stakeholders who contributed through numerous consultations organised by the Coordination and Support Action (CSA) DESIGN OH AMR⁷, funded by the EC. This SRIA has been drafted in close collaboration with the WHO and the quadripartite organisations⁸ to ensure an alignment with their respective AMR agendas^{9,10}. An update of the SRIA is expected three years after the launch the partnership.

⁷ European Commission: [DESIGNing the European Partnership on One Health AMR](#)

⁸ The Quadripartite organisations: the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Health Organization (WHO) and the World Organisation for Animal Health (WOAH)

⁹ [WHO Global research agenda for antimicrobial resistance in human health \(2023\)](#)

¹⁰ [Quadripartite A one health priority research agenda for antimicrobial resistance \(2023\)](#)

Antimicrobial Resistance: one of the top 10 threats for human health

Alexander Fleming published his first article describing the effect of penicillin in 1929 in the British Journal of Experimental Pathology. Since then, many other antimicrobials including, antibiotics, antifungal, antiviral and antiparasitic agents have been developed. Antimicrobials have saved millions of lives, including previously common deaths associated with childbirth, routine surgeries and minor wounds. Modern medicine is reliant on antimicrobials to prevent infections that can occur in immunosuppressed patients undergoing organ transplant or cancer treatment.



“With doses too small, the microbes will not be killed, and there is a danger that they will be educated to resist penicillin. There are few simple rules for penicillin treatment:

- **First, use it only on a suitable microbe**
- **Second, use it in such a way that it gets into contact with the microbe.**
- **Third, use it in sufficient dose**
- **Fourth, keep the treatment long enough to kill them all”**

Sir Alexander Fleming, BBC recording for Science Notebook, 28 August, 1945

Unfortunately, as predicted early on by Alexander Fleming, microorganisms have the capacity to adapt and develop resistance to antimicrobials through genetic modifications (gene mutations or gene transfer). The extensive (and often improper) use of antimicrobials (in medicine, but also in agriculture to prevent infectious diseases in livestock, crops and horticulture) contributes to increasing the selection of resistant microorganisms to alarming levels. Modern medicine is now running out of therapeutic options, and there is a huge risk to revert to the pre-antimicrobial era where even small wounds and routine surgery can be lethal. In addition, reduced antimicrobial efficiency may result in a decline of food production¹¹, contributing to hunger progression in poor countries.

¹¹ World Bank (2017); [Drug-Resistant Infections: A Threat to Our Economic Future](#)



Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to antimicrobial medicines (such as antibiotics), making infections harder to treat and increasing the risk of disease spread, severe illness and death.



Several studies have attempted to investigate the impact of antimicrobial resistance (AMR) by examining its effect on health and the cost of AMR to society^{12,13,14}. Murray et al,¹³ estimated that 1,27 million deaths were attributable worldwide to infections caused by bacterial AMR in 2019¹⁵. The burden of bacterial AMR is unequal and disproportionately high in Sub-Saharan Africa and South Asia. The burden is also alarmingly high in Europe (in particular in Eastern and Central Europe). The burden of resistant bacterial infections in the European Union and the European Economic Area (EU/EEA) is comparable to that of influenza, tuberculosis and HIV/AIDS combined¹³. The O'Neill¹² report argued that bacterial AMR could kill 10 million people per year by 2050 without any prevention and mitigation measures.

The impact of antifungal, antiparasitic, and antiviral resistance on human health is for the moment more difficult to quantify than antibacterial resistance (with the exception of some well characterised pathogens such as HIV and the different species of Plasmodium responsible for malaria). This is mainly due to the lack of robust surveillance data worldwide, and to the absence of suitable diagnostic tests which reliably identify the aetiology of an infection. However, fungal drug resistance is already perceived to be a major threat to public health¹⁶. In eleven years, the number of death attributable to fungal infections nearly doubled, passing from 2 to 3.8 million deaths in eleven years¹⁷, with antifungal resistance as one of the possible drivers responsible for this drastic increase. There is also growing evidence for an increasing rate in antiparasitic and antiviral resistance suggesting that these issues may be of major concern for public health in the coming years, directly affecting human health, or indirectly, through their impact on the livestock production.

The World Bank and the Organisation for Economic Cooperation and Development (OECD) have reported that from 2015 to 2050 the costs of AMR will be 3.5 billion USD per year for the expenditure on healthcare alone.¹⁸ According to the World Bank¹⁹, the economic impact of drug resistance could be as high as a 3.8% loss of global gross domestic product worldwide, including a 7.5% decrease in livestock output. In June 2017, OECD published estimates and calculations for the effectiveness and the cost-effectiveness of policies to promote effective use of antimicrobials and to prevent the spread of infections. For instance, the improvement of hand hygiene strategies could reduce the number of hospital days by 2.45 million and number of deaths by 43%, with an estimated total saving of 2.97 billion euro per year.

¹² O'Neill, J. (2014) Antimicrobial Resistance, *Tackling a Crisis for the Health and Wealth of Nations*.

¹³ Murray C.J.L et al. (2022), *Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis*; DOI: 10.1016/S0140-6736(21)02724-0

¹⁴ Cassini A.M.D (2018), *Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis*; DOI: 10.1016/S1473-3099(18)30605-4

¹⁵ Six pathogens (Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Streptococcus pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa) were responsible for more than 70% of the deaths attributable to infections caused by bacterial AMR.

¹⁶ Kohlenberg A. (2022), *Increasing number of cases and outbreaks caused by Candida auris in the EU/EEA, 2020 to 2021*; DOI: 10.2807/1560-7917.ES.2022.27.46.2200846

¹⁷ David W. Denning (2024) *Global incidence and mortality of severe fungal disease*; DOI: 10.1016/S1473-3099(23)00692-8

¹⁸ OCDE (2018); *Stemming the Superbug Tide*; doi: 10.1787/9789264307599

¹⁹ World Bank (2017); *Drug-Resistant Infections: A Threat to Our Economic Future*

Climate change (mass flooding, temperature change), war (migration), pandemics, disinformation, urbanisation (increased contact between wild-life, humans and domestic animals) and increased exploration of the nature will also likely contribute to the spread of AMR in the coming years.

The burden of AMR on public health, thus, jeopardises achievement of several sustainable development goals (SDGs).



The World Health Organization (WHO) published its first Global Action Plan to combat AMR²⁰ in 2015. Since then, the severity of AMR has been acknowledged in the global health agenda by a number of high-level institutions including the UN Environment Assembly, the Council of the European Union^{21,22}, the European Parliament²³, the European Union²⁴, the G7²⁵, the G20²⁶, and the UN General Assembly²⁷. In 2019, the World Health Organization (WHO) declared AMR as one of the top 10 global public health threats facing humanity²⁸. In 2022, the European Commission and the Member States, identified AMR as one of the top three priority health threats²⁹.

²⁰ World Health Organization (2015); [Global Action Plan on Antimicrobial Resistance](#); ISBN: 9789241509763

²¹ [Council of the EU; Press release \(17 June 2016\)](#)

²² Council of the EU: [Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach](#) (13 June 2023)

²³ European Parliament: [resolution on EU action to combat antimicrobial resistance](#) (1 June 2023)

²⁴ [European Commission, Action Plan adopted on 29 June 2017](#)

²⁵ [G7 health ministers; Communiqué \(5-6 November 2017\)](#)

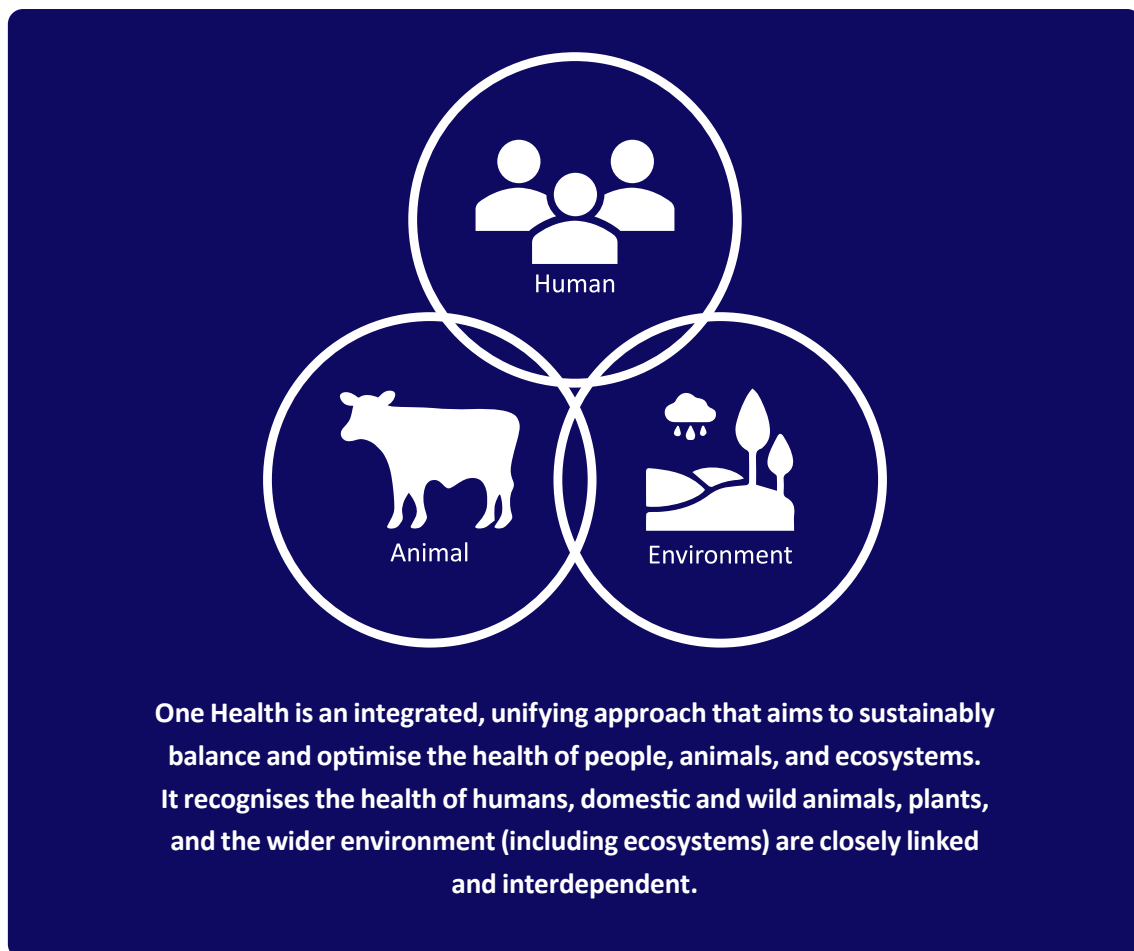
²⁶ [G20 Health Ministers; Communiqué \(19-20 May 2017\)](#)

²⁷ [United Nations General Assembly, Member States, Communiqué \(21 September 2016\)](#)

²⁸ WHO (2019): [Ten threats to global health in 2019](#)

²⁹ Health Emergency Preparedness and Response Authority (2022): HERA factsheet- [HEALTH UNION: Identifying top 3 priority health threats](#)

Considering that resistant microorganisms or resistance genes are transmitted between humans, animals (including wild-life and companion animals) and plants, often via the environment (via waste-water streams and soil³⁰), the different UN organisations recognised that a meaningful impact on human health could only be achieved through a One Health approach that requires a close collaboration between the different One Health sectors (human, animal and environment)^{31,32}. The WHO joined forces with the Food and Agriculture Organisation of the United Nations (FAO), the World Organisation for Animal Health (WOAH) and the UN Environment Programme (UNEP) to form the UN Quadripartite and to develop a One Health Joint Plan of Action³³, in which AMR is one of the action tracks. In addition, in 2017, a UN Interagency Coordination Group on Antimicrobial Resistance (IACG)³⁴ was set-up to coordinate the work of the different UN agencies and the efforts of different sectors including animal health, agriculture and environment to curb AMR.



Thus, there is an urgent need for a truly inter-sectoral, interdisciplinary and coordinated global approach to generate increased knowledge and solutions to prevent and tackle AMR.

³⁰ UNEP (2022) [Environmental Dimensions of Antimicrobial Resistance](#)

³¹ [United Nations General Assembly, Member States, Resolution A/RES/71/3, paragraph 15 of the Political Declaration](#)

³² [Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach \(2023\)](#)

³³ FAO, UNEP, WHO, and WOAH. 2022. [One Health Joint Plan of Action \(2022-2026\). Working together for the health of humans, animals, plants and the environment. Rome.](#)

³⁴ [United Nations General Assembly, Member States, Resolution A/RES/71/3, paragraph 15 of the Political Declaration](#)

³⁵ [Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis, The Lancet](#)



AMR is a major threat to human health around the world. Studies have estimated the global burden of AMR through its effect on incidence, deaths, hospital length of stay, and health-care costs for specific pathogen–drug combinations. The lancet report published in 2022 estimated that 4.95 million deaths were associated with bacterial AMR in 2019, with 1.27 million deaths directly attributable to bacterial AMR. ³⁵

Research and innovation: a pivotal instrument to prevent antimicrobial resistance and mitigate its effect

Existing tools to control and prevent AMR in human, animal and in the environment, and to treat infectious diseases are insufficient. More research and innovation (R&I) is needed to understand the mechanisms of resistance and evolution, as well as transmission routes and drivers, including social factors. R&I on development of innovative solutions for new treatments, revisited treatment regimens, rapid and affordable diagnostics, surveillance methods and preventive and mitigating interventions are also necessary. Boosting R&I will provide more understanding on AMR spread, and develop innovative social and technological solutions to decrease the burden of AMR.

Research and innovation to prevent and mitigate AMR is structured under five thematic areas (figure 1):

- Therapeutics
- Diagnostics
- Surveillance
- Transmission and Evolution
- Interventions for prevention and mitigation

The five thematic areas are complementary but not mutually exclusive meaning that some topics are overlapping between different thematic areas.

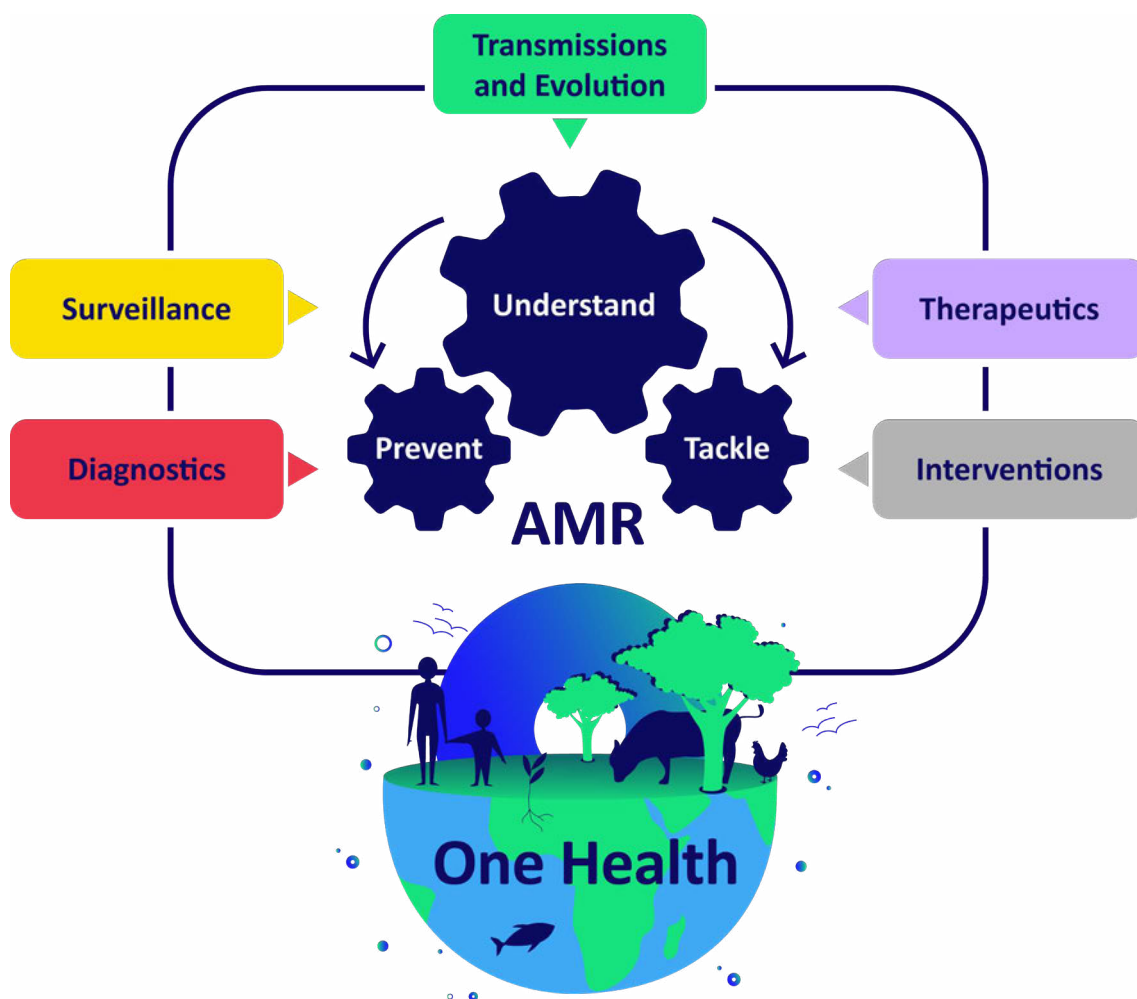


Figure 1. *The five thematic areas.*

Extensive work has been conducted to identify the R&I prospects under these five thematic areas considering the One Health dimensions of AMR, as well as the role of socio-economic factors in the emergence and spread of AMR, the role of implementation science to facilitate the translation and uptake of innovative solutions in real word settings, and the global challenges posed by AMR. The following section provides a concise description of the thematic areas (a detailed information on each of these thematic areas is provided in the long version of the Research and Innovation Objectives available on the OHAMR webpage³⁶).

³⁶ [Research and Innovation Objectives of the OHAMR](#)

Therapeutics

Research and Innovation actions in the Therapeutics area aim to discover new therapeutic targets, develop new antimicrobial agents and therapeutic alternatives, and improve existing antimicrobials and treatment regimens.³⁶

Relevance of the therapeutics area for the prevention and mitigation of AMR

The number of recently approved antibiotics is inadequate and fall short of what is required to mitigate the challenge of AMR. The progressive ineffectiveness of the current antimicrobials will inexorably lead to an immediate increase in the number of human deaths, while the possible banning of antimicrobials to treat animal and plant infections would likely lead to a decrease in food production, and increase hunger worldwide, unless new approaches are investigated and applied to treat infectious diseases. Hence, the development of new therapeutic solutions, including alternatives to antimicrobials, or the improvement of current ones is urgently needed.

Research and innovation prospects in Therapeutics

R&I is needed to improve current antimicrobial therapies and enhance the discovery, preclinical and early clinical development of novel antimicrobials, alternatives to antimicrobials and treatment strategies. This includes the repurposing of existing drugs as well as the optimisation of drug delivery and treatment protocols (dose, administration frequency, duration and drug combination). In addition, R&I in this thematic area should propose solutions to accelerate the entry of novel drugs and innovative treatment protocols to the market by developing pre-clinical models, by proposing innovative regulatory procedures, by developing alternative socio-economic models to stimulate drug development, drug production and drug supply while ensuring a high level of acceptability to end-users, appropriate use through antimicrobial stewardship and minimal impact on the environment. Research should also assess the risk of cross-resistance to antimicrobials used in different One Health sectors to aid development of evidence-based policies and guidelines aimed at rationalising the use of antimicrobials in animals and agriculture.

³⁷ The Review on Antimicrobial Resistance: [Tackling drug-resistant infections globally: final report and recommendations](#)

Effective diagnostic testing plays a pivotal role in addressing AMR. Diagnostic tests are needed to identify the pathogen responsible for the infection and the drugs to which it is susceptible. The development and implementation of rapid point of care diagnostics for infectious diseases could reduce time-to-result, help select appropriate therapies, and assist in the prescription of narrow spectrum antibiotics.³⁷



Diagnostics

Research and Innovation actions in the diagnostics area aim to develop and improve diagnostics to support the use of antimicrobials and alternatives to antimicrobials.³⁶

Relevance of the Diagnostics area for the prevention and mitigation of AMR

Diagnostics are tools that aim to detect and characterise microorganisms (species, strain, and their antimicrobial susceptibility) and that can be used to guide antimicrobial prescription to treat infection or to collect data for AMR surveillance. In the absence of proper diagnostics tests, empirical treatments are prescribed, leading to inappropriate use of antimicrobials (e.g. use of antibiotics for a viral infection), or to the prescription of less effective antimicrobials. When diagnostic tests are co-developed with novel antimicrobials, diagnostic tests can also facilitate the enrolment of patients during clinical trials. Tools developed for diagnostic purposes can in some cases also be used for detection of AMR in non-pathogenic microorganisms, and diagnostic data can feed into surveillance. Thus, development of new and improved diagnostics is vital.

Research and innovation prospects in diagnostics

R&I is needed to design and develop new rapid, cost-effective and reliable diagnostic tests and methods for identification and susceptibility testing of key pathogens, especially point of care diagnostics that can be performed on-site to guide antimicrobial prescription in both human, veterinary medicine and agriculture. Research should also develop environmental diagnostics, an emerging field, to assess the presence of resistant pathogens in the environment. R&I should also contribute to improve the performance, rapidity, feasibility and cost-effectiveness of the existing diagnostics. Since existing diagnostics are under-used by drug prescribers, research should identify and characterise the barriers preventing their acceptance and use. In addition, research in social and behavioural science should also propose solutions to overcome these barriers. Research should also show how diagnostic tests impact clinical outcomes, AMR spread and AMR management costs to convince local authorities to recommend the use of diagnostics. Development of appropriate diagnostic tools is also needed to support interventions to tackle AMR, including infection prevention and control, and antimicrobial stewardship.

Surveillance

Research and innovation actions in the Surveillance area aim to optimise surveillance systems and monitoring tools and methods to understand the drivers and burden of AMR in a One Health perspective and support decision making at all levels.³⁶

Relevance of the Surveillance area for the prevention and mitigation of AMR

Surveillance of AMR involves continuous, systematic collection, analysis, interpretation and communication of data to monitor and act on the level of AMR and antimicrobial use and consumption (AMU/AMC). Surveillance is fundamental to estimate the burden of AMR, and to raise the public awareness on AMR risks. AMR surveillance will also guide the prescription of antimicrobials in humans, animals and crops when adequate diagnostic testing is missing. It acts as an early-warning signal to implement targeted interventions, provide data to better understand the transmission, directionality and risk of the spread of AMR, and produce evidence to evaluate the effect of an intervention. For those reasons, the improvement of the current surveillance strategies, including the optimisation, standardisation and harmonisation of the current surveillance system, is fundamental.

Research and innovation prospects in Surveillance

R&I is needed to strengthen the research on surveillance systems, methods, interpretative guidelines, and communication tools to optimise the surveillance of AMR and antimicrobial use and consumption (AMU/AMC), using a One Health approach. In particular, research should identify the samples and data to be collected for an effective surveillance and develop monitoring tools and methods. Even where substantial surveillance data are already available, their heterogeneity, in terms of nature and quality and sustainability, constitute a real issue for optimising their use. Research should contribute to prioritise and/or harmonise the indicators (microbial species and AMR/AMU data to collect), as well as the place and time to collect them. Research should define standardised and harmonised sampling, analysis, interpretation and communication protocols, to allow comparison of the data across different One Health sectors, including wildlife, and across different regions of the world. Surveillance data should be integrated and analysed together with other types of data, such as meta-data, epidemiological data or social data, for which informatic tools should be developed. Research should also propose strategies and tools to facilitate and encourage data collection, data storage, data sharing, dissemination, communication, and the involvement of the end-users from data collection to data use. Economic studies should demonstrate the cost-effectiveness of different strategies for surveillance, and propose strategies/ frameworks, for quality assured AMR surveillance both in LMICs and in high income countries. Economic or social barriers preventing the development of surveillance should be identified, and solutions should be proposed.

Transmission and Evolution

Research and innovation actions in the Transmission and evolution area aim to understand and prevent the transmission and evolution of antimicrobial resistance in a One Health context.³⁶

Relevance of the Transmission and evolution area for the prevention and mitigation of AMR

Rapid preventive actions need to be implemented to avert the threat of AMR. Such actions include, but are not limited to, the reduction of AMR selective factors in the environment, the restriction of unnecessary AMU, and the control of human or animal exposure to contaminated water. Those actions are difficult to accept by the targeted end-users without strong rationale, and strong evidence of effectiveness, as they often come with an associated cost. Understanding the mechanisms involved in the transmission and evolution of AMR will help health authorities to design efficient preventive interventions. In addition, identifying interventions with proven effects will encourage health authorities to adopt and scale-up the interventions. Furthermore, a better understanding of transmission and evolution mechanisms of AMR could help to identify new drug targets, or improve the existing drugs.

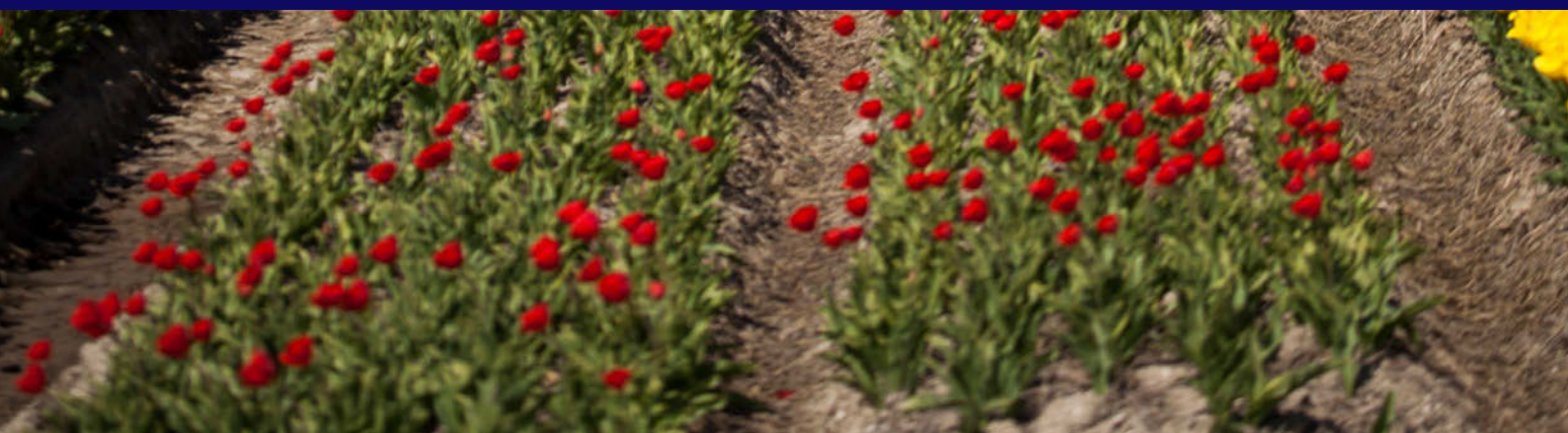
Research and innovation prospects on Transmission and Evolution

R&I is needed to improve the understanding of both the evolution and the physical transmission of microorganisms resistant to antimicrobials within and between humans, animals and the environment. This includes exploring mechanisms involved in gene mobilization, transfer of resistance, mutations, epigenetic modifications, physical transmission and maintenance of resistance under various conditions. It also includes understanding drivers of such processes, all the way from chemical and molecular drivers to socio-economic and behavioural ones (including climate change and population migration), and the design of models to estimate the risk of resistance transmission. Although the massive use of antimicrobials in the medical and agricultural sectors have been shown to be associated with increased AMR in the environment, it remains still unclear how, and to which extent, the prevalence of resistant genes in animals and in the environment contributes to AMR risk in humans. Research should also contribute to identify and characterise AMR reservoirs, evolutionary arenas and provide evidence behind the directionality and scale of AMR transmission (e.g. from environment/animal to humans, but also from non-pathogenic, such as environmental microbiota, to pathogenic strains).

³⁶ Dunne, K et al. (2017), [Intercountry Transfer of Triazole-Resistant *Aspergillus fumigatus* on Plant bulbs](#), *Clinical Infectious Diseases*



Resistance to triazole agents, the leading antifungal therapy in treating aspergillosis caused by *Aspergillus fumigatus* – a fungus that causes fatal pneumonia in immunocompromised patients, is a growing problem. The widespread use of triazole antifungal drugs as fungicides in agriculture and floriculture is considered to be a link connecting with this type of resistance. Plant bulbs have been proposed to be a vehicle for international spread of the triazole-resistant *Aspergillus fumigatus*. Billions of bulbs are produced every year for a global market.³⁸



Interventions for prevention and mitigation

Research and innovation actions in the intervention area aim to develop and innovate approaches to prevent and mitigate the emergence and spread of AMR, across One Health.³⁶

Relevance of the intervention area for the prevention and mitigation of AMR

AMR poses a serious threat to human health in absence of rapid actions. Hence interventions based on new and existing evidences are needed to control and, if possible, reverse the progression of AMR. Those interventions could be to prevent and avoid the emergence and spread of AMR before it reaches a critical threshold, as well as to mitigate when AMR has already reached a significant level. Interventions would include a large variety of actions, such as the use of technological tools, the adoption of laws, regulation and protocols, the creation of economic incentives, or structural reorganisation. On one hand, the health authorities and the national ministries are responsible for the implementation of interventions while on the other hand the researchers are responsible for identifying the needs and opportunities for interventions, and for demonstrating the effectiveness of the interventions in the fight against AMR.

Research and innovation prospects in Interventions

R&I is needed to design, develop and improve approaches/tools, techniques and recommendations for responsible antimicrobial use, prevention and control of infections, surface decontamination, improved access to antimicrobials and quality diagnostics, development of newer vaccines, improved access to water, sanitation, and hygiene, antimicrobial recycling, better agricultural practices, and strengthening health systems. It would also entail identification of barriers during the uptake and scale up of the innovative approaches/tools as well as evaluation of their cost effectiveness. R&I should establish a sound rationale to design pilot interventions, as well as to prove their effectiveness through defining metrics and measures. The pilot interventions could be either technical or social. R&I is also needed to identify the barriers preventing the uptake of a proven intervention and its implementation and to develop strategies to overcome these barriers. The cost-effectiveness of an intervention as well as its acceptability and adaptability to different settings and countries/local contexts is crucial and needs to be well investigated.

A European Partnership on One Health AMR to support AMR Research and Innovation

The European partnership on One Health AMR (OHAMR) is one of the key European partnerships that has been identified by the European Commission (EC) within the framework of the Horizon Europe R&I programme³⁹ to respond to the challenges of AMR described in the earlier section. The OHAMR will enhance coordination and alignment of actions among EU countries and beyond, and boost investments to support cross-sectorial R&I in the fight against AMR. The efforts of the OHAMR are in alignment with the “Council Recommendation on Stepping up EU actions to combat antimicrobial resistance in a One Health approach”⁴⁰ and with the European Parliament recommendation on antimicrobial resistance⁴¹, two recommendations underlying that support to research is crucial for the development, evaluation and implementation of measures against AMR. The OHAMR will also contribute to achieve the objectives identified in the “EU One Health Action Plan against AMR”⁴².

The specific objectives of the OHAMR will be to:

- Enhance European and global synergy, multi-sectoral and multidisciplinary collaboration, and alignment of strategic OH AMR R&I and policies to break silos;
- Boost AMR research & innovation to generate knowledge and develop solutions to prevent and tackle AMR;
- Facilitate knowledge valorisation of research and innovation into products, policy and practice.

The OHAMR builds on the experiences and well-established networks and processes of the Joint Programming Initiative on AMR (JPIAMR). However, the OHAMR extends to a broader and more integrative programme to further strengthen synergy and enable cross-sectoral and interdisciplinary research, including social sciences and economics, through a holistic One Health approach. In addition, the OHAMR has stronger elements of innovation and uptake of solutions by industry, society and policy makers through reinforced engagement with stakeholders, as well as capacity strengthening and data facilitation. Furthermore, the OHAMR aims to expand international networks and attract new partners from the EU and beyond.

The OHAMR will reduce duplication of efforts by promoting coordination and alignment of national, EU and international AMR R&I policies and actions, and by increasing collaboration

³⁹ [Horizon Europe Work Programme 2023-2024, Health](#)

⁴⁰ [Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach](#) (13 June 2023)

⁴¹ [EP resolution on Prudent use of antibiotics and more research needed to fight AMR](#) (1 June 2023)

⁴² [EU One Health Action Plan against AMR \(2017\)](#).

between human health, animal health and environment actors, as well as between different scientific disciplines. The OHAMR will thus result in increased knowledge, solutions and evidence-base to understand, prevent and tackle AMR, thereby strengthening the European Research and Innovation Area (ERA) ecosystem and contribute to making the EU a best-practice region on AMR.

AMR is a complex problem which will need cooperation of multiple related and relevant research programmes. The OHAMR will work in close collaboration and seek synergy with other European partnerships and international initiatives (see section 8 for more details). In particular, the OHAMR will be in close contact with the European Partnership on Animal Health and Welfare (EUP AH&W) to seek synergies, collaborate on joint activities engage and avoid overlaps in the areas of AMR and animal health. Most R&I on AMR in non-zoonotic, veterinary pathogens for food-producing animals will be covered by the EUP AH&W whereas, the OHAMR will address transmission of AMR from animals to humans such as in the case of wild-life and companion animals. The OHMAR will also seek synergy and collaboration with other EU partnerships, such as Global Health European & Developing Countries Clinical Trials Partnership Joint Undertaking (GH EDCTP3-JU), Fostering European Research Area for Health Research (ERA4Health), and Pandemic Preparedness, that will cover clinical trials for infectious diseases. The OHAMR will also collaborate closely with the second Joint Action on Antimicrobial Resistance (JAMRAI-2) to provide a scientific base for the implementation of guidelines and national action plans.

The present OHAMR Strategic Research and Innovation Agenda (SRIA) serves as the strategic foundation of the partnership to guide its future actions and support the development of its annual work plans. The SRIA has been developed based on a large number of consultations (please consult Annex 1 for more details on the SRIA development process). This SRIA has been drafted in collaboration with the WHO and the quadripartite organisations⁴³ to ensure an alignment with their respective AMR agendas^{44,45}.

⁴³ The Quadripartite organisations: the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Health Organization (WHO) and the World Organisation for Animal Health (WOAH)

⁴⁴ [WHO Global research agenda for antimicrobial resistance in human health \(2023\)](#)

⁴⁵ [Quadripartite A one health priority research agenda for antimicrobial resistance \(2023\)](#)

⁴⁶ Hedman, H, et. al (2020), [A Review of Antimicrobial Resistance in Poultry Farming within Low-Resource Settings, Animals](#)

Food animal production is rapidly expanding as well as the use of antibiotics to improve meat production through increased feed conversion, growth rate promotion and disease prevention. The promotion of intensive poultry farming could address issues of food security, but it may also increase risks of AMR exposure to poultry, other domestic animals, wildlife, and human populations through the residues of the antibiotic residues in the food and in the environment.⁴⁶



The OHAMR: Vision, Mission, and Values

Vision

Reduce the burden of AMR

The common vision of the OHAMR is to improve our response to the threat of AMR by reducing the spread of AMR in humans, animals and the environment through an integrated One Health approach, and by increasing the number of effective treatment options available in the different One Health sectors.

Mission

To boost One Health research and innovation leading to improved surveillance of resistant pathogens, better diagnostics and effective treatment of infections and to prevention measures reducing the use of antimicrobials and spread of AMR

The OHAMR will strengthen synergy and improve links between One Health R&I by better coordinating activities and investment and by developing common objectives for participating countries. It will implement concrete actions for breaking silos, boosting R&I, and development of solutions based on a joint and agreed Strategic Research and Innovation Agenda to understand, prevent and tackle AMR.

Values

One Health

The “One Health approach” in the partnership will focus on better understanding how the use of antimicrobials and the spread of resistant microorganisms and resistance determinants in and/or between humans, animals and the environment contribute to the emergence and spread of AMR in humans and to its health consequences, and which interventions are effective to control AMR (figure 2).



Figure 2. *One Health focus of the OHAMR.*

The OHAMR will do a continuous effort to break the silos between the different sectors, by stimulating discussion and collaborations, agreeing on common objectives, and boost investments for intersectoral research. The OHAMR aims to act as a platform to connect the different sectors, at all decision levels (researchers, end-users, funders, ministries). The OHAMR will engage actively with other European Partnerships having a focus on animal health, environment and agriculture to guarantee a synergy of actions and avoid overlaps between the different programmes (see also the section on Synergy and Collaborations)⁴⁷.

Equality, Diversity, and Inclusion

Pathogens circulate on Earth without geographical borders and impact individuals whatever their gender, age or socio-economic settings, making AMR a global threat. However, infections and AMR affect different human populations differently. Treatment regimens adapted for children are lacking, reinforcing their risk to AMR. While, in Low- and middle-income countries (LMICs), resistant infections are mainly driven by less access to second- or third-line antimicrobials and diagnostics, limited surveillance, lack of antimicrobial stewardship, lack of hygiene and proper sanitation, inadequate infection prevention measures, inadequate infrastructure for managing human and animal waste streams. In High Income countries, AMR is largely driven by high consumption of antimicrobials for medical use, and by an inequality of access to healthcare system (low-resource populations). Additionally, men and women are not exposed to AMR in a similar way and their adherence to treatment protocols differ. The present SRIA intends to

⁴⁷ In particular, the OHAMR will be in close contact of the Partnership on Animal Health and Welfare (EUP AH&W). Resistance affecting non-zoonotic, veterinary pathogens for food-producing animals is one of the focus this partnership and some of the animal

cover the R&I priorities relevant for populations living in different socio-economic, demographic or geographical context. The SRIA preparation involved a wide range of stakeholders including experts from different backgrounds and geographic origins, as well as different end-users' networks such as EPHA⁴⁸ and PENTA⁴⁹ to reflect the challenges of AMR in the society, at large. The drafting of this SRIA has also been subjected to different consultations involving global representations to highlight the respective challenges (see the Annex 1 for more details).

R&I to be supported in the framework of the OHAMR will adhere to the principles of social and gender equity, cultural sensitivity and economic viability while addressing the challenges of AMR as well at an organisational level including, the composition of the consortia, leadership and management of R&I projects. The OHAMR will also promote the inclusion of social sciences and implementation science in its R&I efforts to ensure that economic, geographical, social, behavioural and environmental contexts will be considered at all stages of the R&I planning and implementation. R&I projects to be supported by the OHAMR will undertake an intersectional and multi-dimensional approach by integrating sex, gender and other individual and population-level determinants of health (such as age, socio-economic status, ethnicity, religion, class, caste, and other factors) into the project's design, implementation, monitoring, evaluation and knowledge translation activities and plan context-specific interventions that are accessible and affordable to the community.

Strengthening of the European Research Area (ERA)

The OHAMR aims to strengthen Europe resilience to the emerging threat of AMR through a better coordination and alignment of actions and research funding investments among EU countries and beyond. It will facilitate national coherence of research programmes, including various aspects and sectors of AMR R&I (e.g. human health, agriculture, environment, industry). The OHAMR will leverage investments, avoiding unnecessary duplication of efforts and will thus provide support for scaling up R&I efforts. By strengthening the capacity of the research community, the OHAMR will support the sharing of best practices within Europe and beyond, especially towards widening countries⁵⁰ and countries that are highly affected by the burden of AMR. Emphasis will be laid also to support the early career scientists across all sectors, disciplines and boundaries to gain expertise and facilitate their integration to the research community. By creating a platform for knowledge valorisation, the OHAMR also aims to identify and remove the barriers for innovation and to support the transfer of knowledge to industry and small and medium enterprise, reinforcing the long-term competitiveness of Europe.

⁴⁸ European Public Health Alliance

⁴⁹ Paediatric European Network for Treatment of AIDS

⁵⁰ European Commission: [Horizon Europe Widening – Who should apply?](#)

Knowledge Valorisation

Enhanced knowledge translation and uptake of research and innovations into solutions and evidence-based policy is one of the main objectives of the OHAMR. Through the various programmes on transnational R&I calls, capacity strengthening, data exploitation and knowledge mobilisation, OHAMR will ensure that the knowledge generated from funded R&I projects are transformed into sustainable solutions available for uptake for broad societal use and maximal impact (see the section related to the “Impact Programme for knowledge mobilization” further details). This includes knowledge dissemination, which involves making R&I findings known, accessible and available for uptake for the benefit of the society as well as providing a framework for engagement of the knowledge generators with the knowledge-users. The OHAMR will also facilitate skill development and cross-fertilisation of competences and strengthen capacity of researchers. The measures for knowledge dissemination, uptake and translation will be integrated throughout the overarching activities of the OHAMR. This will help support the researchers/innovators to receive a clear understanding of the societal and public health impact as well as market opportunity, and route to translation of innovation and evidence through collaboration between academia and industry. The approaches will be solution-oriented and transdisciplinary and involve implementation research, social and behavioural sciences covering the OH sectors. The OHAMR will thus facilitate the dissemination, transfer, and uptake of the knowledge generated through valorisation.

Focus areas of the OHAMR

A prioritisation exercise organised during the preparation of the OHAMR resulted in the identification of three challenge-driven focus areas that should be addressed by the OHAMR:

- Prevent the emergence and spread of AMR
- Strengthen appropriate use of antimicrobials and infection prevention and control
- Provide innovative and cost-effective treatment options

These three focus areas will guide the development of the annual joint transnational calls and activities. Each focus area includes topics and sub-topics from more than one thematic area (Transmission and Evolution, Therapeutics, Diagnostics, Surveillance, Interventions for prevention and mitigation, see figure 3). These topics and subtopics should be seen as examples and are not exhaustive. Each focus area covers different disciplines (i.e. biological sciences, chemistry, social sciences, engineering) and includes fundamental, translational and implementation research as well as innovation.

The section below presents the three focus areas briefly. More details on the research and innovation sub-topics included under the focus areas could be found in Annex 2 and in the Roadmap of actions⁵¹. An update of the OHAMR SRIA is foreseen after the three first years of the partnership, leaving the possibility to add emerging focus area(s), if needed.

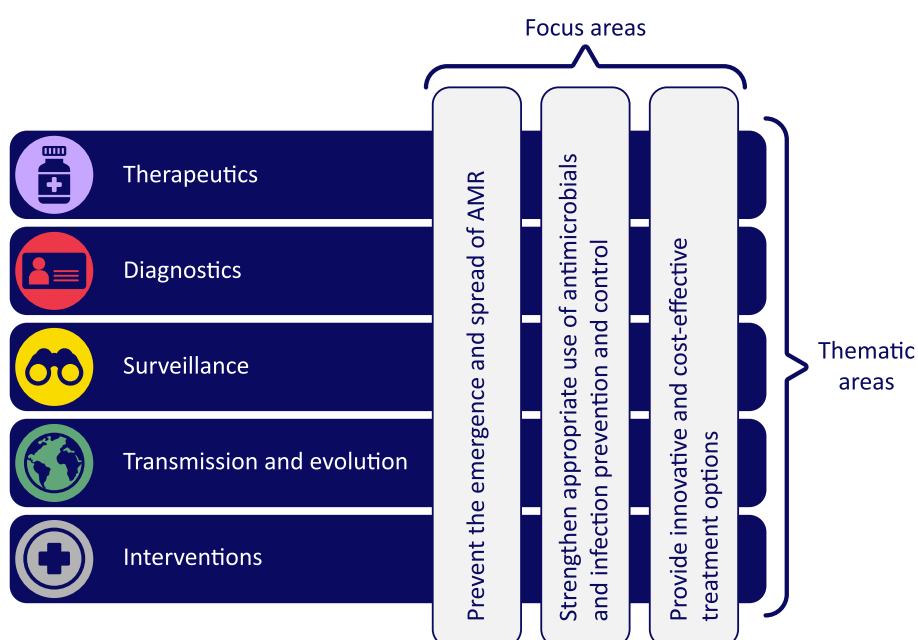


Figure 3. Relationships between the thematic areas and the Focus Areas.

⁵¹ [Roadmap of action \(2025-2032\) of the OHAMR](#)

Focus Area 1: Prevent emergence and spread of AMR

Challenge

Current measures to decrease and control the emergence and spread of AMR and recent technical advances are still insufficient to reduce the burden of AMR. In addition, it is still unclear how the recent measures taken in some sectors, such as the reduction of antimicrobial use in animal husbandry or the restriction of some critical antimicrobials for human cure only, will have an impact on human health. In the coming years, novel and/or improved measures need to be developed to control AMR, based on a better understanding of the mechanisms driving the emergence, evolution, selection, persistence, and transmission of AMR, in and between different OH sectors.

Objectives

- Identification and characterisation of the factors (molecular, behavioural, ecological, social, societal, economic and environmental⁵²) and mechanisms driving the emergence, evolution, selection and maintenance of the resistance genes and resistant microorganisms.
- Identification and characterisation of the risks, drivers, scale and direction of the AMR transmission routes within and between the different OH sectors, utilising mathematical modelling and approaches based on Artificial Intelligence (AI).
- Development of innovative solutions to limit the discharge, persistence, accumulation of antimicrobials and resistant genes/micro-organisms in the environment.⁵³
- Comparison of existing interventions aiming to limit AMR emergence and spread, and evaluation of their impact on AMR, as well as their social, societal and economic benefit.
- Development of solutions to improve the access to social and technological innovations and interventions aiming to reduce AMR emergence and spread, and to facilitate their availability and their uptake by end-users.

⁵² Factors responsible for an inappropriate Antimicrobial use (AMU) will be covered by the focus area 2: “Strengthen appropriate use of antimicrobials and infection prevention and control”.

⁵³ A broad definition of environment is used throughout the document, including social and physical environment, in vivo environment (e.g. microbiota) and wildlife.



Inappropriate use and overuse of antibiotics are one of the main drivers of AMR and have a detrimental impact on the effectiveness of these critical medicines. Curbing the overuse and misuse of antimicrobials in humans, animals and plants is vital to reduce the number of drug-resistant infections.⁵⁴



Focus area 2: Strengthen appropriate use of antimicrobials and infection prevention and control

Challenge

AMR is, to a large degree, driven by misuse and overuse of antimicrobials and poor infection prevention and control practices, in multiple sectors including human health, animal health, aquaculture, agriculture and horticulture.

Objectives

- Identification and characterisation of the behavioural and social/societal factors leading to an appropriate or excessive use of antimicrobials.
- Design of social and technical innovations, including diagnostics and digital tools, aiming to facilitate the appropriate use of antimicrobials.
- Design of social and technical innovations aiming to prevent or reduce the incidence of infections.
- Comparison of existing interventions aiming to reduce antimicrobial use or prevent infectious diseases and evaluation of their impact on human health, as well as their social, societal and economic benefit.
- Identification of barriers to uptake of and access to social, societal and technological innovations aiming to improve antimicrobial use and prevention of infection, and development of solutions to overcome these barriers.

Focus area 3: Provide innovative and cost-effective treatment options

Challenge

Resistant drug infections are responsible for an increasing number of treatment failures, increased mortality and decreased food productivity.

Objectives

- To develop new antimicrobials, novel treatment protocols or alternative treatment therapies against Human Infectious diseases along with their respective diagnostics.
- To improve, preserve and reinforce the clinical efficacy of the current treatment antimicrobials.
- Identification of barriers to access, availability, quality and uptake of therapeutic solutions and development of solutions to overcome those barriers.
- Assessment and prediction of the impact of economic incentives and regulations on drug development, drug production, drug supply and treatment availability.

⁵⁴ Klein, E. et al. (2018) Global increase and geographic convergence in antibiotic consumption between 2000 and 2015, PNAS

Programmes and actions of the OHAMR

The OHAMR will implement different actions to fulfil its mission. These actions will be structured in four different programmes (figure 4):

- R&I Funding programme: to provide financial support to AMR R&I
- Capacity Strengthening Programme: to support training, networking and collaboration across disciplines, sectors, countries and career stages.
- Data Exploitation Programme: to facilitate and promote access, sharing and (re) use of data and research infrastructures
- Impact Programme for knowledge mobilisation: to facilitate uptake of research results into products, practice and policy for maximum societal impact

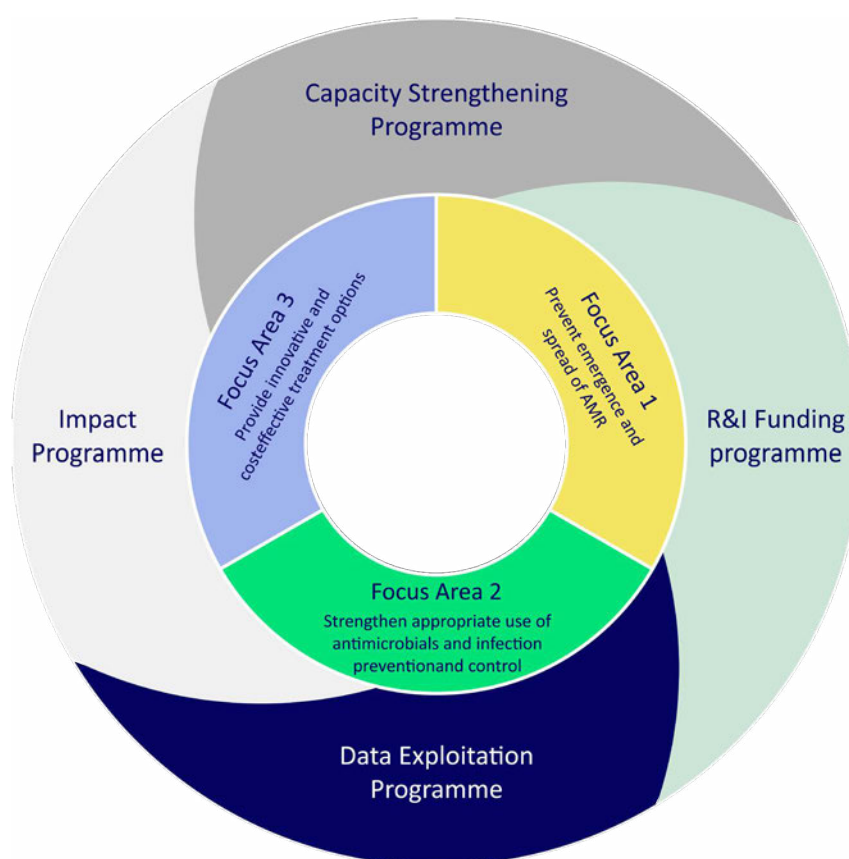


Figure 4. The four programmes and the three focus areas will contribute to tackle the OHAMR objectives.

The execution of the calls and all measures to be included in calls will be handled by the R&I Funding programme, whereas the other programmes will be responsible to coordinate and organise additional activities and events (figure 5). The other programmes may also contribute to the drafting of the annual call based on the needs identified in the mapping exercises conducted by the respective programme. Training activities will be performed by the Capacity strengthening programme in collaboration and cooperation with the Impact programme and the Data exploitation programme.

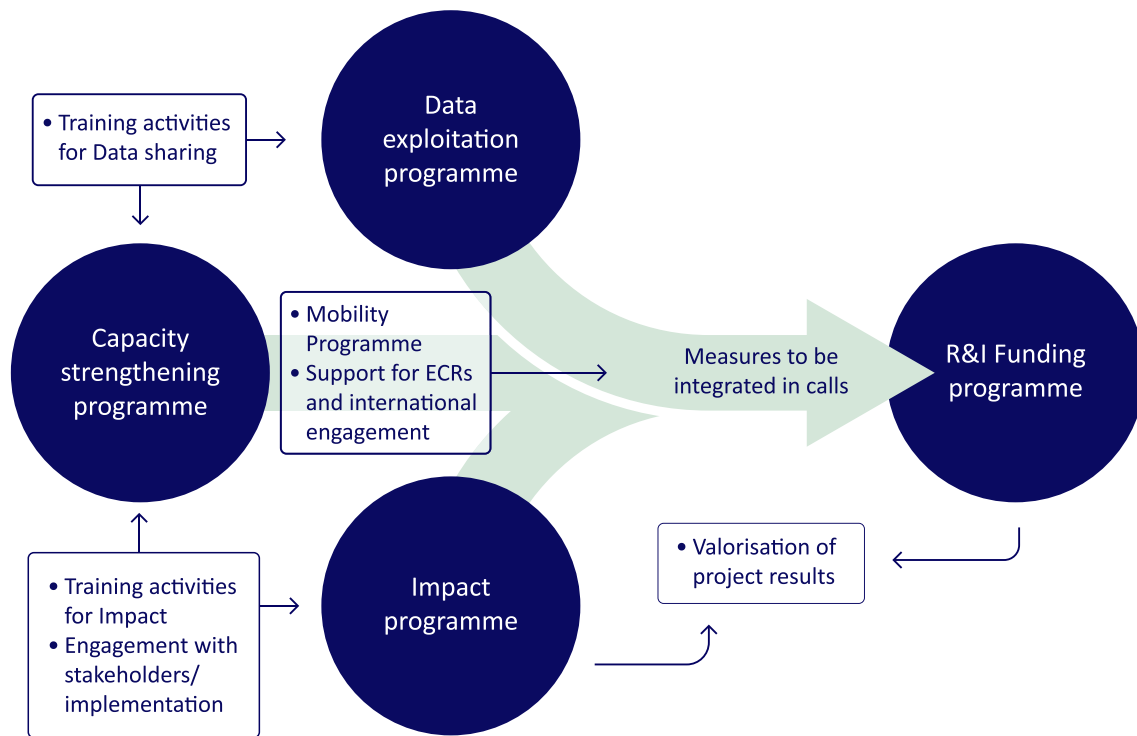


Figure 5. *The connections and cooperation areas of the four OHAMR programmes.*

An annual work plan will be developed and detailed every year for the following year to describe the activities that will be performed by each programme. This will include the identification of topics and sub-topics for joint transnational R&I calls directed to one of the focus areas, as well as additional activities to strengthen research capacity, facilitate data (re)use and maximise impact. The prioritisation will rely on the needs expressed by the research community, by the stakeholders and by the OHAMR partners, but also on the preliminary assessment of the activities organised during the past years, and on the resources available. The process will be coordinated to develop a coherent annual work-plan and to increase synergy between the different programmes across the different years.

The sections below briefly present the four programmes. More details on the different programmes can be found in the Roadmap of actions⁵⁵.

⁵⁵ [Roadmap of action \(2025-2032\) of the OHAMR](#)

R&I Funding Programme

The objective of the R&I funding programme is to provide financial support to OHAMR R&I through the organisation of annual competitive joint transnational calls co-funded by OHAMR national/regional funding partner organisations and the EC. The R&I funding programme will cover the planning of the calls (selection of the scientific topics, funding instruments and measures to be integrated in the calls), their implementation (proposal submission and the selection process) and the monitoring of the funded projects. The launch of one joint transnational call is expected each year (exceptions with more than one call a year may exist). The calls will be opened to researchers and innovators at universities, hospitals, other research performing organisations, and private actors, covering a wide range of scientific disciplines. Inclusion of stakeholders (such as local authorities or patient associations) in the research consortia will also be welcome. The eligibility criteria will depend on the funding partner organisations engaged in the calls.

The calls will support different types of research and innovation activities (figure 6), including:

- Basic research projects - addressing fundamental research questions;
- Innovation, translational research projects - for research translation to technological development, proof of concept studies and innovations;
- Implementation research projects – testing evidence-based solutions and interventions assessing effectiveness in real world contexts;
- Networks to identify current knowledge gaps; identify new research questions and agree on common methods/ metrics/ guidelines. Networks could also support knowledge transfer, uptake of research results, practices and innovations and provide platforms for cross-sectoral and cross-disciplinary collaboration.

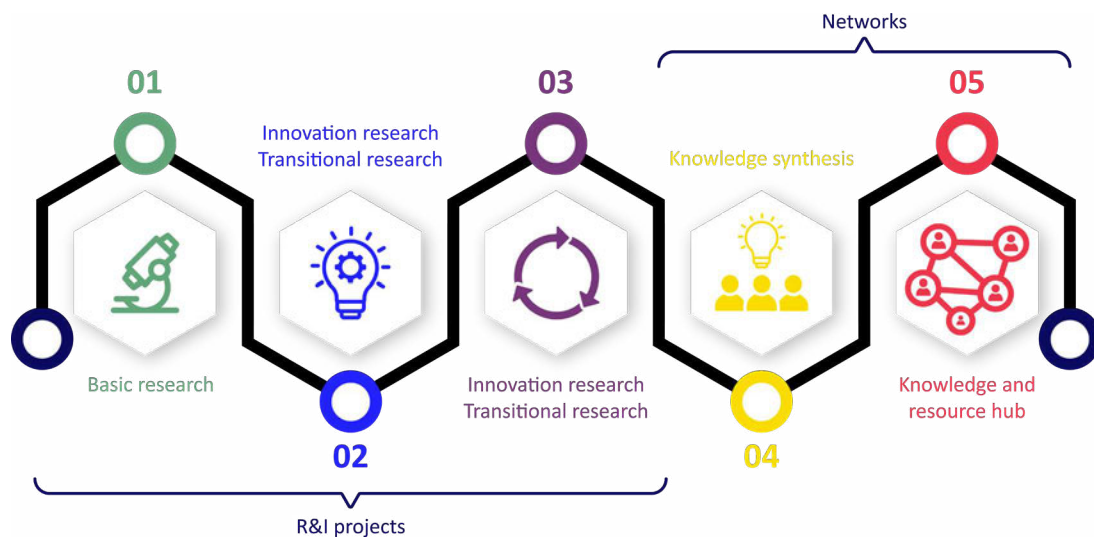


Figure 6. Type of research and innovation activities covered by the call.

In addition to the R&I activities, the call will also support additional activities aiming to support capacity strengthening, data/resources sharing, knowledge transfer and valorisation performed by the funded R&I consortia.

Separate peer review panels and multiple ranking lists will be used if needed to ensure a fair distribution of grant funding between different call topics and funding instruments.

Capacity Strengthening Programme

The capacity strengthening programme aims to strengthen the ERA and leverage the capacity of AMR researchers of different career stages and from diverse scientific backgrounds, OH sectors, professional sectors, gender and geographic origins (including widening countries and LMICs).

The objectives of the programme are:

- To leverage technical and non-technical skills needed to meet the AMR challenges
- To strengthen the collaboration, knowledge exchange and mobility between researchers of different scientific disciplines, OH sectors, professional sectors and countries in EU and beyond
- To create a viable and sustainable AMR research community, including the support of Early Career Researchers (ECRs) as an important segment of this community

To realise the goals of the programme the following activities will be organised:

- Mapping of needs, barriers, actors and target groups for capacity strengthening
- Training activities (e.g. in advanced technologies, in project management, in scientific writing, in communication, in entrepreneurship, on data management, on pathway to impact)
- Activities to facilitate connections, collaborations, mobility and knowledge exchange across sectors, disciplines and countries (e.g. mobility programme, match-making events, conference, workshops to share good practice, directory of researchers)
- Activities to facilitate career progression of the early career scientists (e.g. fellowship programme tailored for ECRs, establishment of a network of ECRs, mentorship programme, contests dedicated to ECRs)
- Activities to promote an international engagement (e.g. sharing of best practices, mobility programme, engagement with international funders and stakeholders)

The Capacity strengthening programme will work in close collaboration with the R&I funding programme to ensure the integration of capacity strengthening measures within the joint transnational calls (measures to promote ECR engagement, to promote the engagement of researchers working in widening countries and in low- and middle-income countries, to promote public/private sector collaborations, to enhance the formation of interdisciplinary and cross-sectorial consortia).

The programme is expected to result in the following outcomes:

- AMR researchers equipped with a comprehensive set of technical and non-technical proficiencies necessary to address the multifaceted challenge of AMR
- Stronger collaboration among AMR researchers and stakeholders, spanning diverse research disciplines, One Health sectors, SMEs, and industries, fostering a deeper comprehension of how each sector can contribute synergistically
- Establishment of a robust network comprising the upcoming AMR researchers, ready to confront the evolving AMR challenges
- Improved AMR research capacity within the EU and beyond, encompassing widening countries, and globally, extending support to Low- and Middle-Income Countries (LMICs), fortifying the collective global capacity to combat antimicrobial resistance

Data Exploitation Programme

The data exploitation programme will support the AMR community to facilitate sharing and (re)using of data and research infrastructures to foster an effective and efficient control and prevention of AMR. The programme will therefore work towards implementing the FAIR principles, as these guide the steps towards data to become findable, accessible, interoperable and reusable for both people and machines (computers). It will be done through subsequent and feasible steps, considering the level of reusability of data resources in the funded projects as well other resources. The ultimate goal would be that funded research and innovation projects produce (or use) FAIR data that remain at their source, that can be visited by algorithms, and be used by computer technology (data science, artificial intelligence). This would facilitate advanced analyses on large amounts of data, from different domains, disciplines and geographical areas. The programme will promote use and re-use of existing resources and research infrastructure relevant in the field of AMR covering the OH sectors. The main objectives of the programme are:

- To identify the stakeholders and users of AMR data and their needs to maximise the potential of data (re)use from various sources within the OH AMR sectors to generate insights for research and policy;

- To identify the needs, barriers and solutions for availability, interoperability and reusability of AMR data resources and existing research infrastructure across OH sectors;
- To develop an operational structure and framework to support researchers and data stewards to produce FAIR data and facilitate different type of users' access to AMR data and information;
- To demonstrate how the produced (meta)data can be (re)used to tackle AMR research, policy or public health issues with a One Health approach.

To realise the goals of the programme the following actions will be undertaken:

- Engage the AMR community to identify the needs, resources and use of data in OH AMR sectors to facilitate data harmonisation and interoperability.
- Engage the AMR community to identify the needs of use of AI based approaches including data mining and machine learning for advanced data analytics and insights on accelerating drug discovery, improving infection diagnosis and antibiotic prescription, and AMR surveillance for predicting disease outbreaks.
- Contact, liaise and collaborate with relevant infrastructures active in the EU and beyond to promote use and re-use of existing resources in the field of AMR.
- Develop data FAIRification framework so that data in the AMR research domain will be optimally produced, and made available for (re-)use for human and machine.
- Exploitation of the (meta)data to support AMR data use and reuse for policy and practice.

The programme is expected to result in the following outcomes:

- Better findability and access for the research community to AMR data and information on existing resources, and ability to use them in new and advanced research.
- Improved awareness and facilitating the research community to use and produce reusable (and as much as possible FAIR) AMR data with the help of standardised and machine-actionable descriptions of data and other resources.
- Improved opportunities for data science and artificial intelligence with FAIRified (meta)data, including advanced automated and integrated analyses on large AMR datasets from different domains, regions and sectors.
- Better interconnectivity of datasets from different OH-sectors to extract more value from existing data and to enable researchers, professionals, policy-makers and other stakeholders for data-informed decision-making to prevent and control AMR.

Impact Programme for knowledge mobilization

The impact programme will facilitate the transfer, uptake and valorisation of the knowledge generated from funded research and Innovation projects for maximum societal impact. It aims to facilitate the translation of knowledge into solutions and sustainable uptake of AMR interventions by providing a framework for collaboration between the knowledge generators (funded researchers and innovators as well as other AMR programmes and initiatives) and the knowledge-users, including policymakers, taking a One Health lens to mitigate AMR in diverse socio-economic settings. The objectives of the programme are:

- To support the identification of unmet needs, ensuring calls for research and innovation projects are informed by the relevant contexts, end-users and policymakers for generating evidence to create maximum impact.
- To facilitate the translation and uptake of innovation and the implementation of evidence-based AMR interventions for sustainable impact.
- To provide a framework to support and engage with knowledge generators, knowledge users and the relevant community for knowledge valorisation.

The programme is proposed to be executed by the “knowledge facilitators” who will act as intermediaries between the knowledge generators and relevant knowledge users and are expected to:

- Scope and identify unmet needs and gaps to inform and shape research and innovation questions for generating evidence in the transnational calls;
- Identify & map the added value and impact of R&I project findings for knowledge mobilisation;
- Facilitate the development of guidelines, recommendations and policy briefs where researchers and policymakers jointly contribute to use evidence to inform policy, programmes and practice;
- Facilitate testing and implementing AMR-sensitive and -specific interventions supported through the R&I funding programmes;
- Provide support to R&I products (new leads, candidates, diagnostics, tools, technologies) to progress for further development.

The knowledge facilitators will deliver on actions and activities directed to three strategic tracks for innovation translation, implementation of evidence for practice and policy-making under the programme engaging the knowledge generators and the users. The programme will connect and engage with the existing actors and networks in the AMR field, globally, partner with diverse stakeholders tapping their experience and expertise and avoid duplication of efforts to accomplish the set objectives. The expected outcomes of the programme are:

- Better informed R&I calls delivering on research for unmet needs to generate evidence for societal impact.
- Equip researchers with translational knowledge to learn about the entire R&I ecosystem, value proposition, end-users need and route to translation.
- Enhanced research impact through translation of research findings into sustainable solutions, products, services and knowledge-based policies made available for uptake and broad societal use.
- Deeper global cooperation and collaboration to maximise knowledge dissemination and translation.



Water bodies play a critical role in the fight against AMR. Antimicrobial residues and antimicrobial resistance genes from different sources enter aquatic systems via wastewater or through run-off to surface water and leaching to groundwater that can drive the development and spread of AMR from the environment to animals and humans.⁵⁶



Monitoring of the progress of the OHAMR towards its objectives

Monitoring the progress of the OHAMR is vital to assess the progress of the partnership towards its goals, objectives and expected impact as well as for informing future actions. The goals of the OHAMR are reflected in the various general, specific and operational objectives in the following section. The outputs from the actions under each operational objective are expected to contribute to the outcomes of one or more specific objectives, which combined, will contribute to the expected impact generated from the general objectives as schematically represented in figure 7 and figure 8. Key performance indicators (KPIs) as proxies for measurement of progress towards the various objectives and defining the underlying impact pathways is necessary to assess the short and mid-term outputs and outcomes as well as longer-term socio-economic impact of the OHAMR. The proposed KPIs, mentioned under each objective, include output indicators at the operational level that can be interpreted after a short term, as well as mid-term and long-term indicators for assessing outcomes and to demonstrate added-value, benefits and impacts for science and society. The proposed KPIs are complementary to the common indicators on the functioning of European Partnerships and Key Impact Pathways (KIPs) of the Horizon Europe (as referred to in Article III⁵⁷).

⁵⁶ [World Economic Forum: The costs and risks of AMR water pollution](#)

⁵⁷ [EU regulation establishing Horizon Europe – the Framework Programme for Research and Innovation](#)

G01

Strengthen resilience to the AMR threat in the European Research Area and beyond

G02

Enhance evidence-based policy measures and innovative solutions to prevent, detect, control, and treat drug-resistant infections in humans

S01

Enhance European and global synergies, multisectoral collaboration and alignment of strategic OH AMR R&I policies to break silos

S02

Boost research & innovation to generate knowledge and develop solutions to prevent, and tackle AMR

S03

Facilitate knowledge valorisation of research and innovation into products, policy and practice

001

Coordination and prioritisation of R&I activities to avoid fragmentation and duplication of efforts across countries and sectors

002

Increase joint support of One Health R&I actions mitigating the threat of AMR

003

Support career and capacity strengthening programmes to create a sustainable AMR research community

004

Facilitate access to AMR research resources platforms and enable sharing and (re)use of FAIR data

005

Support dissemination of research results for knowledge exchange, transfer and uptake by end-users

Figure 7. General, Specific and Operational objectives of the EUP OH AMR. All objectives are interconnected and thus, each OO contributes to several SOs and each SO contributes to both GOs.

OHAMR General objectives and their key performance indicators

The general objectives will provide a basis for assessing the partnership in relation to longer term and more diffuse effects (or global impacts). Indicators at this level are called impact indicators⁵⁸.

GO1. Strengthen resilience to the AMR threat in Europe and beyond

The OHAMR will strengthen the resilience to the AMR challenge in the ERA by creating a structured AMR R&I ecosystem with stronger inclusion of the widening countries. This system will provide synergy and coordination of excellent basic research and innovation, increased capacity strengthening, programmes for the development of talent, and widening measures to increase the engagement of countries and stakeholders, as well as enhanced international collaboration to mitigate the threat from global hotspots of AMR.

Potential impact indicators for GO1:

- Strengthened global cross-sectoral and cross-border One Health AMR R&I ecosystem
 - Strengthened cooperation of the ERA to support R&I to combat AMR
 - Strengthened capacity (talent, knowledge, data, tools, resources) and integration of a One Health cross-sectoral and transdisciplinary AMR R&I ecosystem
 - Enhanced global collaboration for a strengthened OH approach to fight AMR expanded beyond Europe

GO2. Enhance evidence-based policy measures and innovative solutions to prevent, detect, control, and treat drug-resistant infections in humans

The OHAMR will enhance research and innovation impact through translation of research findings, including data, and know-how into sustainable products, services, solutions and evidence-based policies made available for uptake and broad societal use to reduce the burden of AMR.

⁵⁸ ERA Learn: [Glossary of the most important terms for monitoring and evaluation](#).

Potential impact indicators for GO2:

- Knowledge, evidence-based measures and innovative solutions put into action
 - Application of knowledge generated through cross-border, inter-sectoral and interdisciplinary R&I resulting in improved policies and understanding of AMR
 - Policy documents, guidelines, recommendations, strategic roadmaps generated utilising research evidence from funded R&I project results
 - Innovative solutions fulfilling unmet medical needs of human patients and animals, reducing the impact of AMR on food security and environment and contributing to the wellbeing of the society and delivering on EU meeting policy priorities and SDG objectives

OHAMR Specific objectives and their key performance indicators

The specific objectives will provide a basis for assessing the partnership in relation to the short-term effects that occur. Indicators at this level are called outcome indicators.⁵²

SO1. Enhance global and European synergy, multi-sectoral collaboration, and alignment of joint strategic OH AMR R&I policies to break silos

The OHAMR will mobilise and link key AMR stakeholders and provide a framework to break existing silos across One Health sectors and scientific disciplines in the AMR R&I landscape in the ERA, as well as globally. It will structure efforts to curb AMR and facilitate multi sectoral collaboration and joint programming of actions between national and international, scientific and policy communities in coordination with industry, practitioners and end-users, with specific attention to widening and Low- and Middle-Income countries (LMICs).

Potential outcome indicators for SO2:

- R&I based knowledge generation and development of systems-wide solutions
 - Number of prediction models on risk assessment on AMR emergence and spread
 - Number of antimicrobial targets and candidates, therapeutic alternatives, new and improved diagnostics developed
 - Number of innovative products, processes or methods resulted (including IPR applications); creation of start-ups/companies as drivers of innovation
 - Number of evidence-based treatment regimens, stewardship measures and preventive solutions and mitigation measures developed

SO3. Facilitate knowledge valorisation of research and innovation into products, policy and practice

The OHAMR will facilitate innovation translation and implementation of AMR-sensitive and -specific interventions supported through the R&I funding programmes into products, measures, solutions and development of evidence-based policy in the OH AMR domains.

Potential outcome indicators for SO3:

- Knowledge mobilisation for innovations and implementation
 - Improved dialogue and knowledge exchange between researchers, industry, data stewards, policymakers and other end-users
 - Number of original research articles, guidelines, recommendations, strategy roadmaps published (with open access status)
 - Number and type of R&I project outcomes (data, technical tools, protocols and guidelines) and resources generated and made available as FAIR in open platforms
 - Number of projects funded developing links between data/research resources or platforms/infrastructures across sectors and disciplines
 - Share of projects with R&I outcomes adopted for implementation of solutions/products and/or as base for creation of (start-up) companies
 - Scientific basis generated by the research projects for the development of potential regulatory framework/legislation proposals/policy
 - Number of products/innovations transitioning to an advanced TRL maturity in pipeline development
 - Number and types of R&I outputs that are disseminated in a format accessible for end users and citizens at large (e.g. videos, infographics, summaries, social media campaigns)

Operational objectives and their key performance indicators

The Operational objectives will provide a basis for assessing the partnership in relation to its outputs that is directly produced/supplied through the activities and actions carried out during the implementation process. Indicators at this level are called output indicators.⁵²

OO1. Coordination and prioritisation of R&I activities to avoid fragmentation and duplication of efforts across countries and sectors

The OHAMR will stimulate collaborative activities between EU and Member States, associated countries, LMICs and other international initiatives to increase commitment and investment for R&I actions. Provide regular/periodic platforms for information exchange with other partnerships/ initiatives and multiple groups of sectoral and disciplinary stakeholders within and outside Europe will be established to identify prioritised research and innovation objectives targeted to the actual needs (challenge-driven) of societies for stronger OH AMR global cooperation. The OHAMR will also establish governance mechanisms and platforms for regular, periodic cross sectoral and cross disciplinary collaborations between funders and a broad range of stakeholders to capitalise on synergies and continue development of the joint SRIA/Roadmap of Actions.

Potential output indicators for OO1:

- Global stakeholder engagement
 - Establishment of platform among countries (policymaker, regulator), funders/donors, sectoral researchers and industry stakeholders within and outside Europe
 - Membership growth (number and diversity of funding organisations)
 - Joint investment committed for OHAMR R&I actions
 - Diversity of engaged stakeholders (e.g. public, private, geographical and sectoral diversity)
 - Participation of Widening countries and LMICs
- Joint synergistic activities
 - Number and type of activities with other HE partnerships
 - Number and type of activities to facilitate synergies beyond Europe
 - Number of partnerships established between Europe, LMIC and widening countries research management bodies/ AMR programs
 - Continued development of the joint SRIA and roadmap of actions

OO2. Increase joint support of One Health R&I actions mitigating the threat of AMR strengthened through co-creation by end-users

This objective will reflect and encompass the One Health R&I actions through annual joint transnational calls to support cutting edge research with increased funding, new modalities and approaches and strengthen trans- and interdisciplinary and inter-sectoral research. Support for translational research for the development of (challenge-driven) innovative solutions as well

as basic, and implementation research and innovation projects, research networks and other measures will be provided. This objective will be further refined with detailed descriptions of R&I actions corresponding to the prioritised topics identified under the focus areas selected for calls and other activities integrating cross-cutting issues including socio-economic and global aspects, implementation science and innovation in R&I actions. Funded activities will be monitored by a structured framework for collection of research and innovations outputs and other relevant indicators.

Potential output indicators for OO2:

- Upskilled researchers and increased research capacity
 - Share of research and innovation partners in funded projects representing different types of organisations (academic, industry, public health, civil society etc.)
 - Number of Early Career Researchers funded in research projects as well as undertaking mobility programmes, mentoring, training, and benefitting from capacity and career building programmes
 - Number of researchers funded from Widening countries
 - Number of researchers funded from LMICs
 - Knowledge transfer activities targeted to LMICs and widening countries
 - Number and type of activities facilitating and/or supporting sharing and (re)use of AMR data/research resources

OO3. Support career and capacity strengthening programmes to create a sustainable AMR research community

The OHAMR will utilise various funding instruments to support mobility, promote networking, collaboration, and knowledge exchange between researchers of different scientific disciplines, OH sectors, professional sectors and countries in EU and beyond. Support for AMR researchers of different career stages and from diverse scientific backgrounds, OH sectors, and geographic origins is anticipated. Activities to strengthen research capacity in under-represented countries (including widening countries) and in LMICs is also anticipated to promote international engagement.

Potential output indicators for OO3:

- Upskilled researchers and strengthened research community
 - Share of research and innovation partners in funded projects representing different types of organisations (academic, industry, public health, civil society etc.)
 - Number of Early Career Researchers funded in research projects as well as undertaking mobility programmes, mentoring, training, and benefitting from capacity and career strengthening programme
 - Number of researchers funded from LMIC and widening countries
 - Knowledge transfer activities targeted to LMICs and widening countries
 - Number of transversal activities to promote collective mutual learning and exchange of knowledge and solutions between sectors and countries

OO4. Facilitate access to AMR research resource platforms and enable sharing and (re)use of FAIR data

The OHAMR will support the research community to use and produce reusable FAIR AMR data with the help of standardised and machine-actionable descriptions of data and other resources. Opportunities will be also explored to utilise data science and machine learning with FAIRified (meta)data for advanced automated and integrated analyses on large AMR datasets from different domains, regions and sectors. It will facilitate better findability and access for the research community to existing research infrastructure on AMR data and information.

Potential output indicators for OO4:

- Data sharing and (re)utilisation of resources
 - Number and type of activities to inform and engage researchers on available data platforms, research infrastructure, resources and tools for reuse and data sharing.
 - Number and type of activities to support researchers gain FAIR data-expertise through data stewardship training with data experts to generate FAIR research outputs.
 - Number and type of activities with the AMR community (domain and data experts) to identify modern tools/methods for data sharing and advanced data analytics.

OO5. Support dissemination of research results for knowledge exchange, transfer and uptake by end-users

Activities and events will be conducted to connect knowledge generators (the scientific community) with knowledge users (national, EU and international AMR policymakers, investors, industries, civil society organisations) to support knowledge exchange with end-users for further uptake into strategies, policies and practice. Furthermore, brokerage events to promote match-making between researchers, industry, incubators, accelerators and business angels to educate and inform researchers about innovation, policy and implementation needs as well as explore support mechanism for R&I products (new leads, molecules, diagnostics, tools, technologies) to progress for further development. The OHAMR will also organise activities and events to support societal engagement and disseminate research findings to a wider community, beyond the academic audience, including civil society organisations to create better awareness of AMR threats and solutions.

Potential output indicators for OO5:

- Community engagement and knowledge dissemination to end-users
 - Number and type of activities for engagement of projects with industry, regulators, policymakers, and other end-users for dissemination of research findings for innovation and translation
 - Number of activities on science - policy interface, science communication, citizen science etc involving researchers and end-users.
 - Number and type of stakeholders engaged in early engagement and dissemination activities (industry, regulators, policymakers, civil society) and other end-users

The OHAMR pathway to impact

This section highlights the OHAMR strategy map (figure 8) that will capture the relationships between the various activities, their implementation and the expected outcomes and pathway to impact including longer-term socio-economic impact through support of R&I actions. Many of the outcomes and the impact are expected to materialise even after the partnership has completed its activities. The indicators (as listed in the previous sections) forms the basis for measurement of progress and assessing the underlying impact pathway of the OHAMR.

The OHAMR will contribute to building a coherent European Research Area, reinforcing Member States, countries associated to Horizon Europe and the European Commission as internationally recognised driver to jointly support R&I on AMR. The OHAMR will break the silos to form a strong cross-sectoral ecosystem linking the diverse stakeholders encompassing the human, veterinary, agricultural and environmental sectors. Through a joint strategic programming and global coordination of R&I, the OHAMR will thus address various objectives of the EU One Health Action plan against AMR⁵⁹. It will address the priority “making Europe more resilient” of the Horizon Europe Strategic Plan⁶⁰ by responding to the emerging threat of AMR.

The OHAMR will contribute to a sustainable transformation of health care, food production, the environment and society at large. The OHAMR will contribute to the objectives of the Farm2Fork strategy⁶¹, by promoting sustainable food production and enhance food safety and security, as well as the Zero Pollution Action Plan⁶², by addressing the spread of AMR in the environment and thus address the objectives of the European Green Deal initiatives⁶³. The OHAMR will also address the objectives of the Pharmaceutical Strategy for Europe⁶⁴, in terms of fulfilling unmet medical needs on AMR and ensuring that the benefits of innovation reach patients in the EU and beyond. The OHAMR will help unlock the potential of new tools, digital technologies and solutions and build towards a more harmonised data-enabled digital R&I environment for diagnosis, therapy, surveillance and prevention of AMR. Utilising data science and AI, OHAMR will support use of modern tools and technologies for advanced automated and integrated analyses on large AMR datasets from different disciplines and sectors and will contribute to Europe’s strategy for digital transition⁶⁵. By delivering increased knowledge, and evidence-based solutions to prevent and tackle AMR, the OHAMR will thus contribute to making the EU a best-practice region on AMR. By coordinating national research efforts on AMR, in EU, but also beyond EU, the OHAMR will also have an important role to shape the global Agenda, thus reinforcing Europe’s leading role in the fight against AMR. The OHAMR contribute to the UN SGD good health and wellbeing by decreasing the burden of infectious diseases due to antimicrobial resistant pathogens and preparing for emerging threats as depicted in the impact pathway map represented schematically in figure 8.

⁵⁹ [A European One Health Action Plan against AMR \(2017\)](#)

⁶⁰ [The Horizon Europe Strategic Plan 2021-2024](#)

⁶¹ [The Farm2Fork Strategy \(2020\)](#)

⁶² [EU Action Plan: “Towards a Zero Pollution for Air, Water and Soil” \(2021\)](#)

⁶³ [The European Green Deal](#)

⁶⁴ [A Pharmaceutical Strategy for Europe \(2020\)](#)

⁶⁵ [Shaping Europe’s digital future](#)

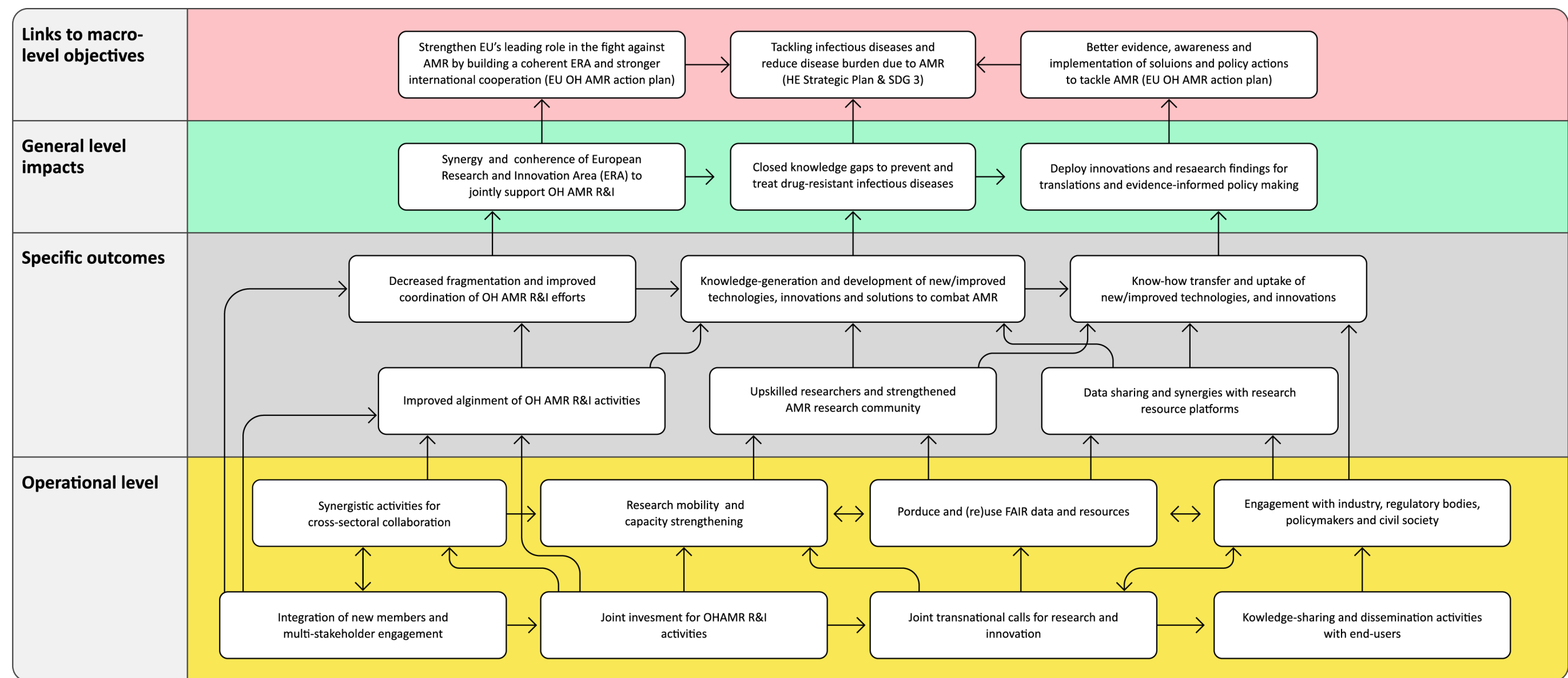


Figure 8. The OHAMR pathway to impact. The pathway links the resources of the OHAMR and the actions to be undertaken towards specific outcomes to achieve multiple general objectives which then result in domain specific impact. All outputs are interconnected and thus, each contributes to several outcomes and each outcome contributes to different impact.

Synergies and Collaborations with other Partnerships, initiatives and Stakeholders

The AMR challenge cannot be solved by a single partnership. Synergies, complementarities and collaboration among the existing and planned partnerships and initiatives are of utmost importance. The OHAMR will therefore engage with these initiatives on a regular basis to identify synergies, plan potential joint activities and avoid duplication of efforts. Synergies and potential collaboration opportunities have been identified and listed in the table 1–3 below.

Table 1. Relevant European Partnerships within Horizon Europe Cluster 1 (Health).

Partnership	Objectives	Potential synergies and collaboration
Global Health European & Developing Countries Clinical Trials Joint Undertaking, (GH EDCTP 3-JU)	The Global Health EDCTP3 Joint Undertaking will support international research partnerships accelerating the clinical evaluation of drugs, vaccines and diagnostics for key infectious diseases affecting sub-Saharan Africa, as well as novel approaches for surveillance and control of emerging/ re-emerging infections in the region and globally. It will also strengthen clinical research capacity in sub-Saharan Africa.	<ul style="list-style-type: none"> • Potential synergies on capacity strengthening. • Exchange of information and peer-learning. • Alignment of calls. • Potential joint workshops for dissemination and uptake of research results.
Pandemic Preparedness	This partnership aims to improve the EU's preparedness to emerging infectious health threats by better coordinating R&I at EU, national (and regional) level, to develop solutions and tools to prepare, predict, prevent and respond to emerging infectious diseases and pandemic outbreaks, and to assure that research infrastructures (including Clinical trial platforms) could be ready to operate in case of pandemic.	<ul style="list-style-type: none"> • Potential collaboration on antiviral and antiparasitic resistance, as well as on clinical trials.

Partnership	Objectives	Potential synergies and collaboration
Personalised Medicine, (EP PerMed)	The vision of the European Partnership for Personalised Medicine (EP PerMed) is to improve health outcomes within sustainable healthcare systems through research, development, innovation and implementation of personalised medicine approaches for the benefit of patients, citizens, and society.	<ul style="list-style-type: none"> • Potential synergies and collaboration opportunities on information exchange, dissemination, awareness-raising and other activities. • Personalised antimicrobial therapies.
ERA for Health Research, (ERA4Health)	<p>ERA4Health focuses on tackling diseases and reducing disease burden by addressing the following challenges:</p> <ul style="list-style-type: none"> • The increasing demand for a better quality of life and a better patient care. • The need to transform public health care systems into more effective, efficient, equitable, accessible, and resilient ones. • The need to strengthen disease prevention and health promotion. 	<ul style="list-style-type: none"> • Exchange of information and peer-learning. • Potential synergies and collaboration opportunities on stakeholder engagement, dissemination to policy and communication towards the public. • Collaboration on European clinical trials networks mapping and on nanotechnologies for improved antimicrobial delivery.
Transforming Health and Care systems (THCS)	THCS aims to bring together stakeholders, create synergies, coordinate Research and Innovation actions, facilitate the digitization of health and care services and support the transformation of health and care systems with innovative solutions driven by knowledge and evidence.	<ul style="list-style-type: none"> • Exchange of information and peer-learning. • Collaboration on antimicrobial stewardship measures in Healthcare system
Innovative Health Initiative Joint Undertaking (IHI JU)	This public private partnership aims to translate health research and innovation into benefits for patients and society. It covers prevention, diagnostics, treatment and disease management.	<ul style="list-style-type: none"> • Exchange of information and peer-learning.

Table 2. Relevant European Partnerships within Horizon Europe Cluster 6 (Food, Bioeconomy, Natural Resources, Agriculture and Environment).

Partnership	Objectives	Potential synergies and collaboration
EUP on Animal Health and Welfare (EUP-AH&W)	The EUP-AH&W's general goals are to progress Europe towards healthy and sustainable livestock production systems (for both terrestrial and aquatic animals), including the reduction of anti-microbial usage, and to greatly improve production animal welfare, in line with the European Green Deal and farm-to-fork strategy.	<ul style="list-style-type: none"> • Alignment of joint translational calls and internal calls. • Potential joint training and data sharing activities. • Regular contact will be held to align the programmes. • Sharing of results (notably on antimicrobial use and antimicrobial surveillance in Animal Health).
Water4All – Water security for the planet	Water4All's Vision is to boost the systemic transformations and changes across the entire water research –innovation – implementation pipeline, fostering the matchmaking between problem owners and solution providers for ensuring water security for all in the long term.	<ul style="list-style-type: none"> • Potential synergies on transmission routes in the environment. • Exchange of information and peer-learning. • Collaboration on water pollutants.
Safe and Sustainable Food Systems for People (PSFS)	The overarching vision of the SFS Partnership is that its actors collectively will achieve environmentally-friendly, socially secure and fair, economically viable, healthy and safe food systems in Europe in order to help realise its goals of the Farm to Fork strategy, in line with the global ambitions of United Nations (UN) Sustainable Food Summit 2021.	<ul style="list-style-type: none"> • Potential Synergies on AMR in the food supply chain. • Exchange of information and peer-learning. • Collaboration on AMR transmission (livestock/ crop to human).
Accelerating farming systems transition: agroecology living labs and research infrastructures	The partnership aims to accelerate the transition towards sustainable, climate- and ecosystem-friendly farming practices. To do so, it will 1) enable a better comprehension of agroecological processes from farm to landscape levels, 2) boost place-based innovation in co-creative environments and 3) improve the flow and uptake of knowledge and innovations on agroecology.	<ul style="list-style-type: none"> • Exchange of information and peer-learning.

Table 3. Relevant European Initiatives within other EU funding programmes/clusters.

Partnership	Objectives	Potential synergies and collaboration
Joint Action on Antimicrobial Resistance 2 (EU-JAMRAI 2)	EU-JAMRAI 2 will support MS/ AC (Member States/Associated Countries) in their efforts to develop and update their National Action Plans on AMR, contributes to several EU4Health policy priorities by strengthening MS/AC coordination and responsiveness against AMR, ensuring the access to important medicinal products and medical devices and, protecting people from AMR.	<ul style="list-style-type: none"> • Synergies and potential collaboration on engagement with stakeholders and policy-makers, dissemination/uptake and training activities.
EIT Health	The ambition of EIT Health is to enable people in Europe to live longer, healthier lives. The work goes beyond conventional approaches to disease management and disease prevention. We are building and growing businesses to create products and services that progress healthcare in Europe, while strengthening our economy.	<ul style="list-style-type: none"> • Exchange of information and peer-learning. • Collaboration on R&I uptake by SMEs and Industry and training activities.
European Open Science Cloud (EOSC)	The ambition of the European Open Science Cloud (EOSC) is to provide European researchers, innovators, companies and citizens with a federated and open multi-disciplinary environment where they can publish, find and re-use data, tools and services for research, innovation and educational purposes.	<ul style="list-style-type: none"> • Potential Synergies on access and sharing of data.

The OHAMR will also interact with other initiatives and stakeholders to ensure maximum synergies, share information and promote uptake of research results, as well as to avoid duplication of efforts. These stakeholders will serve an important role to advice on strategic planning and annual work programme development and to contribute with their expertise to the activities planned by the different programmes. Some examples of such stakeholders are

mentioned below, but they should be seen as a preliminary and non-exclusive list. Continuous information exchange, consultations and joint activities are foreseen throughout the duration of the OHAMR.

International organisations and funders will be of importance to align and seek synergies on research funding, capacity strengthening and implementation in countries outside the EU, in particular in LMICs. Such organisations include Action on Antibiotic Resistance (ReAct), International Centre for Antimicrobial Resistance Solutions (ICARS), the Fleming fund, Wellcome, Bill & Melinda Gates Foundation, Team Europe Initiative Africa, Global AMR Innovation Fund (GAMRIF) as well as national initiatives, including those in LMICs and Widening countries. Furthermore, the EUP OH AMR will also be in close contact with WHO, the UN Quadripartite and other international initiatives, such as the Global Leaders Group on Antimicrobial Resistance (AMR Leaders) and the Global AMR R&D Hub, to align and seek synergy of agendas and R&I actions. In addition, the OHAMR will utilise and build on the outcomes of ongoing EU-projects and initiatives, such as One Health EJP and JAMRAI-2, as well as the national R&I projects in the AMR R&I landscape for uptake and translation of R&I findings.

In order to facilitate translation and uptake of innovative solutions, the OHAMR will also cooperate with international funding initiatives, such as the Combating Antibiotic Resistant Bacteria Biopharmaceutical Accelerator (CARB-X), the Global Antibiotic Research & Development Partnership (GARDP), FIND and the AMR Action fund. Engagement with industrial associations like the Biotech companies from Europe innovating in Anti-Microbial resistance research (BEAM) Alliance or the European Federation of Pharmaceutical Industries and Associations (EPFIA) will also be sought.

To further ensure that solutions are readily disseminated to the society and that the supported R&I respond to actual needs of the society, the OHAMR will utilise the AMR Stakeholder Network, established at the European Public Health Alliance (EPHA), which brings together more than 60 leading organisations and individuals, including patient groups, health professional organisations, NGOs for public health, veterinarians etc. at national, regional and European level and thus is an excellent platform for stakeholder engagement, to advice on societal needs and facilitation of uptake of research results and solutions. Social science networks like the International Network for AMR Social Science (INAMRSS) will also be important to engage with.

The OHAMR will also collaborate with training providers, such as the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and EIT Health, as well as with existing research infrastructures and data sharing initiatives, such as the European life-sciences infrastructure for biological information (ELIXIR), The Microbial Resource Research Infrastructure (MIRRI), Biobanking and Biomolecular Resources Research Infrastructure (BBMRI), GO FAIR and the

European Health Data Space (EHDS).

The OHAMR will also interact with other relevant stakeholders and policy makers, such as EC directorates (DGs) and EU agencies to align needs and provide scientific evidence-base for policy-making. These include DG for Research and Innovation (DG RTD), DG for Health and Food Safety (DG SANTE, including the EU AMR One Health Network), DG for Agriculture and Rural Development (DG AGRI), the Health Emergency Preparedness and Response department (HERA) the European Centre for Disease Prevention and Control (ECDC), the European Food Safety Authority (EFSA), the European Medicines Agency (EMA) and the European Environment Agency (EEA) (including the One Health cross agency task force⁶⁶). In addition, the OHAMR will be in close contact and align programmes of the WHO, the UN Quadripartite (including participation in the AMR Multi-Stakeholder Partnership Platform) and other international initiatives, such as the Global Leaders Group on Antimicrobial Resistance (AMR Leaders) and the Global AMR R&D Hub, the STAR-IDAZ International Research Consortium and the MedVetNet Association.

⁶⁶ [The EU agencies One Health cross-agency task force](#)

Annex 1. SRIA development process and plans for update

Development Process

The current SRIA has been developed by the Coordination and Support Action (CSA) DESIGN OH AMR funded by the European Union (Grant Agreement N°101057036), in close collaboration with the JPIAMR Scientific Advisory Board and other experts (see the list below), the JPIAMR member states and the countries who expressed their interest to join the OHAMR.

Each section of the SRIA has been developed separately. The different sections were then combined into a single document by the drafting team. A first version of the SRIA was subjected to a consultation (survey) directed to partners that had expressed interest to join OHAMR and some of the key stakeholders (eg EU agencies and other partnerships) in April 2023. A second version of the document will be subjected to a second open consultation (survey) in May 2024. This second consultation will be publicly opened and advertised through JPIAMR communication channels (newsletter, social media and website), through national communication channels, and through EPHA (The AMR Stakeholder Network) communication channels. The participation of academic researchers, end-users, SMEs, industry and stakeholders (including other partnerships, EU initiatives and agencies, and EC directorates) will be encouraged. Efforts were made throughout the process to consider the needs expressed by the different sectors (Human Health/Agriculture/Environment, Academic/SME/Industry) and by different disciplines. The SRIA has been drafted in collaboration with the WHO and the quadripartite organisations⁶⁷ to ensure an alignment with their respective AMR agenda^{68, 69}. The OHAMR partners endorse the content of the SRIA. OHAMR SRIA will guide the actions of the OHAMR.

The document contains links to external third-party websites. The links to third-party sites do not imply approval of their content. The CSA DESIGN OH AMR accept no liability for the accessibility or contents of such websites and no liability for damages that may arise as a result of the use of such content.

⁶⁷ The Quadripartite organisations: the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Health Organization (WHO) and the World Organisation for Animal Health (WOAH)

⁶⁸ [WHO Global research agenda for antimicrobial resistance in human health \(2023\)](#)

⁶⁹ [Quadripartite A one health priority research agenda for antimicrobial resistance \(2023\)](#)

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Additional experts have been consulted, such as the Social Sciences working group:

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- Ian Donald, University of Liverpool, United Kingdom
- Jon Pierre, University of Gothenburg, Sweden
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SRIA Update

An update of the OHAMR SRIA is planned three years after the launch of the partnership. The update can be advanced if a need is expressed by the OHAMR partners. The update will be based on the KPI assessment, on the recommendations formulated by the OHAMR Scientific Advisory Board and by OHAMR stakeholders. During the process, consultation (s) opened to academic researchers, SME/ Industry, end-users, country-representatives and stakeholders will take place.

Annex 2. Detailed list of topics and subtopics covered by the three focus areas

Focus Area 1: Prevent emergence and spread of AMR

- Identification and characterisation of the factors (molecular, behavioural, ecological, social, societal, economic and environmental⁷⁰) and mechanisms driving the emergence, evolution, selection and maintenance of the resistance genes and resistant microorganisms
 - Including: Identification of new hot-spots and the factors determining an outbreak from AMR hotspots in different OH sectors; effect of different drugs and drug formulations, effect of disinfectants, effect of climate change, pollution, war, conflicts and migration on AMR emergence; utilisation of, and development of new, innovative tools to study AMR emergence, evolution, selection and maintenance (such as new generation sequencing, metagenomic data-sets machine learning, modelling); identification of new targets for antimicrobials.
- Identification and characterisation of the risks, drivers, scale and direction of the AMR transmission routes within and between the different OH sectors
 - Including: Development of new tools for the harmonisation and integration of surveillance data from different OH sectors and countries, models to simulate AMR transmission, artificial intelligence (AI) tools, and risk assessment models; identification of AMR reservoirs and hotspots at different levels of granularity as well as of determinants of successful transmission; identification of knowledge gaps regarding AMR transmission, including antiparasitic and antiviral resistance.
- Development of innovative solutions to limit the discharge, persistence, accumulation of antimicrobials and resistant genes/micro-organisms in the environment
 - Including: Development of novel solutions to limit AMR in AMR hotspots, novel decontamination strategies and strategies to limit discharge into the environment from all OH sectors; Design of degradable drug scaffolds and de-risking strategies for the recycling of organic waste in agricultural systems.

⁷⁰ A broad definition of environment is used throughout the document, including social and physical environment, in vivo environment (e.g. microbiota) and wildlife.

- Comparison of existing interventions aiming to limit AMR emergence and spread, and evaluation of their impact on AMR and their social, societal and economic benefit
 - Including: Comparison of existing Interventions aiming to limit discharge of AMs and AMR determinants into the environment and to limit transmission between OH sectors; comparison of existing communication strategies directed to the general public, decision-makers and different stakeholders in all OH sectors to increase awareness and on AMR transmission risk.
- Development of solutions to improve the access to social and technological innovations and interventions aiming to reduce AMR emergence and spread, and to facilitate their availability and their uptake by end-users.
 - Including: Identification of barriers of access and uptake; Adaptation to different OH and socio-economic settings

Focus area 2: Strengthen appropriate use of antimicrobials and infection prevention and control

- Identification and characterisation of the factors leading to an appropriate or excessive use of antimicrobials
 - Including: Social, societal, cultural, systemic, economic and behavioural factors that affects antimicrobial use (AMU) and infection prevention and control (IPC) strategies.
- Design and develop social and technical innovations, including diagnostics, aiming to facilitate the appropriate use of antimicrobials
 - Including: Design of easy to use and rapid diagnostic tools to support decision on whether to use antimicrobial or not, and which antimicrobial to use; Improvement of AMR and AMU surveillance to guide antimicrobial empiric prescription; design of tools (e.g. AI tools) to guide antimicrobial prescription; optimisation of treatment protocols to improve antimicrobial use, such as treatment duration, personalised dosing, switch to narrow-spectrum antimicrobials⁷¹; Development of communication strategies tailored to stakeholders, decision-makers and end-users to promote reduced antimicrobial use and prescription.
- Design of social and technical innovations aiming to prevent or reduce the incidence of infections
 - Including: development of solutions to decrease the risk of infection and thereby the need for antimicrobials, such as novel or improved IPC strategies, novel or improved water, sanitation and hygiene (WASH) strategies, anti-adherent surfaces, or probiotics;

⁷¹ Please note that other therapeutic strategies are included in the focus area 3 "Provide innovative and cost-effective treatment options".

identification of vaccination targets; stewardship interventions in human health and agriculture and measures to improve food safety; Development of communication strategies tailored to stakeholders, decision-makers and end-users to promote infection prevention and control, and water, sanitation and hygiene.

- Comparison of existing interventions aiming to reduce antimicrobial use or prevent infectious diseases in humans, animals, and plants and evaluation of their impact on human health, as well as their social, societal and economic benefit
 - Including: Studies demonstrating the cost-effectiveness of the use of diagnostic tools, vaccination and sanitation campaigns and infection and control measures, new reimbursement models, new regulations for antimicrobial prescription, new societal organisation.
- Identification of barriers to uptake of and access to social, societal and technological innovations aiming to improve antimicrobial use and prevention of infection in humans, animals, and plants, and development of solutions to overcome these barriers
 - Including: Uptake of diagnostics and surveillance, as well as interventions aiming to prevent infections (including vaccination); Implementation studies in different socio-economic settings; Proposals of new reimbursement models and new guidelines/regulations for antimicrobial prescription, new societal organisation.

Focus area 3: Provide innovative and cost-effective treatment options

- To develop new antimicrobials, novel treatment protocols or alternative treatment therapies against Human Infectious diseases along with their respective diagnostics
 - Including: development of new antimicrobials (new scaffolds, narrow spectrum antimicrobials, against new drug targets, repurposed molecules ...) and alternative treatments, as well as their associated diagnostics for human infectious diseases; identification of current therapeutic gaps to treat infections resistant to antifungal, antiviral and antiparasitic treatments including needs in LMICs.
- To improve, preserve and reinforce the clinical efficacy of the current treatment antimicrobials
 - Including: Improved drug composition, formulation and drug delivery methods as well as treatment protocols (including personalised medicine, combination therapies) to increase antimicrobial efficacy and decrease the probability of resistance development; strategies to recycle antimicrobials that are not suitable for human use for animal/plant use; cost-effectiveness studies of existing and novel treatment protocols.

- Identification of barriers to access, availability, quality and uptake of therapeutic solutions and development of solutions to overcome those barriers
 - Including: Barriers to uptake alternative treatments (including current regulations); access and availability in low-resource settings; adherence to therapeutic and diagnostic protocols; availability of suitable prescribers, supply chains; healthcare organisation, financing and insurance and agricultural system organisation.
- Assessment and prediction of the impact of economic incentives and regulations on drug development, drug production, drug supply and treatment availability
 - Including: economic analysis, strategic foresight and modelling/forecasting, side-effects of economic models; effect on AMR burden.

Abbreviations

AI	Artificial Intelligence
AMC	Antimicrobial consumption
AMR	Antimicrobial Resistance
AMU	Antimicrobial Use
CSA	Coordination and Support Action
EC	European Commission
ECDC	European Centre for Disease Prevention and Control
ECR	Early Career Researcher
EEA	European Environment Agency
EFSA	European Food Safety Authority
EMA	European Medicines Agency
ERA	European Research Area
ERA4Health	ERA for Health Research
EU	European Union
EUP AH&W	European Partnership on Animal Health and Welfare
FAIR	Findable, Accessible, Interoperable and Reusable
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross domestic product
GH EDCTP3 JU	Global Health European & Developing Countries Clinical Trials Partnership Joint Undertaking
GO	General objective
HERA	Health Emergency Preparedness and Response Department
IACG	Interagency Coordination Group on Antimicrobial Resistance
JAMRAI	Joint Action on Antimicrobial Resistance
JPIAMR	Joint Programming Initiative on AMR
JTC	Joint transnational call
KPI	Key Performance Indicators
LMIC	Low- and middle-income country
NGO	Non-governmental organisations
OH	One Health
OHAMR	One Health AMR
One Health EJP	One Health European Joint Programming
OO	Operational objective
R&I	Research and innovation
SDG	Sustainable Development Goal

SME	Small and medium-sized enterprise
SRIA	Strategic Research and Innovation Agenda
SO	Specific objective
UN	United Nations
UNEP	UN Environment Programme
WHO	World Health Organization
WOAH	World Organisation for Animal Health

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