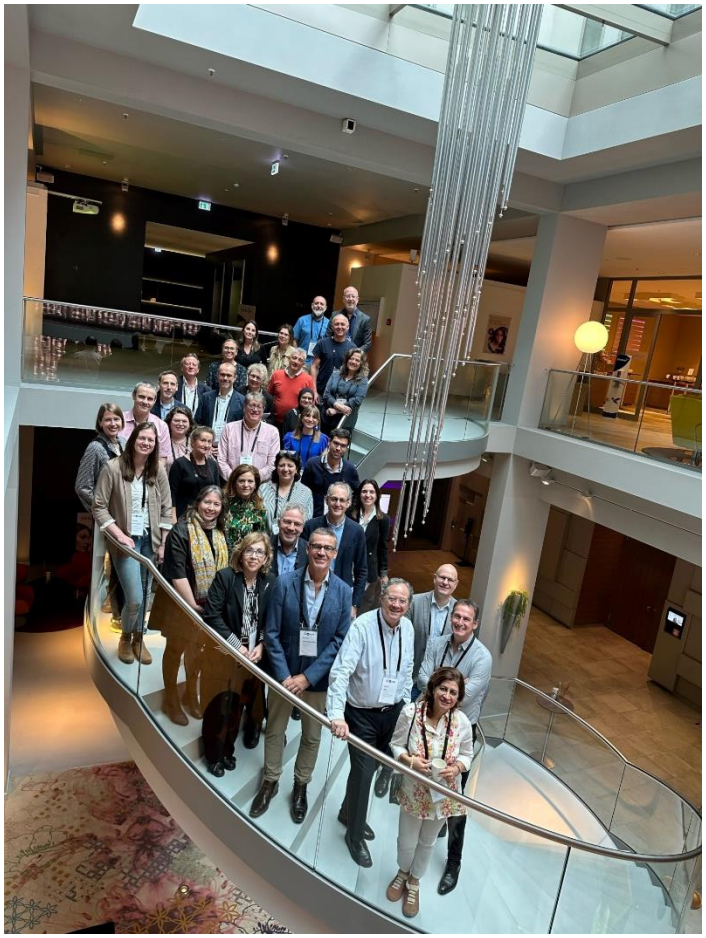
Prioritisation Workshop Report

Development of the Roadmap of Actions for the European One Health AMR Partnership



BERLIN 15TH AND 16TH OF MAY, 2023

AKIN AKKOYUN and BARBARA JUNKER (DLR)

OBJECTIVE:

The objective of the meeting was to provide input for the development of the Roadmap of Actions of the future European OH AMR Partnership (EUP OH AMR), for the period 2025-2032 by combining, developing and prioritising the suggestions for call topics and additional activities proposed by the thematic groups ahead of the workshop.

BACKGROUND:

The implementation plan for the candidate One Health AMR Partnership should include a long-term roadmap of actions for the duration of the partnership (7 years) as well as a work plan for the first year of the EUP OH AMR. The implementation plan should be based on the prioritisation of the research and innovation objectives, that were already identified by five groups of experts (so called "thematic groups" in the rest of this document), and on the list of types of activities that could potentially be carried out.
The prioritisation workshop brought together the members of the five thematic groups (that includes members from the JPIAMR Scientific Advisory board), some stakeholders, and some members of the CSA DESIGN to develop a list of proposals that will be the groundwork for the construction of the Roadmap of Actions of the future OH AMR Partnership. The actions defined at the workshop will be further refined and aligned with the priorities of the future partners of the partnership, in a co-design process with key stakeholders.

CONCEPT AND METHODOLOGY:

The workshop started with a plenary session (Agenda in Annex 1) where the objective of the workshop was presented, as well as the methodology (included the prioritisation criteria that will be used, and the expected outputs), and the working material. Participants (Annex 2) were then divided into three outbreak sessions according to the three aims of the partnership: understand, prevent and tackle. This repartition ensured a high degree of interaction between the members of the different thematic groups that previously worked in isolation. During the discussion, the experts proposed different possible activities contributing to the three aims of the partnership, according to the research and innovation priorities previously identified. At the end of the workshop, the proposals formulated during the break-out sessions were prioritised according to the criteria previously discussed.

EXPECTED OUTCOME

The outcome of the meeting is a list of prioritised actions to be implemented in the EUP OH AMR. (Annex 3). The list was drafted based on a template given in Annex 4.

Concept and Workflow of the Workshop

Input Material

Some documents were made available to participants ahead of the workshop:

- the long version of the Research and Innovation Objectives for the One Health Partnership.
- a list of potential funding instruments and generic activities (e.g. capacity Building) that could be implemented during the lifetime of the Partnership
- preliminary ideas for calls and activities proposed by the Thematic Groups prior to the meeting,
- a template to be completed during the meeting
- the agenda for the meeting (Annex 1)
- guidelines for participants.
- A first draft of the WHO research and innovation Agenda (Human priorities)

Set the scene!

The first half-day of the meeting was dedicated to setting the scene, including the aim of the workshop, the context, the conduct of the day, and an agreement on a common procedure. Previous work by the DESIGN Consortium on Funding Instruments and additional activities like Measures for Capacity Building were presented to the audience. Till Bachmann, the Chair of the Scientific Advisory Board (SAB) of the JPIAMR, shared the expectations of the SAB regarding the candidate One Health AMR Partnership. The chairs of each thematic group then presented how the research and innovation objectives in their respective areas would contribute to the three strategic aims of the partnership (Understand, Prevent and Tackle).

Moving from preliminary ideas to concrete proposals

During Day 1 afternoon, the attendees were split into 3 working groups, and each group was tasked to designate a chair. Each group was in charge of proposing a list of actions that the partnership should develop to tackle the 3 aims of the partnership (Understand, Prevent and Tackle). The actions proposed had to address the research and innovation objectives formulated by the thematic groups, included aspects related to the 4 crosscutting issues (One-Health, Social Sciences and Implementation Research, Innovation, and Internalisation aspects), the global challenges of the partnership (engagement with stakeholders, data access/ data sharing, capacity building, translation of research results, interdisciplinarity and Intersectionality) and include the WHO Research and Innovation Priorities. The discussion started and laid on the preliminary ideas formulated by the thematic groups ahead of the meeting, and those preliminary ideas were refined and developed. Efforts were made to break the silos represented by the thematic pillar in order to have a more integrated view on one specific topic (for example: for alternative therapeutics, importance to develop new specific diagnostics tools in parallel of the treatments). The template for actions had been filled during the sessions. The chairs of the 3 working groups were responsible for sharing the results of their discussions with the whole assembly on Day 2.

Composition of the Working Groups

The 3 established working groups were in charge of one of the Partnership's aims (Improving the Understanding of AMR, Preventing AMR and Tackling AMR). Each Working Group included at least one representative of each Thematic Group, representatives of some key stakeholders and representatives of the CSA DESIGN OH AMR. The composition of the working groups is shown below (name alphabetic order).

Understand	Prevent	Tackle
Akkoyun Akin	Alastruey-Izquierdo Ana	Bertagnolio Silvia
Fagerstedt Patriq	Bachmann Till	Coque Teresa
Gonzalez-Zorn Bruno	Cantón Rafael	Dumpis Uga
Harrison Tom	Essack Sabiha	Gay Sophie
Ploy Marie-Cécile	Junker Barbara	Guardabassi Luca
Ruppé Etienne	Liebana Ernesto	Henning Gädeke
Ruželė Živilė	Madec Jean-Yves	Kapoor Geetanjali
Schultsz Constance	Marin Laura	Lemonnier Marc
Sudbrak Ralf	Martini Alessandra	Menge Christian
Wolff Nora	Rushton Jonathan	Meyuhas Ronit
	Smalla Kornelia	Morel Chantal
	Warmerdam Anouk	Vila Jordi
		Zoubiane Ghada

Prioritisation Exercise

On the second day, the chairs of each working group presented to the whole assembly the list of activities proposed by their respective groups (10-15 min each). Following this presentation each expert had the possibility to vote for the five proposals they would like to be considered with high priority in the future partnership (stakeholders and CSA members didn't take part in the voting). The 3 following evaluation criteria were considered: importance of the need, high potential impact, and potential to be achieved in the framework of the partnership. The Organizing Committee collected the scores and presented the final ranking to the attendees (Figure 1). Actions with overlapping objectives or possible synergies were identified (Figure 1, and Annex 4).

Understand

1) **12 points:** Identify the mechanism driving the **emergence** and **maintenance** of the resistance genes and resistant micro-organisms, including molecular, social, societal, antimicrobial consumption, climate change, and pollution
2) **13 points:** Identify the risks, drivers, and direction of transmission of resistant micro-organisms and their resistance determinants
3) **1 Point:** Translating research outputs into guidance for surveillance, interventions, and prevention

Prevent

1) **13 points:** The impact of the environment on Human AMR
2) **8 points:** The impact of interventions preventing infectious diseases, emergence, and spread of AMR
3) **12 points:** Optimise and facilitate appropriate/prudent antimicrobial use to prevent resistance and co-selection in pathogens
4) **9 points:** Gaps and needs in the communication between AMR research community and other stakeholders

Tackle

1) **4 Points:** How to minimise the persistence and the spread of AMR in/from AMR hotspots
2) **6 Points:** What could be the strategies to preserve the clinical efficacy of antimicrobials?
3) **9 points:** What could be the future innovative therapeutic Treatments and diagnostic tools/methods and how to enable their sustainable development?
4) **3 points:** How to improve the access, availability and quality of essential AMR solutions?
5) **7 points:** What is the impact of socio-economic models for the development and use/ uptake of AMR solutions
6) **3 Points:** How can we enable the development of narrow spectrum activity antimicrobials, including single

figure 1. Results of the ranking of the proposed actions. Actions of similar colour are considered synergistic and may be combined. Detailed proposals can be found in Annex 3.

Summary and Next steps

A document summarising the results of the workshop was sent to the thematic groups for final feedback (Annex 3). Stakeholder engagement will be sought to achieve the proposed actions. Funders and stakeholders will be consulted in the autumn and will also consider the advice on the potential timing of the suggested actions. The final ranking may change depending on funding priorities of the participating funding organisations and their priorities. The final roadmap is expected to be ready by the end of 2023.

Annex 1: Agenda

Day 1 – 15 May 2023

Time	Session	Extra details
09:00 – 09:10	Welcome	Henning Gädeke, BMBF Akin Akkoyun, DLR
09:10 – 09:30	Presentation of the One Health AMR Partnership and Aims of Meeting	Laura Marin, Coordinator DESIGN OH AMR
09:30 – 09:50	Setting the scene for the prioritisation workshop Methodology: Input / Expected Outcome	Sophie Gay, ANR
09:50– 10:10	Funding Instruments and additional activities	Zivile Ruzele, LMT / Ronit Meyuhas, CSO-MOH
10:10 – 10:20	WHO SRIA	Silvia Bertagnolio, WHO
10:20 – 10:30	Questions	All
10:30 – 10:45	Perspective of the Scientific Advisory Board	Till Bachman, JPIAMR SAB Chair
10:45 – 11:00	*Coffee Break*	
11:00 – 12:30	Presentation of the preparative work by the thematic groups (15' by group)	Chairs of thematic group
12:30 – 13:30	*Lunch*	
13:30 – 15:30	Parallel Session "Understand" / Parallel Session "Prevent" / Parallel Session "Tackle"	
15:30 – 16:00	*Coffee Break*	
16:00 – 18:00	Parallel Session "Understand" / Parallel Session "Prevent" / Parallel Session "Tackle"	
19:00 –	*Working dinner*	

Day 2 – 16 May 2023

Time	Session	Extra details
8:30 – 9:00 9:00 – 9:30 9:30 – 10:00	Plenary session: Presentation of the Session "Understand" Presentation of the Session "Prevent" Presentation of the Session "Tackle"	Representatives of Parallel Sessions
10:00 – 10:30	*Coffee Break*	
10:30 – 12:45	Plenary / Consensus session and voting Main conclusions and list of recommendations for potential joint actions for the partnership roadmap for implementation	All
12:45 – 12:55	Closure of the meeting	Laura Marin, Coordinator DESIGN OH AMR
13:00 – 14:00	*Lunch*	

Annex 2: List of Participants

Akkoyun	Akin	DLR, Germany, WP2 CSA DESIGN
Alastruey-Izquierdo	Ana	Instituto de Salud Carlos III, Spain, Thematic Group Surveillance and Diagnostics*
Bachmann	Till	University of Edinburgh, United Kingdom, Thematic Group Diagnostics*
Bertagnolio	Silvia	World Health Organisation
Cantón	Rafael	University Hospital Ramón y Cajal, and Complutense University, Spain, Thematic Group Therapeutics *
Coque	Teresa	University Hospital Ramón y Cajal, Spain, Thematic Group Surveillance
Dumpis	Uga	Pauls Stradiņš University Hospital, Latvia, Thematic Group Interventions *
Essack	Sabiha	University of KwaZulu Natal, South Africa, Thematic Group Interventions and Surveillance *
Fagerstedt	Patriq	SRC, Sweden, WP2 CSA DESIGN
Gay	Sophie	ANR, France, WP2 CSA DESIGN
Ghada	Zoubiane	ICARS, Denmark, WP2 CSA DESIGN
Gonzalez Zorn	Bruno	Complutense University, Spain, Thematic Group Interventions
Guardabassi	Luca	University of Copenhagen, Denmark, Thematic Group Diagnostics*
Harrison	Tom	St George's University of London, United Kingdom, Thematic Group Therapeutics *
Henning	Gädeke	EDCTP
Jean-Yves	Madec	Agency for Food, Environmental and Health Safety, France, Thematic Group Transmission
Junker	Barbara	DLR, Germany, WP2 CSA DESIGN
Kapoor	Geetanjali	Center for Disease Dynamics, Economics & Policy, India, Thematic Group Interventions *
Lemonnier	Marc	BEAM Alliance, Antabio, France, Thematic Group Therapeutics *
Liebana	Ernesto	European Food Safety Authority
Marin	Laura	SRC, Sweden, CSA DESIGN Coordinator
Martini	Alessandra	European Commission, Research and Innovation (RTD)
Menge	Christian	Friedrich-Loeffler-Institut, Germany, Thematic Group Surveillance
Meyuhas	Ronit	CSO- MoH, Israel, WP2 CSA DESIGN
Morel	Chantal	University of Bern, Switzerland, Thematic Group Therapeutics *
Ploy	Marie	JAMRAI2
Ruppé	Etienne	Bichat-Claude Bernard Hospital, France, Thematic Group Surveillance
Rushton	Jonathan	University of Liverpool, United Kingdom, Thematic Group Intervention
Ruzele	Zivile	LMT, Lithuania, WP2 CSA DESIGN
Schultsz	Constance	Amsterdam Institute for Global Health and Development, Netherlands, Thematic Group Transmission *
Smalla	Kornelia	Julius Kühn Institute, Germany, Thematic Group Transmission *
Sturm	Luiza	DLR, Germany, WP2 CSA DESIGN
Sudbrak	Ralf	Global AMR R&D Hub
Vila	Jordi	Hospital Clinic in Barcelona, Spain, Thematic Group Therapeutics *
Warmerdam	Anouk	ZonMw, The Netherlands, WP2 CSA DESIGN
Wolf	Nora	ZonMw, The Netherlands, WP2 CSA DESIGN

* Member of the JPIAMR Scientific Advisor Board (2022-2024)

Annex 3: Outcomes from the workshop

<table>
<tr><td>AMR need to address</td><td colspan="5">Identification of the risks, drivers, scale and direction of transmission of resistant micro-organisms and their resistance determinants.</td></tr>
<tr><td>Pillar</td><td colspan="5">Understand</td></tr>
<tr><td>Prioritisation Score</td><td colspan="5">13</td></tr>
<tr><td>Topics / Elements for action</td><td>Thematic areas covered (Select one or several options for each topic)</td><td>Cross cutting issues covered (Select one or several options for each topic)</td><td>Additional actions needed for capacity building (Select one or several options for each topic)</td><td>Desired outcomes of the supported action(s) for each topic</td><td>Description of action</td></tr>
<tr><td rowspan="2">Topic / Element 1</td><td>☐Diagnostics
☒Surveillance
☒Intervention & prevention
☒Transmission & Evolution
☐Therapeutics</td><td>☒ One-Health
☒ Social Sciences
☒ Implementation research
☐ Innovation
☒ Global challenges</td><td rowspan="2">☒ Engage early career researchers
☒ Mobility/staff exchange between partners
☒ Support to use existing research infrastructure and data platforms
☒ Data sharing and access to existing data platforms
☒ Engage with LMICs</td><td rowspan="2">1. Better Understanding of the directionality, scale and pathways of resistance transmission within and between the different sectors and how and where transmission of resistance occurs.
In particular, characterisation of the flows (sources and transmission routes) of antimicrobials and antimicrobial resistance in the environment to humans. Generate quantitative data and develop appropriate models to quantify the risk of AMR transmission from non-human sources</td><td rowspan="2">One Health basic research call and research networks
1. Building on innovative tools (bioinformatics, AI) and advances in sequencing technologies.

2. Use of metagenomic datasets and build on updated antimicrobial resistance databases, and focus on relevant environments identified by previous studies.

3. Use large datasets of whole genomes from the three sectors with high-quality meta-data and new IT tools to understand the successful transmission of clones and resistance</td></tr>
<tr><td>Type of action needed
(Select one or several options for each topic)</td><td>Nature of research to be supported by the action(s)
(Select one or several options for each topic)</td></tr>
</table>

	☒Call for research and innovation projects ☒ Call for research networks ☒ Webinar ☒ Workshop ☐ Conference ☐ other	☒Basic research ☒ Translation research ☒ Implementation research ☒ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☒ Networks to create Knowledge & resource hub	☒Engage with widening countries ☒ Round tables with regulators/initiatives/ end-users ☐ Mentoring service on translation/innovation management ☐ other	2. Identification of the reservoirs (environment, wildlife, food, microbiota, urban) and hotspots where the transmission of resistance occurs. 3. Understanding of what determines successful transmission of clones and resistance determinants. 4. Technical and social interventions effective to limit transmission. *(NB: partially overlapping with the need: "Limit AMR environmental contamination to avoid impact on Human Health")* 5. Risk assessment of resistance transmission.	determinants. 4-5. Call for risk assessment and cost-effectiveness studies
During the workshop discussion, was proposed to be merged with	**Need:** How to minimise the persistence and the spread of AMR in/from AMR hotspots? **Why:** transfer from knowledge to actions, potential merging identified during the Tuesday morning discussion, as well as during the break-out discussions. If merged, the two topics will also address innovation as a cross-cutting issue. **Pillar:** Tackle **Prioritisation score:** 4 **Desired outcome:** Call for R&I projects (1): - Decontamination strategies and their uptake and adaptation to different settings - Data showing the cost-effectiveness and societal benefit of solutions aiming to minimise the persistence and spread of AMR in/from AMR hotspots - Guidance and best practice for minimising AMR spread from AMR hotspots Call for Research Networks (2): - Assessing existing evidence and identifying knowledge gaps (landscape assessment) (ideally, action (2) should be done before action (1)) **Comments:** In the call text, provide the definition of AMR hotspots. Include all sort of hotspots: environmental, microbiota, urban (including hospitals), agricultural. For the Call for R&I projects: Importance to connect private sector with academia for the design of the technological solutions, and private sector with regulators for the uptake.				

<table>
<tr><td>AMR need to address</td><td colspan="5">Limitation of the discharge, persistence, accumulation of antimicrobials and resistant genes/micro-organisms in the environment to avoid Human Health impact</td></tr>
<tr><td>Pillar</td><td colspan="5">Prevent</td></tr>
<tr><td>Prioritisation score</td><td colspan="5">13</td></tr>
<tr><td>Topics / Elements for action</td><td>Thematic areas covered
(Select one or several options for each topic)</td><td>Cross cutting issues covered
(Select one or several options for each topic)</td><td>Additional actions needed for capacity building
(Select one or several options for each topic)</td><td>• Desired outcomes of the supported action(s) for each topic</td><td>Description of action</td></tr>
<tr><td rowspan="3">How to minimise the discharge and persistence and impact of antimicrobials and AMR into the environment?</td><td>☐Diagnostics
☐Surveillance
☐Intervention & prevention
☐Transmission & Evolution
☐Therapeutics</td><td>☐ One-Health
☐ Social Sciences
☐ Implementation research
☐ Innovation
☐ Global challenges</td><td rowspan="3">☐ Engage early career researchers
☐ Mobility/staff exchange between partners
☐ Support to use existing research infrastructure and data platforms
☐ Data sharing and access to existing data platforms
☐ Engage with LMICs
☐Engage with widening countries
☐ Round tables with regulators/initiatives/ end-users
☐ Mentoring service on translation/innovation management
☐ other</td><td rowspan="3">• Identification and comparison of existing attempts (recycling of non-used drugs, control of effluent from filtering, etc.) to limit discharge of antimicrobials, antimicrobial resistance determinants from sources (ex. production sites, pharmaceutical sites, farms, hospitals, household, Wastewater Treatment Plans), into the environment
• Design of new techniques/ methods (recycling of non-used drugs, control of effluent from filtering, etc.) to limit discharge of antimicrobials, antimicrobial resistance determinants from sources (ex. production sites, pharmaceutical sites, farms, hospitals, household, Wastewater Treatment Plans), into the environment
• Design of drug scaffold with easy degradation or inactivation in the environment (chemistry)
• Research institutional frameworks (cultural, private,) to avoid the discharge and persistence of antimicrobials and AMR into the environment
• Design of de-risking strategies for the recycling of organic waste in agricultural systems (animals, plants and fungi).</td><td rowspan="3"></td></tr>
<tr><td>Type of action needed
(Select one or several options for each topic)</td><td>Nature of research to be supported by the action(s)
(Select one or several options for each topic)</td></tr>
<tr><td>☐Call for research and innovation projects
☐ Call for research networks
☐ Webinar
☐ Workshop
☐ Conference
☐ other</td><td>☐Basic research
☐ Translation research
☐ Implementation research
☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas
☐ Networks to create Knowledge & resource hub</td></tr>
</table>

AMR need to address	Optimisation and facilitation of appropriate / prudent antimicrobial use to prevent resistance and co-selection in pathogens				
Pillar	Prevent				
Prioritisation score	12				
Topics / Elements for action	**Thematic areas covered (Select one or several options for each topic)** ☐Diagnostics ☐Surveillance ☐Intervention & prevention ☐Transmission & Evolution ☐Therapeutics **Type of action needed** (Select one or several options for each topic) ☐Call for research and innovation projects ☐ Call for research networks ☐ Webinar ☐ Workshop ☐ Conference ☐ other	**Cross cutting issues covered (Select one or several options for each topic)** ☐ One-Health ☐ Social Sciences ☐ Implementation research ☐ Innovation ☐ Global challenges **Nature of research to be supported by the action(s)** (Select one or several options for each topic) ☐Basic research ☐ Translation research ☐ Implementation research ☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☐ Networks to create Knowledge & resource hub	**Additional actions needed for capacity building (Select one or several options for each topic)** ☐ Engage early career researchers ☐ Mobility/staff exchange between partners ☐ Support to use existing research infrastructure and data platforms ☐ Data sharing and access to existing data platforms ☐ Engage with LMICs ☐Engage with widening countries ☐ Round tables with regulators/initiatives/ end-users ☐ Mentoring service on translation/innovation management ☐ other	**Desired outcomes of the supported action(s) for each topic** (or comments)	**Description of action**
Topic 1: Design tools and techniques to support the assessment of whether antimicrobial treatments are required, and perform studies on their impact and utility (including existing tools). Topic 2: Design tools and techniques to support the selection which antimicrobials to use (including targeted / narrow-spectrum drugs), and perform studies on their impact and utility (including existing tools). Topic 3: Design tools and techniques to improve the treatment protocols once treatment has started to decrease the risk of AMR emergence / selection, and perform				- Easy to use and rapid diagnostics to avoid the use of antimicrobials when not needed (infected versus non-infected and bacterial versus viral disease) - Improved drug concentration and treatment duration (including in function of patient characteristics such as age, gender, etc.). - Improved delivery of antimicrobials in the appropriate concentration to the infection site (to avoid overuse) - Better understanding of the social, societal and cultural factors promoting the prescription of antimicrobials (including limited uptake and use of diagnostic tests) - Improvement of the current drug composition and formulation to decrease the risk of resistance emergence - Identification of combination therapies with a lower risk of resistance emergence - Characterisation of resistance risks to alternative therapies (mechanisms, frequency) - Improvement of PK-PD to decrease the risk of AMR emergence - Help to reduce antimicrobial use and enhance use of appropriate interventions as key factors influencing AMR selection - Development of novel diagnostic markers and tests that accurately and rapidly identify infections requiring antimicrobial therapy and distinguish between bacterial, fungal, parasitic, and viral infections - Validated and standardized diagnostic methods for selection and quantitative assessment of the efficacy of unconventional antimicrobials (e.g., phage or virulence inhibitors) and alternatives to antimicrobials (e.g. prebiotics and probiotics). - Identification of the barriers for development, uptake and use of diagnostics including economic and behavioural studies.	

studies on their impact and utility (including existing tools). Topic 4: Identify and address risky human behaviour on the use of antimicrobials.				- Identification of the critical cultural and behavioural contexts in which diagnostics will be delivered. Characterisation of how diagnostics will fit within existing community and health care providers environments. - Capacity building for uptake and use of diagnostics - Decrease treatment duration and time with broad spectrum treatment (before targeted treatment/deescalation) - Improvement of AMU Surveillance and linkage to AMR development - Reduction of the use of broad-spectrum antimicrobials through better detection of Resistance strains. - Implementation research to consider the living conditions of the patient (habitat, access to primary resources, migrant or sedentary, etc) for a better adaptation of the possibilities of diagnosis and care	
During the workshop discussion, was proposed to be merged with	**Need:** What could be the strategies to preserve the clinical efficacy of antimicrobials? **Why:** Outcomes are almost the same between the two proposals **Pillar:** Tackle **Prioritisation score:** 6 **Desired outcome:** Call for R&I projects (1) - Novel and Improved drug combinations (and better understanding of the mechanisms that create mutually protective benefits) - Novel/improved drug delivery methods - treatment recommendations in case of coinfections and co-pathologies - Identification of New or Improved Clinical breakpoints - Improved tools & protocols for personalised dosing - Improve the current drugs to overcome resistance - Setting and validating host-, pathogen species- and disease-specific interpretive criteria for antimicrobial susceptibility testing of important bacterial and fungal pathogens for which such criteria are lacking or have not been validated clinically. - Approach to facilitate the switch between narrow and large spectrum antimicrobials/ decrease use of broad-spectrum antimicrobials - Novel or improved Diagnostic tools/methods to support the adequate prescription in the context of antimicrobial resistance - Improved surveillance systems to guide empiric prescription (real time, and AI) - Cost-effectiveness of surveillance and diagnostic strategies on treatment outcome - Identification of the barriers preventing the adherence to the therapeutic & diagnostic protocols and solution to overcome those barriers Call for networks (2): - Guidelines to rationalise the use antimicrobials in the veterinary and agriculture sector.				

<table>
<tr><td>AMR need to address</td><td colspan="5">Better understanding of the mechanisms driving the emergence, evolution, selection and maintenance of the resistance genes and resistant microorganisms, including molecular, social, societal, antimicrobial consumption, climate change, and pollution.</td></tr>
<tr><td>Pillar</td><td colspan="5">Understand</td></tr>
<tr><td>Prioritisation Score</td><td colspan="5">12</td></tr>
<tr><td>Topics / Elements for action</td><td>Thematic areas covered (Select one or several options for each topic)</td><td>Cross cutting issues covered (Select one or several options for each topic)</td><td>Additional actions needed for capacity building (Select one or several options for each topic)</td><td>Desired outcomes of the supported action(s) for each topic (or comments)</td><td>Description of action</td></tr>
<tr><td rowspan="2">Topic / Element 1
Driver of early emergence and selection</td><td>☒Diagnostics
☒Surveillance
☐Intervention & prevention
☒Transmission & Evolution
☐Therapeutics</td><td>☒ One-Health
☒ Social Sciences
☐ Implementation research
☐ Innovation
☒ Global challenges</td><td rowspan="2">☒ Engage early career researchers
☒ Mobility/staff exchange between partners
☐ Support to use existing research infrastructure and data platforms
☐ Data sharing and access to existing data platforms
☒ Engage with LMICs
☒Engage with widening countries
☐ Round tables with regulators/initiatives/ end-users</td><td rowspan="2">1. Identification of risk environments (including in-vivo) for the emergence of AMR.

2. Better Understanding of the pathways of emergence that can be targeted by preventive and therapeutic strategies.

3. Better Understanding of which human behaviour promotes the emergence of new AMR, and how.

4. Better understanding of the impact of antimicrobials on the emergence of AMR.

5- Develop new methods to assess the impact of different drugs (within and between antimicrobial classes), formulations, routes of administration and treatment regimens on selection and zoonotic transmission of AMR</td><td rowspan="2">One Health basic research call and research networks
1 - 5. Focus on the emergence of novel determinants and mechanisms of antimicrobial resistance in pathogens.
1-5. Integrate novel methodologies, such as next generation sequencing, single-cell omics, imaging methods, machine learning studies, and novel modelling studies.
2. Use of metagenomic datasets, innovative culture methods, and build on updated antimicrobial resistance databases, and focus on relevant environments identified by previous studies.
3. Link to prevent and tackle group.
4-5. Social sciences studies at different levels of granularity (hotspots at the interface of the sectors but also at the patient level).</td></tr>
<tr><td>Type of action needed (Select one or several options for each topic)</td><td>Nature of research to be supported by the action(s) (Select one or several options for each topic)</td></tr>
</table>

	☒Call for research and innovation projects ☒ Call for research networks ☐ Webinar ☐ Workshop ☐ Conference ☐ other	☒Basic research ☐ Translation research ☐ Implementation research ☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☒ Networks to create Knowledge & resource hub	☐ Mentoring service on translation/innovation management ☐ other		
Topics / Elements for action	**Thematic areas covered (Select one or several options for each topic)**	**Cross cutting issues covered (Select one or several options for each topic)**	**Additional actions needed for capacity building (Select one or several options for each topic)**	**Desired outcomes of the supported action(s) for each topic** (or comments)	**Description of action**
Topic / Element 2 Drivers of the maintenance of resistance	☐Diagnostics ☐Surveillance ☒Intervention & prevention ☒Transmission & Evolution ☐Therapeutics	☒ One-Health ☒ Social Sciences ☐ Implementation research ☐ Innovation ☒ Global challenges	☒ Engage early career researchers ☒ Mobility/staff exchange between partners ☐ Support to use existing research infrastructure and data platforms ☐ Data sharing and	1. Understanding of the molecular mechanisms underlying maintained resistance. 2. Understanding of the socio-economic mechanisms underlying maintained resistance. 3. Understand of the impact of the use of antimicrobials on the maintenance of AMR.	Basic research call. 1. Assess the evolutionary pathways leading to maintenance (epigenetics, compensatory mutations, regulatory networks). Integrate novel methodologies, such as next generation sequencing, single-cell omics, imaging methods, machine learning studies, and novel modelling studies. 2-3. Social sciences studies at different levels of granularity (hotspots at the interface of the sectors but also at the patient level).

	Type of action needed (Select one or several options for each topic)	**Nature of research to be supported by the action(s)** (Select one or several options for each topic)	access to existing data platforms ☒ Engage with LMICs ☒Engage with widening countries ☐ Round tables with regulators/initiatives/ end-users ☐ Mentoring service on translation/innovation management ☐ other		
	☒Call for research and innovation projects ☒ Call for research networks ☐ Webinar ☐ Workshop ☐ Conference ☐ other	☒Basic research ☐ Translation research ☐ Implementation research ☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☒ Networks to create Knowledge & resource hub			
During the workshop discussion, was proposed to be merged with	No other topics				

AMR need to address : Development of novel innovative therapeutic Treatments along with associated diagnostics tools/methods				
Pillar: Tackle				
Prioritisation Score: 9				
Thematic areas covered (Select one or several options for each topic)	**Cross cutting issues covered (Select one or several options for each topic)**	**Additional actions needed for capacity building (Select one or several options for each topic)**	**Desired outcomes of the supported action(s) for each topic** (or comments)	**Comments**
☒Diagnostics ☒Intervention & prevention ☒Transmission & Evolution ☒Therapeutics	☒ One-Health ☒ Social Sciences ☒ Implementation research ☒ Innovation ☒ Global challenges	☒ Mobility/staff exchange between partners Between private sector and academia ☒ Round tables with regulators/initiatives/ end-users ☒ Mentoring service on translation/innovation management	Call for projects (1) (a) Therapeutics - New antimicrobials (new targets, new scaffolds) (with their associated diagnostics) - Recycling for animal/plant use of antimicrobials that are non-suitable for human use, taking into account the potential risk of cross resistance - Novel Alternative therapies (with associated diagnostics and description of possible resistance mechanisms for those therapies) - Methods to facilitate the uptake of alternative therapies (b) Diagnostics Development of diagnostics supporting the development, uptake and use of novel therapeutics (Dx/Rx partnering) Call for networks (2) - Assessing existing evidence and identifying knowledge gaps (landscape assessment) Worshop with regulators (3) - Identification of the barriers that prevent the development of new therapies and new diagnostics and identification of solutions to overcome those barriers - Support the approval of Alternative therapies (by EMA: new efficacy end-points) and their diagnostics - Improved the cost-effectiveness of clinical trials Webinars/ training activity (4) Strategies to promote drug development expertise within the AMR ecosystem?	Possibility to do a proof of concept call (1+3)
Type of action needed (Select one or several options for each topic)	**Nature of research to be supported by the action(s)** (Select one or several options for each topic)			
☒Call for research and innovation projects (1) ☒ Call for research networks: landscape assessment (2) ☒ Webinar Training (4) ☒ Workshop (3)	☒Basic research ☒ Translation research ☒ Implementation research ☒ Knowledge synthesis: networks to produce systematic reviews on targeted areas			

During the workshop discussion, was proposed to be merged with	**Need:** Understanding the impact of economic models on the development and use/ uptake of AMR solutions **Why:** Economical and structural models (actual, or the future ones) can have an impact on the development of therapeutic solutions. Please note that the original proposal intends to cover the impact of economical models on the development and use of all AMR solutions, including solutions to limit the accumulation of antimicrobials in the environment. **Pillar:** Tackle **Prioritisation score:** 7 **Desired outcome:** - Evidence showing the effect of economical models on drug production, drug availability, economical costs, AMR burden - Prediction or measurement of the side effects of economic models and solutions to overcome those side effects - Prediction or measurement of the performance of the economic models on AMR solutions **Comments:** Should include: - Both New and existing economic models, - innovation incentive + Health system financing models, Health insurance + agriculture models Results should be discussed with JAMRAI for implementation For Health system, collaboration with Transforming HealthCare system partnership to implement the call

<table>
<tr><td>AMR need to address</td><td colspan="5">Improved communication between AMR research and other stakeholders</td></tr>
<tr><td>Pillar</td><td colspan="5">Prevent</td></tr>
<tr><td>Prioritisation Score</td><td colspan="5">9</td></tr>
<tr><td>Topics / Elements for action</td><td>Thematic areas covered (Select one or several options for each topic)</td><td>Cross cutting issues covered (Select one or several options for each topic)</td><td>Additional actions needed for capacity building (Select one or several options for each topic)</td><td>Desired outcomes of the supported action(s) for each topic (or comments)</td><td>Description of action</td></tr>
<tr><td rowspan="2">Topic 1: Identify and prioritise AMR stakeholders and the context of decision-making which impacts AMR selection, emergence and spread (whom and where).

Topic 2: Design tools and techniques to support decision-making processes of stakeholders who</td><td>☐Diagnostics
☐Surveillance
☐Intervention & prevention
☐Transmission & Evolution
☐Therapeutics</td><td>☐ One-Health
☐ Social Sciences
☐ Implementation research
☐ Innovation
☐ Global challenges</td><td rowspan="2">☐ Engage early career researchers
☐ Mobility/staff exchange between partners
☐ Support to use existing research infrastructure and data platforms
☐ Data sharing and access to existing data platforms
☐ Engage with LMICs</td><td rowspan="2">▪ Communication strategies to different contexts (patients, medical staff, nurses, hospitals, LTCFs, sectors (policy, industry), countries/geographies (languages), social situations)
▪ Improved Data Sharing
▪ Data science and ontology
▪ Training
▪ Patient empowerment
▪ Digital health skills and behavioural change
▪ Strengthen national One Health surveillance efforts/policies by the identification of best practice examples of integrated surveillance.
▪ Identification and comparison of models/mechanisms and methods for data exchange needed to develop appropriate integrated surveillance and to allow holistic interpretation;</td><td rowspan="2"></td></tr>
<tr><td>Type of action needed (Select one or several options for each topic)</td><td>Nature of research to be supported by the action(s) (Select one or several options for each topic)</td></tr>
</table>

impact AMR selection, emergence and spread (how). Topic 3: Improve communication of stakeholder needs to research community (communication research)	☐Call for research and innovation projects ☐ Call for research networks ☐ Webinar ☐ Workshop ☐ Conference ☐ other	☐Basic research ☐ Translation research ☐ Implementation research ☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☐ Networks to create Knowledge & resource hub	☐Engage with widening countries ☐ Round tables with regulators/initiatives/ end-users ☐ Mentoring service on translation/innovation management ☐ other	▪ Design new models of awareness and understanding of AMR, to address antibiotic resistance within and across sectors	
During the workshop discussion, was proposed to be merged with	**Need:** Translating research outputs into guidance for surveillance, interventions, and prevention. **Why:** transfer from knowledge to actions, potential merging identified during the Tuesday morning discussion, as well as during the break-out discussions. If merged, the two topics will also address innovation as a cross-cutting issue. **Pillar:** Transmission **Prioritisation score:** 1 **Desired outcome:** Policy briefs for One Health action against AMR & Guidance for optimized and harmonized One Health surveillance data **Comments:** Implementation science projects and networks including researchers from the three sectors and stakeholders. 1. Define and integrate novel markers of AMR to optimise surveillance. Design of intervention and prevention measures to avoid the emergence, maintenance and transmission of resistance. 2. Establish, connect, and harmonise digital platforms.				

AMR need to address	Impact assessment of existing interventions aiming to prevent or mitigate AMR				
Pillar	Prevent				
Prioritisation Score	8				
Topics / Elements for action	**Thematic areas covered (Select one or several options for each topic)**	**Cross cutting issues covered (Select one or several options for each topic)**	**Additional actions needed for capacity building (Select one or several options for each topic)**	**Desired outcomes of the supported action(s) for each topic** (or comments)	**Description of action**
Topic 1: Development of outcome metrics for quantifying the impact of interventions on the AMR threat to human health Topic 2: Assess the impact of existing preventive interventions on AMR in different local contexts Topic 3: Develop new preventive interventions and assess their impact in different local contexts	☐Diagnostics ☐Surveillance ☐Intervention & prevention ☐Transmission & Evolution ☐Therapeutics **Type of action needed** (Select one or several options for each topic) ☐Call for research and innovation projects ☐ Call for research networks ☐ Webinar ☐ Workshop ☐ Conference ☐ other	☐ One-Health ☐ Social Sciences ☐ Implementation research ☐ Innovation ☐ Global challenges **Nature of research to be supported by the action(s)** (Select one or several options for each topic) ☐Basic research ☐ Translation research ☐ Implementation research ☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☐ Networks to create Knowledge & resource hub	☐ Engage early career researchers ☐ Mobility/staff exchange between partners ☐ Support to use existing research infrastructure and data platforms ☐ Data sharing and access to existing data platforms ☐ Engage with LMICs ☐Engage with widening countries ☐ Round tables with regulators/initiatives/ end-users ☐ Mentoring service on translation/innovation management ☐ other	▪ Comparison of existing health outcome measures and development of the ones that are relevant to antimicrobial threat to human health (similar to the use of CO2 equivalent emissions in climate change). ▪ Predictive models to estimate the effectiveness of an intervention on AMR ▪ Improvement of surveillance data to assess the impact of interventions ▪ Development of Interventions preventing the occurrence of infections or the emergence and spread of AMR: e.g. infection prevention and control measures, anti-adherent surfaces, livestock breed selection, vaccination, sanitation and hygiene, feed and food safety, farm biosecurity, Inhibitors of Biofilms, human behaviour ▪ Characterisation of the effectiveness of interventions on AMR emergence and spread	
During the workshop discussion, was proposed to be merged with	No other topics. Attention should be brought to avoid repetitions with the proposal: **“**Better understanding of the risks, drivers, scale and direction of transmission of resistant micro-organisms and their resistance determinants” and “Limitation of the accumulation of antimicrobials and resistant genes/micro-organisms in the environment to avoid impact on Human Health”				

<table>
<tr><td colspan="5">AMR need to address: Improved access, availability and quality of essential AMR solutions (therapeutics, diagnostics, ...)</td></tr>
<tr><td colspan="5">Pillar: Tackle</td></tr>
<tr><td colspan="5">Prioritisation Score: 3</td></tr>
<tr><td>Thematic areas covered (Select one or several options for each topic)</td><td>Cross cutting issues covered (Select one or several options for each topic)</td><td>Additional actions needed for capacity building (Select one or several options for each topic)</td><td>Desired outcomes of the supported action(s) for each topic</td><td>Comments:</td></tr>
<tr><td>☒Diagnostics
☒Intervention & prevention
☒Therapeutics</td><td>☒ One-Health
☒ Social Sciences
☒ Implementation research
☒ Innovation
☒ Global challenges</td><td rowspan="3">☒ Round tables with regulators/initiatives/ end-users</td><td rowspan="3">Call for research networks (1)
- Identification of the barriers to availability: supply chain, , weight of specific producers
- Identification of the barriers to quality
- Identification of the barriers to access: price, availability of suitable prescribers/ trained prescribers
- Identification of novel systemic or technological solutions to overcome those barriers
- Development of novel economic models that can promote the availability and quality of new therapeutic solutions and evaluation (relative cost-effectiveness) of the economic models already in place

Workshop with stakeholders (2)
- A set of best practices and new strategies to secure access to antimicrobials;
- A set of health related and ethical criteria

Stakeholders: WHO , JAMRAI,
Federation of veterinarian in Europe (FVE)
World Small animal veterinary association
GARDP/WOHA</td><td rowspan="3">Engagement with Industry, policy makers and regulators</td></tr>
<tr><td>Type of action needed (Select one or several options for each topic)</td><td>Nature of research to be supported by the action(s) (Select one or several options for each topic)</td></tr>
<tr><td>☒ Call for research networks (1)
☒ Workshop (2)</td><td>☒ Translation research
☒ Implementation research
☒ Networks to create Knowledge & resource hub</td></tr>
<tr><td>During the workshop discussion, was proposed to be merged with</td><td colspan="4">No other topics</td></tr>
</table>

<table>
<tr><td colspan="5">AMR need to address: Facilitate the development of narrow spectrum activity antimicrobials, including single pathogen treatments?</td></tr>
<tr><td colspan="5">Pillar: Tackle</td></tr>
<tr><td colspan="5">Prioritisation Score: 3</td></tr>
<tr><td>Thematic areas covered
(Select one or several options for each topic)</td><td>Cross cutting issues covered
(Select one or several options for each topic)</td><td>Additional actions needed for capacity building
(Select one or several options for each topic)</td><td>Desired outcomes of the supported action(s) for each topic
(or comments)</td><td>Description of action</td></tr>
<tr><td>☒Diagnostics
☒Transmission & Evolution
☒Therapeutics</td><td>☒ Innovation</td><td rowspan="3">☒ Round tables with regulators/initiatives/ end-users</td><td rowspan="3">- Understanding how to optimally target individual pathogenic bacteria while bypassing non-pathogenic microbes
- Prevention collateral damage to the microbiome
- biomarkers/ diagnostic to support narrow spectrum activity antimicrobials
- novel narrow spectrum activity antimicrobials</td><td rowspan="3"></td></tr>
<tr><td>Type of action needed
(Select one or several options for each topic)</td><td>Nature of research to be supported by the action(s)
(Select one or several options for each topic)</td></tr>
<tr><td>☒Call for research and innovation projects
☒ Webinar with regulators</td><td>☒Basic research
☒ Translation research</td></tr>
<tr><td>During the workshop discussion, was proposed to be merged with</td><td colspan="4">No other topics</td></tr>
</table>

Annex 4 Template for Prioritisation WS

(to identify joint actions, also beyond calls, of the prioritised topics with a challenge-driven approach based on the R&I defined objectives of OH AMR partnership)

AMR need to address						
Topics / Elements for action	**Thematic areas covered (Select one or several options for each topic)**	**Cross cutting issues covered (Select one or several options for each topic)**	**Additional actions needed for capacity building (Select one or several options for each topic)**	**Desired outcomes of the supported action(s) for each topic** (or comments)	**Description of action**	**Priority score** (full mark, 1 to 5, with 5 the highest mark for each topic on the proposed criteria)
Topic / Element 1	☐Diagnostics ☐Surveillance ☐Intervention & prevention ☐Transmission & Evolution ☐Therapeutics	☐ One-Health ☐ Social Sciences ☐ Implementation research ☐ Innovation ☐ Global challenges	☐ Engage early career researchers ☐ Mobility/staff exchange between partners ☐ Support to use existing research infrastructure and data platforms ☐ Data sharing and access to existing data platforms ☐ Engage with LMICs ☐Engage with widening countries ☐ Round tables with regulators/initiatives/ end-users ☐ Mentoring service on translation/innovation management ☐ other			Answer to a real need of the AMR community **-0** Potential Impact **-0** Achievable **-0**
	Type of action needed (Select one or several options for each topic)	**Nature of research to be supported by the action(s)** (Select one or several options for each topic)				
	☐Call for research and innovation projects ☐ Call for research networks ☐ Webinar ☐ Workshop ☐ Conference ☐ other	☐Basic research ☐ Translation research ☐ Implementation research ☐ Knowledge synthesis: networks to produce systematic reviews on targeted areas ☐ Networks to create Knowledge & resource hub				

Annex 5: Ranking of Actions