



**DEPARTMENT OF BIOTECHNOLOGY**  
Ministry of Science & Technology



UK Research  
and Innovation

# **India-UK tackling AMR in the environment from antimicrobial manufacturing waste - partnership workshop**

**15-16 May 2019, Shangri La Eros, New Delhi, India**

**Workshop report**

## SUMMARY

UKRI and DBT India have agreed to jointly support a collaborative research programme on AMR in the environment from antimicrobial manufacturing waste. This partnering workshop, held in New Delhi on 15 and 16 May 2019, provided an opportunity for researchers to undertake face-to-face networking and to develop new collaborations. The aims of the workshop were:

- To understand the key challenges around AMR in the environment and antimicrobial manufacturing waste, and the relevant research landscapes in the UK and India.
- For the funders to present an overview of the call aims and objectives and for participants to discuss and understand the scope.
- To facilitate partnerships between the relevant UK and Indian research and innovation communities, and for researchers and industry representatives to network and begin to develop ideas to address the aims of the call.

Approximately 40 academic and industry researchers from India and the UK attended the event. The full attendance list is available in Annex A.

Day 1 was a shared day held jointly with the award-holders and review panel of the India-UK AMR Initiative, to learn from cross-cutting issues emerging from the transnational interdisciplinary projects funded from that call and the opportunity to network within and across delegations.

Day 2 was focussed on understanding the landscape of research and policy on environmental dimensions of AMR related to antimicrobial manufacturing and potential priority research areas for the upcoming call.

DBT and NERC plan to use the outputs of the workshop to refine the text of the call for collaborative projects, which is expected to be published in the summer to allow joint projects to start in spring 2020.

## AGENDA

### Day 1 (Wednesday 15 May 2019)

10:30-10:40	<i>Welcome</i>	Naomi Sykes, Chair
10:40-10:50	Overview of NERC DBT call on tackling AMR in the environment from antimicrobial manufacturing waste	Dr Mohd. Aslam, DBT & Caroline Culshaw, NERC
10:50-11:40	Sharing experiences – short presentations from existing projects then Q&A	
11:40-12:00	<i>Tea and coffee</i>	
12:00-13:00	Networking session between two delegations	
13:00-14:00	<i>Lunch and informal networking</i>	
14:00-14:40	Working in complex international, interdisciplinary teams – what have we learned?	
14:40-15:30	Sharing experiences – breakout discussion	
15:30-15:45	Final thoughts (what has been learned from the session and what will be implemented as a result of the workshop?)	
15:45-16:00	Close and informal networking	
18.30-20.30	Networking dinner	

### Day 2 (Thursday 16 May 2019)

09:30 – 09:35	Welcome and opening remarks	Helen Dewberry, UKRI India
09:35 - 09:45	Background and overview of the aims and objectives of the meeting	Dr Mohd. Aslam, DBT Dr Caroline Culshaw, NERC
Session 1	<b>AMR Landscape – Environment and Antimicrobial Manufacturing</b>	<b>Session Chair: Dr Amit Parikh</b>
09:45 – 10:00	DBT AMR Mission	Dr. Sundeep Sarin, Advisor, DBT
10:00 – 10:15	Overview of AMR landscape	Mr. Manjeet Saluja, WHO India
10:15 – 10:30	AMR Industry Alliance - Environment and Manufacturing	Professor Jason Snape, AstraZeneca
10:30 – 10:45	Overview of the research landscape: AMR in the environment and antimicrobial manufacturing waste - UK academic perspective	Professor Will Gaze, University of Exeter
10:45 – 11:00	Overview of the research landscape: AMR in the environment and antimicrobial manufacturing waste - Indian academic perspective	Dr. Ravikrishnan Elangovan, IIT Delhi

11:00 – 11:15	Scoping Report on Antimicrobial Resistance in India- Key findings	Dr Jyoti Joshi, Center for Disease Dynamics, Economics & Policy
11:15 – 11:30	<i>Tea break</i>	
Session 2	<b>India – UK programme</b>	<b>Session Chair: Caroline Culshaw</b>
11:30 - 11:35	Introduction to the breakout group session	Caroline Culshaw
11:35 – 12:20	Facilitated breakout session – first theme of programme:  <i>Understanding of the extent of environmental antimicrobial pollution from anti-bacterial manufacturing waste (wastewater, solid waste and air) and its pathways through environmental systems in various parts of India.</i>	
12:20 – 12:35	Antimicrobial manufacturing perspective	Ms. Suman Sharma Centrient Pharmaceuticals
12:35 – 13:15	<i>Lunch</i>	
13:15– 14:00	Facilitated breakout session – second theme of programme  <i>Development and validation of globally relevant standardised methods and tools for detection of active antimicrobial residues in industrial effluents and receiving environments.</i>	
14:00 – 14:45	Facilitated breakout session – third theme of programme  <i>Determining the health risks presented by antimicrobial manufacturing waste, through examining antibiotic-resistance in humans and livestock in proximity to the antibacterial manufacturing industry, their interactions with the environment (particularly use of water systems, including wastewater channels) and antibiotic use.</i>	
14:45 – 15:00	Overview of the research landscape: AMR in the environment and antimicrobial manufacturing waste - International perspective	Mr. Chandra Bhushan Centre for Science and Environment
15.00-15.15	<i>Tea break</i>	
15:15 – 15:55	AMR in the environment and antimicrobial manufacturing waste programme overview of the call aims and objectives and timetable (to include questions)	Michelle Truman, NERC Dr Amit Parikh, DBT
15:55 – 16:00	Closing remarks	Dr Caroline Culshaw NERC Dr Amit Parikh, DBT
16:00	Close of workshop	

Full list of attendees is in Annex A.

## **DAY 2 REPORT**

### **Welcome and opening remarks, Helen Dewberry UKRI India**

Helen Dewberry from UKRI India welcomed the attendees to the meeting, noting the breadth and range of past successful collaborations between DBT India and UKRI, including those addressing the clinical and One Health aspects of AMR.

### **Background and overview of the aims and objectives of the meeting, Dr Mohammed Aslam DBT and Dr Caroline Culshaw NERC (Annex B)**

Dr Aslam extended his welcome to the attendees and confirmed DBT's commitment to supporting research in this area. Dr Culshaw gave an overview of the aims of the workshop, namely:

- To understand the key challenges around AMR in the environment and antimicrobial manufacturing waste, and the relevant research landscapes in the UK and India.
- For the funders to present an overview of the call aims and objectives and for participants to discuss and understand the scope.
- To facilitate partnerships between the relevant UK and Indian research and innovation communities, and for researchers and industry representatives to network and begin to develop ideas to address the aims of the call.

### **AMR Landscape**

Invited speakers gave their thoughts on the challenges and research opportunities related to the environmental dimensions of AMR from antimicrobial manufacturing waste. The speakers covered policy, industry and research perspectives from India and the UK and set the scene for later discussion.

### ***DBT AMR Mission, Dr Sundeep Sarin, Advisor DBT (Annex C)***

Dr Sarin introduced the DBT AMR Mission, which delivers the strategic priority on innovations in research and development in the Indian National Action Plan on AMR. He set out the breadth of international collaboration activities on AMR undertaken by DBT in the areas of therapeutics and diagnostics, a new bio-repository and the development of a national priority list for AMR specific pathogens. He also highlighted the work of BIRAC in making India an innovation hub for AMR.

### ***Overview of AMR landscape, Mr Manjeet Singh Saluja, WHO India (Annex D)***

Mr Saluja introduced the work that WHO is involved in on environmental dimensions of AMR at a global policy level, including the AMR Global Action Plan and the evolving regional tripartite coordination between WHO, FAO and OIE, which promotes a One Health response to emerging health threats in the region. He shared his perspective of key areas where further research is needed, including a better understanding of acquisition, selection and transmission.

### ***AMR Industry Alliance - Environment and Manufacturing, Professor Jason Snape, AstraZeneca (Annex E)***

Professor Snape presented an industry perspective of the environmental dimension of AMR, covering stakeholder concerns, the industry response, progress in setting protection goals for environmental and human health, and ongoing scientific and regulatory challenges. He highlighted the need for holistic thinking and showcased the impact that research can have on influencing regulatory guidelines.

***Overview of the research landscape - UK academic perspective, Professor William Gaze, University of Exeter (Annex F)***

Professor Gaze set out the three main issues associated with the environment highlighted in the global and EU AMR action plans: the role of pharmaceuticals in the environment driving emergence of AMR, circulation of AMR in the environment, and environmental transmission of AMR. He highlighted recent research on impacts of mixtures of antibiotics and biocides on resistance in microbial communities and the potential for hydrodynamic modelling to determine locations where investment is most likely to generate improvements.

***Overview of the research landscape - India academic perspective, Dr Ravikrishnan Elangovan, IIT Delhi (Annex G)***

Dr Elangovan presented on the research landscape of transmission dynamics of AMR, covering concepts of the resistome and the challenges in understanding pathways and risk. He raised issues of understanding spatial and temporal variation and the contributions of geography, temperature, social/economical factors, and commented on the potential required outcomes of research in this area to improve surveillance and awareness for better risk assessment, and that technological solutions must be scalable and affordable.

***Scoping Report on Antimicrobial Resistance in India- Key findings, Dr Jyoti Joshi, Center for Disease Dynamics, Economics & Policy (Annex H)***

Dr Joshi presented the methodology used to generate the DBT and UKRI funded scoping report on AMR in India and the key findings of the report, which was used to inform the outline scope of the workshop. She highlighted the recommendations for further research of relevance to the environment.

***Antimicrobial manufacturing perspective, Ms. Suman Sharma, Centrient Pharmaceuticals (Annex I)***

Ms Sharma introduced Centrient's approach to creating a sustainable supply chain for pharmaceuticals and keeping antibiotics effective by fighting antimicrobial resistance. She set out the challenges faced by manufacturers, the types of data that could be available for research (with the manufacturer's permission) and areas where research support is needed.

***Overview of the research landscape, Mr. Chandra Bhushan, Centre for Science and Environment (Annex J)***

Mr Bushan presented the work that CSE has undertaken in policy, advocacy and supporting implementation of AMR National Action Plans. He set out his suggestions for managing AMR in the environment, through an integrated framework for policy, systems and tools and an integrated AMR Surveillance Framework.

## India-UK Programme Themes

The delegates discussed the three themes proposed for the research programme, working in small groups to reflect on the current state of knowledge, priorities for research, data requirements and availability and key stakeholders engagements required to ensure research has impact. The groups then reported back the following key messages to the plenary session.

**Theme 1:** Understanding of the extent of environmental antimicrobial pollution from anti-bacterial manufacturing waste (wastewater, solid waste and air) and its pathways through environmental systems in various parts of India.

- Engagement of large and small pharmaceutical companies and central and state Government pollution control agencies will be key for access to sites and data.
- Effort to characterise the situation in detail will not have impact without considering the impact on the environmental resistome and human gut resistome. The aim should be to determine causal mechanistic relationships now that correlative and statistical relationships have been shown.
- Data on quantities of effluent are already available, but trusting relationships must be built to access more robust data. How researchers, industry and regulators engage will be crucial.
- Research should be targeted where industry is active and seek to understand temporal and geographical differences in the chemistry and biology.
- Clear links are needed between measured data and how it links back to industry processes.

**Theme 2:** Development and validation of globally relevant standardised methods and tools for detection of active antimicrobial residues in industrial effluents and receiving environments.

- A lifecycle analysis approach to measurements are needed.
- When selecting where to measure, bioavailability, strength of selection pressure and residues should all be considered
- New biosensors, biochemical and gene-based assays should all be considered and they need to be validated in a range of matrices and applicable over a broad analytical range.
- The focus on antibiotic residues is too narrow and should be broader
- This theme should recognise that industry likes to work with mass-balance tools, not always analytical chemistry
- Current methodologies use LCMS, which is expensive. Development of tools in collaboration with industry for initial screening would be useful.
- Chemical and biological measurements go hand in hand when developing standards for end-users – a fundamental part of the puzzle is to link them together.

**Theme 3:** Determining the health risks presented by antimicrobial manufacturing waste, through examining antibiotic-resistance in humans and livestock in proximity to the antibacterial manufacturing industry, their interactions with the environment (particularly use of water systems, including wastewater channels) and antibiotic use.

- Will be difficult to quantify health risks and not clear why it is needed, counter argument is that enough evidence exists to justify a focus on mitigation.
- Question should be framed as One Health in every way and not helpful to focus on only manufacturing sources, as they will not be the only source. Question will be intractable in the field but lab studies using effluent might be a way forward.

- This theme is narrow and should include other sources of antibiotics to the environment, particularly agriculture, aquaculture and clinical residues in waste water and how resistance passes into communities, separating out colonisation and infection
- Using E. coli as a marker may not be appropriate due to the high background carriage rates in India. Metagenomics approaches may be more suitable.
- Health risk might be a misleading term: public health studies will be too expensive and phrasing suggests toxicity of chemicals is of interest.

**Overview of call aims and objectives and timetable, Michelle Truman, NERC  
Dr Amit Parikh, DBT**

An overview of the draft call aims and objectives was shared, along with a draft timetable that proposed a call launch in June 2019, closing date in September 2019 and funding decisions in January 2020, for a start in May 2020. Slides are in Annex K.

Participants raised questions about eligibility and costings, which are recorded in the FAQ document in Annex L.

**Closing remarks, Dr Amit Parikh and Dr Caroline Culshaw**

Drs Parikh and Culshaw remarked that it had been an interesting two days and that the meeting had been successful in helping the funders to refine the call scope and to understand more precisely what research is needed. They expressed their hope that new connections had been made and new ideas had emerged. They shared the intention to publish a short report of the workshop online and to publish the call shortly. Thanks were expressed to DBT, NERC and UKRI India for hosting and organising the meeting, to the speakers and facilitators for their support, and to all the delegates for their enthusiastic participation.



Annex A: Attendee list

Annex B: Caroline Culshaw, NERC, introduction slides

Annex C: Sundeep Sarin, DBT, AMR Mission slides

Annex D: Manjeet Singh Saluja, WHO India, WHO perspective slides

Annex E: Jason Snape, AstraZeneca, industry perspective slides

Annex F: William Gaze, University of Exeter, UK academic perspective slides

Annex G: Ravikrishnan Elangovan, IIT Delhi, Indian academic perspective slides

Annex H: Jyoti Joshi, CDDEP, DBT-UKRI Scoping report on AMR in India slides

Annex I: Suman Sharma, Centrient Pharmaceuticals, Antimicrobial manufacturing perspective slides

Annex J: Chandra Bushan, CSE, Research landscape slides

Annex K: Call overview slides

Annex L: FAQ from the workshop