Overview of AMR Landscape

India-UK tackling AMR in the environment from antimicrobial manufacturing waste - Partnership workshop

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Contents

• Background to issues relating to AMR (and importance of the environment)
• Gaps in understanding relating to AMR acquisition, selection and transmission
• Current and planned response and interventions
“The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily underdose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant. “

Alexander Fleming
“Penicillin” Nobel Lecture
December 11, 1945
Why has AMR become so important as to require a UNGA High Level Political Declaration?

Antibiotic consumption doubled in LMICs between 2000 and 2015. Rising incomes, persistent infectious diseases, easy over-the-counter access to antibiotics and lack of access to good quality primary health care are exacerbating the problem of AMR in LMICs. Partly as a result, drug resistance is rising and affects key populations including:

- **newborns** suffering from sepsis, and
- **those requiring** effective antibiotics to prevent infection, for example during **surgery** or in **transplant care** or **cancer treatment**
AMR situation in Asia and the Pacific

Deaths in Asia attributable to AMR by the year 2050

4,752,000
AMR is a complex issue requiring multi-sectoral One Health response

- It is not known how much pharmaceutical waste enters water without onsite treatment

- Up to 80% of antimicrobial agents are excreted as active residues

- 14% of humans globally carry ESBL-producing E. coli in faeces

- 61% of human excreta is not managed safely globally

- 28% of people do not have access to safely managed water
AMR is Everybody’s Business!

1. **No Poverty**
- Rate of AMR is high
- Lack of affordable drugs
- Poor IPC

2. **Zero Hunger**
- Untreatable infections in animals threaten food production and safety

3. **Good Health and Well-Being**

4. **Clean Water and Sanitation**

5. **Decent Work and Economic Growth**

6. **Responsible Consumption and Production**

7. **Partnerships for the Goals**

Antibiotic residues (hospital, pharma & agriculture) contaminate water/environment

*Cumulative costs $120 trillion by 2050

Balance access, innovation and conservation of AM

Multi-stakeholder partnerships

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AMR and environment

• Major sources of AMR/AMs in environment
  • Pharmaceutical waste
  • Hospital waste/effluents
  • Farm/agricultural/abattoir waste
  • Other waste/water

• There is presently no systematic monitoring of antibiotic compounds in environmental matrices and the pathways that act via environmental matrices are not well understood.
Environment’s role in AMR

Environmental hot spots can increase the development and spread of antibiotic resistance through:

• **direct transmission of already resistant microorganisms** via environmental matrices

• **microorganisms selecting for resistance** when exposed to antibiotic residues under favorable conditions.
The extent of transmission of AMR between humans and:
- the environment, and
- the animal sector is still poorly measured and understood.

BMJ 2017; 358:j3393
http://dx.doi.org/10.1136/bmj.j3393
Little is known about:
- the different sources of antibiotics and antibiotic resistant bacteria,
- the role of the environment, and anthropogenic inputs, in evolving resistance,
- the human and animal health impacts of exposure to resistant bacteria,
- and the effectiveness and feasibility of mitigation options (technological, social, economic and behavioural).

This lack of knowledge impedes the ability to accurately estimate the AMR burden and advocate more effectively.
Some key areas where research is needed

• Acquisition & selection
  • Persistence of antibiotics in soil, sediment or water
  • Persistence of antibiotic resistant bacteria/genes in soil, sediment or water
  • Risks from non-environmental bacteria released in the environment
  • Rates of horizontal gene transfer from non-environmental bacteria to environmental bacteria
  • Minimal environmental concentration necessary to select resistance for different antibiotic classes

• Transmission (eg from environment to humans)
  • Dose-response and risk factors for persistence of antibiotic resistant bacteria from aquatic origin in human flora following ingestion
  • Routes, risk factors and rates of transmission of environmental bacteria to human flora other than through ingestion
  • Rates of horizontal gene transfer from environmental to human bacteria in the different human flora (intestinal, skin, nasopharyngeal)
  • Efficiency of wastewater treatment on elimination of antibiotics and antibiotic resistant genes
Antibiotic challenge in SE Asia

- Stewardship of antibiotics low – readily available without prescription
- Access to water & soap can be very limited at household level + poor knowledge
- Poor implementation of infection prevention programmes & poor awareness among Health professionals
- Food safety policies poorly enforced – meat consumption rising
- Ingestion of contaminated water high – 35% of people exposed to faeces contaminated drinking water
- Few countries have legal framework for stewardship of use of antibiotics in animals – use intensifying
- Residues released into environment from human activities – effluent from Health care facilities, inappropriate disposal of waste
- Poor wastewater management & inefficient treatment facilities
## Antimicrobial residues in water bodies downstream of different sources

<table>
<thead>
<tr>
<th>Location / source</th>
<th>Country</th>
<th>Antibiotic</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital wastewater</td>
<td>Thailand</td>
<td>Sulfamethoxazole</td>
<td><strong>PNEC</strong>: 16,000 ng/L <strong>Recorded</strong>: 1,499 ng/L</td>
</tr>
<tr>
<td>Pharmaceutical/industrial</td>
<td>India</td>
<td>Ciprofloxacin</td>
<td>0.064 µg/L</td>
</tr>
<tr>
<td>wastewater</td>
<td></td>
<td>Ampicillin</td>
<td>21 µg/L</td>
</tr>
<tr>
<td>Municipal/community wastewater</td>
<td>India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STP/WWTP</td>
<td>Thailand</td>
<td>Ciprofloxacin</td>
<td>0.064 µg/L</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>Oxytetracycline</td>
<td>0.500 µg/L</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>Enrofloxacin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>Roxithromycin</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Influent – 235 ng/L</strong></td>
</tr>
<tr>
<td>Aquaculture</td>
<td>Thailand</td>
<td>Oxytetracycline</td>
<td>500 ng/L</td>
</tr>
<tr>
<td>Water bodies</td>
<td>India</td>
<td>Ciprofloxacin</td>
<td>0.064 µg/L</td>
</tr>
</tbody>
</table>

- **PNEC** = predicted no effect environmental concentrations
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Progress so far...

- In 2015 – the World Health Assembly agreed a Global Action Plan on AMR. Each year since then World Antibiotic Awareness Week.
- In 2016, the UN General Assembly landmark commitment to tackling AMR setting up significant new inter-agency coordination mechanisms in context of “One Health”.
- In 2017 - WHO released guidelines on the use of medically important anti-microbials in food producing animals.
- At UNEA-3 resolution 3/4 on environment and health emphasised the importance of joint efforts and actions by all relevant stakeholders and requested UNEP to produce a report for UNEA-5 in 2021. Scoping & mapping report underway.
- In 2018, OECD conducted a workshop on managing contaminants of emerging concern in surface waters, focusing on pharmaceuticals.
Global Action Plan for AMR

- to improve awareness and understanding of antimicrobial resistance through effective communication, education and training;
- to strengthen the knowledge and evidence base through surveillance and research;
- to reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures;
- to optimize the use of antimicrobial medicines in human and animal health;
- to develop the economic case for sustainable investment that takes account of the needs of all countries and to
- increase investment in new medicines, diagnostic tools, vaccines and other interventions.
Addressing AMR with a One Health approach

This approach is the collaborative effort of multiple health science professions, together with their related disciplines and institutions – working locally, nationally, and globally – to attain optimal health for people, domestic animals, wildlife, plants and our environment.
Addressing AMR with a One Health approach

• **Specific settings** (e.g., farm, etc.)

• **Specific issues** (e.g., mastitis, parasite resistance)

• **Specific concerns** (e.g., prudent use in animals; access to vet services)

• **Shared settings** (e.g., community, sewage, environment, market)

• **Shared issues** (e.g., MRSA, VRE, ESBL, potential for Horizontal gene transfer)

• **Shared concerns** (e.g., waste management, uncontrolled spill-over)

• **Specific settings** (e.g., hospitals, health facilities, homes)

• **Specific issues** (e.g., MDR-TB, resistance to antiviral drugs)

• **Specific concerns** (e.g., abuse and misuse, quality, access to medical services)
Evolving Regional Tripartite Coordination (DRAFT)

- FAO, OIE and WHO, with UNEP (and other agencies in the future) are seeking to use their close links with human and animal health; food, agriculture and aquaculture; and environment to develop One Health responses to important and emerging health threats in the region.
AMR containment in India

• National Action Plan on AMR (Apr 2017)

*Objective 3.5:* Reduce environmental contamination with resistant pathogens/genes and antimicrobial residues

• Strategy/plan to reduce environmental impact of AMR; standards for AMR and antimicrobials

• Policy on registration of factories, farms, aquaculture, food processing, health care facilities

• Environmental risk assessment

• Producers responsibility for expired/unused/discarded antimicrobials
Despite the progress..

- Challenges persist with respect to **differing country contexts that influence national health priorities**. Higher-income countries may focus on interventions to decrease the evolution of AMR but for lower-income countries, AMR remains an abstract concept, complex and far removed from people’s day-to-day concerns.

- There is a **paucity of national estimates on the burden of AMR** in terms of morbidity, mortality, economics and societal effects which limit many countries’ ability to make a case for substantial investments in containing AMR.

- Given that greater focus on AMR mitigation comes from higher income countries it is no surprise that most research is funded and carried out in these countries.
Thank you!