Containing AMR in the environment

National Workshop on Development and Implementation of State Action Plan on Antimicrobial Resistance
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Rajeshwari Sinha
Deputy Programme Manager, Food Safety and Toxins, CSE
What is environmental AMR?

- Environment – soil, water and air
- Waste from different sources are being discharged into this environment
- AMR determinants present in waste – antibiotic resistant bacteria (ARB), antibiotic resistance genes (ARGs) or antibiotic residues
- Continuously interplay among AMR determinants allow resistant bacteria to multiply and spread
  - persist in the environment, make way into the water and food chain
- Cellular level – mutations or transfer of genetic material from other bacteria through horizontal gene transfer (HGT) further spreads AMR

Environment is a melting pot of AMR determinants. Resistance in one bacterium can on to other bacteria, for one or for multiple antibiotics; like a chain reaction
Understanding the environment sector

### Point Sources

<table>
<thead>
<tr>
<th>Farms</th>
<th>Factories</th>
<th>Households</th>
<th>Healthcare Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste from: Animal farms – poultry, dairy, pig, fish etc. Agriculture farms</td>
<td>Effluents from: Pharma manufacturing Feed mills Slaughter houses Processing units (meat, dairy) Common effluent treatment plants (CETPs)</td>
<td>Effluents from: Sewage treatment plants (STPs) reflecting domestic sewage and disposal of unused, expired drugs</td>
<td>Hospital sewage Waste from veterinary care settings</td>
</tr>
</tbody>
</table>

### Non-point Sources

- Rivers, Reservoirs
- Groundwater
- Agricultural soil

AMR in the environment is a cross cutting issue
Linkages with other sectors

**Source**
- Pharmaceutical Manufacturing
- Feed Mills
- Slaughter-houses
- Processing (dairy, meat, fish)
- Human Healthcare (hospitals, labs, polyclinics, nursing homes etc.)
- Veterinary Care (hospitals, polyclinics, etc.)

**Point Sources**
- Healthcare settings
- Factories
- Households

**Non-point Sources**
- Farm/ factory/ household /healthcare setting input

**Sink**
- Drinking water treatment plants
- Reservoirs/ Rivers
- Surface water
- Soil
- Groundwater

- Treatment and Storage Disposal Facilities
- Common Effluent Treatment Plants
- Biomedical Waste Treatment Plants
- Municipal Dumpsites
- Compost/Biogas
- Sewage Treatment Plants

- Poultry litter
- Feed
- Fertilizer
- Agricultural run offs

- Internal ETPs
- Internal ETPs
Why the environmental AMR needs to be prioritized?

- Environment is both a **sink** and a **source** of AMR determinants.

- **Environment possibly a big contributor to AMR in India**
  - Largely unsanitary conditions
  - High bacterial growth
  - Among top producers of dairy, fish, poultry and antibiotics

- **Waste management is an issue**
  - Lack of AMR-centric waste management approaches

- **Limited guidance** on
  - Waste management
  - Monitoring AMR in the environment
  - Setting discharge limits of AMR determinants in waste

So far, focus has been on what is going in and not what is coming out. Time to rethink and reprioritize?
GROWING GLOBAL MOMENTUM ON AMR IN THE ENVIRONMENT
Growing global momentum on AMR in the environment

**Policy**

- **WHO, 2015**: AMR Global Action Plan: Limited focus on environment
- **FAO, 2016**: Action Plan recognizes environment as a contributor to AMR
- **FAO, 2016**: Review of AMR Report: reduce spread of antimicrobials in environment
- **UNEP, 2016**: AMR identified as an issue of environmental concern
- **IACG, 2019**: Focus on water, waste management in healthcare, farms, manufacturing; AMR surveillance

**Global Tripartite expanded to Tripartite Plus in 2018**

Environment has largely been neglected area. Global momentum is now picking up to prioritize the environment and address the issue.

WAY AHEAD
Growing global momentum on AMR in the environment

- Growing evidence base to understand AMR-specific environmental routes, transmission, mechanism and pathways
- Focus on resistant bacteria, antibiotic residues, antibiotic resistance genes (ARGs) and mobile genetic elements

<table>
<thead>
<tr>
<th>AMR determinants (occurrence, mechanisms, spread)</th>
<th>Waste or effluent from farms, community, hospitals, pharmaceutical manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sewage, wastewater and drinking water treatment plants</td>
</tr>
<tr>
<td></td>
<td>Rivers, water bodies, surface water, agricultural runoffs, etc.</td>
</tr>
<tr>
<td></td>
<td>Airborne transmission of ARGs</td>
</tr>
</tbody>
</table>
Till few years back...

- **Limited focus** on addressing AMR in the environment
- NAP of developed countries talking about research, monitoring etc.
- NAP of developing countries talking about infection, prevention and control etc.

Present day scenario

- Country level NAPs put **strong focus on tackling AMR in environment** in view of One health
- Puts focus on surveillance of AMR in the environment
- Environment Ministries/Departments slowly getting on board
AMR IN THE ENVIRONMENT: PRACTICE AND POLICY IN INDIA
Reduce environmental spread of AMR

Objective 3.5

Reduce environmental contamination with resistant genes, resistant pathogens and antimicrobial residues

Strategic intervention and activities

3.5.1. Develop strategic interventions to reduce impact of AMR on the environment

3.5.1.1. Develop policy on registration of farms, factories, slaughter houses, wet markets, aquaculture units, food processing units, feed manufacturers, health care facilities, veterinary care facilities (NACA, MoEFCC, MoAFW, MoHFW, MoFPI, CDSCO) M-L

3.5.1.2. Based on environment risk assessment develop guidelines for locating farms, factories, slaughter houses, wet markets, processing units, feed manufacturers, health care facilities, veterinary care facilities; ensuring compliance by strengthening existing guidelines and enforcement strategies related to payments, benefits, etc. (MoEFCC, MoHFW, MoAFW, MoFPI) M-L

3.5.1.3. Develop policy & implementation mechanisms on extended producers responsibility for expired/unused antibiotics (CDSCO, DoP/MoCF) M-L

3.5.1.4. Develop and implement a strategy and operational plan to reduce environmental impact on AMR (NACA, MoEFCC, CPCB) S-M-L

- Define standards and monitor antibiotic residues and bacterial load in effluents (S-M-L); disinfection at treatment plant to remove bacteria (S); using waste from unorganized sector to generate biogas (M); develop necessary legislation, awareness & incentives; develop tool for environment risk assessment; develop SOPs and implement best practices (S-M-L)

- Include biosecurity in farmer-field school curriculum (S); sector-specific manuals and guidelines to improve environmental management of AMR (M)
Commits to:
“Initiating and sustaining activities to raise awareness and knowledge about AMR to engage and encourage behavioral change in different audiences, promote evidence based prevention, infection control and sanitation programs in alignment with the Swachh Bharat Abhiyan, Kayakalp and Swachh Swasth Sarvatra initiatives of the Government of India”
### Farms

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<td>Waste from:</td>
<td>Effluents from:</td>
<td>Effluents from:</td>
<td>Hospital sewage</td>
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<tr>
<td>Animal farms – poultry, dairy, pig, fish etc.</td>
<td>Pharma manufacturing</td>
<td>Sewage treatment plants (STPs) reflecting domestic sewage and disposal of unused, expired drugs</td>
<td>Waste from veterinary care settings</td>
</tr>
<tr>
<td>Agriculture farms</td>
<td>Feed mills</td>
<td>(meat, dairy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slaughter houses</td>
<td>Common effluent treatment plants (CETPs)</td>
<td></td>
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<tr>
<td></td>
<td>Processing units</td>
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</tr>
<tr>
<td></td>
<td>(meat, dairy)</td>
<td></td>
<td></td>
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</table>

#### Non-point Sources

- Rivers, Reservoirs
- Groundwater
- Agricultural soil
Waste disposal practices at farms

- **Disposal methods followed in poultry farms**
  - Litter and manure is mostly spread on agricultural fields; sometimes used directly in aquaculture farms
  - No–limited biosecurity measures; variations across different farm types
  - 2017 CSE study showed high multidrug resistance (MDR) poultry farm environment; MDR is moving from farms to agricultural fields in *E. coli*

- **Disposal methods followed in aquaculture farms**
  - Discharged into canals (from which water was sourced) or agricultural fields
  - Reused in broodstock ponds
  - Let out in sewage drains
  - Solid waste, including expired antibiotics are buried in pits
Poultry litter is rich in antibiotic resistant bacteria and un-metabolized antibiotics.

The common practice of using untreated poultry litter as manure in agricultural land is transferring bacteria that are resistant to multiple antibiotics.

HOW DOES AMR SPREAD FROM FARMS?

- **Farm Waste**, which includes faecal matter, litter and dead birds, contains bacteria that are resistant to antibiotics.
- Litter used as manure
- Dead birds
- Liquid waste discharge from farms
- Flies carry the bacteria
- Consumption of meat and eggs
- Farmworkers or visitors

It reaches humans through agriculture produce and waterbodies.
Environmental Guidelines for Poultry Farms
Central Pollution Control Board

- Farm siting criteria
- Criteria for location of feed mills, approaches to limit pest/insect infestation, sanitation and cleanliness
- Management of solid waste
  - Dead birds, manure, hatchery debris
- Manure storage and management
- Hatchery waste management
- Waste water discharge
  - Methods for treatment and disposal of effluent
- Feed and pest management

- Need to strengthen these and making it mandatory to be followed
- Few states have approved these guidelines, such as Punjab, West Bengal, Karnataka. Others must now come forward to adopt and notify these
July 2017 Notification by CPCB

Environmental Guidelines for Poultry Farms including minimization of odour pollution, management of solid waste, management of wastewater discharge, good housekeeping practices, is applicable to all poultry farms irrespective of no. of birds.
BIOWASTE MANAGEMENT

- Disposal/recycling of hatchery waste
  - Incineration, Fermentation, Rendering, Boiling, Enzyme treatment, Composting

- Management of litter waste

- Methods of disposal
  - Composting, Gasification technology

- Disposal of dead birds
  - Incineration, Burial, Composting

- Management of biomedical waste

- Management of wastewater discharge

- Management of biomass waste
Key policy gaps

- Waste from farms not on radar of environment regulators
- Agriculture vs. Industry
  - Farms considered agriculture; regulator’s mandate is trade/industrial effluents
- Pollution-causing potential classification
  - Poultry and hatchery categorized ‘green’; aquaculture not categorized at all
- Farm registration is a lesser priority
- No framework for freshwater aquaculture
- Others
  - Agricultural lands converted for aquaculture purposes
  - Inadequate supervision/outreach by concerned officials
What should be done?

- Environment regulators at the Centre and State should have a greater leadership role and develop AMR-centric environmental regulations for farms.
- **Pollution causing potential** of the poultry farm sector should be re-prioritized.
- **Less risky litter/manure management approaches** such as biogas generation must be preferred over land application. Other options of waste to energy conversion can also be explored.
  - *In-house biogas generation plants* for Big/integrated poultry farms; *Common biogas generation plant* for small poultry farmers.
- **Land application of untreated litter** must be prohibited through laws, awareness and surveillance.
- **Proper composting** for treatment of litter/manure should be encouraged only under very high level of supervision.
- Laws related to approval of composting sites, validation of treated manure and timing of application of litter/manure should be made.
- Poultry litter must **not be allowed** to be in aquaculture.
Factories

**Point Sources**

- **Farms**
  - Waste from: Animal farms – poultry, dairy, pig, fish etc.
  - Agriculture farms

- **Factories**
  - Effluents from:
    - Pharma manufacturing
    - Feed mills
    - Slaughter houses
    - Processing units (meat, dairy)
    - Common effluent treatment plants (CETPs)

- **Households**
  - Effluents from:
    - Sewage treatment plants (STPs) reflecting domestic sewage and disposal of unused, expired drugs

- **Healthcare Settings**
  - Hospital sewage
  - Waste from veterinary care settings

**Non-point Sources**

- Rivers, Reservoirs
- Groundwater
- Agricultural soil
Improper disposal of pharmaceutical industry waste (observations and stakeholder interaction):

- Solid waste given to scrap dealers who dump or burn them at any open area
- Effluents are injected into bore wells dug in ground at night
- Effluent treatment plants (ETPs) release toxic effluents during monsoon
- Smaller companies drain ETP treated water into nallahs
- Sewer lines of some industries are not connected to CETP and open directly into the nearby river
- Pipes/outlets from plants open at backside or are channeled underground to open into bushy low lying areas
### Key policy gaps

**No standards in view of AMR**

- Present standards not aimed to address AMR
- In view of AMR containment, draft standards for residual antibiotics in pharma industry developed by CPCB; yet to be notified

<table>
<thead>
<tr>
<th>Industry/Factory</th>
<th>Type of waste</th>
<th>Standard parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceutical (manufacturing and formulation) industry</td>
<td>Effluents</td>
<td>Compulsory parameters: pH, oil and grease, BOD, TSS, Bioassay test Additional parameters: heavy metals etc.</td>
</tr>
<tr>
<td>Sewage Treatment Plants</td>
<td>Effluents</td>
<td>pH, BOD, TSS, Fecal coliform</td>
</tr>
<tr>
<td>Dairy</td>
<td>Effluents</td>
<td>pH, BOD, suspended solids, wastewater generation, oil and grease</td>
</tr>
<tr>
<td>Common Effluent Treatment Plants (CETPs)</td>
<td>Treated effluent</td>
<td>pH, BOD, COD, TSS, oil and grease, FDS, heavy metals etc.</td>
</tr>
<tr>
<td>Slaughter houses, meat processing units</td>
<td>Effluent</td>
<td>pH, BOD, COD, suspended solids, oil and grease</td>
</tr>
<tr>
<td>Sea Food industry</td>
<td>Effluent</td>
<td>BOD, suspended solids, oil and grease</td>
</tr>
</tbody>
</table>

BOD: Biological oxygen demand, TSS: Total Suspended Solids, COD: Chemical Oxygen Demand, FDS: Fixed Dissolved Solids
Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

- **Production/formulation of drugs/pharmaceutical and health care product**-considered as a process generating hazardous waste

- **Hazardous waste** means any waste which by reason of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment, whether alone or in contact with other wastes or substances

- Components of hazardous waste in production/formulation of drugs/pharmaceutical
  - Process Residue and wastes
  - Spent catalyst
  - Spent carbon
  - Off specification products
  - Date-expired products
  - Spent solvents
Households

Point Sources

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- Healthcare Settings
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  - Waste from veterinary care settings

Non-point Sources

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Disposal of drugs at domestic level

- Drugs which are unused or expired at the household levels are often disposed improperly
  - Disposed into drains, along with regular household waste

- Similar is the fate across other points in the value chain
  - Retailers dispose into open drains/nallahs, bury or dump underground, burn them etc.

- Globally manufacturing companies ensure drug take back from household level; no such provision in India

- Handling of expired drugs at the household or retail level needs attention, in view of rising AMR
  - Recent initiative in Kerala by Dept. of Drug Control and All Kerala Chemist and Druggist Association (AKCDA) to “take back” unused drugs, including antibiotics from households
  - Programme for Removal of Unused Drugs (PROUD)
States that all biomedical waste shall be disposed of in accordance with the Bio-medical Waste Management Rules, 2016, as amended from time to time

- Defines “domestic hazardous waste” to include discarded paint drums, pesticide cans, CFL bulbs, tube lights, expired medicines, broken mercury thermometers, used batteries, used needles and syringes and contaminated gauge, etc., generated at the household level

- Defines "solid waste" to include solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities and other entities mentioned in rule.
Segregation, storage, delivery and collection of Municipal Solid Waste

- Every generator of Municipal Solid Waste shall separate the waste at source of generation into the following categories as applicable and shall store separately, without mixing it for segregated storage in authorized storage bins, private/public receptacles for handing over or delivering to authorized waste pickers or waste collectors as directed by the local authority/body from time to time.

- One category of segregated waste: Fully treated Bio-medical waste.

These talk about correct segregation, storage, delivery, collection of municipal solid waste which can contain out-dated, contaminated, expired medicines generated at household level.
5.7 **Specified household hazardous waste:** (as listed in Schedule III) shall be stored and delivered by every generator of waste to the collection vehicle, which shall be provided weekly/periodically by Municipal Corporation/Council/Municipality/Urban Local Body of XYZ or any other Agency authorized by the XYZ Pollution Control Board / Committee (∅PCB /PCC) for collection of such waste, or to a center designed for collection of such waste for disposal in a manner that is mandated by the Government of XYZ or the XYZ Pollution Control Board / Committee (∅PCB /PCC).

5.8 **Untreated bio-medical waste** (as listed in Schedule IV) shall be collected & stored in specified type of covered receptacles and delivered by every generator of such waste to the collection vehicle which shall be provided weekly/periodically by Municipal Corporation/Council/Municipality/Urban Local Body of XYZ or any other Agency authorized by the XYZ Pollution Control Board / Committee (∅PCB /PCC), or to a center designated for collection of such waste, for disposal in manner that is mandated by XYZ Pollution Control Board / Committee (∅PCB /PCC) in accordance with the Bio-Medical Waste (Management & Handling) Rules, 2016.

Based on the draft, few states have adopted municipal solid waste management Bye-laws
Healthcare settings

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- **Healthcare Settings**
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**Non-point Sources**

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- Defines "bio-medical waste" as any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to the rules.

- **Type of waste: Expired or Discarded Medicines**
  - Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.

- **Type of bag/container to be used**
  - Yellow coloured non-chlorinated plastic bags or containers

- **Treatment and disposal option**
  - Expired `cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200°C or to common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at >1200°C OR Encapsulation or Plasma Pyrolysis at >1200°C
  - All other discarded medicines shall be either sent back to manufacturer or disposed by incineration
WHAT SHOULD STATES DO?
### Responsible Antibiotic Use in Food Animals

<table>
<thead>
<tr>
<th>THEMATIC AREAS</th>
<th>Policy/law/ regulations/ standards/ programmes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply of antibiotics</td>
<td>Implementation tools- Infrastructure/ capacity/systems/ resources</td>
</tr>
<tr>
<td>Reduce need for antibiotics</td>
<td>Advocacy/awareness and education/ training/curriculum</td>
</tr>
<tr>
<td></td>
<td>Record keeping/ database generation/ collation/ dissemination and research/survey</td>
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<tr>
<td></td>
<td>Review/monitoring /feedback</td>
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<thead>
<tr>
<th>THEMATIC AREAS</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Systems</td>
<td>Farms and farmers</td>
</tr>
<tr>
<td>Veterinarians and veterinary services</td>
<td></td>
</tr>
</tbody>
</table>

### Surveilllance of Antibiotic Use, Residues and Resistance

<table>
<thead>
<tr>
<th>THEMATIC AREAS</th>
<th>Antibiotic use in food animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibiotic resistance in animals and food from animals</td>
<td></td>
</tr>
<tr>
<td>Antibiotic residues in food from animals</td>
<td>Environmental surveillance of residues and resistance</td>
</tr>
</tbody>
</table>

### Environment Management to Contain Antimicrobial Resistance

<table>
<thead>
<tr>
<th>THEMATIC AREAS</th>
<th>Registration/ licensing (based on environment risk assessment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosecurity/sanitatio n and hygiene/good manufacturing Practices</td>
<td>Waste management</td>
</tr>
<tr>
<td>Waste management</td>
<td>Research</td>
</tr>
</tbody>
</table>

**Short-term (S): <1 yr; Medium-term (M): 1-3 yrs; Long term (L): 3-5 yrs; Continues throughout: (S-M-L)**
Environmental surveillance of AMR

**Policy/law/regulations/standards/programmes**

- National **AMR surveillance programme** to monitor resistance in environment (S)
- **Regulation on antibiotic residues** in effluent and waste from industries and farms (S)
- **Standards for waste discharge** from farms, slaughter houses, animal food processing industry, pharmaceutical industry and healthcare settings (S)

**Implementati on tools - infrastructure/capacity/systems/resources**

- **Monitoring** and **surveillance framework** including monitoring of antibiotic residues and AMR in indicator bacteria in environment, farms, factories, slaughter house, wet market, processing unit, health care facilities, vet care facility (prioritization based on ground realities) (M)
- **Assess infrastructure needs**, accordingly build/strengthen appropriate infrastructure and capacity (M)
- Develop **systems to adapt, standardize, compare data** across countries (M)
Environmental surveillance of AMR

**Advocacy/ awareness and education/training/ curriculum**

- **Awareness campaigns** on importance and need of environmental surveillance across stakeholders *(S-M-L)*
- **Training needs assessment** for those conducting surveillance *(S)*
- Development of **training material**, protocols and data management *(S)*
- **Capacity building** and training programme (including at university level) *(M)*
- Training of peer/participatory monitoring systems *(M)*
- **Advocacy** at community/institutional level based on surveillance data reports *(S-M-L)*

**Record keeping/ database generation/ collation/ dissemination and research/ survey**

- Data **collection, collation and analysis** at regional and sub-regional level *(S-M-L)* - Selection of sentinel sites to begin with
- Correlation with animal antibiotic use and AMR data *(S-M-L)*
- Development of an online integrated information system and publishing of annual reports and public dissemination of data to ensure transparency *(M)*
- Develop early warning system *(S)*

**Review/ monitoring/ feedback**

- Periodic review and mapping of data with antibiotic use and resistance in animal and human for continued advocacy, awareness and future policy and practice *(S-M-L)*
**Registration and Licensing**

**Policy/law/regulations/standards/programmes**

- **Policy on registration** of farms, factories, slaughter houses, wet markets, processing units, feed manufacturers, health care facilities, veterinary care facilities *(S)*
- **Siting guidelines** and **licensing** for farms, factories, slaughter houses, wet markets, processing units, feed manufacturers, health care facilities, veterinary care facilities *(S)*
- Policy on environment risk assessment for registration and renewal of antibiotics for humans and animals *(M)*

**Implementational tools - infrastructure/capacity/systems/resources**

- Regulatory system for enforcement of laws, ensuring compliance with adequate funding and capacity *(M)*
  - Small producers to be facilitated through required measures
- Tool for environmental risk assessment for siting, registration and renewal of antibiotics *(S)*
## Registration and Licensing

<table>
<thead>
<tr>
<th>Advocacy/education/training/curriculum</th>
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<tbody>
<tr>
<td>• Sensitise regulators, industry and farmers (S)</td>
</tr>
<tr>
<td>- Inclusion of environment management in antibiotics awareness week</td>
</tr>
<tr>
<td>• Build capacity of regulators (S)</td>
</tr>
<tr>
<td>• Development of customised material for awareness and training (S)</td>
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<th>Record keeping/database generation/collation/dissemination and research/survey</th>
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<tr>
<td>• Public database of licensed farms, factories, human and veterinary healthcare settings (S)</td>
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<th>Review/monitoring/feedback</th>
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<tr>
<td>• Comprehensive review framework for policy/regulations and standards (S-M-L)</td>
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</table>
Biosecurity, sanitation and hygiene, good manufacturing practices

- Development of guidelines, best practices for farms, factories, slaughter houses, wet market, health care facilities, veterinary care facilities (S)

- Regulatory system for enforcement of laws, ensuring compliance with adequate funding and capacity (M)
- Adopt progressive pathways to improve management (S-M-L)
- Develop incentives and disincentives for compliance including performance benchmarks and rating system (such as through pond and farm health cards) (S)

- Training and hand-holding on biosecurity (S)
- Sector-specific manuals and guidelines on progressive management pathways to improve environment management (M)
- Inclusion of biosecurity in farmer-field school curriculum or similar such approaches (S)

- Database on biosecurity compliance performance/rating system (depending on local circumstances decision on public disclosure can be made) (M)

- Review of progressive pathways to improve biosecurity management (S-M-L)
- Review of guidelines for their success and impact (S-M-L)

Review/monitoring/feedback
# Waste management

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<th>Policy/Law/Regulations/Standards/Programmes</th>
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<tbody>
<tr>
<td>• <strong>Adopt/develop</strong> standards for antibiotic residues and microbial quality in effluent and solid waste from industries, sewage treatment plants, farms, health care facilities, processing units, slaughter houses (S)</td>
</tr>
<tr>
<td>• Policy on <strong>Extended Producers Responsibility</strong> for expired antibiotics (S)</td>
</tr>
<tr>
<td><strong>Implementation tools - Infrastructure/Capacity/Systems/Resources</strong></td>
</tr>
<tr>
<td>• <strong>Standard Operating Procedures (SOPs)</strong> on waste management for industries, sewage treatment plants, farms, health care facilities, processing units, slaughter houses, wet market, feed manufacturers (S)</td>
</tr>
<tr>
<td>• Regulatory system for enforcement of laws, ensuring compliance with adequate funding and capacity (M)</td>
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<td><strong>Advocacy/Awareness and Education/Training/Curriculum</strong></td>
</tr>
<tr>
<td>• <strong>Stakeholder training</strong> on waste management guidelines and SOPs (S)</td>
</tr>
<tr>
<td><strong>Record keeping/Database generation/Collation/Dissemination and Research/Survey</strong></td>
</tr>
<tr>
<td>• <strong>Online database</strong> on waste discharge quality, rating system, compliance/non-compliance (M)</td>
</tr>
<tr>
<td>• Development of success/failure indicators/milestones as part of review framework (M)</td>
</tr>
<tr>
<td>• Compliance status with review framework (S-M-L)</td>
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<tr>
<td><strong>Review/Monitoring/Feedback</strong></td>
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Managing AMR in the environment

Approach for surveillance

1. Identify target bacteria and antibiotics

2. Identify sampling location, sample type, sample size, collector

3. Standardize and harmonize testing method(s)

4. Develop and operationalise laboratory network(s)

5. Harmonized data analysis and period reporting, available in public domain
Thank you

Amit Khurana
Programme Director
Food Safety and Toxins, CSE
k_amit@cseindia.org

Rajeshwari Sinha
Deputy Programme Manager
Food Safety and Toxins, CSE
s_rajeshwari@cseindia.org

Bhavya Khullar
Programme Officer
Food Safety and Toxins, CSE
bhavya.khullar@cseindia.org

Divya Khatter
Programme Officer
Food Safety and Toxins, CSE
divya.khatter@cseindia.org
• Defines “**Bio-medical waste**” as any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological and including:
  − Discarded Medicines and Cytotoxic drugs (waste comprising of outdated, contaminated and discarded medicines) among others

• Defines “**Municipal Solid Waste**” as commercial and residential wastes generated in a Municipal or Notified Local Body in either solid or semi-solid form excluding industrial hazardous waste but including **properly and fully treated bio-medical waste**

• Defines “**Solid waste**” as solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, **treated bio-medical waste** excluding industrial waste, biomedical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities and other entities mentioned in rule 2;
Status in India

No-limited awareness – environmental policymakers and regulators

- Historic focus on pesticides, heavy metals etc.
- Understanding limited to antibiotic residues in pharma waste – but more as an industrial waste; no standards and monitoring though
- Limited laboratory preparedness on microbiology-related aspects

Lack of monitoring

- No surveillance or monitoring of waste from pharmaceutical industry, intensive animal farm, hospitals for antibiotic residue or resistant bacteria
Drivers of Antimicrobial Resistance

- Water, Sanitation & Hygiene: Lack of access to clean water, sanitation and hygiene; poor infection and disease prevention and control in health care facilities and farms.
- Environment: Discharge of waste from health care facilities, pharmaceutical manufacturing and farms.
- Plants & Crops: Misuse and overuse of antimicrobials; poor infection and disease prevention and control.
- Humans: Misuse and overuse of antimicrobials; poor access to quality, affordable medicines, vaccines and diagnostics; lack of awareness and knowledge; population movement.
- Terrestrial & Aquatic Animals: Misuse and overuse of antimicrobials; poor access to quality, affordable medicines, vaccines and diagnostics; lack of awareness and knowledge; movement of animals.

Impact of Antimicrobial Resistance:
- Risks to food and feed production, businesses and trade; interaction with climate change.
- Increased morbidity and mortality in humans and animals.
- Economic damage, loss of productivity and increased health care expenditures.

Source: No Time to Wait: Securing the future from drug-resistant infections
“Although evidence remains limited, concerns are also growing about the impact of antimicrobial resistance on the environment and natural ecosystems due to overuse and discharge of antimicrobials and resistant micro-organisms in manure and waste from health care facilities and pharmaceutical manufacturing, commercial livestock and plant production, and fish and seafood farming, a problem that may be fuelled by changes in the world’s climate.”

“No Time to Wait: Securing the future from drug-resistant infections (IACG’s final report to the UN Secretary General)