

# State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD)



*Developed jointly by key stakeholders*

Department of Health and Family Welfare; Development Department; Drugs Control Department; Delhi State Health Mission; Department of Animal Husbandry; Department of Food Safety; DPCC; Delhi Jal Board; Directorate of Agricultural Marketing; Department of Social Welfare; Women and Child Development Department; Department of Education; Directorate of AYUSH; Directorate of Information and Publicity; IDSP; MCD; NDMC; State Disease Control Programmes; Delhi State Medical, Nursing, Dental and Pharmacy Councils; medical, agricultural and veterinary colleges and universities; CSE; DSPRUD; FAO; FSSAI; HISI; IAMM; NCDC; WHO



# State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD)



Directorate General of Health Services  
Department of Health and Family Welfare  
**Government of NCT of Delhi**  
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## Message from Chief Minister

Antibiotics are a very powerful weapon for treating many of the most common infectious diseases, but they also present a problem: bacteria eventually develop resistance to antimicrobial agents as they evolve to survive. The misuse and overuse of antibiotics is rampant in India, resulting in “super bugs” that are resistant to all known types of drugs. The severity and frequency of drug-resistant infections will only increase if the current rate of antibiotic misuse continues threatening to reverse all medical progress made so far. There are several subtle factors at play which contribute to the growing AMR such as indiscriminate use of antibiotics not only in the human sector but also in veterinary practice, animal husbandry, agriculture and food industry. The State Action Plan has been developed as a comprehensive state-level mechanism with multi-sectoral, multi-ministerial collaboration and engagement of all sectors as no individual sector has the capacity to address this major public health problem alone.



It is a moment of pleasure and pride to launch the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD) which has been developed to ensure an integrative approach for fighting AMR. I congratulate the Department of Health for taking the lead and am glad to acknowledge the support provided by the World Health Organization Country Office to bring together all the concerned departments with a “One Health” approach.

I urge all the stakeholders to work in unison to implement the State Action Plan and to achieve all the objectives in a time-bound manner. I assure full support of the government for multi-ministerial collaboration and engagement of all sectors required to preserve the efficiency of the precious antimicrobial drugs for the present and future generations.

(Shri ARVIND KEJRIWAL)

## Message from Health Minister

Antibiotics – the most important discovery of the Twentieth century – have transformed healthcare and have played a critical role in treating infectious diseases. However, overuse and misuse of antibiotics have led bacteria to change their response to antibiotics, i.e. infections can no longer be treated by first-line antibiotics, requiring more expensive medicines and higher mortality, longer duration of illness and treatment, hospitalization, increased healthcare costs as well as the economic burden on families and societies. A growing list of infections – such as pneumonia, tuberculosis, blood poisoning, gonorrhoea, and food-borne diseases – are becoming harder, and sometimes impossible, to treat as antibiotics become less effective. If these trends continue antibiotic resistance will put the achievements of modern medicine at risk and organ transplantations, chemotherapy and surgeries such as caesarean sections will become much more dangerous without effective antibiotics for the prevention and treatment of infections.



Although antibiotic resistance occurs naturally, it is accelerated by the misuse and overuse of antibiotics, as well as poor infection prevention and control. Antibiotics are also in addition being used in healthy animals, poultry, agriculture to increase yield and antibiotic-resistant microorganisms are finding ways to contaminate the entire environment and ecosystems. Unless immediate steps are taken at all levels of society using an integrative, comprehensive and preventive “One Health” approach, this highly complex and multifaceted issue will threaten human and animal health, food safety, the global economy, national and global security. Antibiotic use is the major driver for antimicrobial resistance and rational antibiotic use is the only sustainable solution.

I applaud the joint efforts of the Department of Health and Directorate of Health Services together with the WHO Country Office for India to call upon wide consultation with all the stakeholders, institutes of excellence, professional associations, NGOs and civil society to put in their best efforts to formulate the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD) by identifying the current gaps and way forward to tackle this problem effectively.

We will ensure the collaboration amongst various sectors and provide the necessary resources required for implementation of SAP-CARD.

(Shri SATYENDAR JAIN)



## Message from Chief Secretary

Antibiotics have transformed healthcare around the world – making once deadly diseases treatable and saving millions of lives. These lifesaving medicines are increasingly being used inappropriately leading to the problem of antibiotic resistance and have become a major public health problem. Improper utilization of antibiotics especially in high disease-burden settings and for non-therapeutic use as in the veterinary sector, food, agriculture and environmental contamination are major factors for accelerating AMR.



The “One Health” approach is an integrated overarching approach to harmonize immediate action involving multiple sectors in designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes.

I am happy that the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD) has been developed by engaging all key stakeholders including policy-makers, regulators, administrators, quality officers, scientists, and technical experts from healthcare, animal husbandry, agriculture, food, municipal corporations, industries, professional associations, NGOs and civil society.

I congratulate the Department of Health and especially the Directorate of Health Services together with the World Health Organization (WHO) Country Office for India and the Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) for taking the lead and organizing a multi-sectoral multi-stakeholder workshop in August 2019 to get their inputs to address this complex issue.

The sustainability of SAP-CARD depends on the extent of the implementation of the plan by the joint effort of all the stakeholders. I look forward to the plan being implemented efficiently across all sectors and at all levels wherever antibiotics are used which can be achieved by continued communication, collaboration and public engagement.

I assure all support for implementation of this plan and wish all success to stakeholders in their endeavour to combat antimicrobial resistance in Delhi.

(Shri VIJAY KUMAR DEV)

## Message from Principal Secretary (Health)

Antibiotics are a precious resource and all current progress in health can be attributed to antibiotics. Antibiotics are lifesaving for serious infections. The problem of resistance to antibiotics has attained the magnitude of major public health problem and is threatening reversal of medical progress. AMR is an inter-sectoral issue and has potential to derail all developmental activities and achievements. Addressing this challenge requires a proactive, integrated and aggressive approach.



I congratulate the Directorate of Health Services, Government of Delhi for organizing the State workshop in August 2019 with 120 stakeholders from various sectors who contributed towards the development of the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD) in collaboration with the World Health Organization (WHO) Country Office for India and the Delhi Society for Promotion of Rational Use of Drugs (DSPRUD). I am happy to see the motivation of all the stakeholders and the linkages established between different sectors as captured in the “One Health” approach.

I believe that the overuse and misuse of antibiotics can be curtailed with the effective implementation of SAP-CARD. We will need continuous engagement and coordinated mechanisms for all sectors – including human and non-human – agriculture, food, animal husbandry, enforcing strong regulatory mechanisms (drugs and food safety), public–private partnership for rationalizing antibiotic use and monitoring antimicrobial resistance.

The implementation of SAP-CARD depends on the attitude of all the stakeholders in the programme and support for its long-term sustainability.

I wish all success to stakeholders in their endeavour to implement this plan and to combat antimicrobial resistance in Delhi.

(Shri SANJEEV KHIRWAR)

## Message from WHO Representative to India

Antimicrobial resistance (AMR) is a serious threat to global public health. It is estimated that the current 700,000 annual deaths due to AMR are likely to increase to 10 million deaths by 2050 (nearly 4.8 million in the Asia-Pacific region), with a 3.5% impact on global gross domestic product (GDP).



Combating AMR requires proactive action across all government sectors and the society. An effective response requires coordinated action and the Global Action Plan on AMR (GAP-AMR) was endorsed by the World Health Assembly in 2015. AMR is also a flagship priority of WHO Regional Office for South-East Asia.

WHO has supported the Ministry of Health & Family Welfare in establishing and operationalizing the governance mechanisms for AMR — the intersectoral coordination committee, technical advisory group and core working group — to develop the National Action Plan on AMR (NAP-AMR). India's NAP-AMR exemplifies the One Health approach and is closely aligned to GAP-AMR in context of India's needs and priorities.

We are also supporting the development of State Action Plans for Containment of Antimicrobial Resistance (SAPCAR), expanding and standardising AMR surveillance networks, raising awareness about AMR, strengthening infection prevention and control in healthcare facilities, surveillance of antimicrobial consumption, Indian Priority Pathogen List, as well as coordinating donor and partner support for the containment of AMR in India.

WHO congratulates the Delhi Government for developing the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD) and is committed to supporting and collaborating with all stakeholders for the containment of AMR in India.

(Dr HENK BEKEDAM)

## Message from Director NCDC

The National Health Policy 2017 identifies antimicrobial resistance as a problem and calls for effective action to address it. National Centre for Disease Control (NCDC) is the national coordinating center for Global AMR Surveillance System (GLASS) and focal point for implementation and coordination of the National Action Plan.



NCDC is coordinating the “National Programme on Antimicrobial Resistance Containment” initiated during the 12th five-year plan. Under the programme a network of state medical college laboratories across the country are being strengthened in a phased manner for generating quality Antimicrobial Resistance (AMR) surveillance data in order to understand the AMR trends in various geographical regions through a sentinel surveillance platform. NCDC is reporting the annual data to GLASS since 2017.

Health is a state subject under the Indian Constitution and every state has to develop its own State Action Plan depending on their situation, and challenges. Two other states namely Kerala and Madhya Pradesh have developed their own state action plan and I am happy that Delhi has also joined in and developed state action plan with consultation of multi-sectoral stakeholders as a key requirement under one health approach for containment of AMR.

The success and sustainability of state action plan will depend upon the extent the plan is implemented. It is my sincere hope that SAP-CARD is efficiently implemented at all the levels of antibiotic use and Delhi emerges out as a model for the entire nation in effective implementation of the plan.

(Dr SUJEET SINGH)

## Message from Director General Health Services

Antibiotics are crucial for treating infectious diseases, but these lifesaving drugs are losing their efficacy due to antimicrobial resistance (AMR). India has some of the highest rates of AMR among bacteria commonly causing infections in the community and healthcare facilities. The threat of AMR is rapidly progressing and has become a global public health concern. This has also been flagged as an international and national priority requiring immediate comprehensive action to reduce the prevalence and spread of AMR. AMR in India came into limelight with the discovery of superbugs harbouring New Delhi metallo- $\beta$ -lactamase (NDM-1) gene in 2010, igniting much needed discussion and action on AMR at the global and national level.



Health being a state subject, each state needs to develop their own State Action Plan to Combat Antimicrobial Resistance as one of the priorities under the National Action Plan on Antimicrobial Resistance (NAP-AMR). Kerala and Madhya Pradesh have endorsed their state-specific action plans and are implementing them with a One Health approach.

I am happy that Government of Delhi is also launching the State Action Plan to Combat Antimicrobial Resistance in Delhi State (SAP-CARD). Developing SAP-CARD was particularly challenging in view of Delhi's unique challenges – high population density, large floating population, diverse infrastructure ranging from primary health centres to secondary and tertiary care hospitals in both public and private sector. The major reasons for emergence of antibiotic resistance is inappropriate use of antibiotics by healthcare practitioners with over the counter sale of antibiotics and poor regulatory mechanisms on sale of schedule H1 antibiotics. Antibiotics are not only used indiscriminately in hospitals but are also used in community requiring surveillance of antibiotic use and resistance in both settings. Antibiotics are also being misused in agriculture leading to supply of antibiotic-laden foods. The handling of sewage waste in treatment plant, domestic waste, disposal of pharmaceutical products are other major issues that need concerted and collaborative efforts across various departments.

I take this opportunity to thank all those who actively contributed towards finalization of SAP-CARD. I look forward to its implementation by all stakeholders, especially in the healthcare facilities in Delhi, at all levels.

(Dr SUNIL M. RAHEJA)

## Message from Chief Coordinator AMR Containment

Antibiotics are miracle drugs of this century; however, due to misuse and overuse of antibiotics these miracle drugs are losing their efficacy due to development of resistance. This problem of antibiotic resistance is one of the world's most pressing health problems. The overuse and misuse of antibiotics are key factors accelerating development of antibiotic resistance. Antibiotics are not only used indiscriminately in humans but are also used in non-human sector for various reasons.



To tackle this problem, multi-sectoral, multi-ministerial collaborative meetings of the technical committee and advisory committee were organized followed by stakeholder mapping and preparation of the draft state action plan focusing on problems and challenges specifically faced in Delhi. To finalize the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD) a State Workshop was organized in August 2019 in collaboration with WHO and DSPRUD in which 120 experts from various departments and sectors including veterinary, agriculture, municipal corporation, jal board, pollution control, etc. participated in the workshop.

The State Action Plan has been developed as a comprehensive state-level mechanism with engagement of all sectors as no individual sector has the capacity to address this major public health problem alone.

I take this opportunity to thank all the members of the technical committee and advisory committee and all those who actively contributed towards finalization of this document. The general public, doctors and hospitals all play a role in ensuring proper use of the medications and minimizing the development of antibiotic resistance. I look forward to continuing inter-sectoral collaboration and support for its implementation across all sectors and at all levels.

(Dr RAVINDRA AGGARWAL)

## Message from Nodal Officer AMR Containment

The Delhi Declaration on Antimicrobial Resistance (AMR) was endorsed by Ministers of Environment Forest and Climate Change, Health and Family Welfare, and Food and Public Distribution at the Inter-Ministerial Consultation on Antimicrobial Resistance on 19 April 2017.



Delhi State has been working on containment of AMR through its state AMR committees for stakeholder engagement and ownership, as well as oversight and monitoring of activities. The Advisory Committee on AMR provides policy-level guidance and oversight for AMR containment in Delhi and the Technical Committee on AMR provides strategic and operational guidance and support for AMR containment in Delhi, with the “One Health” approach.

Several meetings of the Advisory and Technical Committees were held to formulate the State Action Plan to Combat AMR in Delhi (SAP-CARD). This action plan was finalized through discussions at the State Workshop held in August 2019 with all major key stakeholders including policy-makers, regulators, administrators, quality officers, scientists, and technical experts from healthcare, animal husbandry, agriculture, food, municipal corporations, industries, professional associations, NGOs and civil society. Strategic priorities along with key focus areas have been identified for overall coordination and surveillance, research, infection prevention and control, antimicrobial stewardship for AMR containment.

The Department of Health and Family Welfare and Directorate of Health Services are committed to the cause and confident that effective operationalisation of the SAP-CARD in all sectors would achieve specific results to combat antimicrobial resistance. We are optimistic that this action plan will become a base document and will be implemented in letter and spirit by all the stakeholders in unison and will be revised according to the emerging needs and evidences. I on behalf of the AMR committee would like to place on record the support received from WHO Country Office and experts who lent their time and expertise towards the preparation of this document.

(Dr SANGEETA SHARMA)





## Acknowledgements

We would like to express our special thanks for providing the guidance and oversight provided by Hon'ble Chief Minister Shri Arvind Kejriwal, Hon'ble Minister for Health & Family Welfare Shri Satyendar Jain, Chief Secretary Shri Vijay Dev, and Principal Secretary (Health & Family Welfare) Shri Sanjeev Khirwar.

Special thanks to Dr Ashok Kumar, former Director General Health Services for spearheading the development of the SAP-CARD. We also gratefully acknowledged the guidance and support provided by Dr Sujeet Singh, Director, National Centre for Disease Control and other senior officials from Ministry of Health and Family welfare, Government of Delhi to develop the State Action Plan to Combat Antimicrobial Resistance in Delhi.

We are grateful to the members of the Advisory & Technical Committees for their inputs and suggestions without which this action plan could not have been developed. We are also thankful for the inputs provided by officials and experts from various sectors including agriculture, food safety, FSSAI, veterinary sciences, Central Pollution Control Board, Delhi Pollution Control Committee, Delhi Jal Board, experts from medical colleges & hospitals, Indian Institute of Technology, AYUSH, Dept of Drugs Control, State Health Mission, professional councils/universities, professional associations & societies, civil bodies, pharmaceutical industry and municipal corporations.

Overall technical coordination, documentation and financial support was provided by World Health Organization Country Office for India. Dr Anuj Sharma, Technical Officer – AMR, Health Labs, WHO Country Office India, Dr Ravindra Aggrawal, Additional Director General, Directorate General Health Services, Government of NCT of Delhi and Dr Sangeeta Sharma, Professor, Department of Neuropsychopharmacology, Institute of Human Behaviour and Allied Sciences (IHBAS) and President, Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) coordinated all activities to develop the draft and final versions of SAP-CARD with active support from Dr Vikas Manchanda, Associate Professor, Department of Microbiology, Maulana Azad Medical College and Dr Renu Gupta, Assistant Professor, Department of Microbiology, IHBAS and Secretary, DSPRUD.

## Abbreviations and acronyms

AMR	antimicrobial resistance
AMU	antimicrobial use
AMSP	Antimicrobial Stewardship Programme
BMW	biomedical waste
CSE	Centre for Science and Environment
CSIR	Council of Scientific and Industrial Research
DMA	Delhi Medical Association
DPCC	Delhi Pollution Control Committee
DSPRUD	Delhi Society for Promotion of Rational Use of Drugs
FSSAI	Food Safety and Standards Authority of India
HAI	healthcare-associated infection
HICC	Hospital Infection Control Committee
HISI	Hospital Infection Society – India
IAMM	Indian Association of Medical Microbiologists
ICAR	Indian Council of Agriculture Research
ICMR	Indian Council of Medical Research
ICN	infection control nurse
IDSP	Integrated Disease Surveillance Programme
MCD	Municipal Corporation of Delhi
MoEFCC	Ministry of Environment, Forest and Climate Change
NABH	National Accreditation Board of Hospitals
NAP-AMR	National Action Plan on Antimicrobial Resistance
NCDC	National Centre for Disease Control
NGO	non-governmental organization
NHM	National Health Mission
NQAS	National Quality Assurance System
OTC	over the counter
SAP-CARD	State Action Plan to Combat Antimicrobial Resistance in Delhi
EQAS	External Quality Assessment Scheme
WHO	World Health Organization
WINSAR-D	WHO-IAMM Network for Surveillance of Antimicrobial Resistance in Delhi

## Executive summary

The threat posed by antimicrobial resistance (AMR) to public health is a priority under the Global Action Plan on AMR (GAP-AMR) and the United Nations resolution on AMR. The Government of India has also identified AMR as one of the priorities for collaboration in the World Health Organization (WHO) India Country Cooperation Strategy 2019–23. The WHO Country Office for India supported the Ministry of Health and Family Welfare in developing and finalizing the National Action Plan on AMR (NAP-AMR), and the Delhi Declaration on AMR. These were endorsed at the Inter-Ministerial Consultation on AMR in New Delhi on 19 April 2017, and outline the Government of India's commitment for AMR containment with the One Health approach. Since health is a state subject under the Indian Constitution, the NAP-AMR identifies development of State Action Plans for Containment of Antimicrobial Resistance (SAP-CAR) as one of its priorities.

The Government of Delhi is committed to take suitable action to address AMR by inter-sectoral collaboration with all stakeholders to develop and implement a State Action Plan on AMR, in alignment with the NAP-AMR and the GAP-AMR.

Two AMR committees have been notified by the Government of Delhi for stakeholder engagement and ownership, as well as oversight and monitoring of activities. The Advisory Committee on AMR provides policy-level guidance and oversight for AMR containment in Delhi and the Technical Committee on AMR provides strategic and operational guidance and support for AMR containment in Delhi, with the One Health approach.

A workshop was jointly organized by the Government of Delhi, the WHO Country Office for India and the Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) in August 2019, which was attended by more than 120 participants from multiple sectors and contributed to the development of the State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD). The Hon'ble Health Minister, Shri Satyendar Jain, Chief Secretary, Shri Vijay Dev and Principal Secretary (Health and Family Welfare), Shri Sanjeev Khirwar, Government of Delhi, have reiterated Delhi government's commitment to tackle AMR.

The SAP-CARD identifies the current situation of AMR, key issues and challenges to be addressed, strategic objectives/interventions and activities in alignment with NAP strategic priorities for AMR containment in Delhi as well as key outputs and stakeholders responsible for implementation.

## Strategic priorities

Based on Delhi's needs and priorities, and in alignment with NAP-AMR, six strategic priorities are identified within SAP-CARD:

1. Improve awareness and understanding of AMR among all stakeholders through effective communication, education and training
2. Strengthen knowledge and evidence through surveillance
3. Reduce the incidence of infection through effective infection prevention and control
4. Optimize the use of antimicrobial agents in health, animals and food
5. Promote investments for AMR activities, research and innovation
6. Strengthen collaboration to contain AMR

Strategic priority 1 focuses on improving awareness and understanding of AMR through effective communication, education and training, and has two focus areas – first is information, education, communication (IEC) resources to raise awareness among all stakeholders, and the second focus area is education and training to improve the knowledge, skills and behaviour of professionals in all sectors.

Strategic priority 2 aims to strengthen knowledge and evidence through surveillance of AMR, with two focus areas – strengthening microbiology laboratory capacity to detect AMR in the human, animal, food and environment sectors as well as strengthening surveillance for AMR in humans, animals, food and environment.

Strategic priority 3 attempts to reduce the incidence of infection through effective infection prevention and control in healthcare, animal health and food to reduce spread of AMR and antimicrobials through animals and food, and in community and environment to reduce the spread of AMR and antimicrobials in the environment.

Strategic priority 4 aims to optimize the use of antimicrobial agents in humans, animals and food through regulated access to high-quality antimicrobials, as well as improve appropriate use of antimicrobials in healthcare, animals and agriculture.

Strategic priority 5 aims to promote research and innovation for AMR containment through new medicines and diagnostics, innovation to develop alternative approaches to manage infectious diseases, and promote sustainable financing to ensure adequate resources for containment of AMR.

Strategic priority 6 focuses on strengthening collaborations within the state to contain AMR by establishing inter-departmental collaborations in the Government of Delhi,

strengthening and streamlining intra-state collaborations on AMR, organizing annual consultations on AMR with key stakeholders, including disease control programmes in Delhi to share information and facilitate coordinated action and mobilization of resources for AMR activities and establishing partnership with the private sector, professional associations and civil society organizations.

The monitoring and evaluation framework is an integral part of SAP-CARD and indicators have been developed for each strategic priority identifying inputs, processes, outputs and outcomes at the programme level and population.

### Expected outcomes

- Raising awareness and capacity development regarding AMR in Delhi
- Strengthening of microbiology laboratories for AMR surveillance and enhance the management of surveillance data in humans, animals, food and environment
- Strengthening of the state regulatory authority with restriction of antimicrobials for non-therapeutic use in humans, animals, agriculture and food industry
- Better understanding of transmission dynamics and AMR mechanisms
- Significant reduction of the AMR burden in Delhi in 5 years

## Background

Overuse, misuse and irrational use of antimicrobials are the key contributors to antimicrobial resistance (AMR). Antibiotics are used indiscriminately for prophylactic, therapeutic and non-therapeutic uses in humans, animals, horticulture and fisheries. The use of animal manure in soil and inadequate treatment of effluents from healthcare facilities, pharmaceutical industry, farms and discarded medications from household in the community also contribute to the problem of environmental contamination by antimicrobial-resistant pathogens and antibiotic residues.

AMR is identified as a national priority by the Government of India, and the National Action Plan on AMR (NAP-AMR), which was endorsed at the Inter-Ministerial Consultation on Antimicrobial Resistance in New Delhi on 19 April 2017, outline the Government of India's commitment for AMR containment with the One Health approach.<sup>1</sup>

Since health is a state subject under the Indian Constitution, the NAP-AMR identifies development of State Action Plans for Containment of Antimicrobial Resistance (SAP-CAR) as one of its priorities. The Government of Delhi is committed to take suitable action to address AMR by inter-sectoral collaborations with all stakeholders to develop and implement a State Action Plan on AMR, in alignment with the NAP-AMR and the Global Action Plan on Antimicrobial Resistance (GAP-AMR).<sup>2</sup>

## Current situation of antimicrobial resistance in Delhi

Delhi, the National Capital Territory (NCT) of India, is a large metropolitan area spanning around 1484/sq.km. The population of NCT of Delhi as per the Census 2011 was 16,787,941. The population density of the city is 11,320 persons per sq.km, which is one of the highest in the world. The total slum population is 1,785,390, which is 10.6% of the total population. The floating population is around 0.4 to 0.5 million.<sup>3</sup>

Antibiotics are used indiscriminately for humans, animal health, and as a growth promoter in farming for crops, poultry, vegetables and food. Antibiotics find their way in the river and water bodies, surface and ground water from untreated human and animal waste as well as pharmaceutical industries.

### Human health

There are a large number of healthcare establishments in Delhi. Based on applications received by the Delhi Pollution Control Committee (DPCC), there are approximately 2,070 healthcare facilities across Delhi with 37 government hospitals (10,926 beds), 180 Delhi Government dispensaries, 25 polyclinics, 201 *mohalla* clinics, 59 primary urban health centres (PUHC), 933 registered private hospitals and nursing homes along with numerous unregistered clinics and diagnostic labs. In addition, many patients from other states and abroad visit the NCT for medical/surgical treatment.

Nearly half of the admitted patients receive antibiotics in some form for treatment of infectious or non-infectious diseases in both the public and private sectors. Antibiotics are many times prescribed without adhering to the standard treatment guidelines. Numerous factors such as heavy patient load, insufficient time for consultation or counsel patients, perceived patient demand, diagnostic uncertainty, over-reliance on antibiotics, inadequate infection prevention and control (IPC) practices, fear of losing patients, economic incentives from pharmaceutical companies and lack of continuing medical education are key drivers for irrational antibiotic use. Self-medication, easy access to antibiotics without prescription and informal healthcare providers also contribute to overuse of these precious medicines.

Besides these, there is free accessibility to antibiotics in both public and private healthcare facilities including easy over-the-counter availability of all types of antibiotics. In Delhi state, in the public sector, supply chain of all antibiotics is well maintained but without focus on rationality of use. Some broad spectrum, high-end second and third

generation antibiotics, irrational antibiotic fixed-dose combinations are easily available at the secondary care facilities but are not available at some tertiary care facilities. Pricing of antibiotics is also a problem which promotes the use of some antibiotics especially fluoroquinolones, viz. gemifloxacin, a reserved medicine is priced lower than first-line antibiotics such as amoxicillin + clavulanic acid, azithromycin, and cefuroxime axetil, thus leading to its rampant misuse.<sup>4</sup>

The last resort antibiotics such as carbapenems are being prescribed without any specific indication, thus limiting their usefulness to treat serious infections. Moreover, antibiotics which have been withdrawn or not approved in the developed world due to lack of evidence or immense potential to harm human microbiome are being used in India. Faropenem, the only orally available carbapenem has not been approved in the United States of America but is being used widely in India. The consumption of faropenem increased 154% between 2010 and 2014, according to data obtained from IMS health – exceeding use of all other carbapenems combined over the same period.<sup>5</sup>

### **Animal health, husbandry, food/food products of animal origin**

Antimicrobial drugs in veterinary practice are primarily prescribed for the purposes of maintaining or improving animal health and are also misused for increasing growth, productivity in farm animals for meat and food products. Antibiotics are also used to prevent morbidity and mortality during transport to slaughter houses. Diseases such as bovine mastitis and endometritis are treated indiscriminately by dairy workers and farmers, who give antimicrobials on their own because of multiple factors.

In Delhi, there are 77 government veterinary hospitals and dispensaries. Civil society and media reports indicate the presence of numerous unregistered dairy farms and slaughter houses in Delhi that are said to function in sub-standard conditions.<sup>4</sup> There are only a handful of registered dairy colonies (10), slaughter house (only 1), dairy processing plants (10), and abattoirs cum meat processing plants (12).<sup>6,7</sup> Antibiotics are used indiscriminately and waste from these unregistered, illegal establishments goes untreated into the environment. Also, there is no dearth of wet markets across Delhi which sell antibiotic-laden fish, meat, etc.

In 2010, the Centre for Science and Environment (CSE) tested 12 brands of honey samples from Delhi for the presence of 6 antibiotics – ampicillin, chloramphenicol, ciprofloxacin, enrofloxacin, erythromycin and tetracycline. Most of the samples tested positive for these six antibiotics.<sup>8</sup> In 2014, CSE collected 70 chicken meat samples



from Delhi NCR and tested them for the presence of six antibiotics widely used in poultry.<sup>9</sup> The antibiotics tested were oxytetracycline, chlortetracycline, doxycycline, enrofloxacin, ciprofloxacin and neomycin. Forty per cent of the samples tested were positive for five of these six antibiotics.<sup>10</sup>

Fast food products sold in Delhi have a potential to contain antibiotic residues and contribute to AMR.<sup>11</sup> In 2017, CSE highlighted double standards of antibiotic use in food supply chain by multinational fast food companies wherein their parent countries are using antibiotic-free foods, but in India they are marketing food containing antibiotic residues.<sup>11</sup> Chicken meat procured by these fast food giants are sourced from farms using antibiotics. However, a pilot study recently done by the food department (2019) found antibiotic levels below detection limits in 58 randomly collected samples from commonly used food items such as honey, chicken, egg, meat and milk.<sup>10</sup>

## Agriculture

Delhi is a consumer state and procures a major share of its food products from its neighbouring states. Delhi does have agriculture-allied activities such as crop agriculture, bee keeping, aquaculture, dairy and animal husbandry. Owing to possible antibiotic use practices during food production in different states, the food consumed in Delhi could contain antibiotic residues, antibiotic-resistant bacteria or resistance conferring genes.

Antibiotics are being used rampantly on crops grown in the Yamuna belt.<sup>12</sup> Streptocycline (9:1 mixture of streptomycin and tetracycline) is the commonest antibiotic used on crops grown along the Yamuna bank. Antibiotics/antimicrobials are marketed by pesticide dealers as fungicides and misused in much higher doses and frequency beyond the approved limits. Therefore, antimicrobials enter the food chain, reaching human and animal gut readily.

## Antibiotics in environment

Antibiotics find their way into environment vide many routes, e.g. from healthcare establishments, animal waste, farms, household (municipal) waste and disposal of unused expired drugs. All of these add to the growing reservoir of AMR determinants in the environment. CSE in 2018 demonstrated pan drug resistant *E. coli* isolate from a heavily polluted Delhi stretch of river Yamuna. In 2018, researchers from the Indian Institute of Technology (IIT) Delhi found high levels of carbapenem-resistant bacteria and *bla*NDM-1 in waste water effluent from hospitals, sewage treatment plants, drains

and five locations along the Yamuna River in Delhi. In 2018, a multi-institutional study found a pan drug-resistant *E. coli* isolate from a heavily polluted stretch of river Yamuna in Delhi, which was resistant to 20 of the 21 antibiotics tested. Uninhibited presence of antimicrobials of different classes and generations in huge quantities, contributes to selection of multidrug-resistant microbes which then become the prevalent species.<sup>13</sup>

Approximately 25,000 kg of biomedical waste is generated in Delhi per day (as per DPCC estimates). Inappropriate management of biomedical waste is a very important source of environmental spread of drug-resistant microbes besides being a high risk for acquisition of infections for patients and healthcare workers alike. On-site effluent treatment plants are not tuned to address resistant bacteria, antibiotic residues or genes leading to deposition directly into surface water. Leachate from septic systems and landfills is released into the unsaturated zone and depending on soil conditions it may seep into ground water or spread laterally until it meets a stream or other surface water.<sup>14</sup>

A large amount of animal waste is going untreated into the environment from carcasses, blood, faeces, processing waste, etc. Nearly 10,050 tons of solid waste is collected by municipal authorities of Delhi per day, of which about 60% is incinerated or composted, and remaining goes untreated and is dumped in landfills.<sup>5</sup> Many houses in Delhi are not properly connected to a sewage network and only 13% of sewage is treated in sewage treatment plants (STPs) and very large proportions of untreated sewage water enters the river. Nearly 911 million gallons waste water and 720 million gallons sewage are generated per day in Delhi. Only 13% of the sewage is treated in STPs, and a large proportion of sewage waste is released into the environment. Close to 860 million gallons of untreated and treated sewage is discharged into the Yamuna in a day, making it one of the most polluted rivers of the country.<sup>3,15</sup>

Inappropriate disposal of drugs including expired or unused antibiotics across supply chain (e.g. dealers, sellers, users, etc.) is another area of concern. Large amounts of unused/unexpired drugs are often disposed improperly into open drains/nullahs, buried or dumped underground, burned or disposed along with regular household waste. In Delhi, there is no extended producers' responsibility (EPR) of pharmaceutical companies to take back unused/expired drugs and there are no regulations. Also, waste water from farms containing antibiotic-laden manures and unspent antibiotic run-offs into the Yamuna river and this water is again used for irrigation of agricultural farms resulting in potential for contamination of crops with resistant bacteria and/or residues.<sup>11,12</sup> In

2017, CSE reported presence of resistant bacteria in waste and environmental samples in and around poultry farms situated in Uttar Pradesh, Rajasthan, Haryana and Punjab. Antibiotic use in these farms was also reported. Poultry products from these states is brought to Delhi for meat consumption, which could be a potential route for spread of AMR determinants (antibiotic residues, resistant bacteria) in Delhi.<sup>10,15,16</sup> In 2016, CSE highlighted antibiotic misuse and inappropriate waste management practices in aquaculture through a case study in West Bengal. Fish from other states are brought to Delhi for local consumption; these may contain antibiotic residues and could also likely contribute to AMR.<sup>17</sup>

## Current initiatives towards containment of AMR in Delhi

### Awareness, education and training

#### *Human health*

- Numerous reports, guidelines, policies and regulations addressing the burden of AMR with mitigation strategies are in place, e.g. AMR and its containment in India,<sup>18</sup> scoping report on burden of AMR, NCDC guidelines, ICMR guidelines, implementation guidelines for the *Kayakalp* programme, antibiotic policies based on local antibiogram in individual healthcare facilities.<sup>19</sup>
- There is increased emphasis on induction training and in-service training for IPC and biomedical waste management in all healthcare facilities.
- The Indian Association of Medical Microbiologists (IAMM) is actively involved in increasing awareness about AMR and rational use of antibiotics among doctors, medical and nursing students and technical staff. Awareness programmes for patients and hospitals visitors have been conducted regularly. Few educational programmes with school children have also been conducted. Regular on-going trainings are conducted by various medical institutes of repute on various topics such as antimicrobial susceptibility testing, WHONET, surveillance for AMR and infection control under the banner of IAMM-Delhi Chapter.
- The Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) has developed materials for patient/public education focusing on addressing beliefs and misconceptions about antimicrobial treatment, self-medication, and poor medication adherence. These messages have subsequently been converted into innovative communication products such as short films (“The Doctor Knows the Best” and “Neem Hakeem”), street show, puppet show, games, wall paintings, posters, leaflets.

DSPRUD has also developed module for school children focusing on the problem of growing misuse of antibiotics and AMR. DSPRUD has conducted several national and state level CMEs (conducted about 190 workshops) and trained 8000 doctors, pharmacists and nurses to build skills for rational antibiotic use and in addition conducted three workshops specifically on antibiotic stewardship implementation in hospitals for doctors since 2016. DSPRUD in collaboration with WHO and NCDC also organized the National Workshop on Antibiotic Consumption in Healthcare facilities using AMC tool (with ATC-DDD methodology) for 20 institutes participating in the National AMR Surveillance Network. DSPRUD has developed Standard Treatment Guidelines (STGs) which are a basic component of any effort to improve rational use of drugs including antibiotic use, patient outcomes and patient safety. These are comprehensive, up-to-date, evidence-based guidelines for management of common infectious diseases – titled “Standard Treatment Guidelines: a manual for medical therapeutics” which is in its 5th edition, and special editions for six Indian states have also been published. Besides capacity development programme for healthcare professionals, DSPRUD organizes public education programmes such as regular programmes and panel discussions, broadcast over the national television and radio channels.

- Hospital Infection Society – India (HISI), is actively engaged in promoting IPC activities and is working both in public and private sector institutions, by way of promoting right policies and practices according to current evidence-based medicine. It has been working in the NCT of Delhi as well as at the national-level on minimizing healthcare associated infections and antimicrobial stewardship programme (AMSP).
- Delhi state under the aegis of the Delhi State Health Mission (DSHM) is actively involved in creating awareness and developing skills for doctors, nurses, paramedics, pharmacists about rational use of antibiotics and antibiotic policy. DSHM has developed a *Manual of Standard Operating Procedures for Infection Prevention and Control*. This manual covers all dimensions/working aspects of common processes/procedures being implemented in provision of healthcare in different departments related to IPC. In total, there are 20 chapters including surveillance and reporting of HAI, sterilization, disinfection and decontamination, housekeeping, biomedical waste management, isolation policy, special care units, care of systems and indwelling devices, injection safety and safe drug administration (including blood and blood components), AMSP, vaccines, investigation of an outbreak, visitors policy, food safety, laundry and linen management, vehicle disinfection, engineering control, body holding area, etc. The individual hospital departments may customize and adapt the

standard operating procedures (SOPs) relevant to their settings and resources.

- The Jai Prakash Narayan Apex Trauma Centre affiliated with the All India Institute of Medical Sciences (AIIMS) in collaboration with the Indian Council of Medical Research (ICMR) and Centers for Disease Control (CDC), USA has developed guidelines for surveillance of device-associated infections (central line bloodstream infections) and is imparting training to doctors and nurses regarding collection of standardized data for prioritized actions.
- Hand hygiene awareness programmes are being organized regularly by the Delhi Medical Association (DMA) and HISI, schools and institutes. Hand Hygiene Day is celebrated every year on 5 May and Hand Washing Day on 15 October.
- The Drugs Control Department, Government of NCT of Delhi is involved in education and training of chemists/pharmacists through Chemist Associations for compliance of relevant provisions of the Drugs and Cosmetics Rules 1945, including rational and appropriate dispensing of antimicrobials. The Department regularly participates in “Perfect Health Mela” in which officers of the Department sensitize the public/consumers about misuse/overuse, inadequate use of antibiotics, prescriptions to be taken correctly, potency up to expiry date as well as dos and don’ts for the consumers.
- Several consumer groups and specific self-support patient groups (Positive People’s Network of HIV) have come forward to advocate limited use of antibiotics.

#### *Animal health, husbandry, fisheries*

- Training and education have begun among farmers in poultry and livestock. A seminar on AMR “One Health programme for Delhi veterinarians” was recently conducted by the Delhi Veterinary Association.

#### *Environment*

- CSE has been able to create awareness among stakeholders and generate pressure for necessary changes in policy such as:
  - Defining tolerance limits for antibiotic residues in products sourced from food animals such as meat, milk, eggs, etc. (FSSAI, 2018)
  - Draft standards for residual antibiotics for effluents from pharmaceutical manufacturing as well as common effluent treatment plants (CPCB, 2018)
  - Prohibition of the manufacturing, sale and distribution of certain antimicrobials such as colistin and its formulations for food producing animals, poultry, aqua-

farming and animal feed supplements in India (Ministry of Health and Family Welfare, 2019)

- Commitments made by (select) fast food industry players to eliminate antibiotic misuse in their supply chain.
- There is increased awareness of the Biomedical Waste Management Rules 2016 (amended in 2018 and May 2019) and Solid Waste Management Rules 2016.

## Laboratory network for early diagnosis and surveillance of AMR

### *Human health*

- An AMR surveillance programme has been initiated in 13 government hospitals and 15 private laboratories of Delhi for infections of public health importance, i.e. bloodstream infection, skin and soft tissue infection, respiratory tract infection, and urinary tract infection and to track six priority pathogens (*E. coli*, *Klebsiella* spp., *Acinetobacter* spp., *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Enterococcus* spp.) under the WHO-IAMM Network for Surveillance of Antimicrobial Resistance in Delhi (WINSAR-D), which provides a platform for data sharing from public and private hospital laboratories and stand alone diagnostic laboratories. During the initial phase, around 25 laboratories have agreed to share their data on a common platform, which in turn will be shared with Delhi Government and NCDC, which is the nodal centre for sharing data with the Global Antimicrobial Resistance Surveillance System (GLASS).

### *Animals and food*

- There are very few laboratories for detection of AMR in animal and food sectors. There are a few NABL accredited veterinary disease diagnostic laboratories in Delhi which are equipped for testing only microbial pathogens, and not for antimicrobial susceptibility testing. There is one state laboratory for testing food products in Delhi at Keshav Puram; however, it lacks adequate infrastructure. Additionally, there is a national food laboratory (FSSAI) at Ghaziabad. Currently, FSSAI is upgrading the food testing laboratories for microbiological testing and antimicrobial susceptibility testing.

## Infection prevention and control

### *Human health*

- There is increased adherence to cleanliness, hygiene and sanitation in many hospitals in state government-run hospitals and municipal corporations under the Government of India's *Swachh Bharat Abhiyaan*, which is contributing directly to prevention of infection.
- Most public and corporate hospitals aiming for National Accreditation Board of Hospitals (NABH) certification and accreditation, *Kayakalp* Programme and national quality assurance system (NQAS) implementation have IPC programmes in place with dedicated human resource (infection control nurses) for implementation and monitoring of IPC practices.
- An IPC programme includes cleaning, disinfection and sterilization policy of the hospital, monitoring of staff health activities and immunization, management of biomedical waste and needle stick injuries with on-going training programmes.
- Generation of standardized surveillance data of healthcare-associated infection (HAI) in many intensive care units (ICUs) from Delhi has gained momentum as part of AIIMS Trauma Centre, ICMR and CDC collaborative national level HAI surveillance programme, with generation of hand hygiene compliance data and needle stick injury data.
- Hospital Infection Society – India (HISI) has developed training modules called HISIEPAMS (HISI educational programme for antimicrobial stewardship) for healthcare facilities to suit the needs of administrators, surgeons and microbiologists, which can be adapted for all healthcare institutions. During the previous four years there has been more focus on antimicrobial stewardship through workshops and continuing medical education (CME) programmes in the national conference organized by HISI (HISICON). *The Journal of Patient Safety and Infection Control* is the official journal of HISI and promotes AMSP through updated tools and information.
- DSPRUD has developed a certificate course for nurses integrating IPC with antibiotic stewardship and have conducted two such courses.
- The linkage of health insurance with accreditation – which includes authentication of data by Niti Aayog – has begun.

### *Animal health*

- A total of 224 new hospitals/dispensaries/polyclinics and diagnostic labs have been proposed in the NCT of Delhi in a phased manner as per the Animal Welfare Policy

at 12 entry points at border areas. There is an urgent need to check and ensure adoption of appropriate biosecurity measures for movement of animals for infection control. Control and containment of glanders disease is ongoing.

- There is focus on infection in milk-producing animals, especially cows, due to the high possibility of antibiotics being used in them. Pets such as dogs and cats are not an area of concern.
- Vaccination for prevention and control of infections is also an area of focus, e.g. foot and mouth disease (FMD) and haemorrhagic septicaemia.
- IPC programmes are proposed in dairy colonies.
- The “no milk/withdrawal after antibiotic use” policy is followed.
- Veterinary extension programmes are being carried out.

## Optimize the use of antimicrobials

### *Human health*

- Hospitals that are striving for NABH certification, accreditation, *Kayakalp* programme and National Quality Assurance Standards (NQAS) have initiated AMSP with formulation of an antibiotic policy based on their local antibiograms, antibiotic consumption and audits of antibiotic use.
- Regulation to restrict over-the-counter sale of antibiotics – Schedule H1 – was notified in 2013. Though all drugs are Schedule H drugs and require prescription of a registered medical practitioner, almost all drugs are available over-the-counter due to implementation issues. Schedule X has stringent requirements for prescribing and dispensing of these drugs and meticulous records must be maintained. Schedule H1 include 46 drugs under three categories – third generation cephalosporins, newer antibiotics, second-line anti-tubercular drugs and habit-forming drugs. The supply of a Schedule H1 drug is to be recorded in a separate register at the time of the supply recording the name and address of the prescriber, the name of the patient, the name of the drug and the quantity supplied and, such records should be maintained for three years and be open for inspection. Drug inspectors conduct surprise raids at chemist shops/pharmacies to ensure that the provisions of the Drugs and Cosmetics Rules especially in respect of Schedule H1 are strictly complied by the licensees.
- The Drugs Control Department is working to ensure quality of drugs including antimicrobials, and the compliance of relevant provisions of Drugs and Cosmetics Rules 1945 such as:
  - Presence of registered pharmacist for patient counselling.



- Ensuring the sale of drugs as per prescription of a registered medical practitioner only.
  - To avoid multi-dispensing of drugs on a single prescription.
  - To avoid substitution of drugs prescribed by a registered medical practitioner.
  - Maintenance of Schedule H1 register, and records of anti-TB drugs in the prescribed proforma by the Government of India.
  - Ensuring proper storage conditions.
  - Restricting sale of irrational fixed drug combinations (FDCs) banned by Government of India.
- DSPRUD has been monitoring prescribing practices from time to time to ascertain progress in hospitals. Over the years, DSPRUD has conducted state-wide prescription audits and antibiotic use studies at different levels of healthcare in Delhi as well as in five other states. Though more than 90% of the drugs are prescribed at the various levels of healthcare from the essential drug list but the rate of prescribing for antibiotics has been high in different hospitals. The average number of drugs prescribed across different levels had remained within the optimum range but patients' knowledge about drugs was generally low (50%). The prescriptions using generic names was low initially but has improved because of training programmes on promotion of rational drug use.
  - DSPRUD also conducted several studies to identify and test intervention strategies to improve drug use or to analyse the situation related to prescribing behaviour or practices.<sup>20-22</sup> Two effective intervention models – patient information leaflets and labelling – for improving patients' knowledge about the correct use of drugs prescribed to them – have been demonstrated.<sup>23</sup> Analysis of antibiotic procurement data has been done since 2010 and for the past 6 years (2012–2018) revealed cefuroxime being the most commonly used medicine in mobile health vans. The analysis showed high amounts of budget being spent on antibiotics in Delhi state – approximately INR 15 crore in 2012 to INR 18.26 crore in 2018. A total of 27–38% of the total budget is being spent on antibiotics at the secondary level hospitals whereas antibiotics accounted for 18–25% of the budget in tertiary care hospitals. The following antibiotics are more commonly procured and used – co-amoxiclav, cefixime, azithromycin, cephalexin, amoxicillin, as well as some irrational antibiotic combinations such as ofloxacin plus ornidazole and ciprofloxacin plus tinidazole.

*Animal health/ husbandry and food products of animal origin*

- Some private veterinary diagnostic labs aiming for accreditation by National

Accreditation Board of Laboratories (NABL) are focusing on regulated use of antimicrobials.

- Under the Food Safety and Standards Rules, 2011 and Food Safety Regulations 2018, FSSAI has prohibited the use of 19 antibiotics at any stage of processing of meat and meat products, poultry and eggs, sea foods including shrimps, prawns or any variety of fish and fishery products.
- FSSAI considers AMR in its Scientific Panel of Antibiotics Residues and is also in the process of preparing a guidance document on AMR.
- FSSAI has issued order dated 29 March 2019 whereby tolerance limits of 43 antibiotics and veterinary drugs for the food have been specified. FSSAI is also revising the tolerance limits of antibiotics in honey.
- FSSAI vide direction dated 8 August 2019 operationalized the notification of the Ministry of Health and Family Welfare dated 19 July 2019 prohibiting use of Colistin in food sector.

### Research and innovation

- Many medical colleges and associated hospitals are conducting research studies directed towards measuring AMR burden, genetic studies, newer diagnostics especially point-of-care diagnostics.
- IIT Delhi in collaboration with Maulana Azad Medical College (MAMC) is developing and validating diagnostics wherein candidemia can be diagnosed within 2–6 hours, presence or absence of bacterial infections; and if present, whether the infection is due to Gram-positive or -negative bacteria within 15 minutes. Another study is planned in which drug susceptibility for six antibiotics can be determined in 2 hours.
- Use of artificial intelligence (AI) and predictive modelling has also been initiated at AIIMS and MAMC in collaboration with Indraprastha Institute of Information Technology (IIIT) Delhi, wherein daily susceptibility data is keyed into the computer and a report is given to the patient. The same data is used for predicting infections, bacteria causing infections and guide probable choice of antibiotic for treatment.
- Department of Biotechnology (DBT) funding through special purpose vehicles such as Biotechnology Industry Research Assistance Council (BIRAC) and in collaboration with international funding and knowledge partners is supporting research for newer drug discovery, vaccines, alternatives and rapid diagnosis of infectious diseases.

## Commitment and collaboration

### *Human health*

- Many national, international organizations, professional organizations, civil societies, research institutes and medical colleges are working towards national and state efforts to contain AMR.
- WHO has been working with NCDC, DBT, IAMM (including Delhi Chapter), HISI, CSE, DSPRUD and Government of NCT of Delhi for containment of AMR.

### *Animal and environment*

- CSE has been working to address the animal and environmental aspects of AMR over the past five years and bringing necessary focus on the animal, agriculture and environmental dimensions of AMR in national action plan, state action plans and global policies. It has been working with various government stakeholders – FSSAI, Central Drugs Standard Control Organization, Bureau of Indian Standards, Indian Council of Agricultural Research, Indian Council of Medical Research, Central Pollution Control Board, etc.) to push for necessary changes in policy.
- CSE is also advocating for policies relevant to the global south at various international platforms, including those of the World Health Organization, Food and Agricultural Organization, United Nations Inter-Agency Coordination Group on AMR, etc.

## Issues and challenges

### *Awareness, education and training*

- Inadequate human resources – numbers and skills
- No group-specific analysis of training needs done
- Lack of standardization of evidence-based medical practices across all healthcare organizations
- A few hospitals have adopted standardized antibiotic policies and those who do, may or may not implement them across the organization
- Non-availability of IEC material for patients' families in simple vernacular language
- Lack of awareness about antimicrobials and AMR among the public
- Lack of awareness about antimicrobials and AMR among the farmers

### *Surveillance and laboratory strengthening*

- Paucity of microbiology laboratories manned by trained staff to detect AMR.
- Issues related to reliability of culture and susceptibility reports.
- Current reliance on conventional techniques with limited availability of automation/newer technology for rapid diagnostics for AMR.
- There is a lack of uniform SOPs and quality systems. Relatively few laboratories are accredited.
- There is inadequate focus on data management and hospital/laboratory information systems.
- There is limited budget allocation for microbiology laboratories for upgradation of infrastructure (space, manpower and automated systems), training, EQAS, accreditation and round-the-clock services integrated with patient management protocols.
- Currently no reference laboratories (accredited as per ISO 15189) are identified for conducting training, EQAS, confirming AMR alerts, monitoring support and referral services for unidentified isolates and data management.
- Lack of diagnostic microbiology facilities, especially standardized rapid molecular tests.
- Inadequate awareness about SOP and availability of diagnostic facilities, especially to test food adulteration.
- Lack of standardization of microbiology laboratories.

### *Infection prevention and control*

#### *Human health*

- Lack of standardization of IPC programme for implementation across different health settings. Uniform working manuals and SOPs need to be implemented after creation/modification of an existing document by a task force.
- The lack of standardized surveillance leads to HAI data from different hospitals that cannot be compared.
- Government policies discourage the availability of items and processes which have favourable outcome for minimizing and preventing infections.
- The economics of single-use devices is another challenge.

#### *Animal health, husbandry, fisheries*

- There is an urgent need to ensure adoption of appropriate biosecurity measures at

animal farms and promote access and use of veterinary services, quality diagnostics, vaccines, antibiotic alternatives, antibiotic-free inputs, etc.

- Lack of knowledge about hygiene and standardization of infection control in dairy farms practices.
- Lack of standardization of IPC practices.
- There is need to implement IPC policy on dairy farms, including awareness about hand hygiene practices.
- There is a need to improve the monitoring of cold chain during transportation of food, especially fish, chicken and meat.

### ***Optimizing antimicrobial use***

#### *Human health*

- There is a diversity of prescribing practices for similar population of patients.
- Relatively few hospitals analyse and audit prescriptions.
- Easy accessibility and over-the-counter availability of antimicrobials.
- Availability of irrational combinations of antibiotics without scientific basis.
- Prescriptions audits from local pharmacies and private clinics are challenging.
- No system of tracking antimicrobials after their introduction, no review/withdrawal policy by the regulatory authorities to withdraw antimicrobials with deleterious effects e.g. faropenem.

#### *Animal health*

- Large number of antibiotics are shared for use in animals and humans.
- Many antibiotics are being used as growth promoters.
- Lack of standardization of antimicrobials being used in animal husbandry, aquaculture, and agriculture.
- After antibiotics are given to livestock, there is no policy of withholding meat or milk collection from these animals for a defined period.

#### *Food*

- While Delhi has hardly any control in the manner food is produced (apart from dairy sector in Delhi and crops, which is likely significant), there is no mechanism in Delhi for monitoring presence or absence of antibiotic residues or resistant bacteria in food.

- Regulations are in place, but enforcement needs strengthening in food safety and farm products.
- Implementation is an issue for poultry, role of anthropogenic activities in contaminating the natural water bodies, and over-the-counter sale of antibiotics.

### *Research and innovation*

#### *Humans*

- Baseline antibiotic usage, surveillance of AMR – including genomics/metagenomics – needs to be strengthened, especially in community settings.
- Standardized rapid diagnostic tools which can detect resistance genes and causative organisms should be available at cheaper cost that could be used in most healthcare facilities either individually or in hub-and-spoke model linking private and public-sector laboratories with healthcare facilities. It should be supported by duty relief and industry involvement to reduce pricing. This would greatly impact AMSP by guiding targeted antimicrobials, limit unnecessary usage and abuse, and allow use of currently available antimicrobials rationally.
- Transmission dynamics in humans, animals, agriculture, aquaculture and effluents is needed.
- Assessment of clinical/social/economic impact of AMR and interventions
- Homeopathy/Ayurveda as effective alternative streams for management of infections
- Test potentiation/immunomodulation of currently available drugs, including topical application (Ayurveda)

#### *Agriculture*

- Development of hybrid infection-resistant lines that require minimal use of fertilizer and pesticide
- Promotion of organic farming and its comparisons with chemical fertilizer farming with respect to groundwater/soil – antimicrobial resistant genes/metagenomics.
- Develop specific methods for in-vitro assessment of formulations on both “sensitive” and “resistant” isolates
- Isolation of specific chemical compounds with antimicrobial activity with minimal impact on humans’ pathogens.

## State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD)

In alignment with the NAP-AMR, the following six strategic priorities have been identified for the State Action Plans to Combat Antimicrobial Resistance in Delhi (SAP-CARD):

**1. Awareness and understanding – communications and training**

**2. Knowledge and evidence – laboratories and surveillance**

**3. Infection prevention and control – human health, animal/food and community**

**4. Optimizing use of antimicrobials – regulations, surveillance and AMSP**

**5. Research and innovation**

**6. Collaboration**

## Strategic priority 1

Improve awareness and understanding of AMR among all stakeholders through effective communication, education and training

### Improve awareness and understanding of AMR

*Objective 1.1: Increase awareness and improve communications regarding AMR in Delhi*

#### *Strategic interventions and activities*

- 1.1.1 To assess understanding about preventive aspects of infection, awareness of microbes, antimicrobials, antimicrobial use (AMU) and antimicrobial resistance (AMR)
- Customized knowledge, attitude, practice (KAP) and behavioural studies in a phased manner among the public, patient groups, school children, farmers, professionals (healthcare, AYUSH, veterinary, environment), animal husbandry (poultry, fisheries, livestock) and industry (food, pharmaceutical)
  - Assess awareness needs and document the training needs specific to each sector
- 1.1.2 Document the existing communication, information resources and products on IPC, awareness of microbes, antimicrobials, AMU and AMR
- 1.1.3 Develop group-specific communication programmes/illustrations, standardized information, education and communication (IEC) material such as short videos, pamphlets, animations, booklets, posters articles in media, etc. in local language
- 1.1.4 Create awareness among all stakeholders
- Create awareness among policy-makers, regulators and enforcement officials of human health, animal, fishery, agriculture, food and drug departments on antibiotic use and its linkages with AMR
  - Create drives for safe water, sanitation and hygiene (WASH) for public awareness and in hospitals
  - Improve awareness among the public on antibiotic abuse, AMR, antibiotics in food, labelling of food derived from animals raised with/without antibiotics and responsible use of antimicrobials
  - Create public awareness through mass media (TV, radio, newspapers and mobile-based applications) and targeted consumer campaigns at places of aggregation – such as schools, colleges, hospitals, government offices,



airports, rail and bus stations – on AMR and its linkages with food grown using antibiotics

- Sensitize stakeholders such as veterinarians, agriculture extension officials, food animal producers and crop farmers on importance of responsible use of antibiotics
- Sensitize fast food chains selling meat-based products and organized retailers of processed/cold cut meat about eliminating antibiotic misuse in their supply chains
- Creating websites and/or helplines for reliable information-sharing related to AMR, which are easily accessible to the public
- Improve awareness of existing diagnostic and testing facilities pertaining to requirements of each stakeholder

#### **Key outputs**

- Baseline/trends in KAP and behaviour on IPC, awareness of microbes, antimicrobials, AMU and AMR.
- Consolidated available communication and information resources on IPC, awareness of microbes, antimicrobials, AMU and AMR
- Dissemination of popular IEC material on IPC, awareness of microbes, antimicrobials, AMU and AMR, for understanding of the general population, sanitation workers, farmers, professionals and industry
- Tailored educational material on AMR integrated into school and college curricula
- State communication programme developed and implemented
- Creation of tools to facilitate thorough risk communication in the areas of livestock production, aquaculture and food hygiene

#### **Education and training**

*Objective 1.2: Improve knowledge and capacity of key stakeholders regarding AMR and related topics*

##### **Strategic interventions and activities**

- 1.2.1. Establish a technical review group for annual review and revision of curricula/resources for in-service training of different professionals, i.e. human health, animal health, food industry, agriculture and environment
  - Review/revise curricula/resources for in-service training of different

professionals – health, animal health, food industry, agriculture and environment

- Plan and implement training programmes in all the sectors
- 1.2.2 Strengthen and consolidate IPC, AMR and related topics as core components of professional education and training
- Train all pharmacists, nurses, laboratory and supporting staff, in antibiotic protocols, antibiotic abuse and antibiotic resistance
  - Conduct targeted training programmes for farmers, veterinarians (and veterinary students), and fisheries professionals
  - Educate and train authorized distributors and sellers of antibiotics to ensure sale of approved drugs (against prescription) for use in the food animal sector and crops and importance of maintaining records
- 1.2.3 Conduct intersectoral periodic reviews of consolidated activities done across all stakeholders

#### ***Key outputs***

- Professional curricula reviewed and revised for key stakeholder groups
- Specific AMR training modules developed and implemented for all groups and sectors

#### ***Key stakeholders***

Department of Health and Family Welfare, Directorate General of Health Services, Directorate of AYUSH (Council of Indian Medicine), Board of Homeopathic System of Medicine, Development Department, Environment Department, Department of Education (SCERT and Delhi School Health Programme), Delhi State organizations for National Health Programmes for Communicable Diseases (such as TB, HIV, Malaria, Vector-Borne Disease Control Programme), Drug Control Department and regulatory bodies, medical, agricultural and veterinary colleges and universities, Pharmacovigilance Department of Government of India, professional councils of Delhi State – medical, nursing, veterinary, pharmacy, dental; sanitation workers, DPCC, non-governmental organizations (NGOs) such as Delhi Society for Promotion of Rational Use of Drugs (DSPRUD), Hospital Infection Society – India (HISI), Centre for Science and Environment (CSE), Chintan environment research and action group, etc.; Delhi State nodal officer for *Swachh* (and *Swasth*) *Bharat Abhiyaan*, Delhi State Health Mission; patient groups/organizations (for TB, HIV) and consumer groups (Consumer India), faith-based organizations, etc.

## Strategic priority 2

Strengthen knowledge and evidence through surveillance and laboratory strengthening

### Laboratory capacity

*Objective 2.1: Strengthen microbiology laboratory capacity to detect AMR in human, animal, food and environment sectors*

#### *Strategic interventions and activities*

- 2.1.1 Develop strategy to strengthen microbiology laboratories for antimicrobial susceptibility testing (AST) in human health, animal health, food of animal origin and environment sectors
- Specific budget allocation for microbiology laboratories for automation, training, human resource, guidelines, infrastructure and consumables among all sectors
  - Identify/establish/upgrade laboratories and networks for AMR surveillance among all sectors
  - Develop SOPs to collect, store, transport, process and analyse samples for culture and AMR testing
  - Develop SOPs for quality-assured AST with use of standard strains for regular internal quality control
  - Strengthen capacity for laboratory-based surveillance of AMR with species level identification of bacteria, yeast and AST among all sectors with specific trainings relevant to each sector (e.g. WHONET, QC in AST, colistin BMD for human health)
  - Increase network of surveillance laboratories in both the public and private sectors in a phased manner (10–15 labs in 2 years, 15–30 labs in 2–4 years and >30 labs in 5 years).
  - Provision of rapid molecular diagnostics
  - Strengthen laboratory capacity for detection of AMR determinants (antibiotic residues, resistant bacteria, genes) at various point sources such as waste from hospitals and labs for humans and animals, treatment plants (waste water, sewage and drinking water) animal farms, slaughter houses, meat and milk processing units, and wet market shops

- 2.1.2 Establish routine EQAS for all surveillance laboratories with accreditation of all laboratories engaged in AST
- Enrolment in existing EQAS programmes for human laboratories (WINSAR-D), animal laboratories (ICAR), food laboratories (FSSAI) and environment laboratories (CPCB, MoEFCC)
  - Accreditation of labs in culture and susceptibility tests including isolation, identification and AST
  - Already accredited labs to go for accreditation of genomic molecular assays for early and rapid detection of resistance genes and pathogens
- 2.1.3. Designate reference laboratories for AMR surveillance in human, animal, food and environment sectors
- Identify and strengthen a reference laboratory for AMR surveillance in human health through WINSAR-D
  - Identify and strengthen a reference laboratory for AMR surveillance in animal health/food sectors
  - Identify and strengthen a reference laboratory for AMR surveillance in the environment sector
  - Set up and strengthen FSSAI laboratories (food testing laboratories)
  - Set up and strengthen state drug control laboratories

***Key outputs***

- Strategic plan developed to strengthen microbiology laboratories for AMR surveillance in humans, animals, food and environment
- Training workshops held for AST in medical laboratories, animal and food laboratories and environmental laboratories (including surveillance of antimicrobial residues)

**Surveillance of AMR**

*Objective 2.2: Strengthen surveillance for AMR in humans, animals, food and environment*

***Strategic interventions and activities***

- 2.2.1 Establish and operationalize surveillance framework for AMR with a One Health approach
- Develop/adopt NCDc SOPs for AST/surveillance data
  - Expand existing AMR surveillance network in humans (WINSAR-D) with adoption by Department of Health and Family Welfare

- Support for training of network laboratories
  - Ensure data security and privacy to protect individual healthcare facility
  - Establish AMR surveillance network in animals and food
  - Establish AMR surveillance network in environment, including different point and non-point sources
  - Collect, analyse and share AMR surveillance data in the public domain for all sectors (DPCC, CPCB, Environment Department)
- 2.3 Ensure intersectoral coordination among different stakeholders for surveillance of AMR
- Annual meeting for sharing surveillance data, knowledge-sharing and refresher training
  - Organize annual consultations to strengthen AMR surveillance in humans, animals, food and environment and generate annual reports (Department of Health and Family Welfare, Department of Food Safety, FSSAI, Drugs Control Department, Development Department, Environment Department, DPCC, CPCB)
- 2.4 Testing laboratories
- Microbiology diagnostics and surveillance laboratories – one per district
  - Antibiotic and pesticide residue testing laboratories – one per every big vegetable market
  - Food testing – one per zone
  - Environmental testing labs – to test soil, effluents, water, sewage – one per zone

***Key output***

- AMR surveillance reports available for humans, animals, food and environment

***Key stakeholders***

Department of Health and Family Welfare, Directorate General of Health Services, Integrated Disease Surveillance Project, Medical Colleges and Institutes, Indian Association of Medical Microbiologists, Drugs Control Department, Development Department, Department of Food Safety, FSSAI, veterinary institutes and agricultural universities, Environment Department, DPCC, Pollution Control Board laboratories, Delhi Jal Board, CSE, etc.

### **Strategic priority 3**

Reduce the incidence of infection through effective infection prevention and control

#### **Infection prevention and control in healthcare**

*Objective 3.1: Develop and establish Delhi's plan for IPC in healthcare*

##### ***Strategic intervention and activities***

- 3.1.1 Ensure implementation of IPC policies and guidelines in human health
- Notify a state coordinator for IPC (Department of Health and Family Welfare)
  - Develop and implement policy and action plan for strengthening IPC, based on assessments and gap analyses in healthcare facilities in the state
  - Establish a state surveillance programme for HAIs
  - Organize external validation of data
  - Adopt a working manual after creation/modification of an existing document by a task force
  - Define the components of state IPC programme
  - Decipher common measures to decrease HCAI
  - Encourage industry support and required products for minimizing HCAI
  - Encourage re-utilization of single-use devices
  - Establish an annual action plan for each institution on a risk-based matrix
  - Conduct training programmes for IPC

##### ***Key outputs***

- Delhi's IPC coordinator identified and notified
- State IPC action plan developed and implemented
- HAI surveillance established in healthcare facilities

#### **Infection prevention in animal health and food**

*Objective 3.2: Establish IPC programmes in veterinary settings and animal husbandry*

### ***Strategic intervention and activities***

#### **3.2.1** Ensure development and implementation of IPC programmes in animal and food sectors

- Establish an IPC coordinating unit within the departments of agriculture, animal husbandry, dairying and fisheries, local administration and police
- Increase awareness in community for good production practices – IPC practices for proper hygiene and sanitation
- Develop, implement and monitor the state plan for IPC in the animal and food sectors
- Strict implementation of withdrawal period after antibiotic use
- Strengthening and development of diagnostic facilities in animal health
- Certification for each batch of poultry and fish and other farm products being imported from other states as antibiotic free
- Slaughter houses to provide certification (from authorized laboratories) that the meat and meat products are antibiotic free. Individual butcheries also to provide the same certificate (from authorized laboratories)
- All milk dairies to also provide a certificate of “no residual antibiotic in milk”
- Licensing of butcheries and slaughter houses and dairies to be linked with the certificate of “no residual antibiotic”

#### ***Key output***

- State IPC programme for the animal and food sector to be developed and implemented

### **Sanitation and infection prevention in community**

*Objective 3.3: Strengthen infection prevention and control in the community and reduce environmental contamination with resistant pathogens and antimicrobial residues*

### ***Strategic interventions and activities***

#### **3.3.1** Promote personal hygiene through behavioural change campaign

- Develop and implement IPC campaign under *Swachh Bharat Abhiyaan* and *Kayakalp* programme involving community leaders in villages and schools
- Educate and train school children about importance of personal health and hand hygiene
- Enhance awareness of IPC and hand hygiene among farmers and fishermen

3.3.2 Develop strategic interventions to reduce impact of AMR on the environment

3.3.3 Disinfectant use to be rationalized, e.g. lysol and other disinfectants replaced by soap and water

3.3.4 Develop and implement Delhi's plan to reduce environmental impact of AMR

***Key outputs***

- State IPC campaign for community developed and implemented
- Delhi's plan to reduce environmental impact of AMR developed and implemented

***Key stakeholders***

Department of Health and Family Welfare, Directorate General of Health Services, State Health Mission, Delhi hospitals; colleges and universities (medical, agricultural, and veterinary), Development Department, Environment Department, Department of Food Safety, DPCC, sanitation workers, Department of Education, HISI, DSPRUD, CSE, Chintan, etc.



## Strategic priority 4

Optimize the use of antimicrobial agents in health, animals and food and regulated access to high-quality antimicrobials

### Regulate access to antimicrobials

*Objective 4.1: Ensure uninterrupted access to high-quality antimicrobials*

#### *Strategic interventions and activities*

- 4.1.1 Strengthen the Drugs Control Department to enforce regulations for quality, safety, use and access to antimicrobials
- Ensure dispensing of human, veterinary antibiotics on prescription for right indication and in right dosage by registered practitioners
  - Implement ban/restriction on non-therapeutic use of critically important antimicrobials for humans and as growth promoters for disease prevention in animals.
  - Restrict/phase out use of antibiotics in animal, which are critically important for humans starting with those which are of highest priority
  - Restrict/phase out unapproved use of antibiotics in crops and use of antibiotics which are critically important for humans
  - To coordinate with companies to develop necessary capacity and ensure availability of first-line antimicrobials which are not available (AWaRe: access category to be made easily available)
  - Revisiting older antibiotics and improving their availability (cotrimoxazole, penicillins including piperacillin, tetracyclines, chloramphenicol, sulpha drugs)
  - Ensure uniform colour coded/different packaging for all antibiotics (keeping in view population/literacy levels) with awareness campaigns
  - Implement withdrawal of antimicrobials for which PK/PD rationale and safety are not available and which have been withdrawn in their country of origin/ or other nations due to lack of supportive evidence of their efficacy/usage for any indication(s) or a potential for harm to human and environmental microbiome.
- 4.1.2 Ensure intersectoral coordination to regulate and optimize use of antimicrobials in humans, animals and food

4.1.3 Strengthen Department of Drug Control, Food safety, Pollution Control Department to ensure enforcement (Drugs Control Department, Food safety, Pollution Control Department)

**Key outputs**

- Strengthened state regulatory authority
- Critically important antimicrobials restricted for non-therapeutic use in humans, animals, agriculture and food

**Surveillance of antimicrobial use**

*Objective 4.2: Establish Delhi's surveillance system for antimicrobial use in human, food, agriculture and animal sectors*

**Strategic intervention and activities**

- 4.2.1 Establish surveillance system for AMU in humans, animals, agriculture and food
- Use AMC tool to measure antibiotic consumption in all healthcare facilities in the public and private sectors
  - Measure consumption of antibiotics in animal health facilities, in food-producing animals and agriculture
  - Collect periodic data of antimicrobial usage using a centralized system
  - Establish an independent committee to audit prescriptions across all hospitals including dispensaries
- 4.2.2 Establish a monitoring system to assess antimicrobial consumption in humans, animals, agriculture and food sectors
- Monitor availability of all categories of antimicrobials and formulations for all age groups
  - Monitor stock outs of antimicrobials
  - Monitor consumption of antibiotics in human health, animal health facilities, in food producing animals and agriculture
  - Monitor trends of consumption of antimicrobials through an expert consultation involving all stakeholders
  - Consider inclusion of antibiotics used in crops under the domain of drug control

### ***Key stakeholders***

Department of Health and Family Welfare, Development Department, Drugs Control Department, Department of Food Safety, Pollution Control

### **Antimicrobial stewardship in human health**

*Objective 4.3: Improve appropriate use of antimicrobials in healthcare facilities*

#### ***Strategic interventions and activities***

##### **4.3.1 Establish AMSPs in healthcare facilities**

- Develop/implement local guidelines on appropriate antimicrobial use in all healthcare facilities after wider discussions across all departments to improve ownership and acceptability
- Develop multidisciplinary antimicrobial stewardship committees and teams at various levels of healthcare facilities and implement antimicrobial stewardship trainings
- Use/leverage monitoring by utilizing technology, create electronic health records (EHR)/state health cards
- Ensure incentives and punishment at all levels, e.g. link induction training and retraining to annual increments for important health initiatives like AMR containment
- Leadership and monitoring indicator for supra-institutional monitoring and evaluation to see whether there is an effective stewardship programme in place (for animal and food as well)  
(Department of Health and Family Welfare, Medical Colleges and Hospitals, Professional Associations, NGOs, etc.)

#### ***Key output***

- AMSP implemented in health facilities with regular monitoring indicators

### **Antimicrobial stewardship in animal husbandry and food**

*Objective 4.4: Improve and ensure appropriate use of antimicrobials in animals*

#### ***Strategic intervention and activities***

##### **4.4.1 Develop/implement action plan for antimicrobial stewardship in animal facilities**

- Develop standard treatment guidelines for common infections in food animals

- Ensure that only registered sellers can sell antibiotics for animals and crops as well as antibiotic-laden animal feed/feed-premix and their sales are documented
- Regulate online sale as well as import of antibiotics for animals and crops, as well as antibiotic-laden animal feed/feed-premix
- Work towards institutional procurement (such as in hospitals, government offices, schools, etc.) of food that promotes responsible use of antibiotics

***Key output***

- AMSPs implemented in animal facilities
- Annual report of antibiotic sales for animals and crops in public domain

***Key stakeholders***

Department of Health and Family Welfare, Directorate General of Health Services, Drug Control Department, Delhi Medical Council, Delhi Pharmacy Council, Delhi Dental Council, Delhi Nursing Council, Delhi Veterinary Council, Development Department, medical colleges and universities, veterinary colleges and agricultural universities/institutes, NGOs – DSPRUD, Delhi branches/chapters of professional associations.

## Strategic priority 5

Promote investments for AMR activities, research and innovation for AMR containment

### Financing for AMR

*Objective 5.1: Ensure sustainable investments for AMR containment activities*

#### *Strategic intervention and activities*

##### 5.1.1 Secure sustainable funds for implementation of SAP-CARD

- Develop the operational plan (with budget/costs) to secure funds to implement SAP-CARD
- Mission for AMR Containment (MARC) – Terms of reference and highest level governance with commitment from highest leadership (viz. Chief Minister, Health Minister, Chief Secretary, Principal Secretary Health and Family Welfare, DGHS)
- Focus on the One Health approach – through advisory and technical committees (already existing) – shall be reviewed by top leadership under MARC
- Use of artificial intelligence to monitor surveillance data – human health, animal health, agriculture, food and environment

#### *Key outputs*

- State AMR operational plan developed and implemented
- Establishment of the One Health platform
- Better understanding of transmission dynamics and AMR mechanisms
- Earmarked funds from state government secured

### Research and innovation

*Objective 5.2: Encourage basic and operational research for AMR containment*

Basic research and clinical research shall focus on collaboration and interdisciplinary research. Translational research shall focus on start-ups in medical colleges and research institutes with faculty and students.

***Strategic intervention and activities***

**5.2.1 Encourage research for evidence-informed policy-making in all sectors**

- Mission for AMR containment to collaborate with DBT/ICMR/Industry/WHO to facilitate funding based on the state priorities.
- Develop and implement basic and operational research projects in humans, animals, agriculture, food and environment sectors on
  - Clinical/translational/research/surveillance
  - Identifying novel mechanisms and combinations of antimicrobials
  - Basic research – e.g. novel mechanisms
  - Blue sky research – curiosity-driven science
  - Interdisciplinary research including social science and economic research
  - Rapid diagnostics (viral vs bacterial) for respiratory infections and gastroenteritis
  - Rapid antimicrobial susceptibility testing
  - Artificial intelligence (AI) based methods
  - Non-conventional surveillance
  - Metagenomics/sequencing
  - Transmission dynamics
  - Waste management technologies
  - Vaccines research for humans and animals for infectious diseases
  - Validation studies – alternate medicine to treat infections/modify outcomes
  - Ethics of AMR use
  - Other areas based on the data generated therein
- All public-funded research to be transparently licensed and made available to the health system and people in Delhi
- Basic research and clinical research – collaboration, interdisciplinary research
- Translational research – seed funding to encourage research in medical colleges for students and faculty
  - Earmarked funds with specific goals and defined outcomes from both Central and state government and industry
  - Creation of platforms and constant interactions to understand limitations and implementation issues of AMR with the pharmaceutical industry

***Key outputs***

- AMR research projects documented and implemented
- Novel diagnostics and innovations developed

***Key stakeholders***

Chief Secretary – Government of NCT of Delhi, Department of Health and Family Welfare, Directorate General of Health Services, Development Department, Environment Department, Pharmaceutical industry medical colleges and research institutes, veterinary research institutes and agricultural universities, AYUSH Department, Drugs Control Department, ICAR, Department of Animal Husbandry, MCD, Delhi Jal Board, CSE, FSSAI, ICMR, DBT, DST, professional associations, research institutes, colleges and universities; pharmaceutical, vaccine and diagnostic industry, resident welfare associations (RWAs).

## **Strategic priority 6**

Strengthen Delhi's commitment and collaboration on AMR

### **Strengthen state-level collaborations to contain AMR**

*Objective 6.1: Strengthen collaboration among stakeholders to contain AMR*

#### *Strategic interventions and activities*

- 6.1.1 Establish an inter-departmental collaboration within Government of Delhi
- 6.1.2 Strengthen and streamline intra-state collaboration on AMR
- 6.1.3 Organize annual consultations on AMR with key stakeholders, including disease control programmes in Delhi to share information and facilitate coordinated action and mobilization of resources for AMR activities
- 6.1.4 Establish partnerships with private sector, professional associations and civil society organizations for AMR containment

#### *Key output/outcome*

- Intra-state collaboration and public–private partnerships established and strengthened
- Significant reduction in the burden of AMR in the state in 5 years

#### *Key stakeholders*

Department of Health and Family Welfare, Directorate General of Health Services, Integrated Disease Surveillance Project (IDSP), Directorate of AYUSH, professional councils, Drugs Control Department, State Health Mission, State Disease Control programme (TB, vector-borne disease control, leprosy, AIDS), professional associations and civil society (HISI, IAMM, CSE, DSPRUD, Chintan, etc.), Development Department, Department of Animal Husbandry, Directorate of Agricultural Marketing, Department of Food Safety, Delhi Jal Board, Department of Social Welfare, Women and Child Development Department, State Council of Education Research and Training (SCERT), Environment Department (DPCC), Directorate of Information and Publicity, local governance institutions (MCD, NDMC, Delhi Cantonment Board); intergovernmental and development agencies/partners, institutions and NGO/CBOs, United Nations and international agencies (WHO, FAO, OIE, UK Department of Health, USAID, CDC, etc.)



## Monitoring and evaluation framework

The monitoring and evaluation framework is an integral part of SAP-CARD.

### 1. Awareness, understanding and training

Input (basic resources)	Process (activities)	Outputs (results at programme level)	Outcomes (results at population level)
IEC resources for relevant groups – public and farmers) developed  Training resources developed for professionals in health, veterinary, food, agriculture and environment	AMR awareness campaign among students (schools and professional colleges), public, government and private healthcare providers, pharmacists, veterinarians in all districts  Engagement of media for raising AMR awareness  KAP studies in health workers and vets on AMR and its implications	Number of print articles covering AMR  Total number of minutes of audiovisual clips aired  Inclusion of AMR in curricula of professional universities  Inclusion of AMR in curricula at school and college level  Number of KAP studies and numbers of each target group covered	AMR awareness levels in target populations, e.g. percent of population who know that it is inappropriate to use antibiotics for viral infections or avoiding self-medication  Improvement in KAP of health workers and veterinarians on AMR and antimicrobial use

### 2. Laboratories and surveillance

Input (basic resources)	Process (activities)	Outputs (results at programme level)	Outcomes (results at population level)
State Coordinating Centre for AMR surveillance established with clear terms of reference	Number of microbiology laboratories (all sectors) participating in quality assurance programme  SOPs established for AMR surveillance and antimicrobial residues in food-animals, agriculture, food and environment	Surveillance systems established for AMR and (antimicrobial residues) in human, animals, food and environment	Reduction in AMR levels in <i>E. coli</i> , <i>Klebsiella</i> spp., <i>Pseudomonas aeruginosa</i> , <i>Salmonella</i> , <i>Acinetobacter</i> spp., MRSA and <i>Enterococcus</i> spp.

### 3. Infection prevention and control

Input (basic resources)	Process (activities)	Outputs (results at programme level)	Outcomes (results at population level)
Delhi State Health Mission (DSHM) identified as IPC coordinator	<p>Percent hospitals with functioning hospital infection control committee (HICC)</p> <p>Percent hospitals with adequate ICNs</p> <p>AMR issues incorporated in biosecurity guidance for farms and slaughterhouses</p>	<p>Hib/rotavirus/typhoid, PCV vaccine coverage across Delhi</p> <p>Proportion of hospitals and nursing homes with IPC programme in place (including monitoring of hand hygiene)</p> <p>Number of hospitals with WASH facilities</p> <p>Number of commercial poultry farms compliant with IPC guidelines and good practices</p>	<p>Improved average hand hygiene compliance rates in hospitals and Mohalla Clinics</p> <p>Percent HAI rates in health facilities under <i>Kayakalp</i> (and private sector)</p> <p>Number of hospitals with effective BMW management</p> <p>Number of pharmaceutical companies manufacturing antibiotics with effluent treatment plants</p> <p>Number of licenses issued or revoked by DPCC</p>

### 4. Optimizing use of antibiotics

Input (basic resources)	Process (activities)	Outputs (results at programme level)	Outcomes (results at population level)
<p>Delhi State Antibiotic Policy</p> <p>Number of notices issued by drug control department (DCD) regarding over the counter (OTC) sale of H1 antibiotics</p> <p>Number of notices issued by DCD regarding OTC sale of Schedule H antibiotics</p> <p>Delhi AMR surveillance network established</p>	<p>Treatment guidelines developed as per Delhi's Antibiotic Policy for human health</p> <p>STG for animal health</p> <p>Analysis of antibiotic consumption in Delhi Government hospitals</p> <p>Collate data on total antibiotic consumption in Delhi (based on sale, import, distribution, etc.)</p>	<p>Numbers of hospitals with updated antibiotic guidelines, based on local antibiogram, aligned with Delhi's STG</p> <p>Percentage of medical colleges/hospitals implementing antimicrobial stewardship programme</p> <p>Implementation of ban/restrictions on antibiotic premixed food in animal husbandry and aquaculture</p>	<p>Annual consumption of antibiotic in Delhi</p> <p>Percent of hospitals monitoring trends of antibiotic consumption</p> <p>Percent of antibiotics tested by DCD with acceptable quality (human and non-human)</p> <p>Ban on incorporation of antibiotics in pre-mixed animal feeds</p>

## 5. Research and innovation

Input (basic resources)	Process (activities)	Outputs (results at programme level)	Outcomes (results at population level)
<p>AMR research network established</p> <p>Financial and human resources allocated</p>	<p>Delhi state AMR research agenda established</p>	<p>Number of research projects on AMR</p>	<p>Percent fund utilization for AMR activities</p>

## 6. Collaboration

Input (basic resources)	Process (activities)	Outputs (results at programme level)	Outcomes (results at population level)
<p>Annual stakeholder meeting during WAAW</p>	<p>Number of meetings of Advisory Committee on AMR</p> <p>Number of meetings of Technical Committee on AMR</p> <p>Number of professional associations engaged for AMR</p>	<p>Sector-specific ATRs</p>	<p>Percentage of sectors actively engaged in combating AMR</p>

## Annex 1

Governance mechanisms are critical for stakeholder engagement and ownership, as well as oversight and monitoring of activities. Two committees were notified by the Delhi Government – Advisory Committee on AMR and the Technical Committee on AMR. Monitoring and evaluation is also an integral part of SAP-CARD to ensure its implementation.

### Advisory Committee on AMR

The Advisory Committee on AMR provides policy-level guidance, coordination and oversight for AMR containment in Delhi, with a One Health approach.

#### *Terms of reference*

1. Oversee coordination within the health system and with other sectors to achieve AMR containment in Delhi
2. Facilitate collaboration between government, private, civil society and NGOs for AMR-related activities
3. Ensure information sharing about AMR-related activities in all sectors and facilitate synergy between existing and new AMR initiatives
4. Review and endorse policy level advice from the Technical Committee on AMR
5. Ensure availability of adequate infrastructure, logistics and resources for AMR containment in Delhi
6. Endorse the State Action Plan for Antimicrobial Resistance Containment in Delhi (SAP-CARD) and oversee its progress and achievement of milestones

#### *Members*

The Advisory Committee on AMR has been constituted under the chairmanship of the Secretary (H&FW), Government of NCT of Delhi, with the following members:

Principal Secretary	Health and Family Welfare	Chairperson
DGHS	Directorate General of Health Services	Member
Dr Ravindra Aggarwal	Additional MS, Lok Nayak Hospital	Chief Coordinator AMR Containment
Dr Sangeeta Sharma	Professor, Neuropsychopharmacology, IHBAS and President, DSPRUD	Member-Secretary (Nodal Officer – AMR Containment)
Dr Anuj Sharma	Technical Officer – AMR and Labs, WHO India	Member
Member-Secretary	Delhi Pollution Control Committee	Member
Commissioner	Department of Food Safety	Member
Commissioner	Department of Agriculture	Member
Chief Executive Engineer	Delhi Jal Board	Member
Director	Animal Husbandry	Member
Nodal Officer	Climate Change	Member

Any other stakeholder may be co-opted for meetings with permission of the chairperson.

## Technical Committee on AMR

The Technical Committee provides strategic and operational guidance as well as implementation support for AMR containment in Delhi, with a One Health approach.

### Terms of reference

1. Provide technical and operational oversight for initiatives to combat AMR in Delhi
2. Identify/map stakeholders for AMR activities in Delhi
3. Engage all relevant stakeholders for AMR-related activities
4. Develop SAP-CARD, engaging all key stakeholders
5. Provide technical advice and reports to Advisory Committee on AMR
6. Ensure regular data collection and information sharing amongst all AMR stakeholders
7. Monitor and evaluate the implementation of SAP-CARD
8. Develop and disseminate annual AMR reports

### Members

The Technical Committee on AMR was constituted under the chairmanship of DGHS, Government of NCT of Delhi, with the following members:

DGHS	Directorate General of Health Services	Chairperson
Dr Ravindra Aggarwal	Additional MS, Lok Nayak Hospital	Chief Coordinator AMR Containment
Dr Sangeeta Sharma	Professor, Neuropsychopharmacology, IHBAS and President, DSPRUD	Member Secretary (Nodal Officer AMR Containment)
Dr Anuj Sharma	Technical Officer – AMR and Labs, WHO India	Member
Dr B.L. Sherwal	Director, RGSSH	Member
Dr Raman Sardana	Hospital Infection Society – India	Member
Dr Poonam Loomba	Professor, Microbiology, GIPMER	Member
Dr Sonal Saxena	IAMM, Delhi Chapter	Member
Dr Vikas Manchanda	Associate Professor, Microbiology, MAMC	Member
Dr Renu Gupta	Assistant Professor, Microbiology, IHBAS	Member
Dr Sundeep Miglani	Additional Director (Hospital Coordinator), Directorate General of Health Services	Member
Dr Pawan Kumar	Additional Director (CME and SHIB), Directorate General of Health Services	Member
Additional Director (SHS)	Directorate General of Health Services	Member
Additional Director (AQC)	Directorate General of Health Services	Member
SMO, BMW/AMR	Directorate General of Health Services	Member
Nodal Officer – IDSP	Directorate General of Health Services	Member
Assistant Drug Controller	Drug Control Department	Member

State Action Plan to Combat Antimicrobial Resistance in Delhi (SAP-CARD)

Director or nominee	Animal Husbandry	Member
Medical Officer In-charge	Delhi Jal Board	Member
Joint Director	Department of Food Safety	Member
Joint Director	Department of Agriculture, Government of Delhi	Member
Deputy Director (QA)	Food Safety and Standards Authority of India	Member
Deputy Director (ISM)	AYUSH division Delhi	Member
Sr. Environmental Engineer	Delhi Pollution Control Committee	Member
Representative	Centre for Science and Environment	Member
President	Delhi Medical Association (DMA)	Member
Chairman	AMR Standing Committee, IMA	Member
President	Delhi Veterinary Council	Member

Any other stakeholder may be co-opted for meetings with permission of the chairperson.

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