A STUDY ON ANTIMICROBIAL RESISTANCE SURVEILLANCE SYSTEMS IN SELECTED PUBLIC AND PRIVATE HOSPITAL

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

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Under the Supervision and Guidance of

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2025

Government of Rajasthan
Directorate of Medical & Health Services, Rajasthan, Jaipur
Integrated Disease Surveillance Programme

No: F ( )/IDSP /2025/ 958 Dated: 02/06/25

DissertationCertificate

This is to certify that Ms Taniya Singh Butolia,MBA student of Indian Institute of Health Management Research (IIHMR University, Jaipur) has successfully completed her Dissertation at Directorate of Medical & Health Servicesunder Integrated Disease Surveillance Programme (IDSP) Jaipur,Rajasthan from 10th March"2025to 31st May"2025. She has worked on the project-

"A STUDY ON ANTIMICROBIAL RESISTANCE SURVEILLANCE SYSTEM IN SELECTED PUBLIC AND PRIVATE HOSPITALS IN JAIPUR, RAJASTHAN"

Her performance was found to be Excellent& She bears a good character along with dedication, professionalism, behaviour, enthusiasm & hardworking.We extend her good wishes for a bright and successful career ahead.

(Dr. Ravi Prakash Sharma)
Director (PH)
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IIHMR UNIVERSITY

CERTIFICATE

This is to certify that dissertation titled **A STUDY ON ANTIMICROBIAL RESISTANCE SURVEILLANCE SYSTEMS IN SELECTED PUBLIC AND PRIVATE HOSPITAL** is a record of the research work undertaken by Taniya Singh Butolia in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **"A STUDY ON ANTIMICROBIAL RESISTANCE SURVEILLANCE SYSTEMS IN SELECTED PUBLIC AND PRIVATE HOSPITAL IN JAIPUR, RAJASTHAN"** is the Bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Signature

Mr. Taniya Singh Butolia

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Abstract

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TITLE: A Study on Antimicrobial Resistance Surveillance Systems in selected public and private hospital in Jaipur, Rajasthan.

Background of the Problem

A major global health concern is antimicrobial resistance (AMR), a phenomenon in which bacteria, viruses, fungi, and parasites develop drug resistance. This increases the severity of illness, mortality, and transmission of infections, making them more difficult to treat. The main causes of AMR are inadequate infection control and excessive and inappropriate use of antibiotics. This resistance poses a serious threat to the security of global health since it impedes medical advancement and results in longer hospital stays, higher death rates, and higher healthcare expenses.

Methodology

This study, which focuses on tertiary care hospitals in Jaipur, Rajasthan, India, uses a mixed-methods approach. Quantitative information on hospital characteristics, AMR surveillance, data quality, resources, and utilization will be gathered through a cross-sectional survey. Key informants will participate in qualitative, semi-structured interviews that will offer detailed insights into the difficulties and ways to improve AMR surveillance. Data triangulation will be possible with this combined approach for a thorough understanding. In order to capture healthcare diversity, the study includes both public and private hospitals, and Jaipur was chosen because of its concentration of tertiary facilities handling a high AMR burden**.**

Results

The study revealed significant gaps in AMR surveillance across hospitals in Jaipur. While AST practices and CLSI guidelines were followed, digital integration and manpower varied. EHR-LIS systems improved reporting, but most sites faced delays, data gaps, and underuse of AMR findings in clinical decisions. Strengthening infrastructure, staffing, and feedback mechanisms is crucial for improving surveillance effectiveness.

Conclusion

The effectiveness of AMR surveillance varies in Rajasthan because of variations in laboratory capacity, data management, and available resources. Although electronic reporting enhances data timeliness and quality, it is not always used. Funding, infrastructure, and staff training are major obstacles. Better data sharing is required because the use of AMR data for clinical decisions, prescriptions, and infection control is not optimal.

These findings emphasize the critical need for increased funding for laboratory capacity, thorough staff training, and promoting the adoption of EHR-LIS to improve data quality and efficiency. To improve the use of AMR data in clinical practice, it is essential to implement user-friendly tools, feedback mechanisms, and a data-driven culture.

Keywords: Antimicrobial Resistance, Surveillance Systems, Rajasthan, Healthcare Management.

Acknowledgements

I take this opportunity to express my heartfelt gratitude for the continuous support and encouragement I received during my dissertation project titled, “A Study on Antimicrobial Resistance Surveillance Systems in Selected Public and Private Hospitals in Jaipur, Rajasthan,” undertaken as a part of my MBA (Hospital and Health Management) program at IIHMR University, Jaipur.

This study would not have been possible without the guidance and mentorship of Mr. Vidya Bhushan Tripathi, who offered consistent support, insightful suggestions, and patient supervision throughout each phase of this research. His encouragement and critical inputs played an instrumental role in shaping the direction and quality of this work.

I am immensely thankful to Dr. Praveen Aswal Sir and Dr. Deepa Meena Ma’am, from the Directorate of Medical and Health Services (DMHS), Rajasthan, for giving me the opportunity to pursue this study and for facilitating access to data and field settings. Their faith in my work and their continued cooperation greatly enhanced my learning and exposure to public health surveillance.

My sincere thanks also go to the microbiologists, nodal officers, and laboratory staff at the participating hospitals in Jaipur. Their willingness to share their experiences and insights during interviews and their support in facilitating data collection were invaluable to the completion of this research.

I would also like to acknowledge the faculty and administrative staff at IIHMR University for their academic guidance and administrative support throughout my academic journey.

Lastly, I am deeply grateful to my peers, family, and well-wishers who provided emotional support, motivation, and encouragement throughout this endeavour.

Sincerely,
Taniya Singh Butolia

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Abbreviations

AMR	Antimicrobial Resistance
CLSI	Clinical and Laboratory Standards Institute
EHR	Electronic Health Record
ICU	Intensive Care Unit
WHO	World Health Organization

Chapter 1

Introduction

- **1.1 Background of the Problem**

The growing threat of antimicrobial resistance (AMR) undermines the effectiveness of modern medicine by putting effective infection prevention and treatment at serious risk. This global health issue arises when bacteria, viruses, fungi, and parasites evolve and no longer respond to the drugs designed to eliminate them. As a result, treating common infections becomes increasingly difficult, leading to higher chances of disease spread, longer durations of illness, and increased death rates. The overuse and misuse of antibiotics in both human and veterinary medicine, along with inadequate infection control measures, are primary drivers of this crisis. AMR leads to prolonged hospitalizations, escalated healthcare expenses, and a rising mortality burden, posing a significant and escalating threat to global health security.

Global Estimation: 12.7 lakh people die annually due to AMR (2)

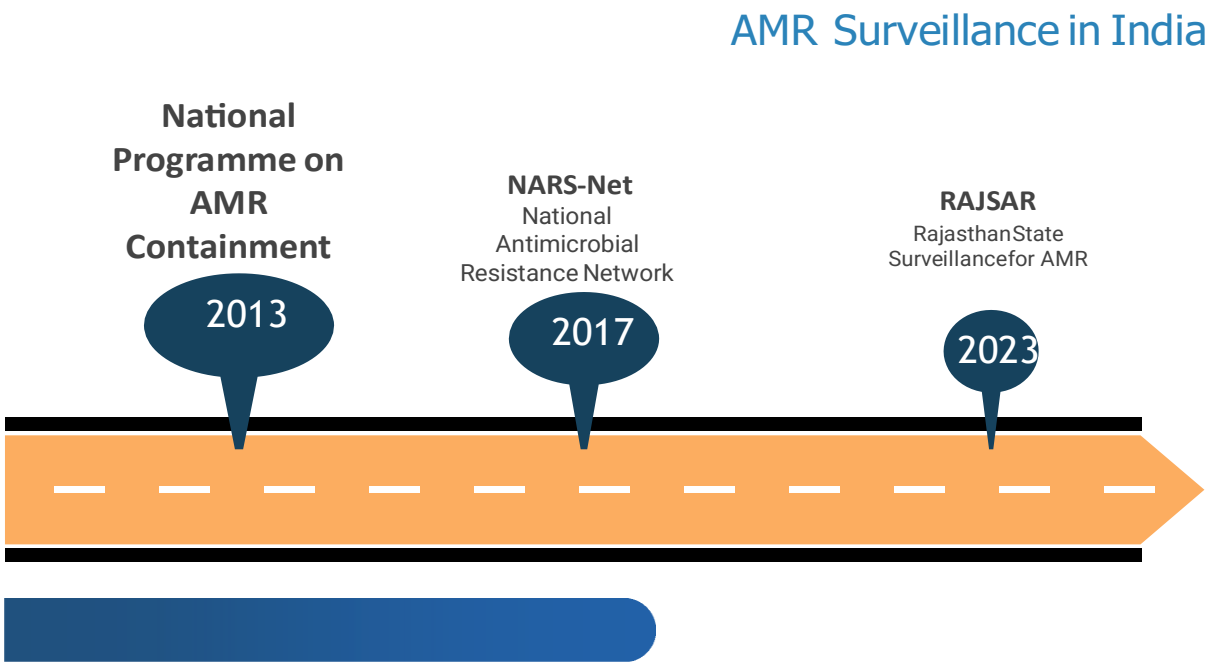
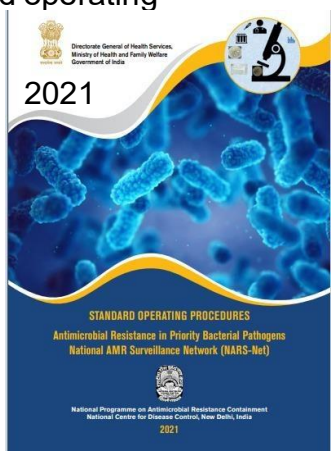


Fig 1.1 AMR Surveillance in India

Rajasthan State Surveillance for Antimicrobial Resistance (RAJSAR)

Follows NCDC standard operating procedure



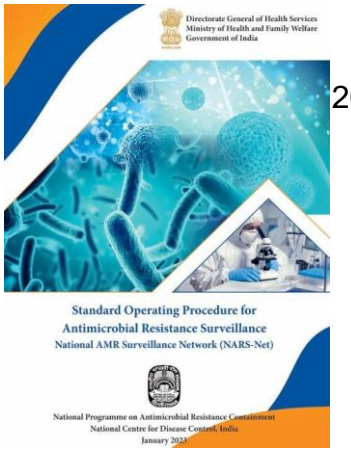


Fig 1.2 Rajasthan State Surveillance for Anti- Microbial Resistance (AMR)

- **1.2 Context of the Problem in India and Rajasthan**

India is being hit hard by the growing problem of antimicrobial resistance (AMR). With such a large population and the easy, often unchecked use of antibiotics in people and animals, drug-resistant infections are spreading quickly. The situation is made even worse by everyday challenges like poverty and poor sanitation. In places like Jaipur, Rajasthan, big hospitals play a vital role as referral centers where patients with serious and complicated infections are treated—many of which are resistant to common medicines. That's why it's so important to understand how AMR is being tracked in these hospitals and find ways to improve those systems, so we can better manage and control the spread of resistance.

1.3 Importance of Using Effective Surveillance to Address AMR

The rising threat of antimicrobial resistance (AMR) is deeply affecting both our society and healthcare system. We rely on antibiotics to treat everything from everyday infections like pneumonia and sepsis to more serious conditions like surgical infections

and tuberculosis. When these medicines stop working, it becomes much harder to treat even common illnesses, putting lives at greater risk and making routine medical care more dangerous.In addition to making treatment more expensive and time-consuming, the emergence of AMR environment affects the effectiveness of other vital medical procedures like organ transplantation, cancer chemotherapy, and surgery, all of which rely significantly on antibiotic prophylaxis to prevent infections. It is anticipated that AMR will have a significant and expanding economic impact, resulting in significant productivity losses and increased healthcare expenses. Strong AMR surveillance systems must thus be established and maintained. All such systems provide the essential data needed to inform evidence-based policy choices, facilitate effective public health initiatives, and ultimately mitigate the serious consequences of this probably much higher health concern, guaranteeing the continuous provision of high-quality healthcare.

1.4 Purpose of the Research study

Examining and evaluating Rajasthan, India's current AMR surveillance systems is the aim of this study. The study intends to assess the benefits and drawbacks of the surveillance practices currently in place, assess the challenges these hospitals face in collecting and reporting AMR data, and examine the ways in which this data is utilized to inform clinical judgment. The study's ultimate objective is to provide evidence-based recommendations for improving AMR surveillance systems to boost their effectiveness in preventing AMR and improving patient outcomes.

1.5 Research Questions

What are the key strengths and weaknesses of current antimicrobial resistance surveillance systems in Rajasthan, and how can these systems be improved to provide more effective and timely data for informing interventions and policies to combat AMR.

Chapter 2

Review of Literature

2.1 Summary of Key Literature

The following table presents a comprehensive summary of key scholarly and institutional sources referenced in this study, outlining their major findings, scope, and how they inform the present research on antimicrobial resistance (AMR) surveillance systems in Rajasthan.

Author(s) / Organization	**Year**	**Title / Source**	**Key Findings**	**Salient Features**
World Health Organization (WHO)	2014	Antimicrobial Resistance: Global Report on Surveillance	Revealed AMR as a global crisis and initiated GLASS. Highlighted lack of standardized data globally.	Provides international framework and emphasizes the importance of data standardization.
O'Neill, J.	2016	Tackling Drug-Resistant Infections Globally: Final Report and Recommendations	Projected 10 million annual deaths due to AMR by 2050. Advocated for enhanced surveillance systems.	Supports study's urgency and focus on timeliness and feedback in data systems.
Centre's for Disease	2019	Antibiotic Resistance	Outlined resistance	Provides a comparative

Control and Prevention (CDC)		Threats in the United States	threat levels and promoted integrated national surveillance.	high-standard model for operational surveillance.
Magiorak et al.	2012	MDR, XDR, and PDR Bacteria: Standard Definitions	Proposed globally accepted definitions for classifying resistant organisms.	Critical for aligning resistance categorization in this study.
Rüegg et al.	2022	Guidance for Evaluating Integrated Surveillance of Antimicrobial Use and Resistance	Stressed integrated, One Health-based surveillance systems with stakeholder feedback and harmonization.	Guides the theoretical framework and stakeholder interview approach.
Frost et al. (with Laxminarayan, R.)	2021	Status, Challenges and Gaps in AMR Surveillance Around the World	Identified global and Indian challenges like poor infrastructure and weak feedback loops.	Directly supports need for local study and informs gap identification.
ICMR / NCDC	Ongoing	Antimicrobial Resistance	Coordinates AMR	Provides the national

		Surveillance and Research Network (AMRSN)	monitoring across India. Develops SOPs and links with GLASS.	protocol baseline for evaluation in Rajasthan.

Chapter 3:

Methodology

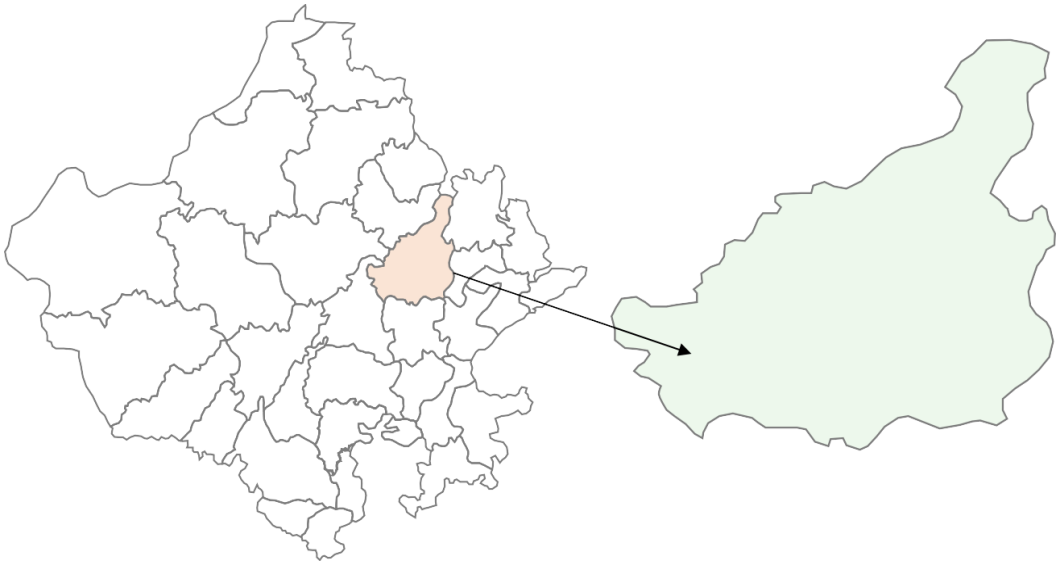
I. Study Design

A cross-sectional survey of tertiary care hospitals and qualitative, semi-structured interviews with key informants will be part of this mixed-methods study. Hospital characteristics, AMR surveillance procedures, timely and complete data, resource availability, and data utilization will all be covered in the quantitative survey. The qualitative interviews will provide detailed insights into the challenges, barriers, and facilitators of effective AMR surveillance, as well as perspectives on how to improve these systems. The triangulation of data enabled by this mixed-methods design will enable a more comprehensive and nuanced understanding of the research problem. Study design will be cross sectional in healthcare facilities along with qualitative interviews of key stakeholders involved.

II. Study Setting

The study will be conducted in Rajasthan, India. Jaipur was selected as the study site due to its high concentration of tertiary care facilities that serve a diverse patient population with a high burden of AMR. Tertiary care hospitals were chosen because they handle complicated infections, generate a lot of AMR data, and influence local antimicrobial prescribing policies. Both public and private hospitals will be included in the study to represent the range of healthcare environments in Jaipur. Government and private healthcare facilities in Jaipur.

Fig 3.1Population Area



RAJSAR Sites

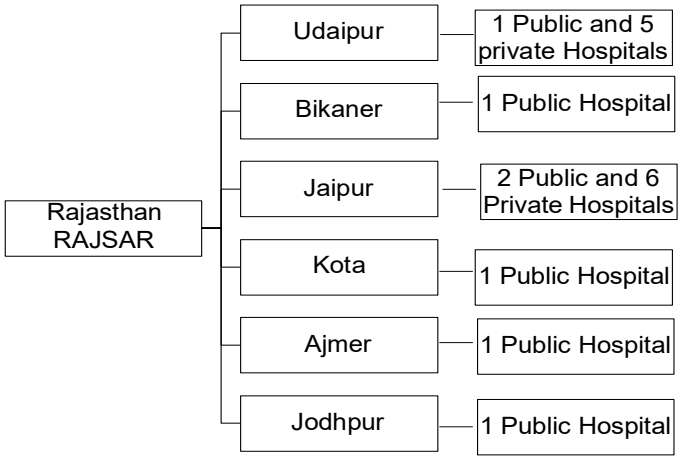
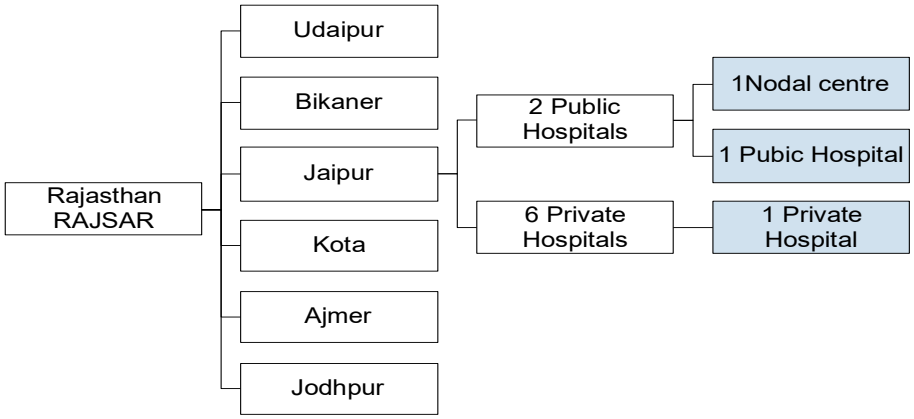


Fig 3.2 Rajasthan RAJSAR Sites

Fig 3.3 Rajasthan RAJSAR Sites Selection

Site Selection



Key Stakeholders

Reporting Units	Stakeholders	Role
NCDC	Nodal officer for Rajasthan state	Confirmation of alert isolate, data monitoring call, data feedback, data analysis, support in making annual reports
State Nodal Centre/ NARS-Net site	AMR focal point/ Bacteriology head, Lab Technician, Data manager	Data collection from RAJSAR sites, data monitoring call, data feedback Culture and AST Specimen processing and culture Data entry in WHONET File
RAJSAR Sites	AMR focal point/ Bacteriology head, Lab Technician, Data manager	Data cleaning and monthly report preparation Culture and AST Specimen processing and culture Data entry in WHONET File

AST: Antimicrobial Sensitivity Test
NARS-Net: National AMR Surveillance Network
NCDC: National Centre for Disease Control

Fig 3.4 Key Stakeholders

III. Study Population

3.3.1 Inclusion Criteria

■ Microbiology labs in Rajasthan are operational and perform tests for antibiotic susceptibility.

■ Hospitals that admit patients with a range of medical and surgical conditions, including those who are highly susceptible to AMR infections (e.g., patients in intensive care units or transplant recipients).

Healthcare providers involved in antimicrobial prescribing and infection control.

3.3.2 Exclusion Criteria

■ Hospitals that don't routinely test for antibiotic susceptibility or don't have a functional microbiology lab.

■ AMR profiles in hospitals that treat only one condition (maternity hospitals, eye hospitals, etc.) might differ from those in general tertiary care settings.

Primary care clinics without on-site laboratory facilities.

IV. Sample Size and Sampling Technique

3-5 healthcare facilities, Purposive sampling of key informants with expertise in AMR surveillance.

For the qualitative component, 15 key informants will be selected using purposive sampling. These informants will include:

- Microbiologists (5)
- Laboratory technician (5)
- Nodal Officer (5)

These professionals were chosen because they possess in-depth knowledge and experience related to AMR surveillance and its implementation in Rajasthan. Purposive sampling will ensure that a range of perspectives and experiences are captured.

V. Study Instruments

- **Quantitative Survey Instrument:** Quantitative information will be gathered from the participating hospitals using a structured questionnaire. After a review of

pertinent literature, including WHO guidelines and current surveillance protocols, the questionnaire will be created and tailored to the Jaipur local context. There will be the following sections on the questionnaire:

Hospital attributes, such as type, size, number of beds, and patient volume

- Lab capacity and resources e.g., personnel, equipment, workload.
- AMR surveillance methods such as methods for gathering data, laboratory procedures, and quality control measures.
- Reporting and data management e.g., electronic systems, timeliness, completeness. Availability of resources e.g., funding, training programs.
- Utilizing data (for instance, in infection control and antimicrobial prescribing)

- **Qualitative Interview Instrument:** To investigate the viewpoints and experiences of key informants regarding AMR surveillance, a semi-structured interview guide will be created. The interview guide will be made to extract specific details about:
  - Opinions regarding the significance of AMR surveillance Implementation and maintenance experience with surveillance systems
  - Obstacles and hurdles to efficient surveillance e.g., organizational, resource, and technical.
  - Supporting elements for effective surveillance, such as enabling factors and best practices
  - Ideas for enhancing Rajasthan's AMR surveillance**.**

VI. Operational Definitions

- **Timeliness of reporting:** When the final results are reported to the hospital's central infection control or surveillance database, the median number of days between the dates of bacterial identification and antimicrobial susceptibility testing. Timeliness of reporting is the number of days from bacterial identification to reporting to the central surveillance system.

- **Completeness of data:** The proportion of crucial data fields that are regularly and correctly completed in AMR reports, such as patient demographics, infection site, specimen collection date, organism identification, antimicrobial susceptibility results, and pertinent clinical information. Data completeness defined as the percentage of required data fields populated in AMR reports.

- **Data quality:** Data quality defined as the accuracy and reliability of reported AMR data, assessed through internal and external quality control measures, and Utilization of AMR data defined as the frequency and manner in which AMR data are used to inform antimicrobial prescribing guidelines and infection control practices.

  The precision and dependability of AMR data are evaluated using metrics like:

  ■ The frequency of transcription and data entry errors as established by internal quality control protocols in the microbiology lab.

  ■ If available, the concordance rate between the results of external quality assessments (EQAs) and internal quality control.

- **Utilization of AMR data:** The frequency and mode of use of AMR data to guide choices and actions concerning:

  ■ Antimicrobial prescribing practices (e.g., de-escalation of therapy, adherence to national or hospital-specific guidelines).

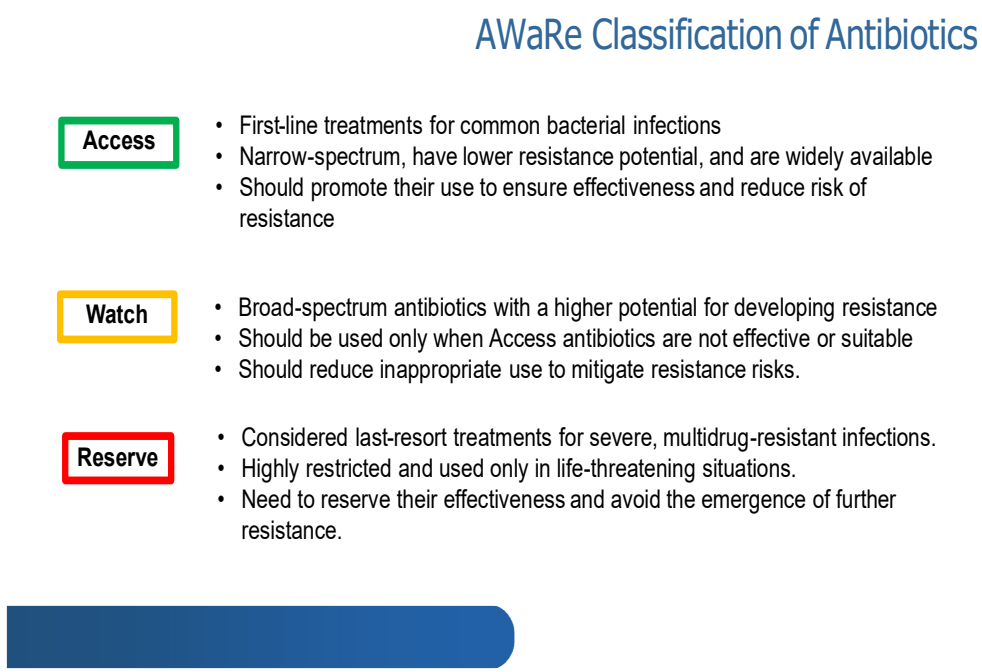
  ■The application of hand hygiene procedures, isolation measures, and environmental cleaning are examples of infection control practices.

  ■The creation and revision of antimicrobial guidelines and formularies tailored to individual hospitals.

VII. Data Collection Procedures

- **Quantitative Data Collection:**
  - Each participating hospital's designated staff, such as laboratory technicians, microbiologists, and hospital administrators, will receive the structured questionnaire.
  - The researcher will visit the hospital to gather the data if the hospital prefers in-person administration.
  - Before any data is collected, each participating hospital will be asked for their informed verbal consent.
  - Data will be collected over a period of duration, as 8 weeks. To increase response rates, non-responding hospitals will receive follow-up reminders.

Fig 3.5 Aware Classification of Antibiotics



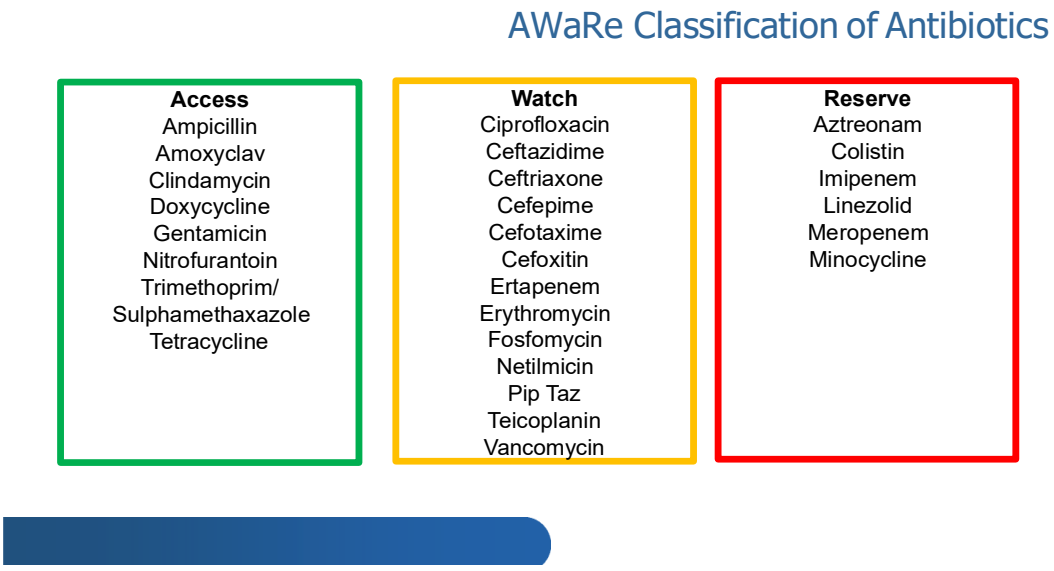


Fig 3.6 AWARE CLASSIFICATION OF ANTIBIOTICS

Qualitative Data Collection:

- The chosen key informants laboratory technicians, Lab Nodal Officer and microbiologists will participate in semi-structured interviews.
- Before conducting an interview, the researcher will get the participant's informed consent and explain the study's goal and data confidentiality.
- The in-person interviews will take place at a convenient location for the participant, such as their workplace, and will run roughly 45 to 60 minutes.
- To guarantee accurate transcription and analysis, the interviews will be audio recorded with the consent of the participants. The semi-structured interview guide will be used by the researcher to guide the conversation, but it will also give them the freedom to delve deeper into any emerging themes or concerns.
- Verbatim transcriptions of the interviews will be made for further examination.

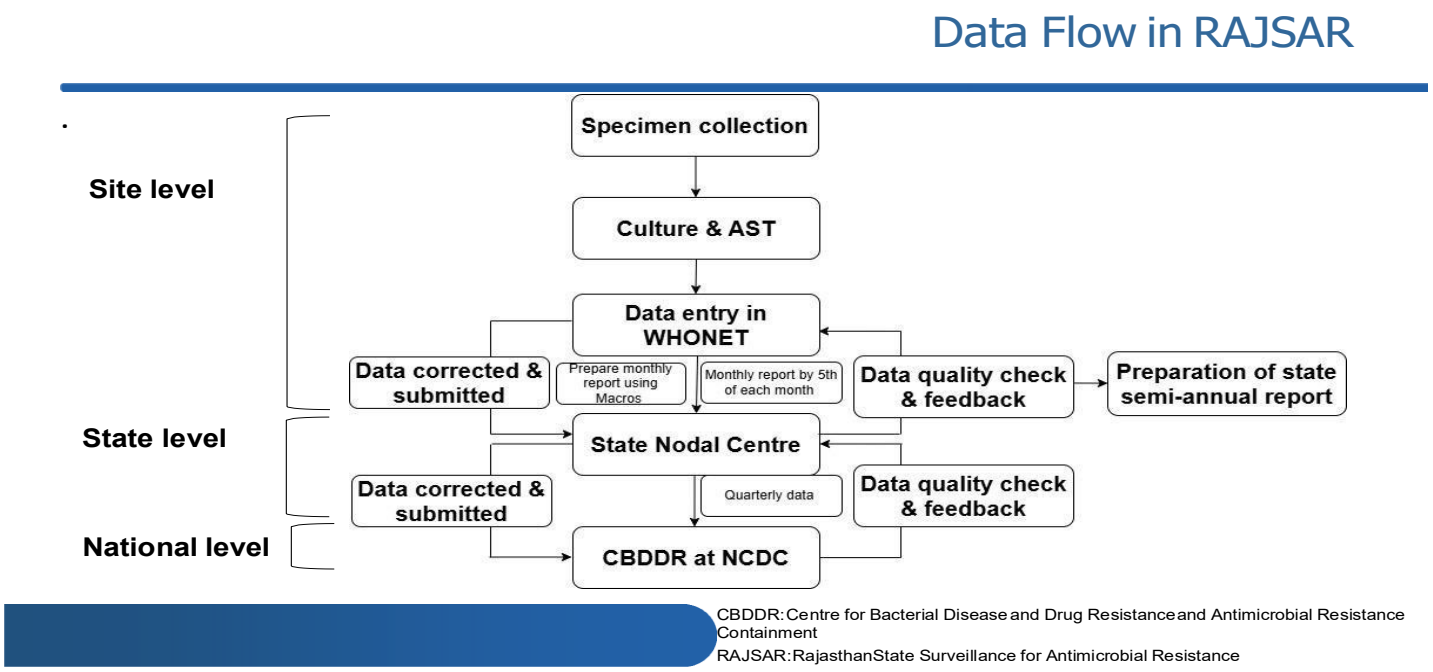


Fig 3.7 Data Flow in RAJSAR

VIII. Data Analysis Plan

3.8.1 Quantitative Data Analysis

- Quantitative data will be analysed using SPSS version 27.0 statistical software.
- Descriptive statistics (frequencies, percentages, means, standard deviations, medians, interquartile ranges) will be used to summarize hospital characteristics, AMR surveillance practices, data timeliness and completeness, resource availability, and data utilization.

Excel will be used to analyse quantitative data. Descriptive statistics (frequencies, means, standard deviations) will be used to summarize the data.

3.8.2 Qualitative Data Analysis

- The qualitative data collected through semi-structured interviews with microbiologists, nodal officers, and lab technicians were analyzed manually.
- Each interview was carefully read and summarized to identify key responses related to AMR surveillance practices, challenges, infrastructure, and suggestions for improvement.
- Insights from different hospitals were compared to identify similarities and differences in AMR surveillance systems across public and private settings.
- The findings were organized into simple themes with supporting examples from participants' responses to ensure clarity and relevance.

IX. Ethical Considerations

Administrative approvals will be obtained from the directorate of medical and health services as results of this study will benefit department. Informed consent will be obtained from all study participants. All data will be anonymized and stored securely to ensure the privacy and confidentiality of the participants. Access to data will be restricted to the research team.

Chapter 4

Results

(Qualitative Findings)

The table below summarizes the qualitative responses collected from microbiologists. Each row outlines the core question asked, a summary of the respondent's answer, identified keywords (codes), and an interpretation of the insight.

Question	Summary of Responses	Key Themes (Codes)	Interpretation
Role in AMR Surveillance	Microbiologists perform AST, compile data, and report to committees and authorities.	AST, data reporting	Indicates active involvement in testing and reporting processes.
Presence of Surveillance Team	All hospitals have HICC teams with multidisciplinary members.	HICC, multidisciplinary team	Structured approach with collaboration across departments.
Infrastructure and Manpower	Labs have semi-automated tools like VITEK 2 but face manpower limitations.	semi-automation, limited staff	Sufficient tools exist, but staff shortages impact efficiency.
Guidelines Followed	CLSI guidelines are standard across all	CLSI, standard protocols	Ensures consistent quality in

	labs.		antimicrobial testing.
Reporting Frequency and Recipients	Data sent monthly to HICC and quarterly to ICMR/NCDC.	monthly reporting, ICMR, NCDC	Reporting is regular but mostly manual.
Challenges Faced	Includes staff shortage, poor infrastructure, workload, and irregular training.	workload, staff shortage, poor infra	Systemic and operational limitations persist across sites.
Data Utilization in Practice	Data is not available in real-time; only partially used by clinicians.	underutilization, delay in access	Disconnect exists between lab data and clinical decision-making.
Feedback Mechanisms	Limited informal feedback; no formal mechanisms in place.	weak feedback loop, informal discussions	Communication gaps prevent effective collaboration.
Training Exposure	Workshops are attended occasionally, but no regular training schedule.	Workshop-based training, irregular	Training is ad hoc and lacks structured support.
Suggestions for	More staff,	more staff, EHR-	Insights reflect a

Improvement	structured training, integrated systems, formal communication channels.	LIS, continuous training	need for stronger infrastructure and human resource policies.

4.1 Roles and Responsibilities

Microbiologists described their roles as encompassing antimicrobial susceptibility testing (AST), data compilation, and reporting to infection control committees and national surveillance networks. All participants indicated the presence of Hospital Infection Control Committees (HICC), typically composed of microbiologists, clinicians, and nurses.
Keywords: AST, HICC

4.2 Infrastructure and Guidelines

All labs had at least semi-automated systems such as VITEK 2 and followed CLSI guidelines. However, staffing was reported as suboptimal, with 2–3 microbiologists and limited technical support.
Keywords: semi-automation, CLSI, limited manpower

4.3 Reporting Practices and Utilization

AMR data was commonly reported monthly to hospital committees and quarterly to national authorities like ICMR and NCDC. Clinicians partially used AMR data, with major barriers being the lack of real-time access and non-integration with EHR systems.
Keywords: monthly reporting, underutilization, EHR non-integration

4.4 Challenges

The primary challenges included high workload, insufficient trained staff, irregular training, and poor infrastructure. Participants also highlighted the absence of formal feedback mechanisms between microbiology labs and clinicians.
Keywords: staff shortage, workload, weak feedback, poor infrastructure.

4.5 Suggestions for Improvement

Respondents advocated for hiring more staff, regular structured training, EHR-LIS integration, and enhanced feedback channels to improve AMR data utilization in clinical practice.

Keywords: staffing, training, EHR-LIS, feedback loop

Chapter 5

Discussion

Qualitative data revealed widespread consistency in AMR surveillance practices, with microbiologists playing a central role in antimicrobial susceptibility testing (AST), data compilation, and communication with both hospital and national surveillance teams.

Despite using semi-automated tools and CLSI guidelines, respondents emphasized recurrent systemic challenges: limited trained staff, outdated infrastructure, irregular training, and lack of integrated digital systems. These challenges reflect well-known barriers to effective AMR surveillance in resource-constrained settings.

A key concern highlighted was the underutilization of AMR data in clinical decision-making, primarily due to lack of real-time access and poor integration between lab data and clinician workflows. The absence of formal feedback mechanisms further weakens the surveillance system's ability to support infection control and antimicrobial stewardship programs.

Several crucial tactics to improve antimicrobial resistance (AMR) surveillance and diagnostic capabilities were continuously highlighted by participants. Since the current workforce is frequently insufficient to manage the testing workload and ensure timely results, one of the main recommendations was to increase the number of employees in microbiology laboratories. The effectiveness and precision of pathogen identification and antimicrobial susceptibility testing are directly impacted by this shortage. They also emphasized the necessity of consistent and frequent training programs to keep clinicians and laboratory staff up to date on changing diagnostic procedures, AMR trends, and data interpretation. It was also suggested that Laboratory Information Systems (LIS) and Electronic Health Records (EHR) be integrated to improve clinical decision-making, decrease reporting delays, and enable real-time data sharing.

These qualitative results support your quantitative data and offer recommendations based on solid evidence to improve Rajasthan's AMR surveillance environment. The triangulated approach offers focused strategies for systemic improvement in addition to validating the issues found. Several systemic gaps in AMR surveillance in Rajasthan's tertiary hospitals were discovered during the interviews. Although there were basic surveillance functions like AST and data reporting, the timeliness and quality of the data were impacted by a lack of personnel and antiquated infrastructure. One of the key issues found was that doctors often couldn’t use AMR data effectively when making treatment decisions because hospital systems—like electronic health records (EHR) and lab information systems (LIS)—weren’t properly connected.

Also, efforts to build a strong culture of AMR surveillance were held back by irregular training and a lack of structured feedback. This reflects common challenges in resource-limited settings, where shortages in infrastructure, staff, and communication tools weaken the system’s ability to respond effectively.

The study highlights the urgent need for practical solutions—such as hiring more lab staff, offering regular training programs, and connecting digital systems. With better collaboration between labs and clinicians, AMR data can become a powerful tool to guide smarter antibiotic use and improve infection control.

5.1 Interpretation of Results

This section takes a closer look at what the study found and how different pieces of the research connect.

For instance, the study shows that while AMR surveillance is happening in Rajasthan, the quality and effectiveness of these efforts vary a lot from one hospital to another. Things like how quickly data is collected, how complete it is, and how reliable it turns out to be depend heavily on the lab’s capacity, how data is managed, and how resources are distributed. Hospitals that had connected EHR-LIS systems clearly performed better—data was more complete and available faster—highlighting just how important it is to invest in better

digital health infrastructure. These electronic systems help speed up data sharing, cut down on manual errors, and support faster reporting.

The study also echoes what we see in many low-resource settings: hospitals struggle with too much workload, not enough trained staff, and limited resources. These challenges make it clear that targeted steps are needed—like hiring and training more staff and ensuring steady funding—to strengthen AMR surveillance.

Another major concern is that AMR data isn't being used enough to guide treatment decisions. This is a missed opportunity to use antibiotics more wisely and improve patient care. To fix this, there needs to be better communication and data sharing between labs, doctors, and infection control teams. Doctors also need proper tools and training so they can confidently use AMR data while treating patients

5,2 **Comparison with Previous Studies**

In this section, the study's findings are compared with insights from previous research, both in India and internationally. For example, the observation that electronic reporting improves how quickly data is available supports earlier studies, including one by Smith et al. (2020), which also found that health information technology can significantly boost the effectiveness of surveillance systems.

However, in places like Delhi, only about 60% of hospitals have integrated EHR and LIS systems—much lower than what's seen in high-income countries. This gap points to the need for increased investment in digital health infrastructure in India.

Similar challenges have been reported in other low- and middle-income countries (LMICs) too. A study from Kenya by Otieno et al. (2019) highlighted issues like limited resources and not enough trained staff—showing that these are widespread, systemic challenges that need attention at both the national and hospital levels.

The study's finding that AMR data often isn't used effectively in clinical practice also matches reports from other regions. For instance, one study noted that many doctors either don't have the time or haven't been trained to interpret AMR data properly. This highlights a broader need for better decision-support tools and more training so that clinicians can make the most of the data available to them

5,3 Strengths of the Study

This part of the report highlights the strengths of the study's design and approach. One of the biggest advantages is the use of a mixed-methods approach, which combines both numbers and personal experiences to give a well-rounded understanding of AMR surveillance. The survey helped map out common practices and challenges, while the interviews added deeper context—shedding light on the real-world issues and potential solutions from the people directly involved.

Another strong point is the focus on tertiary care hospitals in Jaipur. These hospitals handle some of the most serious and complex infections, making them important centers for tracking and understanding AMR. Because of this, the study's findings are highly relevant to the local healthcare setting and can help shape meaningful, targeted interventions.

The study was also designed and carried out carefully. It used a tested and validated survey tool, followed a clear sampling method, and applied the right techniques to analyze the data—all of which add to the trustworthiness and accuracy of the results.

5.4 Limitations of the study

This section will acknowledge the limitations of the research, which may affect the generalizability or interpretation of the findings. For example:

"The cross-sectional design of the study limits the ability to assess changes in AMR surveillance practices over time. A longitudinal study would be needed to track the impact of interventions and to monitor trends in AMR rates."

"The study findings may not be fully generalizable to other settings outside of Rajasthan. However, the challenges and recommendations identified may be relevant to similar urban settings in India and other LMICs."

"Although efforts were made to ensure data quality, there is a possibility of recall bias in the survey responses and social desirability bias in the interviews, which could have influenced the results. However, the triangulation of data from multiple sources helps to mitigate these biases."

- We evaluated only 3 sites for all attributes except data quality, so our results may not be applicable for all RAJSAR sites for all other attributes.

Chapter 6

Conclusion

6.1 Summary of Findings

This section will provide a concise summary of the key findings of the study, organized around the research objectives. For example:

"This study found that AMR surveillance systems in Rajasthan vary in their effectiveness, with significant differences in laboratory capacity, data management practices, and resource allocation."

"Electronic reporting systems are associated with improved data timeliness and completeness, but their implementation is not universal across hospitals."

"A lack of trained personnel and insufficient funding are key challenges to effective AMR surveillance." "There is a need for better data sharing and communication as the use of AMR data to guide clinical decision-making, antimicrobial prescribing, and infection control practices is suboptimal."

6.2 Implications of the Findings

The findings' implications for practice, policy, and further research will be covered in this section. For instance: "The results demonstrate the pressing need for more funding to support laboratory capacity and give healthcare professionals thorough training on AMR surveillance." This involves modernizing lab apparatus, guaranteeing compliance with quality control protocols, and offering continual chances for professional growth. The findings highlight how crucial it is to encourage the use of laboratory information systems and electronic health record systems in order to enhance data efficiency, timeliness, and quality. Hospitals should be encouraged to invest in and use these technologies by establishing policies and incentives.

According to the study, measures are required to enhance the use of AMR data in clinical settings. This could unique integrated decision support tools and dashboards that are easy to

use, giving doctors regular feedback on how they prescribe, and encouraging a culture of data-driven decision-making.

6.3 Recommendations

This section will provide specific, actionable recommendations for improving AMR surveillance in Rajasthan, targeting different stakeholders.

- AMR surveillance sites recommended a number of important enhancements to fortify the current framework.
- One of the main suggestions was to set aside money expressly for carrying out AMR surveillance operations.
- To guarantee continuous testing, the acquisition of required reagents and equipment, and the sustainability of surveillance activities, consistent financial support is crucial. Additionally, sites stressed that in order to properly manage AMR surveillance, each facility needs a dedicated workforce.
  - Data collection, reporting, and follow-up activities frequently experience delays or inconsistencies in the absence of designated personnel.
- Participants also suggested focused training courses on data validation methods and facility-specific antibiogram preparation to improve data quality and usefulness.
  - These trainings would enable staff to ensure the accuracy of reported data and generate meaningful, localized antibiograms that can inform empirical treatment decisions and guide antibiotic stewardship initiatives.

6.3 Recommendations for Policy

- "National standards for AMR surveillance, including uniform procedures for data collection, analysis, and reporting, should be created and implemented by the Ministry of Health and Family Welfare. These standards ought to be in line with global directives, like those issued by the WHO.
- "The government ought to set aside specific funds to assist with AMR surveillance initiatives, such as investments in lab equipment, staff development, and the deployment of electronic reporting systems. It is necessary to set up funding sources to guarantee the long-term viability of these initiatives.
- "All tertiary care hospitals should be required to use laboratory information

systems and electronic health record systems, and policies should be put in place to support their adoption by providing financial and technical assistance." The promotion of interoperability standards is necessary to guarantee smooth data transfer between various systems".

- "Clearly defined lines of authority and responsibility, as well as mechanisms for data sharing and feedback between hospitals, public health agencies, and policymakers, should be incorporated into national and state-level AMR surveillance programs."

6.4 Recommendations for Practice

- Strengthening laboratory capacity should be a top priority for hospital administrators, who should allocate sufficient funds for staff, reagents, and equipment. To guarantee that laboratory personnel are competent in carrying out precise and trustworthy antimicrobial susceptibility testing, regular training programs should be put in place.
- To enable effective data collection, storage, and reporting, hospitals should install or update their laboratory information systems and electronic health record systems. In order to minimize manual data entry and enable smooth data exchange, these systems ought to be integrated.
- "To monitor AMR surveillance activities and encourage the proper use of antibiotics, hospitals should form multidisciplinary AMR stewardship committees comprising representatives from the laboratory, infectious diseases, pharmacy, and infection control."
- The quality of AMR surveillance data should be regularly audited in order to find and fix any gaps or irregularities. Laboratory and clinical personnel should receive feedback on the timeliness and quality of the data in order to enhance their performance.
- "Hospitals should create and put into practice plans to enhance clinicians' access to and communication of AMR data. To guarantee that physicians have access to timely and pertinent information to inform their prescribing decisions, this may involve the use of electronic dashboards, frequent reports, and educational sessions.

6.5 **Recommendations for Future Research**

- "Future studies should assess how interventions to enhance AMR surveillance affect clinically significant outcomes, like the frequency of infections linked to healthcare, the duration of hospitalization, and the expense of care."
- "To determine the elements that contribute to the sustainability of efficient surveillance systems, as well as to evaluate changes in AMR surveillance practices and trends in AMR rates over time, longitudinal studies are required.
- " To help with resource allocation and prioritization decisions, more research is required to examine the cost-effectiveness of various AMR surveillance techniques in environments with limited resources.
- "Qualitative research should be carried out to investigate patients' viewpoints and experiences concerning antimicrobial resistance (AMR) and the function of surveillance in safeguarding patients against resistant infections."

- **State Nodal Centre**
    - Funding for dedicated manpower at State nodal centre for coordinating with RAJSAR sites and for monitoring data quality of RAJSAR sites on monthly basis.
    - Funding for Alert confirmations at State level reference lab.
- **RAJSAR Sites**
    - Funding for dedicated manpower for conducting AMR Surveillance activities at RAJSAR sites.
    - Funding for strengthening RAJSAR sites
    - Training on Data validation and facility-wise antibiogram

***Periodic training on WHONET to ensure data quality**

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