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A Report

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“Thankfulness is the beginning of gratitude.

Gratitude is the completion of thankfulness.

Thankfulness may consist merely of words.

Gratitude is shown in acts.”

I wish to express my sincere appreciation to those who made this work possible and helped shape its contents.

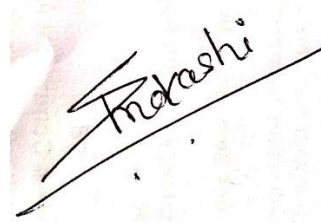
First and foremost, I must gratefully acknowledge, **Faculty of School of Pharmaceutical Management, IIHMR University, Jaipur, Dr. Sandeep Narula, Associate Professor** whose inspiration and influence continues to guide me as it did. Without him, none of this work would have been possible. I would also like to thank my teacher’s support and patience encouraged me throughout the write up of this manuscript.

This Internship Report was the start of my journey in MBA PM and I have not travelled in a vacuum in this journey. This Internship Report has been kept on track and been seen through to completion with the support and encouragement of numerous people including my faculty members, my well-wishers, my friends, colleagues. I would like to thank all those people who made this report possible and an unforgettable experience for me. At the end of my Internship Report it is pleasant talk to express my thanks for gratitude to all those who contributed in many ways to the success of this study and made it an unforgettable experience for me.

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No research is possible without library, the center of learning resource. Most of the result described in the project would not have been obtained without a close collaboration with few laboratories. Above all I owe it all too almighty God for granting me the wisdom, health and strength to undertake this research task and enabling me to its completion.

Thank you.

A handwritten signature in black ink, reading "Mokashi", is written over a horizontal line. The signature is slanted upwards to the right.

Date: July 07, 2020

Mr.Sushil Raghunath Mokashi

MBA PM - 11

Roll No. 0213

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List of Abbreviations

Sr. no.	Symbol	Abbreviation
1	AMR	Antimicrobial Resistance
2	GHSA	Global Health Security Agenda
3	NHP	National Health Policy
4	OTC	Over the Counter
5	MDR	Multi Drug Resistance
6	ABR	Antibacterial Resistance
7	PICO	Population, Intervention, Comparison, Outcome
8	FP	Family Physicians
9	GP	General Practitioners
10	MRSA	Methicillin – Resistant Staphylococcus Aureus

Perspective and Resulting Methodologies to Estimate Antimicrobial Resistance

Abstract

Background

The growing figure and comprehensive spreading of pathogen resistance to various antimicrobial drugs has been identified as greatest threats to global health with thoughtful economic and health consequences. This review is aimed to focus the extent of this greatest threat in terms of economy and health which resulted into health emergencies result from these antimicrobial resistances were easy to tackle. The pathogen which are resistant to standard antimicrobial treatment gives rise to elongated hospital visits, costly treatment medicines, augmented mortality. AMR is listed among the Global Health Security Agenda (GHSA) of which India is also the donating nation.

Research Question

What perspectives and resulting methodologies have been used to estimate Antimicrobial Resistance (AMR) burden and how family physicians can take part to tackle AMR?

Strategic Objective

- ❖ To develop knowledge and understanding related to antimicrobial resistance burden;
- ❖ To boost the awareness in public through investigation and examination; and
- ❖ To reduce the burden of antimicrobial resistance by the pathogens;

Keywords

Antimicrobial resistance, antimicrobial drugs, global burden of disease, pathogen, treatment

Introduction

AMR has been identified as foremost health care burden in India. It is arising due to adaption of various pathogens like bacteria, fungi, parasites, and viruses to standard antimicrobial treatment. It subsequently results into incompetence of drug to fight with infection and increases the risk of major healthcare burden and transmission of diseases. From the reports which are recently available, pathogens which shows resistance to antimicrobial infection are growing day by day. Therefore, a detailed approximation about AMR burden with the help of health policies are crucial to updated to avoid the antimicrobial resistance to the standard antimicrobial treatment. As in most of the cases AMR shows natural mode of transpires, the rise and rapid blow-out of the pathogen resistance mechanism to the standard antimicrobial treatment are augmented. In most of the regions, antibiotics are administered without appropriate medical prescription and are taken with misuse. The pathogens which shows resistance to standard treatment guideline of antimicrobials are exist in people, animal, food, and the environment and will transmit through people and animal. To identify and analyse the antimicrobial resistance to numerous pathogens, the standpoint to be carried out must well formulated. But to identify and analyse the perspective of antimicrobial resistance, there are numerous responsibilities as there are inadequate and undependable data about spread and prevalence of antimicrobial resistance by the pathogens. Most importantly, in detailed information received from the government and private segments are even not organized in the form of national and international division which cover less data about discrete antimicrobial consumers and the results after the administration. Moreover, a big issue which is related to selection bias for whom the AMR testing is done and also the testing results and data is being entered or not into data systems on which all laboratory data related to AMR is stored. For the generation of accurate laboratory data orderly efforts must made to analyse and examine antimicrobial treatment patterns with related antimicrobial resistance pathway, which may give a vital information related to AMR. For the construction of precise health burden due to resistance developed by the pathogens, procedures and guidelines need to be formulated in such a way that it should be standardized for treatment measures and AMR data gathering. As AMR is listed among the Global Health Security Agenda (GHSA), the pledge to fight with pathogen resistance to antimicrobial treatment was supplementary reinforced by the higher authority summits which are based on AMR at the United Nations General Assembly dated on 21 September 2016. A national policy for AMR control in India was issued in 2011. Recently, Indian Prime Minister Shri Narendra Modi confirmed the pledge to combat with pathogen resistance to antimicrobial treatment by the joint Indo-US to Global Health Security Agenda (GHSA) with periodically updating its objects. Also, they have pointed out countries position and participation in the sector of AMR in India. The burden of antimicrobial resistance by the pathogens were highlighted in 2017 by the National Health Policy (NHP) and demand for a fast action related to calibration and implementation of strategies related to antimicrobial use, practice of OTC medication under antimicrobial treatment.

Literature Review

De Angelis G, D’Inzeo T, Fiori B, Spanu T, Sganga G. (2014) discussed various infection that may occurred due to antibiotic resistant Gram-negative bacteria and their major impact on morbidity and mortality in their review article **“Burden of antibiotic resistance gram negative bacterial infections: evidence and limits”**. The revised study reveals that, the Gram-negative bacteria which shows Multi Drug Resistance (MDR) trigger a substantial economic burden. On the other hand, the lack of consistency in resulting methodology and findings does not allow to find definitive conclusion. The above study also addresses that, the mode of communication between clinical researchers and economists should be upgraded for the formulation of transparent and reproducible standards. The development in the mode of communication is the starting point for the assessment of the mediation approaches with the goal of controlling the multiplication of Multi Drug Resistance infection.

Landers TF, Cohen B, Wittum TE, Larson EL. (2012) reveals that the practice and use of antibiotics in food animals is extensive. In their review article **“A review of antibiotic use in food animals: Perspective, policy, and potential”** they noticed of uniformity in national and international guidelines. In the above review article, they reviewed the existing literature based on the nature and scope of antibiotic practices in animal settings. The epidemiologic relations between the practice of antibiotics in animal settings and their significant resistance overview in humans was also reviewed. In this review article, they deliver an overview of the complex risk analysis outline required to comprehend the current issues related to antibiotic practice. Lastly, they reviewed national and international guidelines in the context of antibiotic practices in animal and human settings and their regulatory recommendations.

Prestinaci F, Pezzotti P, Pantosti A. (2015) focuses on Antibacterial Resistance (ABR), which is the major healthcare threat at the moment, both for the high rates of resistance detected in infectious pathogens that produce common pathogenic infections and for the complexity of the outcomes antibacterial resistance in their review article **“Antimicrobial resistance: a global multifaceted phenomenon”**. In this review article they portray the health and economic impact of ABR in human settings, the primary factors for its prevalence, in general, they give emphasize on four most common antibiotic resistant bacteria of international importance – *Staphylococcus aureus*, *Klebsiella pneumoniae*, non-typhoidal *Salmonella* and *Mycobacterium tuberculosis* – for whom they reported resistance data internationally. Also, they discussed that, in the community settings and in healthcare professional’s antimicrobial stewardship needs to be extended. The measures such as information campaigns for the patients, training, and education to the healthcare professionals, to improve diagnostics, treatment guidelines, prescription audits should consider.

Kotwani A, Wattal C, Joshi PC, Holloway K. (2016) studied the awareness and knowledge of practice and use of antibiotics and resistance among students and school teachers in their research article **“Knowledge and**

Perception on Antibiotic Use and Resistance Among High School Students and Teachers in New Delhi, India: A Qualitative Study”. In this study they found that students had poor knowledge and awareness of antibiotics and antibiotic resistance, whereas only few teachers had a basis knowledge and awareness. In order to create awareness and basic understanding, both groups recommended a multidimensional attitude along with vigorous public campaigns for awareness and understanding.

Outline of Antimicrobial Resistance (AMR) in India

Even if, the phenomenon of resistance by pathogens to the standard antimicrobial treatment shows natural mode of transpires, choice of bacterial species which shows resistance to this phenomenon is the optimal antimicrobial treatment in human and animal segments. The bacterial species which shows the resistance to the antibiotic treatment is developed from gram-positive and gram-negative strains. The example of such antibiotic resistant species *Staphylococcus aureus*, *Enterococcus* species, *Pseudomonas aeruginosa*, *Actinobacterium* species, *Escherichia coli*, *Klebsiella pneumoniae*, and *Neisseria gonorrhoeae*. One of the most common antibiotic species known as *Mycobacterium tuberculosis* shows multi-drug resistance in the treatment of tuberculosis results in antibiotic resistance.

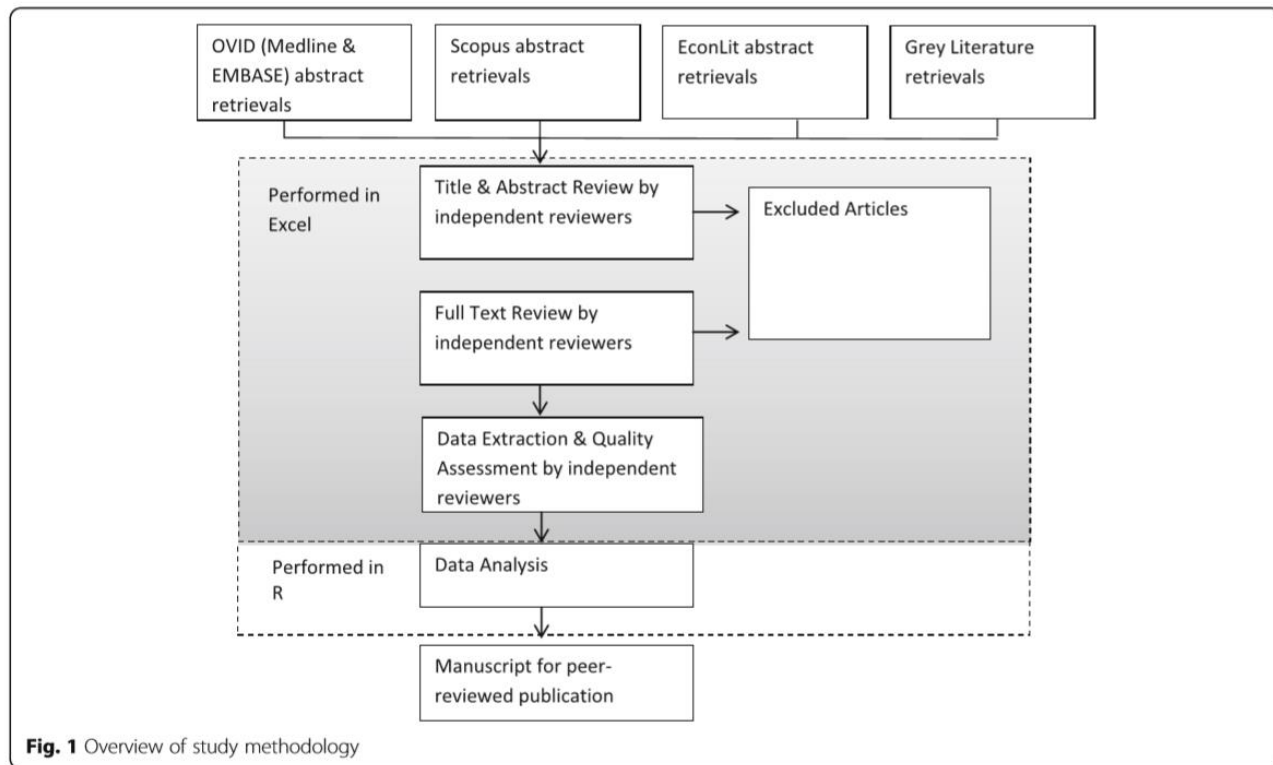
The bacteria species which shows antibiotic resistance in the antimicrobial treatment shows different pathway by which they produce antibiotic resistance. From the last many years, different pathway and distribution or spreading pattern of antimicrobial resistance have been recognized. Another commonly known concept in terms of antibiotic resistance called as “superbugs” which develop organism which shows resistance to antibiotic treatment that can be cured with high dose of antibiotics only. The group of species which comes under the category of superbugs are, *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* species. The research related antibiotic resistance in India are inadequate and further study related to this is needed to ascertain the pathway of showing resistance.

Methods/Design

Research Question

What perspectives and resulting methodologies have been used to estimate Antimicrobial Resistance (AMR) burden and how family physicians can take part to tackle AMR?

Study overview



Study eligibility

All the studies which focuses on estimating the burden of antimicrobial resistance in human being is reflected in this systematic review. Also, the research articles which conducts studies within any infectious pathogens, pathogenic infections, and all country settings.

The revised Population, Intervention, Comparison, Outcome (PICO) studied for this systematic review with inclusion and exclusion criteria can be found in Table 1.

Search strategy

The designing methodology used for the formulation of this systematic review taken the reference of Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guideline. The search strategy starts from 2013 onwards. For the formulation of systematic review, OVID (Medline & EMBASE) abstract retrievals, Scopus abstract retrievals, EconLit abstract retrievals, Grey Literature retrievals will be examined from predesigned website agencies. After referring to a group of researchers who are working under AMR, the following website agencies were specified. The content from the following website agencies was then examined for AMR reports and related articles with population of interest:

- ❖ Public Health England
- ❖ Public Health Wales
- ❖ Health Protection Scotland
- ❖ NHS Health Scotland
- ❖ Department of Health (UK)
- ❖ Health Protection Agency
- ❖ National Institute for Health and Care Excellence
- ❖ Centers for Disease Control and Prevention
- ❖ World Health Organisation
- ❖ European Commission for Public Health
- ❖ Review on Antimicrobial Resistance

From the previously published research articles it comes to know that many articles do not refer to AMR usually, but instead specific pathogens. To deal with it, a supplementary 13 clinically important pathogens in AMR point of view is emphasized in the following review.

All the abstracts related to AMR with complete title was then reviewed. After reviewing abstracts and title, the full texts under the title was also then reviewed. At the same time, a complete parallel review of the title, abstract and full texts was accomplished by independent reviewers. The key role of these independent reviewers to review a proportion of the total retrieval items. Any deviation from the retrieved items was then reviewed and re-investigated till further settlement was attained.

Data collection and analysis

All the data obtained from full texts was then saved by the lead reviewer. The collected data was then transferred into Excel for standardized data extraction. The same data was assessed independently to confirm quality. From the data collected from full texts, following information was removed: study identifiers, study attributes such as perception, country settings, study methods/design, concern effects such as mortality rates, cost, findings, asserted constraint. For the formulation of the systematic review, informative combination of the data related to AMR and associated methodology was provided. The informative combination of data includes a tabular representation of data on particular point and outline of graphical interpretation with study attributes like scatter plot and financial costing.

Use of Antibiotics

Research proved that resistance to antibiotic is dependent on the use of antibiotic against different cases of infection. Hence it is very crucial to identify the prototype of antibiotic use. Amongst all the antibiotic consumption countries India reported the uppermost use in 2010. Apart from highest antibiotic use, a augmented administration of carbapenems, lincosamides, glycopeptides, linezolid, and daptomycin shown in research. The cause behind such condition are numerous, which are shown under.

1. Easy availability of antibiotic and related drugs over the counter in pharmacy.
2. Unethical practices which are used in the promotion for selling large number of antibiotics.

Along with misuse and drug abuse, underuse because of limited availability is also a natural phenomenon in India. Due to deficient availability and accessibility to imperial quality antibiotics results in substantial mortality, and thereafter here is a vital necessity to boost the availability of antibiotics also on the other hand to regulate the excessive antibiotic use to restrict drug abuse. Apart from health segment, the use and necessity of antibiotics is found in animal husbandry, fisheries, and agricultural segments for numerous treatment care and as a growth enhancer in various species.

Table 1: Inclusion/exclusion criteria

Criteria	Inclusion	Exclusion
Population	Humans	Animals
	All ages All sexes Infection with antimicrobial resistant organism	Plants
Intervention	Not applicable	Not applicable
Comparator	Not applicable	Not applicable
Outcomes	Associated health burden, to include but not restricted to: Morbidity; for example excess length of stay in hospital Mortality	Health-related quality of life only
	Associated Healthcare cost burden, to include but not restricted to: Resource use Opportunity cost	Molecular biology only
	Economic burden, to include but not restricted to: Costs associated with loss of productivity and reduced labour force Work-loss hours per/case episode	Epidemiology only
	Secondary burden from not being able to use antibiotics in ways previously or currently used in healthcare, to include but not restricted to: Reduced surgery Reduced use in chemotherapy and similar	Outcomes associated with the evaluation of an intervention such as clinical cure rate only

	therapies	
Study design	Case-control studies	Editorials
	Cohort studies	Letters
	Cross-sectional studies	Case series report
	Longitudinal studies	Conference abstracts/reports
	Randomised controlled trials	Evaluations of treatments/interventions
	Modelling studies Economic evaluations	Reviews
Other	English language	



National Action Plan on Antimicrobial Resistance

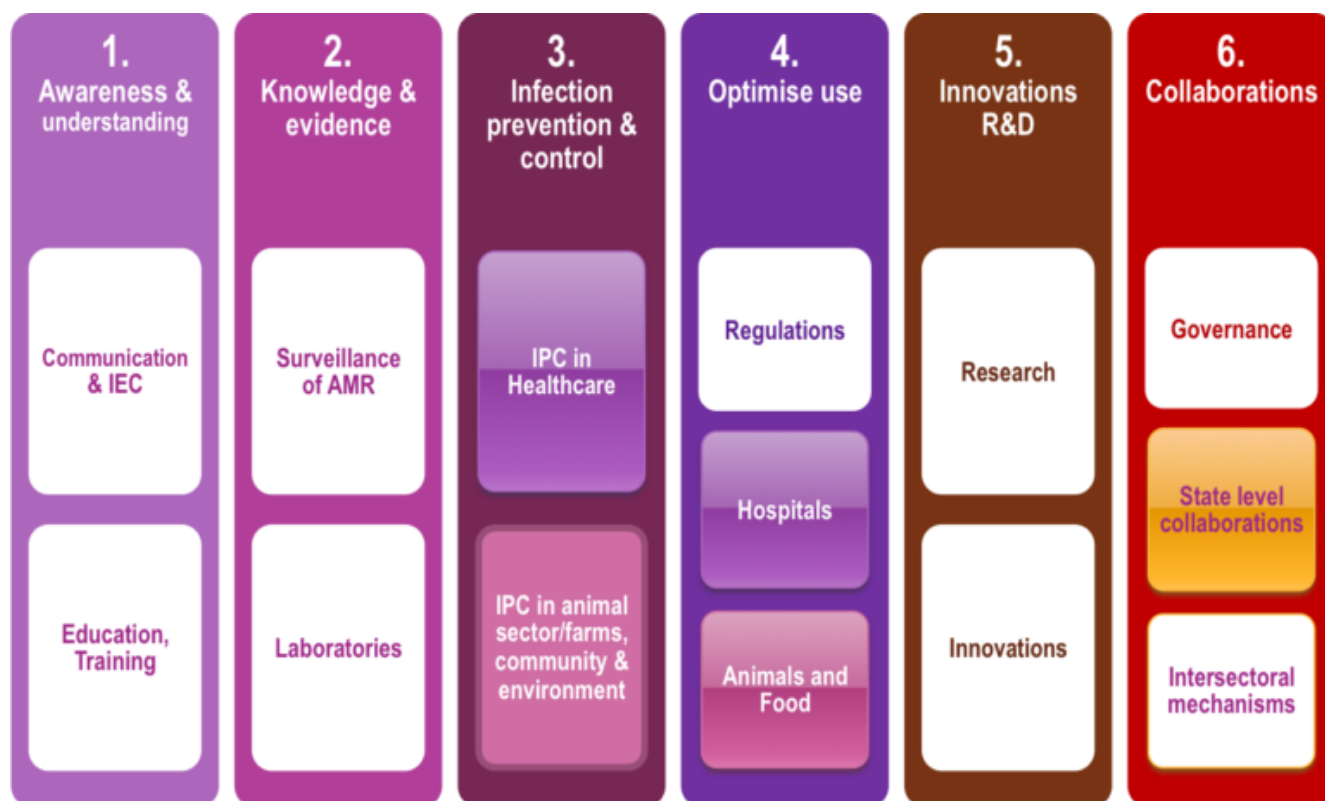
Goal

A key goal of the National Action Plan on Antimicrobial Resistance (NAP-AMR) is to successfully fight against the most common healthcare problem known as Antimicrobial Resistance, and to promote and tackle this public health hazard. The following action plan be going to formulate and reinforce the governance pathway as well as the position of all shareholders to combat the overload of AMR in India.

Objectives

The National Action Plan for Antimicrobial Resistance recommends pointing different crucial characteristics of AMR in both human and non-human segments. To implement and achieve the following action plan there are different key objectives which are listed as short term which consists of period within one year, medium term which is of 1 to 3 years, and the preceding period lasts more than 3 years which is termed as long-term period. The various strategic priorities

The first five strategic objectives of NAP to combat AMR mainly focusing on improving awareness, strengthening the knowledge about AMR, to reduce and optimize the incidence of infection with various promotional investments activities. While the sixth strategic objective emphasize in strengthening India's contribution in prevention and controlling AMR by the side of international level comparing to various other competing nations and related organizations. All the strategic priorities developed by NAP-AMR is discussed in Table 1. Also, the crucial amendments taken by India with their brief description is listed in Table 2.



Strategic Priority 1

This strategic priority gives emphasize on various measures for understanding, designing, and to create awareness and communication activities about the “Information, Education and Training”. Also, this strategic priority gives insights to implement on the other community and participants who are actively contributed in antibiotic practises for conduction of various communication activities. Moreover, this strategic priority offers amended syllabus for the healthcare professionals and formulate various courses for creating responsiveness among people. Along with offering different syllabus and course curriculum it also offers various Education and Training activities for improving knowledge and building awareness among key stakeholders’ groups like college students, healthcare professionals, faculties, and pharmacy professionals related AMR and other subjects. To reinforce competence and assistance for active participants in AMR they have conducted Training Needs Analysis (TNA) for various sectors and industrial segments like human, animal, environment, pharmaceutical, and food industries. For improving active communication between various departments and with different sectors this strategic priority focused on developing a strategy for permitting various organisations to actively communicate and to share data related to AMR with related microbiologists and lab technicians. But further research and survey program revealed that most of the stakeholder group which are mentioned above are did not have the awareness about the AMR and hence shows serious concerns. And hence responsiveness among various stakeholders must be enhanced. Special awareness program and campaigns must be planned such a way that it would give more emphasize on AMR. In results to this for generating awareness among various stakeholders’ special program are planned in November for one week during World Antibiotic Awareness Week.

Strategic Priority 2

This Strategic Priority comes with main purpose of strengthening the AMR knowledge of microbiology laboratory including private sectors and launch evidence-based surveillance in human, animal, food, and environmental sectors. The main objective behind surveillance is to collect and publish surveillance data related to AMR every year in human, animal, food, and environmental sectors. For strengthening microbiology laboratories, it needs to develop a nation-wide approach which is grounded on lab valuations for Antimicrobial Susceptibility Testing (AST) in medicinal laboratories to ensure Standard Operating Procedure (SOP) for generating standard community data. The same nation-wide approach is developed for Antimicrobial Susceptibility Testing (AST) for animals and food sectors. For designing and updating the treatment guidelines for AMR, it is crucial to know the resistance pathogen and their respective vulnerability pathway.

The focus of surveillance of AMR is to formulate a standard and organized pathway for nation-wide surveillance of AMR. To provide regulated data analysis and information management for AMR surveillance they define mechanical pathway for AMR data gathering, ordering and analysis. Strengthen microbiology laboratory capacity and to generate numerous data related to AMR after community and private healthcare clinics to be



started, to give clear insights about AMR resistance pathway throughout the globe. To expand the services and excellence of microbiology laboratories, microbiologists should be trained enough as they are foundation for AMR surveillance. Also, to expand the services and excellence pattern of microbiology laboratories there should be improved number of trained microbiologists in the laboratory, they should have hands-on training provision provided by tertiary care hospitals.

Strategic Priority 3

This strategic priority mainly focuses on reducing the prevalence of pathogenic infection with active infection inhibition and regulator. The prevalence of pathogenic infection is done mainly through Infection Prevention and Control (IPC) in healthcare, veterinary and animal husbandry. The infection prevention in healthcare mainly focuses on developing a stratified nation-wide strategy related to AMR for IPC in health care. Also, it helps in ensuring various infection control and their related management for prevention through all tiers of healthcare sectors which describes the fundamental elements of IPC, and formulate consistent terminologies for these elements at various tiers of health sectors in private and community domain. Along with prevalence of pathogenic infection it also rationalises hand sanitisation as a part of routine observing system within different aspects of initiative schemes such as

Swachh Bharat Abhiyaan, and **Swachh Swasth Sarvatra** at different tiers of health care settings. The infection prevention among veterinary settings supports in formulating various IPC schemes and services in animal health. This IPC schemes and services are executed and supervised at national and sub-national level.

Through personal hygiene, hand sanitization and infection control among public settings it reinforce infection control outside healthcare provinces to regulate the expansion and spread of pathogenic infection and endorse various hygiene activities such as behavioural change to evaluate the hygiene awareness in different social groups. To lessen the spread of antimicrobial infection in the environment, it formulates strategic intervention with development of plan to regulate new and existing registration of farms and industries. For executing operative infection prevention programs, the foremost barriers amongst the staff associates are non-existence of infrastructure, lack of trained employees, industrial workload, language problems, etc. On the society point of view, different actions to expand the accessibility to safe water, hand sanitization and personal hygiene are recently in trend through various campaigns like **“Swachh Bharat Abhiyan”** and **“Kayakalp Programme”** started by the Indian Government. Along with government initiation, a solid backing is required from high-level stakeholders which are working with AMR and functioning public contribution for operative execution of AMR programs and activities.

Strategic Priority 4

This strategic priority is for optimizing the use of antibiotics in human health, animal settings and food for development a governing agenda in context to hospital and industrial waste and to control environmental contamination. To regulate easy accessibility of superior quality antimicrobials, it confirms continuous accessibility to such superior antibiotic in human health, animal settings and food.

It reinforces national regulatory bodies to supply of high-quality antimicrobials along with safety and efficacy as mandate which reviews national regulations related to substandard use of antimicrobials, spurious and incorrectly labelled medicines.

To regulate the easy access and proper supply of antimicrobials ICMR issued its guidelines 2017. All the hospital and clinical staff are anticipated to circulate the related guideline issued by ICMR and confirms observance by proper practice on antibiotic stewardship. Antibiotic Stewardship states that, “coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy, and route of administration”. Also, it formulates self-governing veterinary regulatory framework to regulate and control phase-out non-therapeutic practices of antimicrobials in veterinary health for growth promoters and infection prevention due to pathogens. Under this independent veterinary framework, it regulates the sale of antimicrobials through prescription and the practice of respected prescription medicines are under observation. Along with high burden of co-morbidity problems in large number of community settings in India, most of the health care providers are facing number of healthcare issues like a smaller number of diagnostics services available at the health centres and patient affordability. For surveillance on use of antimicrobials in human health, veterinary settings, agricultural and food sectors, it formulates the national surveillance system to develop a practice for estimating overall antibiotic consumption with consultation from skilled professionals. By ensuring antimicrobial consumption registration and through gathering of numerous data from various stakeholders in the field of antibiotic manufacturing, selling, prescribing it measures use and practices of antibiotics among animal health, food, agricultural facilities.

In addition, most of the postgraduates who came as a medical intern tend manage large number of outpatients

where teaching hospitals is in collaboration with medical institutes during their training program. During this heavy workload at the workstations, they handle large number of outpatients without appropriate regulation from skilled professionals. So, to regulate and control such situation, special training should be provided to those interns. For introducing antibiotic stewardship actions among the community settings and in formulating infection prevention guideline, healthcare professionals and lab microbiologists perform a crucial character. For effecting formulation of antibiotic stewardship among public sectors, there is requirement of healthcare professionals, hospital staff, pharmacy professionals which are focussed and skilled in infection prevention and control. Also in addition to this, clinical pharmacists and pharmacologists in the field of AMR measures can also play an important role in prescription auditing, use and practice of antimicrobials, antibiotic stewardship for execution of antimicrobial consumption monitoring in human health, veterinary settings, agricultural and food sectors. To promote awareness among the public settings related to antimicrobial consumption, it organizes various awareness programs which targets healthcare professionals which prescribes the antibiotic prescription, suppliers and clinical pharmacists who dispenses the prescription. The awareness campaigns may also target institutes and universities.

To reinforce the regulation related to use and practices of antimicrobials among community settings, it consults with controlling bodies to evaluate existing laws and protocols related to handling of antimicrobial prescription for strengthening current and upcoming laws and regulations. The upcoming laws and regulations will help to notify supplementary adjustments which are needed for the implementation of Schedule H1 and X. For improving knowledge and skillset of healthcare professionals, clinical pharmacists, and medical apprentices, it works together with various regulatory bodies to order training programs for optimising antibiotic consumption practices. Along with structured training programs, it frames approaches for improving effectiveness of vaccines to widen their handling and practices.

Strategic Priority 5 and 6

This strategic priority deals with promoting investments related to AMR activities, research, and invention to tackle AMR. For new drug development and research projects involving novel antibiotics, unfortunately, does not assure a return-on-investment as many bacterial species can easily develop resistance pathway to those novel antibiotics, and antibiotics are used for short fixed durations, unlike drugs used for the cases of chronic infections. Apart from this, there is huge responsibility for the novel antibiotics to set as the last course of action for emergency patients. To formulate the economic strategic priority for sustainable investments in AMR activities, the investment gap as a strategic priority for NAP-AMR must estimate. Also, as sustainable investments, a continuing strategy for resource transition along with appropriate roles and responsibilities of various stakeholders must develop. To strengthen intersectoral harmonization of AMR events, it establishes cross-cutting intersectoral harmonization methods for AMR also it reviews current collaboration on AMR by India to discover significant regions where the coordination mechanisms can be strengthened. Under research and innovation, priorities for fundamental and operating studies to improve the current practice of antimicrobials and to optimize infection control measures in human and animal settings must be identified. To promote other research activities, requirement for the novel antibiotics, vaccines, diagnostic innovations need to review. To accelerate drug development around the globe, WHO has issued a list of highly infected pathogens for which

novel antibiotic development are urgently required. Along with research and innovations pertaining to development of novel antibiotics against the listed highly infected pathogens by WHO, novel inventions in the field of probiotics and vaccines formulations are also required.

Monitoring and evaluation plan

Monitoring and Evaluation (M&E) is an essential element of the National Action Plan on Antimicrobial Resistance (NAP-AMR) to safeguard objective assessment and examining the execution development. The M&E framework shall be finalised according to the final National Action Plan and shall be established based on the summary below.

Planning element (activity linked to the NAP-AMR)	Indicator	Type and purpose	Value (calculation)	Frequency of data collection	Data source	Method	Baseline	Target
Measure awareness and knowledge of AMR in different social and professional groups	Level of awareness by target group	Assessment, baseline survey, monitoring and evaluation of outcome	Awareness scores stratified by target group (composite indicator)	Baseline, and periodic (based on schedule of awareness campaigns)	Baseline survey, post-intervention survey reports	Awareness survey; knowledge-attitude-practice (KAP) studies	Measured in baseline survey	50% increase over baseline score
Awareness/behaviour change communication campaign on AMR and AMU	Number of IEC resources developed	Monitoring and evaluation of output	IEC resources stratified by stakeholders	Annually	Baseline, post-campaign	Awareness campaign report	None	Based on NAP
Review and consolidate AMR in curricula for health professionals	Revised curricula available for target professional groups	M&E of input	Yes/No No. of curricula / No. of professional groups targeted	Annually	Key informant at MoHFW	Key informant interview	...	Revised curricula with AMR
Review and consolidate AMR in curricula for professionals in animal health, food industry and agriculture	Revised curricula for target professional groups	M&E of input	Yes/No No. of curricula / No. of professional groups to target	Annually	Key informant at MoAFW, MoEFCC	Key informant interviews	...	Revised curricula with AMR

Planning element (activity linked to the NAP-AMR)	Indicator	Type and purpose	Value (calculation)	Frequency of data collection	Data source	Method	Baseline	Target
Write and approve terms of reference for a national coordinating centre for AMR surveillance	National coordinating centre terms of reference approved	M&E of input	Yes/No	Annually	Key informant at MoHFW	AMR surveillance programme implementation report	No terms of reference for national coordinating centre	Defined ToR for national coordinating centre
Write and approve terms of reference for national reference laboratory(ies) (NRL[s])	National reference lab terms of reference written and approved	M&E of input	Yes/No	Annually	Key informant at MoHFW	AMR surveillance programme implementation report	No terms of reference for NRL	Defined terms of reference for NRL
Write and approve terms of reference for a national infection prevention and control coordinating unit	IPC unit terms of reference written and approved	M&E of input	Yes/No	Annually	Key informant at MoHFW	IPC programme implementation report	No terms of reference for IPC unit	Defined terms of reference for IPC unit
Establish a quality management system for the medicines supply chain	QMS established and introduced	M&E of input	Yes/No	Annually	Key informant Department of Pharmaceuticals, CDSCO	Key informant interview	No quality management system	Quality management system implemented
Write generic terms of reference (ToR) for multidisciplinary antimicrobial stewardship committees and teams	Antimicrobial stewardship committees ToR written and approved	M&E of input	Yes/No	Annually	Key informant at MoHFW	Key informant interview	No terms of reference for antimicrobial stewardship committees	Defined ToR for AMS committees
Engage relevant experts to identify research topics on AMR	Draft research agenda prepared	M&E of input	Yes/No	Annually	Key informant at MoHFW	Key informant interview	No research agenda	Defined AMR research agenda

How Family Physicians (FPs) can take part to tackle AMR

The common signs and symptoms reported after pathogenic infection were fever, cold, sore throat, cough, diarrhoea and many more. With these types of signs and symptoms, the Family Physicians (FPs) and General Practitioners (GPs) were the first one who comes in communication with infected patients while reporting, diagnosing and treatment. Such type of conditions mainly reported in rural parts of India where practice and

availability of quality health care is restricted due to number of reasons. As a matter of fact, antibiotics act as a helping hand for combating such infection. Due to extensive use in treating various pathogenic infection, the practice of antibiotics in rural and semi-urban parts is high leads to misuse. Though it can be used in extensive cases to treat infection, inappropriate use of such antibiotics results in ineffective outcomes which further leads to AMR. To limit the incidence of AMR there should be proper practice and use of antibiotics with accurate prescribing practices done by Family Physicians and General Practitioners. And therefore, Family Physicians and General Practitioners play an important role in combating AMR.

As discussed earlier, the Family Physicians (FPs) and General Practitioners (GPs) were the first one who comes in communication with infected patients while reporting, diagnosing and treatment, they are the best suited to give learnings and to describe the natural pathway by which pathogenic infection transpires, also they will give best available treatment for the pathogenic infection and assist an appropriate treatment approach to the patient's family members. With the use of digital platforms, pictures, print medias, informal videos, the Family Physicians and General Practitioners can spread awareness about the use and practices of antibiotics. The various important topics like misuse of antibiotics, spread of natural infection through pathogens, their mechanism of spread, how resistance occurs, they can educate and explain to the patient and to the patient's family members.

Other healthcare promotional techniques like need of appropriate vaccination to combat pathogenic infection, they can spread by displaying posters in waiting rooms of the clinics and hospitals.



Conclusion

This review aims to formulate the perspective and resulting methodologies to estimate current AMR burden. In this systematic review article 214 studies were included, out of which 187 articles delivers an estimation of burden from health perspective, 75 articles from healthcare systems perspective and 11 articles from economic perspective. This systematic review attempts the network of estimation that fall over these perspectives and resulting methods to formulate those perspectives. Under patient health and healthcare system burden perspective, regression analysis was the most applied method for the calculation of patient health and healthcare system burden. Moreover, this review aims to assess health, healthcare system and economic burden as quality support. From this review article it comes to know that, economic burden reports under AMR are less in number, with the median quality score of these reports being lower compared to the health and healthcare systems reports.

With increasing proportion of patient mortality attempts to significantly impact patient health. Compared to significant resistance by pathogens and susceptible infection, only 50% of the related reports shows a statistically substantial impact on patient health. There are many reports which estimates the impact of pathogenic infection after the course of resistance in Gram-negative bacteria on mortality rate by parametric regression or Cox proportional hazards methods. Increase in period of hospital stay after infection, the factors which drives the significant economic burden on patient during hospital stay has no correlation in terms of operational selection and assessments. Most of the review articles which are focussing on period of hospital stay after pathogenic infection did not openly convey that there will be increase or associated length of stay rather projected ordinary period of stay in a healthcare facility. The reports which estimate increased period of stay in healthcare centers, it was projected that multistate model period of stay estimates in comparison to the reports which found using alternatives methods would be more moderative. Moreover, in continuation with multistate model, this review article retrieved that, the period of stay in healthcare facility after Methicillin – Resistant *Staphylococcus Aureus* (MRSA) infection were increased compared to stepwise analysis and regression analysis as those reports were established in different nations and single centre reports which were less valid. To estimate attributable health and cost of burden during the period of stay in hospitals onset infections, the use of multistate modelling methods been proposed as traditional regression techniques may exaggerate the period of stay in healthcare facility and thereafter misjudging burden of AMR.

As 6 out of 11 study reports make the use of evidence-based synthesis and step-by-step methods or multistate models, there is no harmonisation on resulting methodology to estimate the economic burden. The report entitled as “The Review of Antimicrobial Resistance” addresses lack of economic burden estimation in AMR. However due to wide general perspective in the field of AMR, the concepts used in above report may be inappropriate in the context of cost-effectiveness. Moreover, in the above mention study report calls for the estimate in the field of AMR to be established with the use of data-driven attributes. Hence, such type of study reports in recent times called into question because of insufficiency in scientific scrutiny and lack of transparency in resulting methodologies.

The salient feature of this systematic review includes its well-organized systematic approach in terms of methods of selection and utilization of various quality assessment tools in the prevention of the first systematic

condition of the quality of current AMR burden estimates. Selection and utilization of various quality assessment tools is very important in the case of formulating the current evidence-based system, as previously issued study reports in the field of AMR have not incorporated any quality assessment tools. Although this systematic review has some drawback such as comparatively small search time. Also, the Health-Related Quality of Life was not the part of this review as an outcome of interest.

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Online Course Report on

Tableau 2020 A-Z: Hands-On Tableau Training for Data Science

Description

Tableau is a most popular analytical tool in particular to data visualisation and interaction which enables every user to develop a platform where data is integrated and combined. This data is taken from various sources regardless of size, dimension, and variants to create effective visualization. The data which is integrated and combined for effective visualization can gain access to single desktop environment through popular function like Tableau Desktop.

Strategic Objectives

To learn various features of Tableau for data visualisation and interaction.

To understand new elements with updated version of Tableau.

Tableau Desktop

Tableau Desktop is analytical tool which most popular in development tool for generating various analytical grade reports. As a analytical tools for generating report using multiple data, data is taken from various sources regardless of size, dimension, and variants for formatting a data and to create effective visualization.

Tableau Server

Tableau Server is essentially an online hosting platform through the help of which we can easily share the dashboard developed in Tableau Desktop with others platform through any browser and devices. This online hosted platform is in support with Enterprise Reporting and Analytics and provided by Northwestern IT. The data which you want to visualize should store here for effective interpretation and the system work in the same way like any other server. The stored data is completely safe and you can access and make the changes any time if needed. For security and limited access to your data you can set permission to various tasks such that no one can play or interfere with your data without your permission. It work especially in the case of big organizations and firms where you can determine who can access and interact with what.

Use Tableau to analyse and visualize data so you can respond accordingly

- ❖ Connect Tableau to a variety of dataset
- ❖ Analyse, Blend, Join, and Calculate data
- ❖ Visualize data in the form of various charts, plots, and maps

Course Content

- ❖ Install Tableau Desktop 2020
- ❖ Connect Tableau to various Datasets: Excel and CSV files
- ❖ Create Barcharts
- ❖ Create Area Chart
- ❖ Create Maps
- ❖ Create Scatterplots
- ❖ Create Piecharts

- ❖ Create Treemaps
- ❖ Create Interactive Dashboards
- ❖ Create Storylines
- ❖ Understand types of Joins and how they work
- ❖ Work with Data Blending in Tableau
- ❖ Create table calculations
- ❖ Work with parameters
- ❖ Create dual axis charts
- ❖ Create calculated fields
- ❖ Create calculated fields in blends
- ❖ Exports results from Tableau into powerpoint, word and other software
- ❖ Work with timeseries data (two methods)
- ❖ Creating data extracts in tableau
- ❖ Understand aggregation, granularity, and level of details
- ❖ Adding filters and quick filters
- ❖ Create data hierarchies
- ❖ Adding actions to dashboards (filters and highlighting)
- ❖ Assigning geographical roles to data elements
- ❖ Advanced data preparations (including latest updates in Tableau)

Learning Methodology used in the course

The complete course comes with videos lecture on each topic with key learning and quiz at the end of each session. Each session is further divided into subsection.

Key Learning from the course

The Tableau product suite consists of

- ❖ Tableau Desktop
- ❖ Tableau Public
- ❖ Tableau Online
- ❖ Tableau Server
- ❖ Tableau Reader

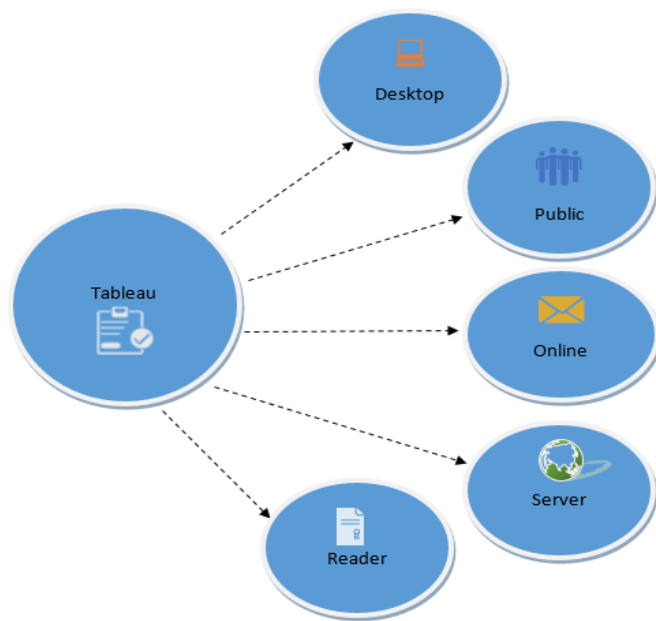


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Tableau Online

As the name suggests, it is an online sharing tool of Tableau. Its functionalities are similar to Tableau Server, but the data is stored on servers hosted in the cloud which are maintained by the Tableau group. There is no storage limit on the data that can be published in the Tableau Online. Tableau Online creates a direct link to over 40 data sources that are hosted in the cloud such as the MySQL, Hive, Amazon Aurora, Spark SQL and many more.

To publish, both Tableau Online and Server require the workbooks created by Tableau Desktop. Data that is streamed from the web applications say Google Analytics, Salesforce.com are also supported by Tableau Server

and Tableau Online.

Tableau Reader

Tableau Reader is a free tool which allows you to view the workbooks and visualizations created using Tableau Desktop or Tableau Public. The data can be filtered but editing and modifications are restricted. The security level is zero in Tableau Reader as anyone who gets the workbook can view it using Tableau Reader.

If you want to share the dashboards that you have created, the receiver should have Tableau Reader to view the document.

How does Tableau work?

Tableau connects and extracts the data stored in various places. It can pull data from any platform imaginable. A simple database such as an excel, pdf, to a complex database like Oracle, a database in the cloud such as Amazon webs services, Microsoft Azure SQL database, Google Cloud SQL and various other data sources can be extracted by Tableau.

When Tableau is launched, ready data connectors are available which allows you to connect to any database. Depending on the version of Tableau that you have purchased the number of data connectors supported by Tableau will vary.

The pulled data can be either connected live or extracted to the Tableau's data engine, Tableau Desktop. This is where the Data analyst, data engineer work with the data that was pulled up and develop visualizations. The created dashboards are shared with the users as a static file. The users who receive the dashboards views the file using Tableau Reader.

The data from the Tableau Desktop can be published to the Tableau server. This is an enterprise platform where collaboration, distribution, governance, security model, automation features are supported. With the Tableau server, the end users have a better experience in accessing the files from all locations be it a desktop, mobile or email.

Excel Vs. Tableau

Both Excel and Tableau are data analysis tools, but each tool has its unique approach to data exploration. However, the analysis in Tableau is more potent than excel.

Excel works with rows and columns in spreadsheets whereas Tableau enables in exploring excel data using its drag and drop feature. Tableau formats the data in Graphs, pictures that are easily understandable.

Parameters	Excel	Tableau
Purpose	Spreadsheet application used for manipulating the data.	Perfect visualization tool used for analysis.
Usage	Most suitable for statistical analysis of structured data.	Most suitable for quick and easy representation of big data which helps in resolving the big data issues.
Performance	Moderate speed with no option to quicken.	Moderate speed with options to optimize and enhance the progress of an operation.
Security	The inbuilt security feature is weak when compared to Tableau. The security update needs to be installed on a regular basis.	Extensive options to secure data without scripting. Security features like row level security and permission are inbuilt.
User Interface	To utilize excel to full potential, macro and visual basic scripting knowledge is required	The tool can be used without any coding knowledge.
Business need	Best for preparing on-off reports with small data	Best while working with big data.
Products	Bundled with MS Office tools	Comes with different versions such as the Tableau server, cloud, and desktop.
Integration	Excel integrates with around 60 applications	Tableaus integrated with over 250 applications
Real time data exploration	When you are working in excel, you need have an idea of where your	In Tableaus, you are free to explore data without even knowing

	data takes you to get to know the insights	the answer that you want. With the in-built features like data blending and drill-down, you will be able to determine the variations and data patterns.
Easy Visualizations	When working in excel, we first manipulate the data that is present and then the visualization such as the different charts, graphs are created manually. To make the visualizations easily understandable, you should understand the features of excel well.	Whereas in Tableau, the data is visualized from the beginning.

To conclude, Tableau beats Excel in major areas like the interactive dashboards, visualizations, capabilities to work with large-scale data and many more.

Summary

- Tableau is a powerful and fastest growing data visualization tool used in the Business Intelligence Industry
- The Tableau Product Suite consists of 1) Tableau Desktop 2) Tableau Public 3) Tableau Online 4) Tableau Server and Tableau Reader
- Tableau Desktop has a rich feature set and allows you to code and customize reports
- In Tableau public, workbooks created cannot be saved locally, in turn, it should be saved to the Tableau's public cloud which can be viewed and accessed by anyone
- Tableau server is specifically used to share the workbooks, visualizations that are created in the Tableau Desktop application across the organization
- Tableau online has all the similar functionalities of the Tableau Server, but the data is stored on servers hosted in the cloud which are maintained by the Tableau group.
- Tableau Reader is a free tool which allows you to view the workbooks and visualizations created using Tableau Desktop or Tableau Public.

- Tableau connects and extracts the data stored in various places. It can pull data from any platform imaginable.
- The spreadsheet application used for manipulating the data while Tableau is a perfect visualization tool used for analysis