وزارة الصحة
Ministry of Health

KINGDOM SAUDI ARABIA NATIONAL ACTION PLAN ON combating ANTIMICROBIAL RESISTANCE

January 2017

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Abbreviations and acronym

AMR	Antimicrobial Resistance
C-DIFF	*Clostridium Difficile*
CLSI	The Clinical and Laboratory Standards Institute
CRE	Carbapenem-Resistant *Enterobacteriaceae*
DDD	Defined Daily Dose
DOT	Days of therapy
ESBL	Extended-Spectrum Beta-Lactamases
EUCAST	European Committee for Antimicrobial Susceptibility Testing
FAO	The Food and Agriculture Organization of the United Nations
GLASS	Global Antimicrobial Resistance Surveillance System
GCC-I-C	Gulf Cooperation Council- Center of infection control
GDIPC	General Directorate of Infection Prevention and Control
GHSA	Global Health Security Agenda
GNB	Gram-negative bacteria
HCAIs	Healthcare-Associated Infections
HESN	Healthcare Electronic Surveillance Network
IPC	Infection Prevention Control
KFMC	King Fahd Medical City
KSA	Kingdom of Saudi Arabia
MOH	Ministry of Health
MOE	Ministry of Education
MEWA	Ministry of environment, water, and agriculture
MDROs	Multi-Drug Resistant Organisms
MRSA	Methicillin Resistant *Staph Aureus*
NGHA	National Guard Health Affairs
NHSN	National Healthcare Safety Network
OIE	World Organization for Animal Health
Saudi FDA	Saudi Food and Drug Administration
US-CDC	United States Center for Disease Control and Prevention
Vet. Clinics	Veterinary Clinics
VRE	Vancomycin-Resistant *Enterococci*
WHO	World Health Organization

Foreword

Antimicrobial resistance threatens the advancement in medicine and the ability to respond to the threat of infectious diseases. The complexity of management and care of patients require effective antimicrobial drugs to prevent and treat associated infections with various conditions and especially those with surgeries and receiving chemotherapy. Misuse and overuse of antimicrobials in human medicine and food production have put every nation at risk, and the Kingdom of Saudi Arabia is not an exception. Few replacement products are in the pipeline. Therefore, an immediate action on a global scale is required before we lose such essential agents. Without such action, we are heading towards a post-antibiotic era in which common infections could once again kill. It is suggested that without policies to stop the worrying spread of AMR, today's already large 700,000 deaths every year would become an extremely disturbing 10 million every year, more people than currently die from cancer. Indeed, even at the current rates, it is fair to assume that over one million people will have died from AMR since he started this Review in the summer of 2014. AMR also has a very real economic cost, which will continue to grow if resistance is not tackled. The cost regarding lost global production between now and 2050 would be an enormous 100 trillion USD if we do not act.

Alert to this crisis, the May 2015 World Health Assembly adopted a global action plan on antimicrobial resistance, which outlines five objectives:

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

This action plan for the Kingdom Saudi Arabia to combat antimicrobial resistance has been formulated in the line of the WHO five objectives. It addresses the need for effective “one health” approach involving coordination among numerous national sectors and actors, including human and veterinary medicine, agriculture, finance, environment, and well-informed consumers. Therefore, a large committee of all stakeholders was formed with five technical subcommittees were established to addresses every aspect to contain antimicrobial resistance in the country.

Hail M. Al-Abdely, MD
Head, AMR National Committee

Executive summary

World Health Assembly adopted a global action plan in May 2015 on antimicrobial resistance, which outlines five objectives, so, Kingdom Saudi Arabia conjoined National Committee for tackling the antimicrobial resistance representing members from different national organizations and formulated five technical committees to implement the WHO AMR objectives.[1]

The Kingdom Saudi Arabia AMR national action plan highlights the need for effective "one health" approach including human and animal health.

<u>The core component of the KSA AMR national action plan consists of:</u>

1. Strategic plan (goal and objectives, priories and intervention)
2. operational plan (activities, implementation arrangements, time table, responsible entities, detailed budgeting and costing
3. Monitoring and evaluation plan (performance indicators, targets and timelines, and data collection and reporting methods)
4. The objectives of the plan will be achieved by implementing the following Strategic activities

4.3 Improvement the awareness of antimicrobial resistance and promote behavioral change
4.4 Studying the pattern of antimicrobial resistance
4.5 Implementing Infection control programs
4.6 Implementing an antibiotic stewardship program
4.7 Study the Economic burden of AMR in human and animal health

Introduction

Antimicrobial resistance (AMR) in bacteria is emerging and spreading rapidly worldwide. This phenomenon is nowadays affecting public and animal health dramatically on a global level. Unfortunately, the current dependence on antibiotics - whether to treat, prevent, or stimulate food animal growths - have exponentially increased this resistance. When antibiotics are used, selective pressure is created, and possibly forcing the exposed bacteria to mutate or acquire pieces of DNA to become antibiotic resistant. The selection pressure resulting from the overwhelming use and misuse of antibiotics is exponentially supporting the AMR phenomenon. The multidrug-resistant (MDR) pathogens are spreading rapidly in many parts of the world causing severe medical and economic consequences. It is estimated that at least every 10 minutes a patient dies in the USA or Europe because of fatal infections caused by antibiotic-resistant bacteria [1]

The Goal of the WHO Global action plan is to ensure, for if possible, continuity of successful treatment and prevention of infectious diseases with effective and safe medicines that are quality-assured, used in a responsible way, and accessible to all who need them. In May 2015 World Health Assembly adopted a global action plan on antimicrobial *resistance with five objectives* [1,2]

Objective 1: Improve awareness and understanding of antimicrobial resistance through effective communication, education, and training

Objective 2: Strengthen the knowledge and evidence base through surveillance and research

Objective 3: Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures

Objective 4: Optimize the use of antimicrobial medicines in human and animal health

Objective 5: Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions

The kingdom Saudi Arabia AMR action plan underscores the need for effective “one health” approach involving coordination among numerous international sectors and actors, including human and veterinary medicine, agriculture, finance, environment, and well-informed consumers. The action plan recognizes and addresses both the variable resources nations must combat antimicrobial resistance and the economic factors that discourage the development of replacement products by the pharmaceutical industry. The objectives of WHO were also adopted by The Kingdom of Saudi Arabia.

Situational Analysis and Assessment

A literature review of MDR in Gram-negative bacilli (GNB) showed a substantial increase in the rate of carbapenem-resistant GNB in Saudi Arabia over the last decade in comparison with the rates of the 1990s[3]. It also documented the increasing prevalence of extended spectrum beta-lactamase (ESBL) producing isolates from Saudi Arabia, where some institutions had 29% ESBL rates among Escherichia coli (E. coli) and 65% ESBL rates among *Klebsiella pneumoniae* (K. pneumoniae). Thus, these increasing rates have been associated with many reported outbreaks and mortality that ranged between 11-40% [3]

Recent region-wide surveillance studies reported that most of carbapenem-resistant *Enterobacteriaceae (CRE)* from the Gulf Cooperation Council States (GCC) had been found to harbor the carbapenemase-encoding genes blaOXA-48-type, and blaNDM-1.[4] *Carbapenem*-resistant *Acinetobacter baumannii (A. baumannii)* (CRAB) from Saudi Arabia have also increased dramatically over the years. A recent study from Riyadh[5] showed that the susceptibilities of *A. baumannii* to meropenem and imipenem in 2006 ranged between 64-81.2%, while the susceptibility in 2012 ranged between 8.3-11%. Molecular investigation on different CRAB isolates obtained from all the GCC states revealed that many isolates, from different countries, have clustered together, suggesting clonality.[6] The colistin resistant and even pan-drug resistant GNB have already been reported.

A Saudi national surveillance on Gram-positive cocci demonstrated that 32% of Staphylococcus *aureus (S. aureus)* are methicillin-resistant (MRSA), and 33% of *Streptococcus pneumoniae* are resistant penicillin G and 26% are resistant to erythromycin.[7]

Several factors are associated with the increasing emergence and spread of MDR bacteria in Saudi Arabia. It is evident that the unoptimized use of antibiotics is a major factor for AMR development. A hospital in Riyadh has well demonstrated the overuse of antimicrobial agents from 4 adult ICUs in 2010, where the highest use was meropenem (33.2 defined daily doses [DDD] per 100 bed-days), followed by piperacillin-tazobactam (16.0 DDD/100 bed-days). On the other hand, the DDD/100 bed-days in 37 ICUs in the United States was 3.75 for carbapenems and 7.08 for antipseudomonal penicillins.[3] Over-the-counter antibiotics without prescription in Saudi community pharmacies is another issue that is driving the improper use of antibiotics. Only one out of 88 pharmacists in Eastern province refused to sell antibiotics without a prescription, and 77.6% of the pharmacies in Riyadh dispensed antibiotics without a prescription[3]

Heavy international travel activities are occurring due to the large population of expatriates and to pilgrimage the Holy cities. A recent study showed that returned travelers from Hajj had acquired MDR A. baumannii and NDM-producing E. coli during the Hajj event. Previous data from 2 major hospitals in Makkah showed that ceftazidime resistance is evident in 24.6% of E. coli, 34.4% of K. pneumoniae, and 52.7% of P. aeruginosa.[8]

Another issue that can contribute to the spread of AMR is the challenges related to the adherence of infection control practices. The hand hygiene compliance rate in a hospital in Makkah in 2011 was 50.3%.

The effectiveness of hand hygiene compliance was well demonstrated in controlling a nosocomial outbreak caused by carbapenem-resistant K. pneumoniae in Riyadh[3].

There hasn't been a structured national plan on laboratory surveillance and preventive measures to circumvent the ongoing surge in microbial resistance. A survey of 20 MOH laboratories survey done in 2015 has shown that 18 out 20 hospitals reported antibiograms with current CLSI reference. They have AMR policy and quality assurance, it was found that 60% of *staph aureus* were resistant to oxacillin, and 50% of *E Coli* were resistant to 3rd generation cephalosporins,60% of *Acinetobacter* resistant to Amikacin AND Colistin 40%). Although detection and reporting happen at the institutional level, but coordination between health institutions was not established. No data exist on incidence, mortality and economic impact. Now through the National AMR program, a systematic approach toward the problem is established in guidance with WHO and GHSA action package.[9]

Country Response

Governance

A conjoined National Committee for Tackling the problem of AMR signed with the highest authority (His Excellency the Minister of Health) has been formed with representatives from the following bodies:

Ministry of Health

1. National CDC
2. Assistant deputy ministry for preventive medicine (The General Directorate of Infection prevention and control, The General Directorate for Infectious Diseases, Field Epidemiology program)
3. The General Directorate of Laboratories and Blood Banks
4. National Health Laboratory
5. The General Directorate of Pharmaceutical Affairs
6. The General Directorate for Hospitals
7. The General Directorate for Media and general affairs
8. Medical Cities
9. The Directorate of Medical Licensing

Governmental non-MOH

1. Ministry of Environment, Water, and Agriculture
2. Ministry of Education
3. Ministry of Defense- Health Affairs
4. Ministry of Interior – Health Affairs
5. Ministry of National Guard - Health Affairs
6. Ministry of Culture and Information
7. King Saud University
8. King Abdul Aziz City for Science and Technology (KACST)
9. King Saud Bin Abdul Aziz University for Health Sciences
10. King Faisal Specialist Hospital and Research Center
11. Saudi Food and Drug Authority
12. Gulf Cooperation Council - Centre for Infection Control
13. Central Board for Accreditation of Healthcare Institutions (CBAHI)
14. Saudi Commission for Health Specialties

Non-Governmental organizations (NGOS)

1. The Saudi Society for Medical Microbiology and Infectious Diseases
2. The Saudi Society for Pediatric infectious diseases
3. The Saudi Society for Sterilization and Infection control

Part I:

Strategic Plan

KSA AMR Strategic Plan

Global action plan strategic objective 1: Improve awareness and understanding of antimicrobial resistance through effective communication, education, and training		
Objective 1. Increase National Awareness about AMR		
Strategic interventions	**Activities**	**Milestone**
1.1. Establish an evidence-based communication program targeting the public for both human and animal health	1.1.1 Assess public awareness about AMR and Survey on public awareness of use and misuse of antibiotics. Assign a research team to conduct qualitative (focus group) and quantitative (surveys) data collection. Survey on knowledge and attitude toward use and misuse of Antibiotics in Livestock 1.1.2. Production of Media related materials including documentary on AMR 1.1.3. Awareness campaign during Antimicrobial Awareness Week (November 2016) in response to WHO World Antibiotic Awareness Week from 14- 20 November 2016 with the theme this year "Antibiotics: Handle with Care." The activities include: - Preparation of awareness materials and brochures, Short awareness messages for broadcasting on Twitter and snap chat, Awareness Video " History of war between bacteria and antibiotics" on YouTube, Broadcasting on TV channel and national newspapers to sensitize society about antimicrobial resistance and rationalizing antibiotic use, Attraction of famous players in Saudi teams to participate in sending the awareness messages, survey study to assess community awareness of antibiotic use. 1.1.4. Mainstream media engagement 1.1.5. Applying the tailored interventions 1.1.5.1. Universities carry out direct public engagement campaigns.	Oct 2017

	1.1.5.2. Award university clubs. 1.1.5.3. Work with MOH and launch the Public Health Champion program. 1.1.5.4. Work with MOE on national curriculum to include the AMR topic.	
1.2. Establish an evidence-based public communication program targeting the healthcare providers for both human and animal health	1.2.1 Awareness program will be prepared for health care providers for both in human and animal health	Oct 2017
Objective 2. Improve knowledge of AMR and related topics		
2.1. Include AMR and related topics as a core component of professional education, training, certification and development	2.1.1. AMR and related topics in undergraduate curricula for human health professionals, animal health professionals and food industry and agriculture professionals. 2.1.2. AMR E-Learning educational program 2.1.3. AMR revised and approved educational programs in health care facilities	Oct 2017

Global action plan Strategic Objective 2: Strengthen the knowledge evidence base through surveillance and Research		
Objective 3. Set up a national surveillance system for antimicrobial resistance		
3.1. Establish a national coordination structure for surveillance of AMR.	3.1.1. National coordinating committee with appropriate mandate and terms of reference and a focal point (Lab surveillance technical committee, Dr. Ali Alsomaily)	Jan 2017
3.2. Designate and develop reference microbiology laboratory facilities to coordinate an effective epidemiologically surveillance of antimicrobial resistance	3.2.1. Seven CAP accredited. Laboratories were designated to collect the antimicrobial resistance data for the last five years. Riyadh: (KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital); Eastern Province: King Fahd University hospital in Khobar; Western Province: King Abdulaziz University Hospital. 3.2.2. Twenty-four MOH laboratories Antibiogram from various regions of the kingdom.	June 2017

	3.2.3. Determination of KPIs needed from each of the sentinel sites. 3.2.4. Utilizing Point of care testing	
3.3. AMR surveillance Sentinel sites in human	3.3.1. 12 AMR surveillance Sentinel sites from different regions are selected • KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital); Eastern Province: King Fahd University hospital in Khobar; Western Province: King Abdulaziz University Hospital. • King Abdulaziz – Jeddah • King Fahd Hospital – Jeddah • Dammam Medical Complex - Eastern Region • Assir Central Hospitals Assir • King Khaled Hospital – Tabouk	March 2017
3.4 AMR Sentinel sites in animal	3.4.1. Six Sentinel sites for surveillance of infections caused by AMR pathogens: • Riyadh. • Al-Hassa, • Al-Dammam • Jeddah • Assir • Al-Kharj 3.4.2. Surveillance for detection of salmonella, campylobacter and total bacterial count in poultry in all regions of Kingdom (2016).	JAN 2017
3.5. Determine the country priority microorganisms with mechanisms of resistance for AMR surveillance and adapt and apply WHO model systems for antimicrobial resistance surveillance (GLASS)	3.5.1. WHO priority pathogens including (*S. aureus, E. coli, K. pneumoniae plus added pathogens of national priority as VRE, Non-Fermentative GNB*. *Acinetobacter, Pseudomonas*) 3.5.2. GLASS protocol was endorsed to laboratories during a workshop (10 Labs) and includes age and sites in the upcoming data.	June 2017
3.6. Establishment of systems IT for	3.6.1. Working on software to link Designated sentinel to	

monitoring antimicrobial and link all sentinel sites to the national center for analysis and reporting.	national lab to improve reporting analysis	June 2017
Objective 4. Build laboratory capacity to produce high-quality microbiological data for patient management and support surveillance activities in both human and animal sectors		
4.1. Designate a national reference laboratory for AMR surveillance	4.1.1. The National lab will assume responsibility for AMR lab in the future. Currently, the AMR Sentinel sites labs will perform required AMR testing and reporting	June 2017
4.2. training workshops for microbiologist and laboratory technicians	4.2.1. Plan for series training, workshops will be formulated for Microbiology doctors and lab technicians for all hospitals> 150 beds	June 2017

Global action plan strategic Objective 3: Reduce the incidence of infection through effective sanitation, hygiene and prevention measures		
Objective 5. Establish a national infection prevention and control program		
5.1. Create a formal organizational structure to ensure proper development and use of infection prevention and control policies and strategies	5.1.1. IC Organizational structure has been established 5.1.2. Core component has been established and distributed 5.1.3. Infection control national manual distributed to all health care regions 5.1.4. IC Auditing tool program 5.1.5. Hand hygiene campaign	2017
Objective 6. Introduce infection prevention and control program in veterinary settings and animal husbandry		
6.1. Create a formal organizational structure to ensure proper development and use of infection prevention and control policies and strategies	6.1.1. Write and approve Infection Control Guideline in animal health by KSA MEWA	June 2017
6.2. Include hygiene and infection prevention and control as core	6.2.1. MEWA plans for Infection control training	June 2017

(mandatory) content in training and education of veterinary professionals		
Objective 7 Limit the development and spread of AMR outside health settings by infection prevention and control		
7.1. Promote personal hygiene by social mobilization and behavioral change activities	7.1.1. Estimate knowledge of personal hygiene in different social groups as a basis for the social mobilization campaigns	June 2017

Global action plan strategic Objective 4: Optimize the use of antimicrobial medicines in human and animal health		
Objective 8. Ensure uninterrupted access to high-quality antimicrobial medicines		
8.1. Strengthen the pharmaceutical supply chain, including the procurement, supply, and management system.	8.1.1. Establish a quality management system for the supply of medicines, covering storage, transport, expiry date, etc.	June 2017
Objective 9. Improve and measure appropriate use of antimicrobial agents in health care		
9.1. Create formal antimicrobial stewardship programs in health care facilities	9.1.1. Plan for series training, antimicrobial stewardship programs workshops will be formulated in all healthcare facilities > 150 beds	Dec 2017
9.2. Awareness and Education on stewardship for Healthcare facilities & veterinary practice	9.2.1. Target selected hospitals based on bed capacity from each region of the kingdom: 1- Antibiotic Awareness week 2- Workshops, seminars, case studies, grand rounds, etc. 3-Booklets, brochures, posters, &pocket cards 4- Teleconference or phone consults to hospitals with no ID or Clinical pharmacists to perform ASP 5- Increase awareness of public pharmacist on ASP 9.2.2. To consider standardized educational material or electronic tool	June 2017
9.3. Guidelines and order sets	4.7.1 Development, awareness & Implementation of empiric antimicrobial guidelines for treatment of community & healthcare associated infection to 20 MOH hospitals.	June 2017

	4.7.2 Integrating those guidelines into electronic health records whenever possible. 4.7.3 Standardizing Surgical Antibiotic Prophylaxis through preset order sheets in 20 selected MOH hospitals.	
9.4. Clinical Care Standards "bundle" implementation	9.4.1. Medium sized (>150 beds) hospitals should apply "MOH-approved" stewardship bundles/ best practices to optimize prescribing practices	Dec 2017
9.5. Mandating Stewardship implementation in all JCI/ CBAHI accredited hospitals	9.5.1. Communicate with CBAHI to include ASP in the requirements for accreditation/ reaccreditation."	June 2017
9.6. Requesting Stewardship Program KPIs on process and outcome	9.6.1. 5 Antibiotics, 5 MDROs: 1- DOT per 1000 patient days 2- Duration of empiric antibiotics therapy more than seven days 3- Prevalence and trend of CDI	April 2017
9.7. Postgraduate education: enrollment requirement for national residency training programs	9.7.1. Communication with Saudi Commission for Health Specialties to add to Infection control module Stewardship component; it can be an online module as a prerequisite for enrollment in all medical, nursing, paramedical, and Pharmacy residency programs."	Jan 2018
9.8. Building Capacity: Training Clinical Pharmacists and ID Fellows	9.8.1. Antimicrobial Stewardship training programs	Jan 2018
9.9. Train the Trainers once a group of certified trained personnel is available	9.9.1. Setting up a training center/ academy in MOH to train trainers in Principles and Practice of Implementation of ASP in Healthcare Settings	Jan 2018
9.10. Antimicrobial Stewardship Research	9.10.1. -National Point Prevalence Survey on antimicrobial consumption & resistance in line with Global PPS -Multicenter study on the impact of implementation of stewardship on length of stay & cost saving	June 2017
Objective 10. Ensure prudent use of antimicrobial agents in terrestrial and aquatic animals and agriculture		
10.1. Restrict use of critically important antimicrobials for human medicine in food production animals	10.1 Ongoing surveillance of antibiotics consumed in food production animals and avoiding the following antimicrobial classes: Quinolones, 3rd and 4th generation cephalosporin antibiotics, macrolides,	Jan 2018

	ketolides, and glycopeptides	

Global action plan strategic objective 5: Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions		
Objective 11. Identify gaps in research and prepare the economic case for utilization of new medicines, diagnostic tools, vaccines and other interventions		
11.1. Economic impact assessment and burden of antimicrobial resistance	11.1.1. Study the cost and economic burden of AMR in Humans. 11.1.2. Study the cost and economic burden of AMR in animals.	June 2017 Oct 2017

Part II: Operational plan and budget

Operational plan and budget

Activity	Unit	Quantity	Date	Location	Responsible entity	Cost (SAR)	Source of funding	Indicator
Strategic intervention 1.1. Establish an evidence-based communication program targeting the public for both human and animal health								
1.1.1. Assess public awareness about AMR through: ○ Survey on public awareness of use and misuse of antibiotics. Assign a research team to conduct qualitative (focus group) and quantitative (surveys) data collection. ○ Survey on knowledge and attitude toward use and misuse of Antibiotics in livestock.	Public Awareness Survey Public Awareness Survey	1 1	NOV 2017 NOV 2017	Nationwide Nationwide	AMR awareness technical committee AMR awareness technical committee	100,000	MOH MEWA	Increases level of awareness
1.1.2 Production of Media related materials including documentary on AMR	AMR website	1	NOV 2017	Network	AMR awareness technical committee	70,000	MOH	Number of documentaries produced
1.1.3 Annual awareness campaign during Antimicrobial in response to WHO World Antibiotic Awareness Week	awareness campaign	1	NOV 2017	Nationwide	AMR awareness technical committee	200,000	MOH	Number of participating sectors
1.1.4 Mainstream media engagement	awareness campaign	2	NOV 2017	Nationwide	AMR awareness technical committee	-	MOH	Number of participating TV channels

1.1.5 Applying the tailored interventions: 1.1.5.2 Award university clubs. 1.1.5.3 Work with MOH and launch the Public Health Champion program. 1.1.5.4 Work with MOE on national curriculum to include the AMR topic.	awareness campaign	5	NOV 2017	Nationwide	AMR awareness technical committee	25,000	MOH	Number of participating universities
	awareness campaign	2	NOV 2017	Nationwide	AMR awareness technical committee	10,000	MOH	increased awareness of AMR among school students
	awareness campaign	1	NOV 2017	Nationwide	AMR awareness technical committee	20,000	MOE	
Strategic intervention 1.2. Establish an evidence-based public communication program targeting the healthcare providers for both human and animal health.								
1.2.1 Awareness program will be prepared for healthcare providers for both in human and animal health	awareness program	1	NOV 2017	Nationwide	National AMR awareness technical committee	200,000	MOH + MEWA	Number of participating healthcare providers for both in human and animal health
Strategic intervention 2.1. AMR and related topics as core components of professional education, training, certification and development								
2.1.1 AMR and related topics in undergraduate curricula for human health professionals, animal health professionals and food industry and agriculture professionals.	AMR curricula	1	NOV 2017	Nationwide	National AMR (Stewardship & technical committee)	0	MOH	Prepared by committees and approved curriculum by Saudi Commission

2.1.2	AMR E – Learning educational program	Program	1	Jan 2018	Nationwide	GDIPC	300,000	SCFHS	Prepared by committees and approved by Saudi Commission
2.1.3	AMR revised and approved educational programs in health care facilities	Program	1	Nov. 2017	Nationwide	National AMR (Stewardship & technical committee)	210,000	MOH	Prepared by MOH
Strategic intervention 3.1. Establish a national coordination structure for surveillance of AMR									
3.1.1	National coordinating committee with appropriate mandate and terms of reference and a focal point	National coordinating committee	1	JAN2017	Nationwide	Lab surveillance technical committee.	-	-	Committee formation
Strategic intervention 3.2. Designate and develop reference microbiology laboratory facilities to coordinate effective epidemiologically surveillance of antimicrobial resistance									
3.2.1	Seven CAP accredited. Laboratories were designated to collect the antimicrobial resistance data for the last five years. Riyadh: (KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital); Eastern Province: King Fahd University hospital in Khobar; Western Province: King Abdulaziz University Hospital.	Seven CAP accredited hospital	Retrospective 5 years Antibiogram report	Nov 2017	Assigned CAP-accredited labs	Lab surveillance technical committee.	-	-	Percentage of resistant organisms

3.2.2 Twenty-four MOH laboratories Antibiogram from various regions of the kingdom.	24 MOH labs	Biannual Antibiogram reports	March 2017	MOH labs	Lab surveillance technical committee.	-	MOH	Percentage of resistant organisms
3.2.3 Utilizing Point of care tests	National Lab	3	DEC 2017	Nationwide	Lab surveillance technical committee	2,000,000	MOH	total number of centers UTILIZING point of care tests
Strategic intervention 3.3. AMR surveillance Sentinel sites in human								
3.3.1. AMR surveillance Sentinel sites from different regions are selected • KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital); Eastern Province: King Fahd University hospital in Khobar; Western Province: King Abdulaziz University Hospital. • King Abdulaziz – Jeddah • King Fahd Hospital – Jeddah • Dammam Medical Complex - eastern region • Assir Central Hospital	National Lab	12	June 2017	Nationwide	Lab surveillance technical committee	225,000	MOH	Percentage of AMR priority pathogens resistance

Assir • King Khaled Hospital – Tabouk								
Strategic intervention 3.4. AMR surveillance Sentinel Sites in animal								
3.4.1 Six Sentinel sites for surveillance of infections caused by AMR pathogens: • Riyadh. • Al-ahssa • Al-Dammam • Jeddah • Assir • Al-Kharj	AMR animal sentinel sites	6	June 2017	Nationwide	Lab surveillance technical committee	100,000	MEWA	Percentage of resistance of priority pathogens in animals
3.4.2. Surveillance for detection of salmonella, campylobacter and total bacterial count in poultry in all regions of Kingdom	MEWA report	1	Dec. 2017	Nationwide	Lab surveillance technical committee	100,000	MEWA	Percentage of resistance
Strategic intervention 3.5. Determine the country priority microorganisms with mechanisms of resistance for AMR surveillance and adapt and apply WHO model systems for antimicrobial resistance surveillance (GLASS)								
3.5.1 WHO priority pathogens including (*S. aureus, E. coli, K. pneumoniae MRSA, VRE, Non-Fermentative GNB Acinetobacter, and pseudomonas)*	Number of isolated priority pathogens	Number of isolates for each pathogen	Dec. 2017	Human sentinel sites	Lab surveillance technical committee	-	MOH	Percentage of resistance of each pathogen
3.5.2 GLASS protocol was endorsed to laboratories during a workshop (10 Labs) and includes age and sites in	Number of labs endorsed in GLASS	10	March 2017	MOH labs	Lab surveillance technical committee	70,000	MOH	Number of labs implementing

the upcoming data.								GLASS protocol
Strategic intervention 3.6. Establishment of systems IT for monitoring antimicrobial and link all sentinel sites to the national center for analysis and reporting.								
3.6.1 Working on software to link Designated sentinel to national lab to improve reporting analysis	Number of labs linked to software	20 MOH	Oct 2017	Sentinel sites	Lab surveillance technical committee	225.000	MOH	Number of labs reporting through the software
Strategic intervention 4.1. Designate a national reference laboratory for AMR surveillance								
4.1.1 The National lab will assume responsibility for AMR lab in future. Currently, AMR sentinel sites labs will perform required AMR testing and reporting	National Lab	1	DEC 2017	NATIONAL LAB	NATIONAL LAB	1,500,000	MOH	percentage of referral of isolates of AMR to national AMR lab
Strategic intervention 4.2. Training workshops for microbiologist and laboratory technicians								
4.2.1 Plan for series training, workshops will be formulated for Microbiology doctors and lab technicians for all hospitals> 150 beds	Training course	5	NOV 2017	Nationwide	Lab surveillance technical committee	70,000	MOH	Number of trained staff
Strategic intervention 5.1. Create a formal organizational structure to ensure proper development and use of infection prevention and control policies and strategies								
5.1.1. IPC Organizational structure has been established	Organizational structure	1	2017	Nationwide	IPC technical committee	0	MOH	Number of hospitals have IPC organizational structure
5.1.2. Core component has been established and distributed	Core component	1	2017	Nationwide	IPC technical committee	60,000	MOH	Number of hospitals implementing

								core component
5.1.3. Infection control national manual distributed to all health care regions	IPC manual	1	2017	Nationwide	IPC technical committee	60,000	MOH	Number of hospitals implementing IPC manual
5.1.4. IC Auditing tool program	Auditing tool	1	2017	Nationwide	IPC technical committee	60,000	MOH	Auditing tool Scoring
5.1.5. Hand hygiene campaign	HH campaign	1	2017	Nationwide	IPC technical committee	200,000	MOH	Number of participating sectors
Strategic intervention 6.1. Create a formal organizational structure to ensure proper development and use of infection prevention and control policies and strategies (in veterinary and animal husbandry)								
6.1.1. Write and approve Infection Control Guideline in animal health by KSA MEWA	IPC Guideline	1	June 2017	Nationwide	IC technical committee	60,000	MEWA	Number of Vet Clinics implementing guidelines
Strategic intervention 6.2. Include hygiene and infection prevention and control as core (mandatory) content in training and education of veterinary professionals								
6.2.1. MEWA plans for Infection control training	Training program	1	June 2017	Nationwide	IPC technical committee	100,000	MEWA	Number of trained staff
Strategic intervention7.1. Promote personal hygiene by social mobilization and behavioral change activities								
7.1.1. Estimate knowledge of personal hygiene in different social groups as a basis for the social mobilization campaigns	Awareness social hygiene campaigns	1	June 2017	Nationwide	GDIPC	200,000	MOH	Increased level of public awareness about personal hygiene
Strategic intervention 8.1. Strengthen the pharmaceutical supply chain, including the procurement, supply and management system								
8.1.1. Establish a quality management system for the supply of medicines, covering storage, transport, expiry date, etc.	Chain of supply	1	June 2017	Nationwide	Drug economy and technical research committee	50,000,000	SFDA	no of implemented system

Strategic intervention 9.1. Create formal antimicrobial stewardship programs in health care facilities.								
9.1.1. Plan for series training, antimicrobial stewardship programs workshops will be formulated in all healthcare facilities > 150 beds	Training program	3	DEC 2017	Nationwide	MOH	210,000	MOH	Number of trained staff
Strategic intervention 9.2. Awareness and Education on stewardship for Healthcare facilities & veterinary practice								
9.2.1. Target selected hospitals based on bed capacity from each region of the kingdom: 1- Antibiotic Awareness week 2-Training Activities in ASP	educational activities	5	Nov 2017	Nationwide	Stewardship technical committee	350,000	MOH	Number of implemented activities
9.2.2 To consider standardized educational material or electronic tool	standardized educational tool	1	June 2017	Nationwide	Stewardship technical committee	100,000	MOH	Number of staff using electronic tool
Strategic intervention 9.3. Guidelines and order sets								
9.3.1. Development, awareness & Implementation of empiric antimicrobial guidelines for treatment of community & healthcare associated infection to 20 MOH hospitals.	Guidelines	1	June 2017	Nationwide	Stewardship technical committee	60,000	MOH	Number of hospitals implementing guidelines
9.3.2 Integrating those guidelines into electronic health records whenever possible.	Electronic Guidelines	1	June 2017	Nationwide	Stewardship technical committee	100,000	MOH	Number of hospitals linked to electronic guidelines
9.3.3 Standardizing Surgical Antibiotic Prophylaxis through preset order sheets in 20 selected MOH hospitals.	Antibiotic surgical prophylaxis Guidelines	1	June 2017	Nationwide	Stewardship technical committee	60,000	MOH	Number of hospitals implementing surgical prophylaxis

Strategic intervention 9.4. Clinical Care Standards "bundle" implementation								
9.4.1. hospitals (>150 beds should apply "MOH-approved" stewardship bundles/ best practices to optimize prescribing practices	Steward-ship bundles	1	Dec 2017	Nationwide	Stewardship technical committee	100,000	MOH	Number of MOH hospitals applying stewardship bundles
Strategic intervention 9.5. Mandating Stewardship implementation in all JCI/ CBAHI accredited hospitals								
9.5.1. Communicate with CBAHI to include ASP in the requirements for accreditation/ reaccreditation."			June 2017	Nationwide	Stewardship technical committee	-	CBAHI	
Strategic intervention 9.6. Requesting Stewardship Program KPIs on process and outcome								
9.6.1. 5 Antibiotics, 5 MDROs	- DOT per 1000 patient days - Duration of empiric antibiotics therapy more than seven days - Prevalence and trend of CDI	1	April 2017	Nationwide	Stewardship technical committee	-	MOH	DOT per 1000 patient days - Duration of empiric antibiotics therapy more than seven days -Prevalence and trend of CDI
Strategic intervention 9.7. Postgraduate education: enrollment requirement for national residency training programs								
9.7.1 Communication with Saudi Commission for Health Specialties to add to Infection control module Stewardship component; it can be an online module as a prerequisite for enrollment in all medical,	Online IC module stewardship	1	Jan 2018	Nationwide	GDIPC	100,000	SCFHS	Number of staff linked to Online IC module stewardship

nursing, paramedical, and Pharmacy residency programs."								
Strategic intervention 9.8. Building Capacity: Training Clinical Pharmacists and ID Fellows								
9.8.1 Antimicrobial Stewardship training programs	training program	1	Jan 2018	Nationwide	Stewardship technical committee	500,000	SCFSH	number of candidates joining the asp training program
Strategic intervention 9.10. Antimicrobial Stewardship Research								
9.10.1. -National Point Prevalence Survey on antimicrobial consumption & resistance in line with Global PPS -Multicenter study on the impact of implementation of stewardship on length of stay & cost saving	PPS study	1	June 2017	Nationwide	Stewardship technical committee	250,000	MOH	Antimicrobial consumption rate
Strategic intervention 10.1. Restrict use of critically important antimicrobials for human medicine in food production animals								
10.1.1. Ongoing surveillance of antibiotics consumed in food production animals and avoiding the following antimicrobial classes: Quinolones, 3rd and 4th generation cephalosporins, macrolides, ketolides, and glycopeptides	Surveillance program	1	Jan 2018	Nationwide	Stewardship technical committee	250,000	MEWA	Antibiotic consumption in food production
Strategic intervention Economic 11.1. impact assessment and burden of antimicrobial resistance								
11.1.1. Study the cost and economic burden of AMR in Humans	Research study in human	1	June2017	Nationwide	Drug Economy and technical research committee	250,000	MOH	Percentage of AMR and cost of antibiotics
11.1.2. Study the cost and economic burden of AMR in animals.	Research study in human	1	Oct 2017	Nationwide	Drug economy and research technical committee	250,000	MEWA	Percentage of AMR and cost of antibiotics

Part III: Monitoring and evaluation plan

Monitoring and evaluation plan

Planning element (activity linked to the strategic plan)	Indicator	Purpose	Calculation	Frequency of data collection	Data source	Method	Baseline
1.1.1 Assess public awareness about AMR through: ○ Survey on public awareness of use and misuse of antibiotics. Assign a research team to conduct qualitative (focus group) and quantitative (surveys) data collection.	Increases level of awareness	M&E of input	No. of participating in the survey / total No. groups to target	Annually	AMR awareness committee	Baseline survey and	What measured in baseline survey
2.1.1. Include AMR and related topics in undergraduate curricula for professionals in human and animal health, the food industry and agriculture professionals.	number of approved curricula available for undergraduate	M&E of input	No. of curricula / No. undergraduate groups to target	Annually	MOE	Baseline survey and post-interventio n survey	What measured in baseline survey
2.1.2. AMR E – Learning educational program	approved PROGRAM by Saudi Commission	M&E input	of No., of curricula / No. undergraduate groups to target input	Annually	GDIPC	SCHF	Number of trained staff

3.2.1. Seven CAP accredited. Laboratories were designated to collect the antimicrobial resistance data for the last five years. Riyadh: (KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital); Eastern Province: King Fahd University hospital in Khobar; Western Province: King Abdulaziz University Hospital.	Percentage of retrospective AMR in hospitals	M&E of input and Output	No. of AMR isolates / Total No of isolates target	Annually	Lab surveillance technical committee.	Lab surveillance technical committee report.	Total no of isolates
3.2.6. Utilizing "Point of care tests	total number of centers utilizing point of care tests	M&E of input	No of centers utilizing point of care tests / total no of targeted centers		Lab surveillance technical committee.	Lab surveillance technical committee report.	Centers utilizing point of care testing currently
3.3.1 AMR surveillance Sentinel sites from different regions are selected • KAMC-Riyadh, King Faisal Specialist Hospital & Research Center, KFMC, and King Khaled University Hospital); Eastern Province: King Fahd University hospital in Khobar; Western Province: King Abdulaziz University Hospital. • King Abdulaziz – Jeddah • King Fahd Hospital – Jeddah	Percentage of resistance of priority pathogens in animals	M&E of input And output	No of AMR Isolate /Total No of isolates of priority pathogens	Annually	AMR lab surveillance committee	AMR surveillance program implementation report	Total No of AMR isolates

• Dammam Medical Complex - eastern region • Assir Central hospitals Assir • King Khaled Hospital – Tabouk							
3..4.1 Six Sentinel sites for surveillance of infections caused by AMR pathogens: • Riyadh. • Al-Ahssa • Al-Dammam • Jeddah • Assir • Al-Kharj	Percentage of resistance of priority pathogens in animals	M&E of input And output	No of AMR Isolate /Total No of isolates of priority pathogens	Annually	AMR lab surveillance committee	AMR surveillance program implement ation report	Total number of AMR isolates
4.2.1. Plan for series training, workshops will be formulated for Microbiology doctors and lab technicians for all hospitals> 150 beds	Number of trained staff	M&E of input	No of trained staff/total No of target staff	Annually	AMR lab surveillance committee	AMR surveillance program implement ation report	Current number of trained staff of target group
5.1.4. IC Auditing tool program	Auditing tool Scoring	M&E of input and output	No. of hospitals /total no. Health care organizations	Annually	IPC technical committee	IPC technical committee report	Number of participating health care organization
5.1.5. Hand hygiene campaign	Number of participating	M&E of input	No. of participating organization	Annually	IPC technical committee	IPC technical committee	Number of participating

	health care organization		/total no. Health care organizations		report	report	health care organization
6.1.1. Write and approve Infection Control Guideline in animal health by KSA MEWA	Number of Vet Clinics implementing Guidelines	M&E of input	No. of Number of vet clinics participating /total no. VET clinics	Annually	IPC technical committee report	IPC technical committee report	Number of participating vet clinics
6.2.1. MEWA plans for Infection control training	Number of trained staff	M&E of input	Some trained staff/no. Of target group	Annually	IPC technical committee	IPC technical committee report	Number trained staff of target group
7.1.1. Estimate knowledge of personal hygiene in different social groups as a basis for the social mobilization campaigns	Increased level of public awareness about personal hygiene	monitoring and evaluation of outcome	Awareness scores stratified by target group (composite)	Annually	Baseline survey report the post-intervention survey report	Awareness survey report	Baseline survey report
8.1.1. Establish a quality management system for the supply of medicines, covering storage, transport, expiry date, etc.	No. of implemented system	M&E of output	No. of implemented system/ NO health care of organization	Annually	Drug economy and technical research committee	supply chain report	NA
9.1.1. Plan for series training, antimicrobial stewardship programs workshops will be formulated in all healthcare facilities > 150 beds	Number of trained staff	M&E of input	No of trained staff/total NO of targeted staff	Annually	Stewardship technical committee	Stewardship technical committee report	No. training staff

9.2.1. Target selected hospitals based on bed capacity from each region of the kingdom: 1- Antibiotic Awareness week 2- training actives in ASP	Number of implemented activities	M&E of input	No of trained staff/total NO of targeted staff	Annually	Stewardship technical committee	Stewardship technical committee report	No training staff
9.3.1. Development, awareness & Implementation of empiric antimicrobial guidelines for treatment of community & healthcare associated infection to 20 MOH hospitals.	Number of hospitals implementing guidelines	M&E of input	Number of hospitals implementing guidelines/ total no. of target hospitals	Annually	Stewardship technical committee report.	Stewardship technical committee' s survey.	No hospitals implementing guidelines in the baseline survey
9.3.3 Standardizing Surgical Antibiotic Prophylaxis through preset order sheets in 20 selected MOH hospitals.	Number of hospitals implementing surgical prophylaxis guideline	M&E of input	Number of hospitals implementing guidelines/ total no. of target hospitals	Annually	Stewardship technical committee report.	Stewardship technical committee survey	No standardized surgical antibiotic prophylaxis preset order sheets
9.10.1. National Point Prevalence Survey on antimicrobial consumption & resistance in line with Global PPS -Multicenter study on the impact of implementation of stewardship on length of stay & cost saving	Antimicrobial utilization rate	M&E of input and output	1- DOT per 1000 patient days 2- Duration of empiric antibiotics therapy more than seven days	Annually	stewardship technical committee survey	Stewardship technical committee. Survey	antimicrobial utilization report
11.1.1. Study the cost and economic burden of AMR in Humans.	The cost of management	M&E of output	Composite	annually	Drug economy	Drug economy	No previous research

	of AMR patient				committee report.	committee report.	
11.1.2. Study the cost and economic burden of AMR in the animal.	The cost of AMR in animals	M&E of output	Composite	annually	drug economy committee report.	Drug economy committee report.	No previous research

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