



Egypt National Action Plan For Antimicrobial Resistance

(2018-2022)



**World Health
Organization**
Egypt

*Developed with support
from WHO country office of Egypt*



The problem of antimicrobial resistance is a growing global problem that poses a real public health challenge that threatens to increase morbidity and mortality and represents an additional economic and health burden on the health care systems of various countries. The WHO has issued repeated calls to urge Member States to develop national plans to combat antimicrobial resistance (AMR). This problem has become serious that the topic has been included in the

work of the United Nations General Assembly meetings of 2016 and 2017, respectively.

The Arab Republic of Egypt as a pioneer in the field of health regionally and globally address and respond to this problem. The Ministry of Health and Population has taken the initiative to develop the national anti-microbial resistance plan in cooperation and coordination with all ministries, bodies and institutions concerned with public, animal and environmental health.

As we issue the National Action Plan for the Control of Antimicrobial resistant Microbes. We hope that it will contribute to the improvement of community health and help rational and optimal use of antibiotics, guided by the vision and directives of His Excellency the President of Egypt, which has ensured that an integrated health system is one of the pillars that effectively contribute to achieve Sustainable development goals.

Minister of Health and Population

Professor. Hala Zayed



The rise of antimicrobial resistance is a growing challenge, recognized as one of the greatest threats on the global health security agenda, and jeopardizing the efficacy of antibiotics, which have transformed medicine and saved millions of lives. The prolonged illnesses and increased mortality resulting from infections caused by drug-resistant organisms has been shown worldwide to lead to decreased productivity, higher treatment costs, and economic losses.

The need to control and combat antimicrobial resistance should be implemented within the framework of one health approach through multi-sectorial cooperation and coordination between Human, animal and environmental sectors.

In May 2015, the Sixty-eight World Health Assembly adopted the global action plan on antimicrobial resistance. The goal of the global action plan is to ensure, for as long as 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.

I would like to seize the opportunity to thank the government of Egypt represented by the Minister of health and population under the directions and instructions of HE. Dr. Hala Zayed Minister of health and population for developing Egypt National Action Plan for Antimicrobial Resistance.

I am totally confident that this valuable strategic document will pave the way for an effective and sustainable response to anti-microbial resistance, allowing all concerned stakeholders to work together through an effective "one health approach" to tackle AMR in Egypt

Dr. Jean Yaacoub Jabbour

WHO representative, Egypt

Abbreviations

Ab	Antibiotic
AHRI	Animal Health Research Institute
AMC	Antimicrobial Consumption
AMR	Antimicrobial Resistance
AMU	Antimicrobial Utilization
ASP	Antibiotic Stewardship Programme
AST	Antimicrobial Susceptibility Testing
CAPA	Central Administration for Pharmaceutical Affairs
CCB	Communication Coordination Body
CLSI	Clinical Laboratory Standards Institute
CPHL	Central Public Health Laboratory
E. Coli	Escherichia Coli
EQA	External Quality Assessment
ESBLs	Extended Spectrum Beta Lactamases
FAO	Food and Agriculture Organization of the United Nations
GAP	Global Action Plan
GDP	Gross Domestic Product
GLASS	Global Antimicrobial Resistance Surveillance System
GOVS	General Organization for Veterinary Services
HAIs	Healthcare Associated Infections
HCP	Health Care Providers
ICU	Intensive Care Units
IPC	Infection Prevention & Control
KAP	Knowledge, Attitude and Practice
M&E	Monitoring and Evaluation
MDR	Multi Drug Resistance
MDROs	Multi Drug Resistant Organisms
MoA	Ministry of Agriculture
MoE	Ministry of Education
MoEnv	Ministry of Environment
MoHE	Ministry of Higher Education
MoHP	Ministry of Health and Population
MRSA	Methicillin Resistant Staphylococcus aureus
NAP	National Action Plan
NCASP	National Committee on Antibiotic Stewardship Programme
NEQAS	National External Quality Assessment Scheme
NFP	National Focal Point for AMR
NGO	Non-Governmental Organization
NRL	National Reference Laboratory
OIE	World Organization for Animal Health
OTC	Over the Counter
PHC	Primary Health Care Units
REQAS	Regional External Quality Assessment Scheme
S. aureus	Staphylococcus aureus
SCU	Supreme Council of Universities
SOP	Standard Operating Procedure
Spp.	Species
SSIs	Surgical Site Infections
TWG	Technical working Groups
WHA	World Health Assembly
WHO	World Health Organisation

List of Figures:

Fig. (1): Map of Egypt10

Fig. (2): The five strategic objectives for containment of AMR13

Fig. (3): The overall strategy14

Fig. (4): The prevalence of pathogens in these 32 hospitals19

Fig. (5): Extensive resistance to currently available antimicrobial 20

 agents is demonstrated in Escherichia coli and Klebsiella species in Egypt

Fig. (6): Quality indicator and prescription patterns for Antibiotic use 22

Fig. (7): National Action Plan for AMR committee 26

Fig. (8): GLASS Enrolment map (2017) 44

Executive Summary

Discovery of antimicrobial agents a few decades back is hailed as one of the greatest discoveries of mankind. It has saved millions of lives. Use of antimicrobials is also integral to any complex surgery and use of modern technologies. Impact of recent advances in technology can be negated by ineffectiveness of antibiotics, a phenomenon we are witnessing now due to misuse and overuse of these medicines in humans and animals. The antimicrobial resistance has emerged as the biggest threat to mankind's battle against communicable diseases. The pipeline for the development of new classes of antibiotics has also dried up. The rise of AMR means that many common infections may again kill leading humanity to dark ages of pre-antibiotic era.

Threat of AMR is rapidly burgeoning. Current estimates indicate annual global mortality due to AMR to be 700,000. This number is projected to rise to 10 million by 2050. Most of these deaths will occur in developing countries. AMR shall also severely affect global economy and hamper development processes. Cost of inaction to combat AMR till 2050 is projected to be a cumulative loss of \$100 trillion. The world's GDP could drop by as much as 3.5%. Economic losses will be greatest in developing countries affecting most of the countries inhabited by poor people.

The United Nations General Assembly and several other intergovernmental organizations especially World Health Organization (WHO), Food and Agriculture Organization (FAO) and World Organisation for Animal Health (OIE) have given calls to mount globally coordinated action to prevent and contain AMR.

In May 2015, the sixty-eighth World Health Assembly (WHA) endorsed the Global Action Plan on Antimicrobial Resistance (GAP-AMR). The WHA resolution 68.7 has urged Member States to align their National Action Plan on AMR with GAP-AMR by May 2017. Commitment by global leaders to combat AMR was further strengthened at the High-Level Meeting on AMR at the United Nations General Assembly on 21 September 2016. FAO and OIE have also endorsed similar Resolutions.

Recognizing the existence and possible impact of AMR in Egypt, and in accordance with the commitment in the World Health Assembly, and to contribute to global health, Egypt initiated drafting of its national action plan (NAP) that was coordinated by the Ministry of Health and Population (MOHP) with assistance from WHO.

The objectives of NAP are aligned with the global action plan based on national needs and priorities.

The emphasis is on One Health approach with all sectors especially human health, animal health and environment contributing towards minimizing the emergence and impact of AMR in Egypt.

Four goals have been identified under the NAP, which are:

1. Improve public **awareness**, understanding of antibiotic use and antimicrobial resistance.
2. Slow the emergence of new resistant patterns and control spread of resistant pathogens via **optimizing the use** of antimicrobial medicines in human and animal health.
3. Strengthen National **One-Health Surveillance** Efforts to combat resistance that can arise in humans, animals, and the environment.
4. Implement evidence-based **infection control practices** that can prevent the spread of resistant pathogens.

NAP AMR is expected to reflect the five principles based on which the global action plan on AMR strategies have been enunciated. These include:

1. Whole-of-society engagement including a One Health approach,
 2. Prevention first,
 3. Access,
 4. Sustainability, and
 5. Incremental targets for implementation
- **Goal 1** focuses on improving awareness and understanding of AMR through effective communication, education and training, thus bringing about a change in behaviour of user and prescribers.
 - **Goal 2** aims to promote rational and optimized use of antibiotics in various settings through strengthening of enforcement of regulations, ensuring access and surveillance of antimicrobial use, antimicrobial stewardship in healthcare as well as animal health and agriculture.
 - **Goal 3** is directed to achieve strengthening of knowledge and evidence based on surveillance and research, through the establishment of a national One Health surveillance system for AMR and supporting laboratory capacity. It also aims to track use of antimicrobials in various locations and develop policies that promote their rational use.

- **Goal 4** attempts to reduce the incidence of infection through effective infection prevention and control in healthcare and veterinary settings and to limit the development and spread of antimicrobial-resistant infections and multidrug-resistant bacteria.

The Operational Plan to implement NAP has identified various activities that need to be carried out by different sectors in a time bound manner to meet the targets set in this NAP. A monitoring and Evaluation (M&E) Plan has also been proposed to keep track of the progress made and modifying the operational plan, if needed.

Using an efficient multi-sectoral model with One Health approach, as envisaged in this National Action Plan, Egypt aims to combat AMR in near future and thus contribute to welfare of its people and also contribute to global health security.

Chapter 1

Introduction

The discovery of antibiotics a few decades back revolutionized medicine, transforming often fatal diseases into curable, or at least manageable, problems. These medicines were soon considered as "magic bullets" or panacea for all illnesses and accordingly extensive irrational use, misuse and abuse became rampant. This accelerated the survival process in microorganisms too who rapidly developed several defence mechanisms to protect themselves from antibiotics. The advantage accrued to them because of selection pressure by antibiotics. The more antibiotics were used greater became the resistance.

Inaction on the part of human beings for past few decades have now culminated in antimicrobial resistance (AMR) becoming an increasing threat to global health security, potentially compromising gains made in public health worldwide. AMR is currently considered one of the greatest threats to health.

AMR has emerged as a critical issue since approximately 70 per cent of known bacteria have developed resistance to one or more antibiotics, threatening a return to the pre-antibiotic era. Resistance has been reported for entire classes of antibiotics, and untreatable multi-drug resistant bacteria are increasingly documented.

The speed with which resistance has been developed has not been matched with development of new antibiotics. The current urgent need for new antibiotics is not being met by the pharmaceutical industry. Most of the antibiotic classes were discovered before 1970 and over the past three decades only two new classes have become available. The pipeline for the development of new antibiotics seems to have dried out.

The ramifications of resistance manifest themselves not just in the impact on human health, but also in potentially heavy economic costs. The immediate health consequences are increased sickness and death rates, prolonged illness and a greater risk of complications. In economic terms this leads to a loss of productivity and increased costs for diagnosis and treatment, which stretched health services have difficulty in affording. It is difficult to quantify the geographical spread, health and economic burden imposed because the surveillance evidence currently available is very patchy.

Every year AMR kills about 700,000 people worldwide – a number that is projected to rise to 10 million by 2050 as a consequence of inaction. Most of these deaths will be in the developing world, with enormous adverse social and economic effects. The economic impact of AMR may be devastating. A loss of USD \$100 trillion is estimated. Global GDP may decrease by 3.5%. The World Bank estimates that 28 million people are likely to be pushed into poverty as a direct consequence of disease due to resistant pathogens¹. Global exports may see a decline of 3.8%. Livestock production may be reduced by 7.5% throughout the world, thus decreasing food security².

Recognizing the importance of AMR and its implications towards human morbidity, mortality and economic consequences to the country, Egypt has also initiated systematic national efforts to contain this threat to the prevention and control of communicable diseases.

The Country

The Arab Republic of Egypt spans the southwest corner of Asia and the northeast corner of Africa. It is bordered by both land and sea: the Mediterranean is to its North, the Gulf of Aqaba to its East, the Red Sea to the East and South, Libya to the West and Sudan to the South. Egypt has an area of 1.01 million square kilometres.

Egypt is one of the most populous countries in Africa and the Middle East. With a 2018 estimated population of 99.38 million, and ranks 15th in the world. The population density of Egypt as a whole is 84 people per square kilometre.

For administrative purposes, Egypt is divided into twenty-seven governorates. A governorate is administered by a governor, who is appointed by the President of Egypt and serves at the president's discretion.



Fig. (1) : Map of Egypt

The Gross national income (GNI) per capita (2011 PPP\$) in Egypt is estimated to be 10064. With a GDP of USD 332,792 million, World Bank has ranked Egypt at number 31.

Life expectancy at birth in Egypt in 2012 was estimated at 72.93 years for the total population, with 70.33 years for the male population, and 75.66 years for the female population. The birth rate was of 24.22 births for 1000 people, and the death rate of 4.8 deaths for 1000 people.

UNDP in 2016 has accorded a human development index of 0.691 to Egypt with a rank of 111 among all the countries.

The culture of Egypt has thousands of years of recorded history. Ancient Egypt was among the earliest civilizations all over the world. Egypt maintained a strikingly unique, complex and stable culture that influenced later cultures of all humanity. The medical practices of the ancient Egyptians have been documented.

Until the 19th century, the main sources of information about ancient Egyptian medicine were writings from antiquity. Hippocrates (the "father of medicine"), Herophilos, Erasistratus and later Galen studied at the temple of Amenhotep, and acknowledged the contribution of ancient Egyptian medicine to Greek and global medicine.

Health profile

Egypt has a highly pluralistic health care system, with many different public and private providers and financing agents. Health services are currently managed, financed and provided by agencies in the various sectors of the government under different laws, operating with variable levels of independence. They are also made available by private providers of different categories and at variable levels of intervention.

Egypt Government has accorded high priority to health over past many years. Egypt has an extensive health care infrastructure, with 95.0% of the population within a distance of 5 km of a health facility. A law passed in 2017 on new universal health insurance stipulates that the government will fully cover health expenses for those who are unable to pay for their medical treatment. This number is almost 30 percent of Egypt's population.

The burden of disease (2012) attributable to communicable diseases is 10.7%, while non-communicable diseases contribute 84.7%. Spectacular success has been achieved in mitigating communicable diseases through efficient vaccination coverage, strong vertical programmes for priority communicable diseases along with access to safe water and sanitation. Access to improved sanitation facilities is 90.1%, while access to improved drinking-water is 97.7%.

The efficacy and outreach of Expanded Programme on Immunization has been phenomenon. Immunization coverage among 1-year-olds improved between 1990 and 2013 for BCG from 89.0% to 98.0%, DTP3 from 87.0% to 97.0%, and measles from 86.0% to 96.0%. In 2013, hepatitis B (HepB3) vaccine coverage among 1-year-olds was 97.0%.

Among the communicable diseases, viral hepatitis C has been a major public health problem with percent of people living with hepatitis C perhaps the highest in the world. Among communicable diseases, hepatitis C has been the biggest killer. Emphasizing both preventive and curative components and addressing growing public health challenge of viral hepatitis, Egypt has developed a national strategy and action plan for the prevention, care and treatment of viral hepatitis 2014–2018. This document articulates an important role of surveillance and infection control activities – both of which are equally critical for national activities against antimicrobial resistance.

The Infant mortality rate in 2016 was estimated to be 19 per 1000 live births, down from 210 in 1960. The maternal mortality ratio has steadily declined since the 1990s and the under-5 mortality rate is 27 deaths per 1000 live births. The leading causes of under-5 mortality are

acute respiratory infection (10.0%), prematurity (29.0%), intrapartum-related complications (13.0%) and congenital anomalies (21.0%).

Total expenditure on health per capita at international exchange rate increased between 2005 and 2013 from US\$ 66.6 to US\$ 151.3, of which general government expenditure on health increased during the same period from US\$ 26.1 to US\$ 61.5. However, total expenditure on health as a percentage of the gross domestic product is 5.1%. In addition, the health financing system is characterized by a high share of out-of-pocket spending, at 58.0% in 2013.

Overview of genesis of global action plan

Several national, regional and global initiatives are engaged in tackling AMR, or more specifically antibiotic resistance. In 1998 the World Health Assembly (WHA) of the World Health Organization (WHO) urged member states to develop suitable measures to tackle the former. In 2000, WHO called the rise of AMR a global crisis, and in 2001 it released its first global strategy for its containment. However, the real impetus came in 2011 when WHO dedicated the World Health Day theme to antimicrobial resistance.

In 2015, WHO developed Global Action Plan (GAP) on Antimicrobial Resistance and called upon, through a Resolution of the World Health Assembly (WHA68.7) all countries to develop their respective National Action Plans (NAP) in alignment with GAP before May 2017. GAP advocates One Health approach for combating AMR thus involving animal health and environmental areas also in these global efforts.

The Food and Agriculture Organization of the United Nations (FAO) and the World Organization for the Animal Health (OIE), the intergovernmental agencies engaged with health of animal and agriculture, two other areas where antibiotics are extensively used, have also adopted GAP. In September 2016, the United Nations General Assembly came out with a political declaration asking all countries to galvanize their efforts in combating AMR using One Health approach.

Development of national action plan to combat antimicrobial resistance in Egypt emanates from global efforts as have been reflected in the WHO Global Action Plan for AMR (2015). This GAP was approved by all Member States through WHA resolution WHA68.7. GAP embraces the 'One Health' concept for integrated management of AMR in the food chain. The Global Action Plan on AMR provides a broad framework for combating AMR.

Goal of GAP

The goal of GAP-AMR is to ensure, for as long as 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.

Strategic Objectives of GAP

The Global Action Plan has defined the following five strategic objectives for containment of AMR (Fig 2):

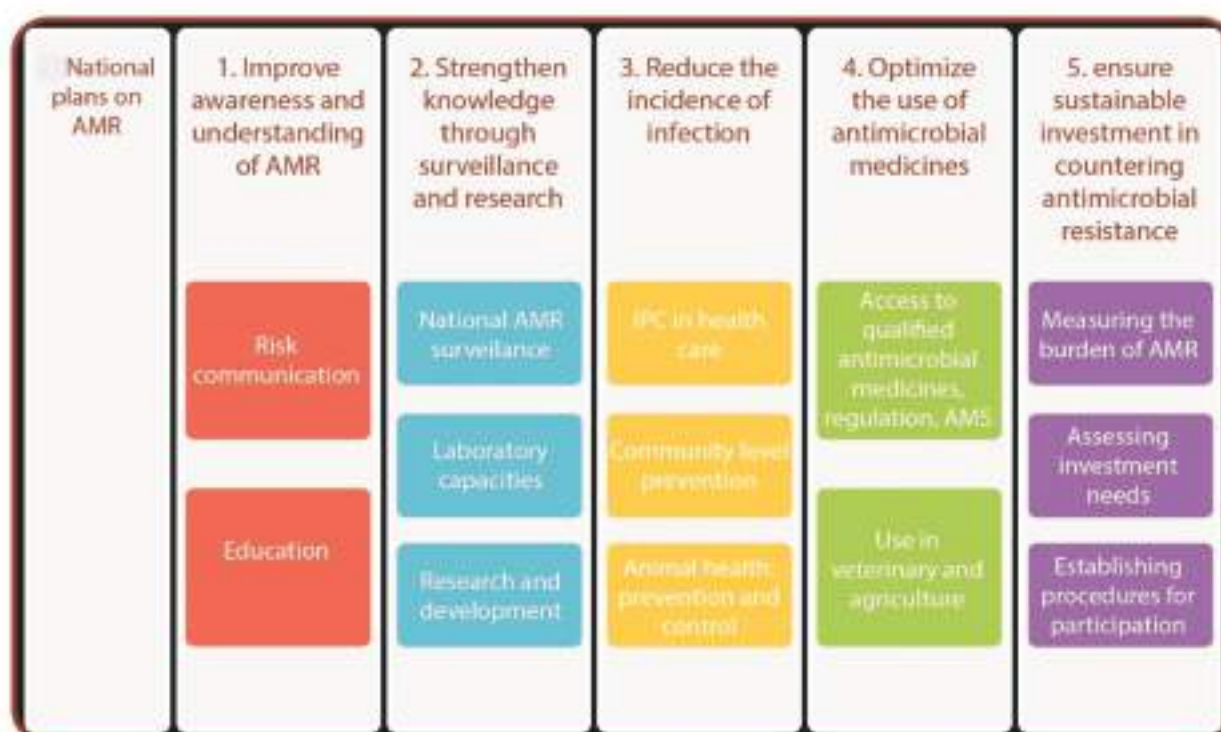


Fig. (2): The five strategic objectives for containment of AMR

1. Improve awareness and understanding of antimicrobial resistance;
2. Strengthen knowledge through surveillance and research;
3. Reduce the incidence of infection;
4. Optimize the use of antimicrobial agents; and,
5. Develop economic case for sustainable investment based on country needs and increase investment in new vaccines, diagnostics and other interventions.

Guiding Principles for implementation of GAP

GAP suggests that all action plans should reflect the following principles:

1. Whole-of society engagement including “One Health” approach.
2. Prevention first.
3. Access.
4. Sustainability.
5. Incremental Targets for implementation.

Genesis of National Action Plan in Egypt

In accordance with World Health Organization Resolution WHA 68.7, all, Member States, including Egypt agreed on the importance of moving forward to develop national action plans by May 2017. The national plan would be aligned with the GAP for the use of antimicrobial medicines in animal health, agriculture and human health.

Accordingly, in 2017 Egypt decided to follow the overall strategy as recommended by WHO and shown in (Fig 3).



Fig. (3): The overall strategy

Egyptian Government designated its National Focal Point (NFP) in Ministry of Health to lead and coordinate national efforts on development of its National Action Plan on AMR. The NFP underwent orientation and sensitization in WHO intercountry meetings.

A meeting of national experts on health was convened in April 2017 to discuss the outline and structure of National Action Plan. Recognizing the importance of a One Health approach a multi-sectoral meeting held at Cairo in November 2017 that came out with draft NAP. The draft was finalized in another multi-sectoral meeting that was held in March 2018 and participated by more than 50 national experts from diverse fields (Annex 1).

Major Stakeholders

A large number of important institutions, organizations and agencies are to actively work together in mitigating AMR to ensure success in implementation of NAP. Accordingly, all were engaged from the planning stage of development of NAP. Some of these are:

Ministry of health and Population:

The antimicrobial resistance coordination committee including Curative sector, Preventive sector, Infection control department, Central Administration for Pharmaceutical Affairs, Central public health laboratory and the Environmental health sector.

Ministry of Agriculture:

General Organization of veterinary services (GOVS)

- Central Administration of Veterinary Quarantine
- Central Preventive Medicine Department
- Common Diseases Department
- Care and Treatment Department
- Plant Quarantine Department

Ministerial Agricultural Lab

- Central laboratory of residue analysis of pesticides and heavy metals in food
- Animal health institute

Other Potential Sectors:

- Focal point of University hospitals (Ministry of Higher Education)
- Focal point of Ministry of Education
- Ministry of interior
- Focal point of Drug Industry Room

- Focal point of Ministry of Environment
- Focal point of Private Sector
- Focal point of WHO – FAO – OIE

Situation Analysis

Control of health care associated infections has been priority in Egypt for last several years. A national healthcare-associated infection surveillance programme started in Egypt in May 2011. The surveillance programme was done in collaboration with the US CDC, Egypt Country Office, USAID in Egypt and the national partners. The objectives of the HAI surveillance in Egypt have been to define benchmarks of HAIs and describe microbiological profile and resistance pattern of pathogens causing HAIs. HAI surveillance has been implemented in a phased approach, and currently 101 Egyptian hospitals in 26 governorates including 408 intensive care units and 3207 ICU beds are participating in the national HAI surveillance. Laboratory capacity building was adopted to ensure good quality of AMR data is available. Hospital microbiology laboratories were trained and CLSI guidelines were used. Two national reference laboratories, CPHL from MOH and Ain Shams Specialized hospital laboratory for the University hospitals are providing EQA for hospital laboratories.

A fully automated electronic system is used for national HAI surveillance. Data entry is done by hospital surveillance coordinators in ICUs using smart devices. A secured Web-based surveillance application hosted on the cloud was developed to allow surveillance coordinators to upload the HAI data immediately to the Web. AMR data about HAI from hospital laboratory is also uploaded to this web application where it is merged with the HAI epidemiological data. This Web application includes automatic data checks using predefined criteria and allowed hospital IPC teams to generate automated HAI reports and antibiograms.

In the future, all ICU beds will be joining this national HAI surveillance programme and expansion of surveillance activities beyond intensive care units could be easily implemented.

Antimicrobial resistance in humans

Overuse of antibiotics has contributed to the emergence of antibiotic-resistant bacteria globally. In Egypt, patients can purchase antibiotics without a prescription. Physicians frequently prescribe antibiotics for conditions that do not warrant these. Maha Talat et al³ documented that antibiotics were reportedly prescribed most of the time or sometimes for colds by 150 (64%) physicians and 326 (81%) pharmacists. The most commonly prescribed antibiotics were β -lactams. Macrolides were the second most commonly prescribed for colds and sinusitis. Fifty physicians (21%) agreed that they had prescribed antibiotics unnecessarily⁴. This and several other factors have contributed to emergence and spread of antimicrobial resistance in Egypt. An overview is given below.

In a study⁵ in five hospitals of Cairo in 1999-2000, high rates of resistance were found in most of the bacteria studied. Only 29% of *S. aureus* isolates and 23% of coagulase-negative staphylococcal isolates were oxacillin susceptible. Both groups of staphylococci were highly resistant to erythromycin, co-trimoxazole, clindamycin and doxycycline; all isolates were susceptible to vancomycin. Susceptibility of *Streptococcus pneumoniae* isolates to penicillin, ceftriaxone and fluoroquinolones was 63%, 84% and 82%, respectively. Vancomycin susceptibility of the enterococci was 96%; susceptibility to high-level gentamicin and streptomycin was 54% and 48%, respectively. Resistance to most relevant antimicrobials was common place among the Gram-negative bacilli; however, most remained susceptible to imipenem. The percentage of bloodstream isolates of *Escherichia coli* susceptible to common antimicrobial agents was as follows: ampicillin (6%), ampicillin-sulbactam (38%), co-trimoxazole (38%) and aminoglycosides (52%).

In another study⁶ while 71% of *Streptococcus pneumoniae* were susceptible to penicillin, this number came down to 51% by 2004 warranting shifting to ceftriaxone as the drug of choice for treatment of children with bacterial meningitis.

In the laboratory-based surveillance conducted in a network of 14 hospitals 45% ampicillin resistant isolates of *Haemophilus influenzae* were reported, 37% of which demonstrated beta-lactamase production⁶.

In patients with cancers, decreased susceptibility to most antibiotics tested including non- β -lactam antibiotics such as aminoglycosides (gentamicin) and quinolones (ciprofloxacin, levofloxacin) was observed in isolates of *Escherichia coli*, *Klebsiella*, *Enterobacter*, *Pseudomonas* and *Acinetobacter* species. In addition, isolates exhibited simultaneous resistance to more than one non β -lactam drug. *Acinetobacter* species exhibited higher resistance to ciprofloxacin 68.1% than to gatifloxacin (49.3%) and Levofloxacin (56.5%). Meropenem resistance was also detected in *Acinetobacter* species (81.8%) and *Pseudomonas* species 50% ⁷

Several Gram-negative isolates have been observed to be highly resistant to cefotaxime and ceftazidime. Simultaneous resistance to cefotaxime and ceftazidime has been evident in *Escherichia coli*, *Enterobacter* and *Klebsiella*.

In an exhaustive study⁸ conducted during 2012-2014 in 28 hospitals including 91 ICUs, among 1,904 ICU-onset infections (excluding SSIs), 2,073 organisms were identified. *Klebsiella* spp were the most commonly reported organisms, accounting for 28.7% of all organisms, followed by *Acinetobacter* spp 13.7%. Among the gram-negative pathogens, 42.5% of *Klebsiella* spp. and 54% of *E. coli* were ESBL producers, whereas 48.1% and 13.7% were carbapenem-resistant, respectively. Multidrug-resistant phenotypes were also identified in *Acinetobacter* spp 92.8% and in *Pseudomonas* spp 59.8%. Among the gram-positive pathogens, 78.9% of *S. aureus* isolates were methicillin-resistant *S. aureus*, and 35.0% of *Enterococcus* spp were vancomycin resistant.

In a study of 32 hospitals on monitoring hospital associated infections, MOHP assessed various rates and also analysed the causative pathogens. The figure given below (Fig 4) shows the prevalence of pathogens in these 32 hospitals. Of major pathogens, 35% *klebsiellae* were MDR and more than 20% were ESBL producers. Corresponding figures for *Escherichia coli* were 14% and 47% respectively. Seventy four percent of *Staph.aureus* were MRSA and 63% isolates of *Acinetobacter* were MDR.

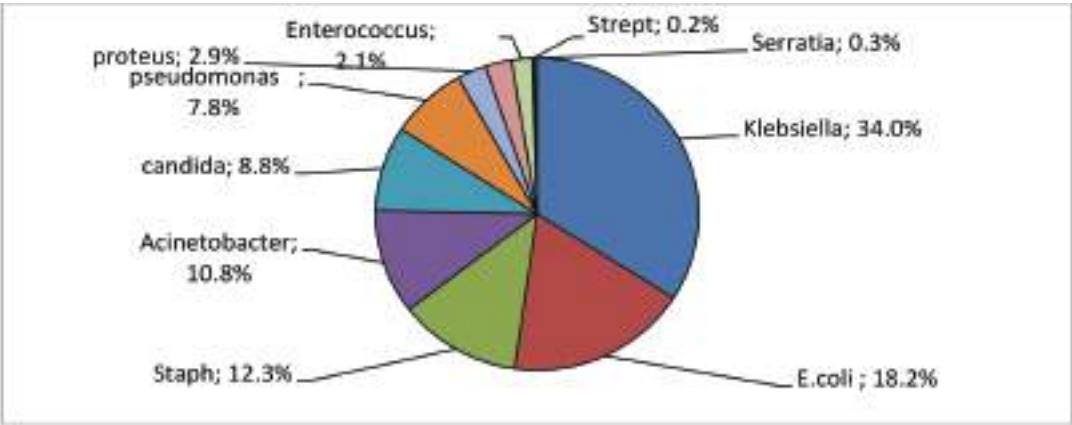
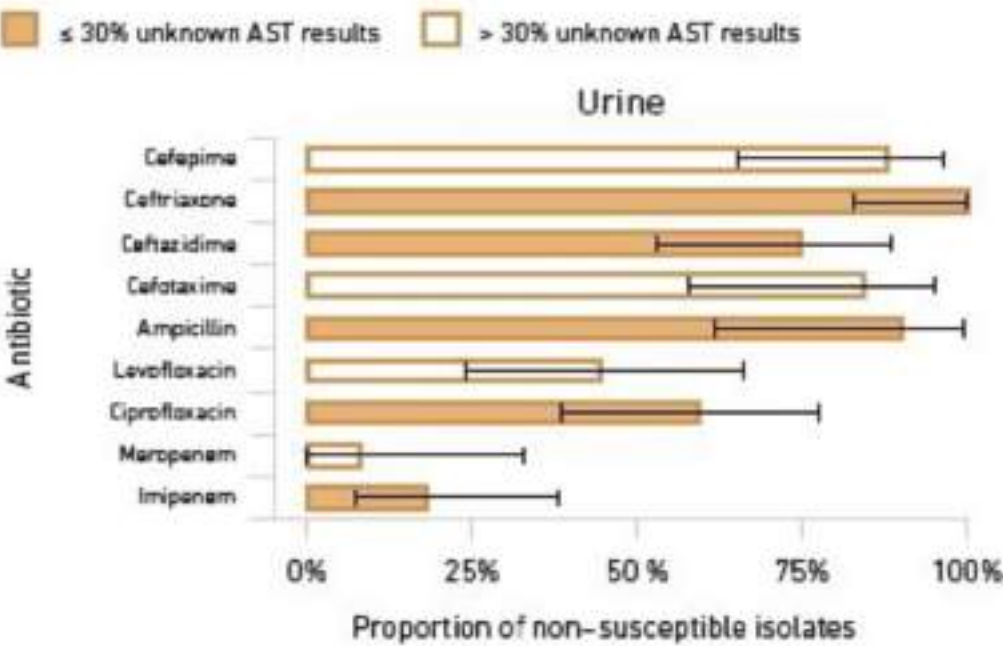


Fig (4): The prevalence of pathogens in these 32 hospitals

Egypt has a well-developed and functional Central Public Health Laboratory that undertakes standardized antimicrobial susceptibility testing. Through this laboratory, Egypt has been contributing data to the WHO Global Antimicrobial Resistance Surveillance System (GLASS) as well as to the national authorities. Data from 15 sentinel sites has been submitted to GLASS in 2016-2017. Extensive resistance to currently available antimicrobial agents is demonstrated in *Escherichia coli* and *Klebsiella* species indicating the growing nature of AMR in Egypt¹⁰.

Escherichia coli



Klebsiella pneumoniae

■ ≤ 30% unknown AST results □ = 30% unknown AST results

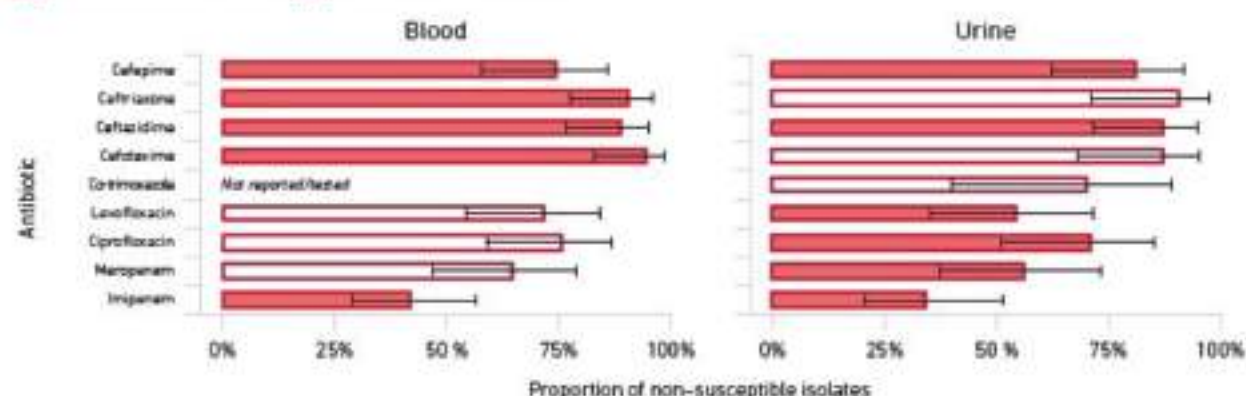


Fig. (5): Extensive resistance to currently available antimicrobial agents is demonstrated in *Escherichia coli* and *Klebsiella* species in Egypt.

There are other well equipped laboratories especially in university hospitals some of them are accredited and their data are contributed to the supreme university council. Data from the private sector, which provides 25-30% of health care in Egypt, are not reported to the central laboratory.

Antimicrobial resistance in Animals

Antimicrobial agents are used in animal sector in Egypt both for treating the animals with various communicable diseases and also for preventing occurrence of infections or as growth promoters. The practice of giving antimicrobial agents to otherwise healthy animals is to protect them from poor biosecurity and thus ensure great growth. These uses of antimicrobials in sub-therapeutic doses invariably provide selection pressure to resistant populations of bacteria making them dominant prevalent flora. Through environmental mechanisms these strains reach human populations and thus act as an important source of resistant pathogens in community and hospital acquired infections.

Data and trends on prevalence of drug resistance in pathogens causing diseases in animals are sparse in Egypt. Different studies reveal varying pattern of susceptibility.

In a study during 2014-2015, all *Salmonella enterica* serovar Enteritidis isolates from poultry were susceptible to all tested antimicrobials. The phenotypically resistant *Salmonella enterica* serovar Typhimurium isolates against ampicillin, tetracycline, sulphamethoxazole and chloramphenicol were harbouring various resistance plasmids. The sensitivity rate of *Salmonella enterica* serovar Typhimurium to gentamycin, trimethoprim/sulphamethoxazole and streptomycin were 100, 94.8, 89.7%, respectively¹¹.

Of *S. aureus* isolated from cases with mastitis, 57.9% had a high molecular weight plasmid. *S. aureus* isolates showed high resistance to methicillin, followed by oxytetracycline, ampicillin and sulphamethoxazole-trimethoprim. 95% of the examined *S. aureus* isolates were sensitive to vancomycin¹¹. All methicillin resistant *Staphylococcus aureus* (MRSA) strains were *mecA* gene positive by PCR. It is clear that MRSA in bovine population can easily spread between animals and under certain conditions to humans.

Raw milk and cheese in Egypt have been found to be harbouring resistant pathogens. Among the 222 *E. coli* isolates, 66 (29.7%) were resistant to one or more antimicrobials, and half of these resistant isolates showed a multidrug resistance phenotype (resistance to at least three different drug classes)¹². The resistance traits were observed to tetracycline (27.5%), ampicillin (18.9%), streptomycin (18.5%), sulfamethoxazole-trimethoprim (11.3%), cefotaxime (4.5%), kanamycin (4.1%), ceftazidime (3.6%), chloramphenicol (2.3%), nalidixic acid (1.8%), and ciprofloxacin (1.4%). No resistance to fosfomycin or imipenem was observed. These data suggest that antimicrobial-resistant *E. coli* are widely distributed in the milk production and processing environment in Egypt and may play a role in dissemination of antimicrobial resistance to other pathogenic and commensal bacteria.

Antimicrobial use in Egypt

Antimicrobial therapy was mostly prescribed empirically, while the antimicrobial therapy prescribed based on cultures were reported only in 4% of antimicrobials prescribed for community acquired infections and in 18% of antimicrobials prescribed for hospital acquired infections. About four fifths (81%) of patients undergone different surgical procedures had received prophylactic antibiotics inappropriately for more than one day duration, while those who received just single dose prophylactic antibacterial were just 6%.

Beta-lactams antibacterials were the highest prevalent antibiotics used and represented slightly more than two-thirds of total antibiotics used (67%). The most commonly used beta-lactams classes were combinations of (penicillin's + beta lactamase inhibitors and third generation cephalosporins).

The antimicrobial prescriptions showed that about half of patients received multiple antibiotics for one or more infections. In addition, the intravenous route was the most prescribed way of administration of antimicrobials in all wards ICU, surgical and medical (93.8%, 92.7% & 73.9% respectively). Antibiotic prescribing quality indicators showed that Stop/review date documentation in notes was applied in more than half of the ICU prescriptions but was rarely documented in other wards. On the other hand, both guidelines compliance and documentation of reasons for antimicrobials use in notes were applied only in about half of all prescriptions. A summary of prescription patterns is shown in (fig. 6) below.

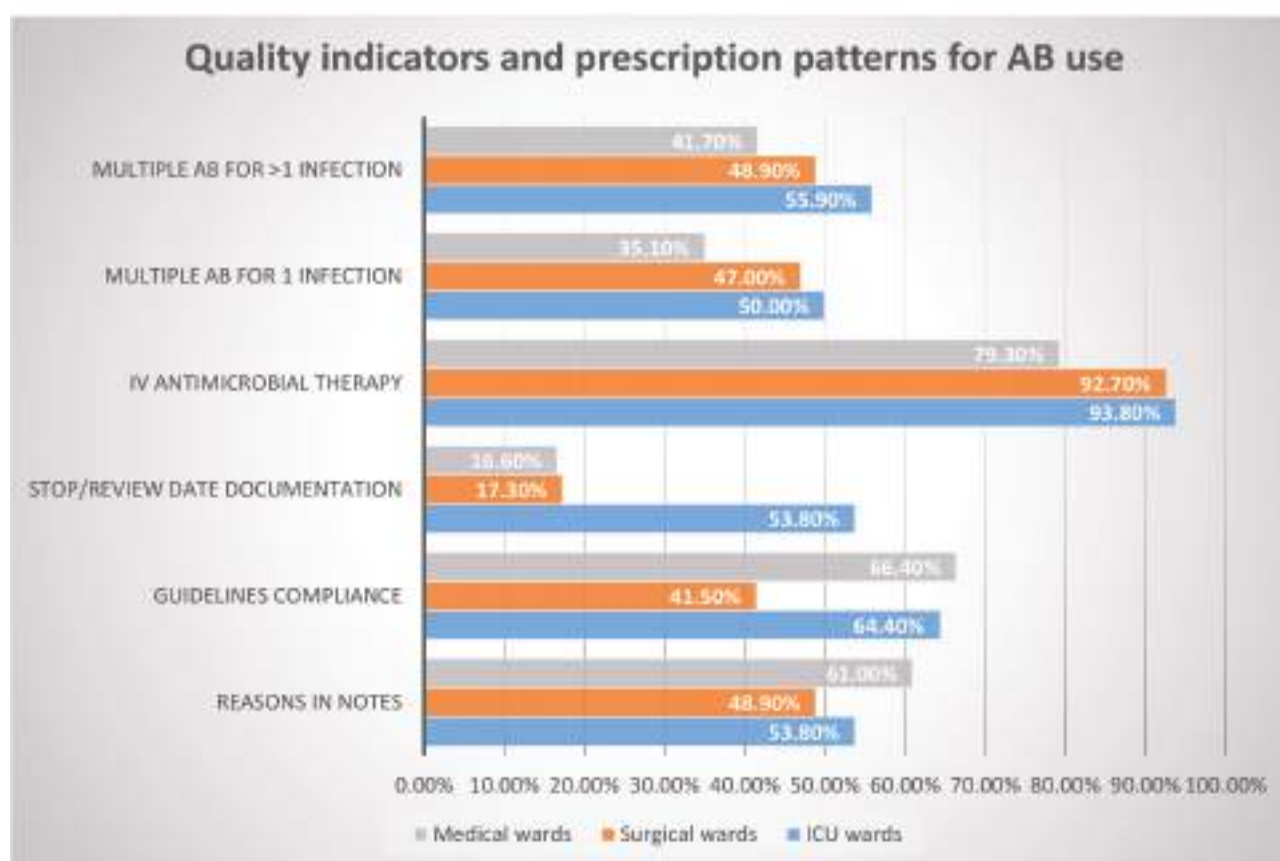


Fig. (6): Quality indicator and prescription patterns for Antibiotic use.

National SWOT Analysis

Extensive review of the national scenario has revealed several strengths, some weaknesses, different opportunities and some threats to successful implementation of NAP in Egypt. These have been summarized in context of each of the four Goals of the NAP of Egypt.

Based upon this SWOT analysis, national experts proposed the Strategic Plan for the country and also indicated major activities and a plan for M&E of these activities. Subsequent chapters elaborate these for each of the four Goals.

Chapter 2

National Strategic Action Plan on AMR

Vision

Egypt will endeavour to prevent, detect, and control infections caused by Antimicrobial resistant microorganisms by implementing measures to slow the emergence of Antimicrobial resistant microorganisms and prevent spread of infections.

Mission

To minimize the morbidity and mortality rates through control of AMR by raising public health awareness, strengthen infection control measures, containment of the emergence and spread of AMR organisms, activate Lab-based surveillance system, rational use of antimicrobials and finding novel therapies in Egypt

Strategic Goals

Following are the four strategic goals for Egyptian NAP. These align well with the WHO Global Action Plan and incorporate all key elements that have been articulated in the GAP.

1. Improve public awareness, understanding of antibiotic use and antimicrobial resistance.
2. Optimizing the use of antimicrobial medicines in human and animal health.
3. Strengthen National One-Health Surveillance Efforts to combat resistance that can arise in humans, animals and the environment.
4. Implement evidence-based infection control practices that can prevent the spread of resistant pathogens.

Targets

By 2022, Egypt will achieve

- Ten Percent reduction in deaths associated with drug resistant pathogens
- Twenty Percent reduction in incidence of infections due to drug resistant pathogens
- Ten Percent reduction in use of antibiotics for growth promotion or prophylactic purposes in livestock, poultry, fishes
- Ten Percent reduction in use of antibiotics in plant protection
- Ten Percent reduction in total use of antibiotics in the country

To achieve these objectives, several activities have been planned which are described in the following chapters along with plans for their monitoring and evaluation

Chapter 3

Governance mechanism

There will be a national AMR committee directly under the supervision of Minister of health, consists of 4 main technical working groups (TWG). Each goal in the NAP will be moderated by a separate TWG that is composed of **different expert members** from **all sectors (MoHP, GOVS, MoHE, MoEnv, etc..)** involved in the NAP. Additional TWG will be formulated and concerned with fund raising



Fig. (7): National Action Plan for AMR committee.

Concerted and nationally coordinated efforts shall be needed to bring together various stakeholders and harness their expertise and the resources available within the country in different sectors to efficiently implement this NAP.

Following is a step by step approach for implementing NAP that would be adopted by Egypt

1. Constitution of a high supreme committee for NAP AMR with all stakeholders from the public and private sectors represented, which is chaired by Minister of health and population. The Committee acts as coordinating mechanism as well as guides all national activities and provides oversight. The Committee has overarching responsibility of steering the national action plan.

2. Allocation of adequate financial; resources on sustained basis.
3. Establishment of a cell and focal point in the MoHP to coordinate with the national and international partners and empowered to provide evidence-based directives for rational use of antimicrobial agents and on disease prevention and control interventions.
4. Establishment of corresponding cell and focal points in Ministry of Agriculture and Ministry of Environment.
5. Designation of subgroups in specialized areas and matching with each Goal of the NAP.
6. Frequent meetings at different levels to review the progress and troubleshooting.
7. Modifications in NAP according to the needs, availability of resources and advances in knowledge.

Chapter 4

Improve public awareness, understanding of antibiotic use and antimicrobial resistance

Public awareness on rational use of antimicrobial agents and necessity for bringing about a change in their behaviour towards rational use of these medicines has been recognized in the NAP. Accordingly, several levels of interventions have been considered targeting the general community, school going children, professionals and policy makers. These shall be implemented with specific tools on a sustainable basis to bring necessary behavioural changes.

The Egyptian national authorities shall work towards making AMR a core component of the professional education training, certification, continuing education and development for medical, dental, pharmacy, nursing, and veterinary professionals as well as workers.

All awareness and behaviour modifying activities will be carried out across Egypt in a systematic way and using evidence-based interventions and tools. The curricula of different target groups shall be reviewed and revised. School education shall be fortified with adequate information on AMR but with focus on prevention of diseases, good hygiene and appropriate knowledge on this area. NAP recognizes that it is a critical aspect which has been often neglected

Strategic objectives

The strategic objectives to achieve this Goal shall be followings:

1. Develop a national awareness raising, communication and education programme
2. Encourage sustained behaviour change for infection control, biosecurity measures and for antibiotics stewardship programmes
3. Enhance community awareness on hygiene and vaccination
4. Advocate for adopting appropriate policies, legislations, and allocating resources for AMR communication

SWOT Analysis

Strengths	Weaknesses
1. Adequate human resource, expertise and infrastructure available within the public sector. 2. Strong mass media presence with extensive reach in country	1. Lack of sustainability and continuity in communication activities. 2. Inadequate financial resources for awareness programmes and campaigns. 3. Prevailing cultural myths and beliefs on use of antibiotics 4. Weak enforcement of existing laws 5. Inadequate leadership commitment. 6. Lack of national surveillance record for evidence to create awareness. 7. Not available adequate mass-media equipment and/or educational programme.
Opportunities	Threats
1. National initiative to develop National Action Plan for AMR 2. Approaching development partners and NGO working in Egypt and power of public relationship accepted in Egypt 3. Fundraising and sponsorship. 4. Global interest in AMR and influence on national leadership 5. Growing reach of social media	1. Perceived opposition by pharmaceutical Industry 2. Low resources that may not be sustained

Operational Plan

Objective 1.1: Develop a national awareness raising, communication and education programmes

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Establish a communication technical working group to develop the national awareness programme lead by the MoHP	Q4/2018	MoHP	3,900,000
Develop a communication plan including campaign objectives, messages, activities and tools	Q1/2019	Communication technical working group	
Develop a fund raising plan to support the national awareness programme activities	Q4/2018	Communication technical working group	
Conduct Capacity building workshops (TOT) for those implementing the awareness programme	Annually	MoHP, MoEnv, MoE, MoHE, MoA	
Conduct a public awareness campaigns	Annually	MoHP	
Develop a monitoring and evaluation plan to evaluate the national awareness programme	Q4/2019	Communication technical working group	
Conduct a baseline and post KAP survey	Q1/2019 Q4/2021	MoHP, MoEnv, MoE, MoHE, MoA	
Inclusion of the use of antimicrobial agents and resistance in school curricula	Q1/2020	MoHP & MoE	

Objective 1.2: Encourage sustained behaviour change for infection control, biosecurity measures and for antibiotics stewardship programmes

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Develop and implement pilot behaviour change linked with stewardship programmes, IPC interventions and biosecurity programmes	Q4/2018	MoHP MoA	450,000
Advocate for successful completion of course related to AMR and infection control as prerequisite to post graduate studies for student with medical, agricultural and environmental background	Q2/2019	MoHP MoA MoHE	
Develop training curriculum and material for imparting training to professionals on communication and behaviour change	Q1/2019	MoHE	
Support and encourage operational research to understand behaviour patterns on irrational use of antibiotics	Q1/2019	MoHE	

Objective 1.3: Enhance community awareness on hygiene and vaccination

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Develop a comprehensive vaccine promotion programmes for animal and agriculture sectors including communication via various mass media channels as well as community outreach	Q1/2019	communication technical working group MOA	1,500,000
Develop strategies to improve hep B vaccine uptake among healthcare workers and conduct awareness activities	Once a year	communication technical working group	

Objective 1.4: Advocate for adopting appropriate policies, legislations, and allocating resources for AMR communication

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Developing a comprehensive advocacy plan Sensitizing parliamentarians and other opinion leaders on need to support rational use of antibiotics at policy levels and enactment as well as enforcement of appropriate laws	Q4/2018	Communication technical working group	150,000
Mapping of policy makers and organizing orientation programmes for the leadership (decision makers – managers of hospitals Heads/ head sectors/ veterinary sector and environment)	on going	Communication technical working group	

M&E Plan

To monitor the progress made and evaluate the achievements, Egyptian NAP shall undergo continuous monitoring and periodic evaluations using SMART indicators. An outline of the M&E Plan is given below:

Objective	Target BY 2022	Baseline	Indicator	Frequency of measurement	Responsible Officer/Institution
1.1 Develop a national awareness raising, communication and education programme	20 % increase of community members that are aware of antimicrobial resistance	To be established through baseline surveys	Percent of community members that are aware of antimicrobial resistance	Every 2 years	Communication technical working group
1.2 Encourage sustained behaviour change for infection control, biosecurity measures and for antibiotics stewardship programmes	20% increase in the KAP of HCP towards the antimicrobial resistance	To be established through planned surveys	Percent of HCP that have proper KAP towards the antimicrobial resistance	Every 2 years	National Multisectoral Task Force on Communication
1.3 Enhance community awareness on hygiene and vaccination	20 % increase of community awareness of the utility of vaccination in reducing disease burden in animals	To be established through planned surveys	Percent of members of community that are aware of the utility of vaccination in reducing disease burden in animals	Every 2 years	Communication technical working group
1.4 Advocate for adopting appropriate policies, legislations, and allocating resources for AMR communication	Promulgation of national laws for proper sale, distribution and use of antibiotics in human and animal sectors	No national laws for proper sale, distribution and use of antibiotics in human and animal sectors exist	Promulgation of national laws for proper sale, distribution and use of antibiotics	Every 2 years	Communication technical working group

Chapter 5

Optimizing the use of antimicrobial medicines in human and animal health

Emergence of resistance in microorganisms is a natural and unstoppable phenomenon. Selection pressure exerted by antimicrobial agents accelerates the emergence of resistant strains and their becoming predominant population in any biome. Use of antimicrobials in any form, even when rational and prudent, can precipitate resistance in target microbes. Easy access to these affordable medicines during past few decades has resulted in its rampant misuse leading to AMR in virtually all pathogens.

Egypt has a functional National Drugs Regulatory Authority that is responsible for regulation and licensing; pharmacovigilance and market authorization. AMR stewardship is being introduced in several institutions with the aim of uniformly ensuring its application across Egypt.

Post marketing surveillance inspections including for retail pharmacies and OTC sales are carried out on limited scale. However, the country lacks important instruments and systems such as a National AMR containment policy and AMU surveillance including sales of antimicrobial agents. Animal health sector, however, lags on all of the above fronts.

Egypt proposes to further strengthen its system for regulation and surveillance of use of antimicrobial agents for control of human and veterinary use of antimicrobials. Some of the measures taken will include a National AMR Containment and Use Policy, revised essential medicines list and standard treatment guidelines with special reference to use of antimicrobial agents, evidence-based guidelines for National Antimicrobial Stewardship Programme in human and animal health care, and an AMU monitoring programme in humans and food animals.

All of the above systems aim to optimise the use of antimicrobials. These will be implemented in a phased manner, first during 2018-2020 and expanded thereafter.

Strategic objectives of Goal 2

Improvement to optimize use of antimicrobials across the sectors shall be carried out through following strategic objectives:

1. Establish governance accountability and regulations.
2. Enhance national capacities of health care providers in proper use of antimicrobial drugs.
3. Develop and implement antibiotic stewardship programme (ASP) in health care settings.
4. Establish a national surveillance system for antimicrobial use in human.
5. Develop and implement ASP in the animal sector.
6. Establish a national surveillance system to monitor antimicrobial use in animals.
7. Optimize the antimicrobial use in agriculture.

Goal 2: Optimizing the use of antimicrobial medicines in human and animal health

Strengths	Weaknesses
1. Presence of National regulatory body for assuring availability of essential and needed drugs including antimicrobials in the Egyptian market for human and animals 2. Presence of over the counter sale (OTC) list of drugs 3. Qualified microbiologists and standardized practice in central labs of MoHP and other health care facilities 4. Presence of approved IPC programme on national basis 5. Initiation of a surveillance programme of MDROs at national basis	1. Lack of some legislations and regulations governing antimicrobial use in human and animal 2. Lack of national guidelines or ASP 3. Deficiency of Infectious disease physicians and clinical pharmacists 4. Limited capacity of clinical microbiological labs in peripheral hospitals 5. Limited resources for research and improvement projects in health care facilities 6. No surveillance data for monitoring antibiotic use in humans and animal sectors

6. Starting development of rational drug use guidelines for medication management and use in hospitals	7. Locally produced livestock and animal products are not monitored for antibiotic clearance 8. No national data concerning the use of antimicrobials in plant sector 9. Lack of local antibiograms in many health care facilities (HCFs) 10. Lack of strict compliance to the antibiotics policies in many HCFs
Opportunities	Threats
1. Availability of Global action plan for combating AMR (WHO) 2. Collaboration with concerned NGOs and scientific societies 3. Availability of successful national plans for AMR in some countries 4. Recent development of compulsory medical training programme for all medical graduates 5. Presence of some examples of success stories for improving inpatient AMS in some hospitals 6. International support (WHO- OIE- FAO) 7. Aiming for international accreditation by some healthcare facilities	1. Impact of industry marketing practices on prescribing habits 2. No new antimicrobial agents in the pipeline 3. Patient's insistence on having antibiotics

Operational Plan

Objective 2.1: Establish governance accountability and regulations.

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Establishment of Antimicrobial Stewardship technical working group under the overall supervision of the National AMR committee	Q4/2018	National AMR committee	150,000
Assess/ Review the current legislation for regulating antimicrobial prescribing and dispensing practices, and preventing self-medication	Q2/2019	ASP technical working group	
Conduct Advocacy meetings with concerned Policy/decision makers in order to enforce the implementation of existing and proposed legislations	Ongoing	ASP technical working group	

Objective 2.2: Enhance national capacities of health care providers in proper use of antimicrobial drugs.

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget
Introduce/ promote infectious diseases training among medical professionals	2019-2022	MoHE MoHP	600,000
Incorporate the ASP within the under and post graduate curricula of all the medical, dental, pharmacy veterinary and agriculture faculties	Q2/2019	MoHE MoHP	
Advocate for the use of point of care rapid diagnostic tests and promote their availability	Q2/2019	MoHP	

Objective 2.3: Develop and implement antibiotic stewardship programme (ASP) in health care settings

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Baseline assessment of existing antibiotic stewardship programme & the related national capacities	Q4/2018	ASP technical working group CAPA	2,400,000
Development of standards, protocols and guidelines for implementation of ASP core elements	Q1/2019	ASP technical working group CAPA	
Establishment of ASP committees in hospitals and assign of focal persons in PHC and outpatients	Q4/2018	CAPA	
Training of national trainers (TOT) for conducting a training programme to ASP teams at healthcare settings	Q4/2019	CAPA	

Objective 2.4: Establish a national surveillance system for Antimicrobial use in human

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Establish a national sentinel surveillance system of AMU	Q4/2018	CAPA	600,000
Train HCP on conducting data collection and analysis regarding use of antimicrobials	Q1/2019	CAPA	
Develop and disseminate annual antimicrobial use report	Q4 every year	CAPA	

Objective 2.5: Develop and implement ASP in the animal sector

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Establish national database of all farming animals, poultry sector and fish producing facilities	Q4/2018	GOVS	1,800,000
Baseline assessment of existing antibiotic stewardship programme & the related national capacities	Q1/2019	GOVS	
Formulate and disseminate ASP guidelines in veterinary sector	Q2/2019	GOVS	
Develop continuous professional programmes on optimizing therapeutic use of antimicrobials in veterinary sector	Q1/2020	GOVS	

Objective 2.6: Establish a national surveillance system to monitor antimicrobial use in animals

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget
Conduct situation analysis for the surveillance system implemented in fish farms for local production and export to expand it to other veterinary sectors	Q4/2018	GOVS	300,000
Develop national guidelines of AMU in animals	Q1/2019	GOVS	
Enhance human resources and capacity for surveillance in veterinary sector	on-going	GOVS	
Develop audit form for national surveillance of antimicrobial use and consumption of veterinary section	2020	GOVS	
Train veterinarians in use of audit forms	2020	GOVS	

Objective 2.7: Optimize the antimicrobial use in agriculture

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Assess the current situation of antimicrobial use in agriculture sector	Q1/2019	MoA	150,000
Set and disseminate regulations required for optimizing use of antimicrobials in agriculture	Q2/2019	MoA	
Develop and implement guidelines for optimum use of antimicrobials in agriculture	Q4/2020	MoA	
Use generated data for advocacy purposes and to discourage use of antimicrobials for plants protection	on-going	MoA	

M&E Plan

Objective	Target BY 2022	Baseline	Indicator	Frequency of measurement	Responsible Officer/Institution
2.1 Establish governance accountability and regulations	Availability of a functional national ASP technical working group	No national ASP technical working group	Establishment of functional national ASP technical working group Number of revised/ issued legislation regulating antimicrobial prescribing and dispensing practices	Annual	NAP AMR committee
2.2 Enhance national capacities	20 % increase in institutions offering training course/ academic degrees on ASP	No institutes offering training course/ academic degrees on ASP	Percent of institutions offering training course/ academic degrees on ASP	Annual	ASP national committee
2.3 Develop and implement antimicrobial stewardship programme (ASP) in healthcare settings	20 % increase in health care facilities having functional ASP	To be determined during the baseline assessment	Percent of hospitals with functional ASP Percent of PHC with functional ASP	Twice a year	ASP National Committee

2.4 Establish a national surveillance system for antibiotics use in human	National surveillance system established for estimating antibiotic use in humans	No national surveillance system established for estimating antibiotic use in humans	Annual report on national AMC in human	Annual	CAPA
2.5 Ensure prudent use of antimicrobial agents in the animal sector	30 % increase in registered farms implementing ASP	To be determined during the baseline assessment	Percent of registered farms implementing ASP	Annual	GOVS
2.6 Establish a national surveillance system to monitor antimicrobial use in animals	National surveillance system established for estimating antibiotic consumption in animals	No national surveillance system established for estimating antibiotic consumption in animals	Annual report for AMC in animal sector	Annual	National Focal Point of GOVS
2.7 Assess the current situation about antimicrobial use in agriculture sector	10 % reduction in use of antibiotics in plant protection	To be determined during the baseline assessment	Percent reduction in use of antibiotics in plant protection	Annual	National Focal Point of MoA

Chapter 6

Strengthen National One-Health Surveillance Efforts to combat resistance that can arise in humans, animals and the environment

Surveillance of antimicrobial resistance in humans, animals, environment and their interfaces is the cornerstone of any policy and programme that may be developed to combat AMR. Recognizing the importance of both surveillance and One Health approach, Egypt has identified the need to establish an evidence-based surveillance for AMR in the nation.

Egypt has substantial infrastructure and expertise to undertake effective surveillance. Through this NAP, it aims to strengthen descriptive epidemiology of resistant organisms as they emerge, understanding how resistance develops and spreads, improve its capacity to rapidly characterise the emergent resistant organisms, initiate studies to understand social sciences, behavioural and other research needed for holistic fulfilment of all five strategic objectives of NAP, ensuring access to prevention and treatment of infections, especially in the poor resource settings, promoting basic and translational research to support the development of new treatments, diagnostic tools, vaccines and other interventions, identifying alternatives to non-therapeutic uses of antimicrobial agents in the context of agriculture, aquaculture and their use in crop protection and performing economic research.

The process of surveillance of AMR in Egypt is ongoing. In 2017, it became member of WHO Global Antimicrobial Resistance Surveillance System (GLASS) and contributed its data to this global database (fig. 8). The surveillance shall be further accelerated by strengthening human resource and material resources capacity in the country.

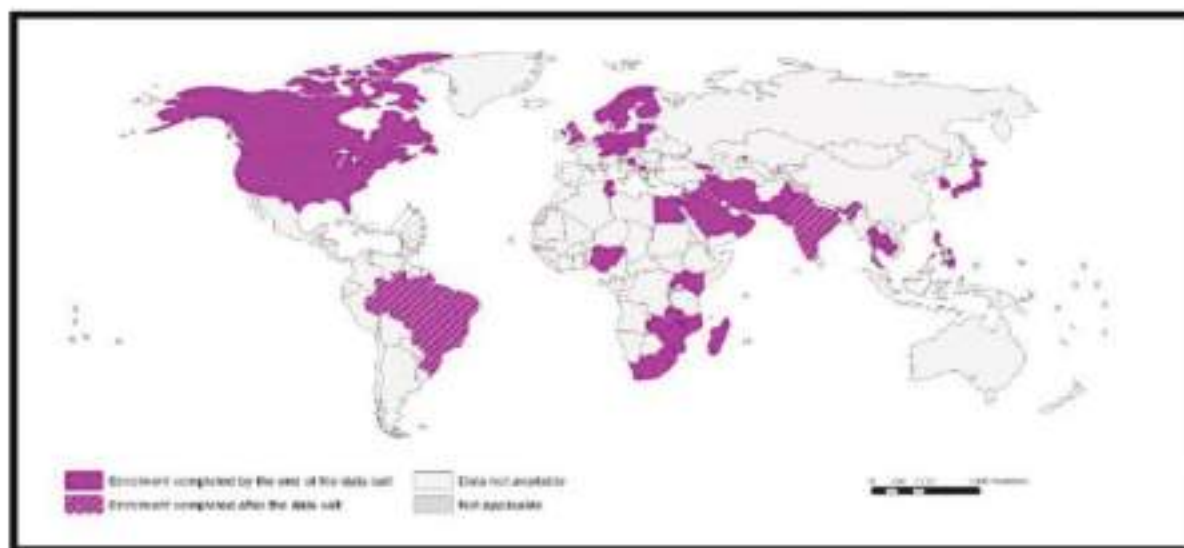


Fig. (8): GLASS Enrolment map (2017)

By 2020, Egypt will have a nationwide AMR surveillance system in place. Resistance profiles of priority pathogens will be reported. These efforts will be supported by quality assured national referral laboratories in human and animal health sectors and their network of surveillance laboratories. By 2020, a national early warning system will be in place to identify early the emergence of resistance in priority pathogens and to critical antimicrobials.

Strategic Objectives of Goal 3

The Strategic Objectives are as follows:

1. Strengthening lab capabilities for detection and characterisation of AMR in all relevant sectors
2. Establishing and strengthening surveillance system for AMR in all relevant sectors
3. Strengthening the knowledge and evidence base through research

SWOT Analysis

Strengths	Weaknesses
1. Availability of adequate number of qualified microbiologists 2. Initiation of Governmental lab national networks for AMR in human labs 3. Availability of several appropriately equipped laboratories 4. Establishment of National reference lab in both human and animal sectors 5. CPHL designated as the National reference for AMR and participating in WHO sponsored Regional EQA (REQAS) 6. Electronic network between central labs and some peripheral labs in health sector 7. Well established lab-based surveillance system managed by MoHP and SCU 8. Presence of epidemiological electronic system in sentinel sites 9. National hospital accreditation system 10. National lab licensing and accreditation system (clinical, food & water) 11. Well established electronic surveillance system in the universities for reporting quality AMR data in partnership with CDC-Egypt 12. Presence of National electronic disease surveillance system in veterinary sectors and aquacultures 13. Established One health committee (veterinary, Health, environment)	1. Uneven distribution of qualified personnel 2. Lack of renovation plan for microbiological laboratories with poor infrastructure 3. Weak overall infrastructure of many microbiology laboratories 4. Lack of equipment maintenance support in some laboratories 5. Absence of situation analysis of national microbiological laboratories 6. Electronic lab networking is not covering all microbiological laboratories in human health sector 7. Private labs are not under proper governmental supervision 8. Frequent noncompliance of guidelines for microbiological processing 9. Lack of awareness among lab staff on AMR 10. No electronic network among animal health labs 11. AMR is not a priority among researchers in all sectors 12. Lack of AMR surveillance in animal health sector 13. Lack of data sharing and communication inter and intra sectorial 14. Lack of antibiotic use surveillance in human and non-human sectors 15. Inadequate communication between food & water labs in different sectors (veterinary, human, environment) 16. Absence of National Laws and regulation for testing domestic food production for antibiotic residues 17. Absence of National Laws and regulation for testing imported animals for AMR

Opportunities	Threats
1. Acceptance of One health platform approach 2. Establishment of One Health technical advisory group 3. Growing International and global concern 4. Availability of new technologies for detection of AMR 5. Well established community based surveillance AMR 6. Political desire for updating and setting new regulations in AMR articulated 7. Availability of GLASS IT platform	1. Lack of sustained financial support 2. Weak enforcement of national regulation for lab licensing 3. Thriving illegal market for antibiotics 4. Inadequate investment in AMR from donors 5. The emergence of new resistance genes 6. Lack of funding in cutting edge technology for identification of new types of resistance

Operational Plan

Objective 3.1: Strengthening lab capabilities for detection and characterisation of AMR in all relevant sectors

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Baseline assessment and Mapping of all potential microbiology labs in veterinary and human (private and governmental) sectors	Q4/2018	MoHP	2,700,000
Expand the number of participating sentinel surveillance sites	Q2/2019	MoHP	
Establish mechanism for licensing & accreditation of microbiology labs in all sectors (private and governmental)	Q1/2019	MoHP	
Implement a lab quality management system in all laboratories	Ongoing	MoHP	
Establish a system that assures sustainability of resources & supply chain (backup procurement system)	Ongoing	MoHP	
Designate high capacity subnational reference labs to complement the work of NRL	Q4/2018	MoHP	
Develop and implement a training plan for microbiologists in NRL and Sentinel sites	Q4/2018	MoHP	
Develop and update the procurement plans in all labs to ensure the provision of lab supplies and diagnostics according to updated international guidelines (e.g CLSI)	Ongoing	MoHP	
Establish linkages between labs (inter and intrasectoral) for exchange of reference materials and isolate sharing	Q1/2019	MoHP	
Facilitate participation of reference laboratories in the international EQAS	Q4/2018	MoHP	
Operationalize NEQAS and make participation of all labs mandatory	2019	MoHP	

Objective 3.2: Establishing and strengthening surveillance system for AMR in human and animal sectors

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget
Establish a technical working group on integrated AMR surveillance from all relevant sectors	Q4/2018	MoHP	2,700,000
Develop national guidelines for HAIs & AMR surveillance systems across the different health sectors	Q1/2019	Surveillance technical working group	
Training and Capacity Building of HCP running the AMR surveillance programme	Q1/2019	IPC central unit CPHL	
Developing a central network server hosted by MOHP to receive AMR surveillance data	Q2/2019	IPC central unit CPHL	
Establish an electronic networking between labs and Surveillance units	Q2/2019	IPC central unit CPHL	
Establishment of Monitoring and evaluation plan/ programme to ensure proper implementation and reporting of the surveillance data	Q1/2019	IPC central unit CPHL	
Prioritize AMR pathogen and antibiotics of concern in all sectors according to the National priority, WHO recommendations and global concern	Q1/2020	IPC central unit CPHL	
Update the mapping of governmental & private animal farms, slaughtering houses and clinics as potential surveillance centres	Q1/2019	GOVS	
Develop national guidelines for AMR surveillance systems across the different animal sectors	Q1/2020	Surveillance technical working group	
Training and Capacity Building of veterinarians running the AMR surveillance programme	Q2/2020	GOVS	
Integration of antibiotic residues surveillance in animal farms (domestic, meat production, poultry, aquatic farms)	Q1/2020	GOVS	
Draft legislations/ standards for detection & quantification of antibiotics residues in imported and locally processed food products	Q1/2021	Surveillance technical working group	

Objective 3.3: Strengthening the knowledge and evidence base through research

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Identify of concerned national research centers in relevant sectors	Q4/2018	MoHP MoHE MoA	600,000
Develop/ update plan for research priorities in the academic centers and institutions to address the national challenges of AMR	Q2/2019		
Support researchers to implement intervention plans to limit the spread of AMR through funded projects	Q2/2019		
Establish a national bacterial (including drug resistant) isolate repository	2022		
Encourage the twining and partnership with international research institutes	on-going		
Support research on the economic impact of AMR and its interventions	Q1/2020		

M&E Plan

Objective	Target BY 2022	Baseline	Indicator	Frequency of measurement	Responsible Officer/Institution
3.1 Strengthening lab capabilities for detection and characterisation of AMR in all relevant sectors	20% increase of labs in the national network that have capability to isolate pathogens and undertake AST in a quality manner	To be determined during the baseline assessment	Percent of labs in national network having capability to isolate pathogens and undertake AST in a quality manner	Annual	CPHL GOVS
3.2 Establishing and strengthening surveillance system for AMR in all relevant sectors	20% increase of Healthcare settings actively functioning in the national surveillance system for AMR 10% increase of veterinary settings actively functioning in the national surveillance system for AMR	To be determined during the baseline assessment	Percent of settings actively functioning in the national surveillance system for AMR	Annual	MoHP GOVS
3.3 Strengthening the knowledge and evidence base through research	At least 10 AMR priorities identified for undertaking research in Egypt	No AMR priorities identified for undertaking research in Egypt	Number of AMR priorities identified for undertaking research in Egypt	Annual	MoHE

Chapter 7

Implement evidence-based infection control practices that can prevent the spread of resistant pathogens

Egypt health system accords high priority to infection control practices (IPC) in health care facilities. Substantial work has been done in establishing good infection prevention and control practices in several hospitals. IPC is an extremely important aspect of a strategic plan to contain AMR. This is essentially because a clinical setting represents an ecosystem of high antimicrobial usage. Within this ecosystem, exist patients, who may be immunologically impaired. These patients not only represent the population that is vulnerable to serious, life threatening infections, at the same time, they promote the emergence of resistance.

On the other hand, better hygiene, and infection prevention and control (IPC) represent methods to cut down on the spread of infections in ambulatory human and animal care facilities, in food production systems and in the community in general.

Vaccination in humans and animals and biosecurity in food production systems are specific interventions that if implemented effectively, can result in better health outcomes and reduced risk of emergence of AMR. Egypt has excellent vaccination coverage and same needs to be sustained and expanded for better results especially amongst the animal population.

Egypt has made considerable progress in implementing IPC measures in governmental health settings. Further activities can be carried out by strengthening the effective role of the existing infection control committee as steering committee, formulating a technical committee, standardising the national guidelines and standardization and reporting of national health care associated infection surveillance programme, also improving education and training for infection control professionals.

Strengthening hygiene best practices in animal health or biosecurity, which can be achieved by promoting disease prevention in animals with innovative strategies and tools and strengthening the monitoring system for AMU and AMR in poultry sector are planned.

Improvement of infection prevention and control in healthcare shall be carried out through following strategic interventions leading to fulfilment of following strategic objectives:

Strategic objectives

1. Promote infection control practices across all tiers of healthcare system.
2. Establishment of Adult Immunization programme.
3. Promote of biosecurity measures in veterinary settings and animal husbandry.
4. Establishment of environmentally safe treatment and disposal system for hazardous waste.

SWOT Analysis

Strengths	Weaknesses
1. Well established national IPC programme in majority of hospitals a. Presence of regularly updated national IPC guidelines b. Presence of technical support services 2. Availability of IPC training and educational programmes (Academic certificates, fellowships, diploma, post graduate studies) 3. Availability of M&E system (centrally and peripherally) in MoHP and some governmental entities 4. Availability of strong expanded immunization programme for Children	1. Improper implementation of IPC programme in some private and governmental hospitals and HCFs 2. Absence of independent authorized body responsible for M&E of IPC activities in different healthcare settings 3. Limited financial and human resources needed to support IPC implementation 4. Improper hazardous waste management system 5. Non-compliance to isolation policy in some HCFs 6. The infrastructures in many HCFs do not meet the required infection control standards

5. Availability of many accredited HCF whether at the national or international level 6. Availability of strong vaccination system 7. Availability of biosecurity measures in licensed farms 8. Established collaboration with the central animal research lab 9. Presence of training and educational programmes (under-graduate and post-graduate studies) 10. Initiation of registration programme for large animals and animal insurance programme	7. Absence of clear policy for active screening cultures for MDROs colonizers 8. Absence of robust immunization programme for adults 9. Absence of national standardized guidelines for biosecurity measures 10. Absence of national standardized guidelines for infection control measures in zoonotic diseases 11. Shortages in financial and human resources needed to support biosecurity measures 12. Presence of high number of unlicensed farms 13. Improper waste management (animal waste disposal) 14. Presence of illegal animal shelters and house holders
Opportunities	Threats
1. Legislation of the national health insurance law 2. Global initiatives for supporting national action plans fighting AMR	1. Introducing of new microbial strains and genotypes from other countries and re-emergence of resistant strains

Operational Plan

Objective 4.1: Promote infection control practices across all tiers of healthcare system

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Activate the National Advisory Committee for IPC	Q4/2018	MoHP	2,100,000
Establish an IPC technical working group from all relevant sectors	Q4/2018	MoHP	
Establish an independent authorized body responsible for monitoring of IPC activities in all Healthcare Settings	Q1/2020	IPC technical working group	
Review/enforce laws related to proper implementation of IPC programme in all health care facilities	Q2/2019	IPC technical working group	
Include compulsory educational and training activities on the IPC measures for under and post graduates of health specialities (medical, dental, pharmacy, nurses)	Q2/2019	MoHE	

Objective 4.2: Establishment of Adult & Occupational Immunization programme

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Risk assessment of the on-going immunization programmes & the national capacities by immunization experts	Q1/2019	MoHP	900,000
Setting up an Organizational structure for the Adult & Occupational Immunization programme	Q4/2019	MoHP	
Developing National Adult & Occupational Immunization guidelines	Q1/2020	MoHP	
Training and Capacity Building of HCP running the programme	Q1/2021	MoHP	

Objective 4.3: Promote biosecurity measures in veterinary settings and animal husbandry

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Activate the National Advisory Committee for Biosecurity measures	Q1/2019	GOVS	2,100,000
Baseline assessment of the ongoing biosecurity measures in the veterinary sector and animal husbandry	Q1/2019	GOVS	
Review available materials and laws on biosecurity in veterinary sector and convert into draft legislation, if needed	Q2/2019	National Advisory Committee for Biosecurity measures	
Developing/ updating of national standardized guidelines for biosecurity measures	Q1/2020	National Advisory Committee for Biosecurity measures	
Impart training to veterinarians on implementation of guidelines on biosecurity measures	Q1/2021	GOVS	
Establish a Monitoring and evaluation system to evaluate the biosecurity programme	Q1/2022	GOVS	

Objective 4.4: Establishment of environmentally safe treatment and final disposal system for hazardous waste*

Activities:

Activity	Time Frame Q/Y Quarter/Year	Responsible Officer/Institution	Estimated Budget in EGP
Conduct situational analysis for the safe disposal and treatment system for hazardous waste	Q1/2019	MoEnv GOVS MoHP	900,000
Develop/ update national policies, strategies and plans for hazardous waste management	Q2/2019	MoEnv	
Undertake capacity building and infrastructure strengthening for hygienic disposal of hazardous waste	Q1/2020	MoEnv	
Establish a Monitoring and evaluation system to evaluate the safe disposal and treatment system for hazardous waste	Q1/2021	MoEnv	

* Hazardous waste includes both medical and veterinary wastes

M&E Plan

Objective	Target by 2022	Baseline	Indicator	Frequency of measurement	Responsible Officer/Institution
4.1 Promote infection control practices across all tiers of healthcare system	20% increase of health care facilities implementing IPC national standardized programme	To be determined during the baseline assessment	Percentage of health care facilities implementing IPC national standardized programme	Annually	Independent IPC authorized body responsible for M&E
4.2 Establishment of Adult Immunization programme	30% Vaccination coverage among targeted adult groups	N/A	Percent of Vaccination coverage among targeted adult groups	Annually	MoHP
4.3 Promote of biosecurity measures in veterinary settings and animal husbandry	20% increase of veterinary settings implementing biosecurity measures	To be determined during the baseline assessment	Percentage of veterinary settings implementing biosecurity measures	Annually	GOVS
4.4 Establishment of environmentally safe disposal and treatment system for hazardous waste	20% increase of Hazardous waste correctly disposed	To be determined during the baseline assessment	Hazardous waste produced per sector per year Hazardous waste correctly disposed	Annually	MoE

Annex 1

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Annex 2

National Committees to implement NAP

National Steering Committee

Composition

To be notified by the national government. Should be multisectoral and comprise of senior policy makers from different sectors. Must meet at least twice a year.

Terms of Reference

1. To lead and coordinate comprehensive national efforts in combating antimicrobial resistance
2. To oversee and guide finalization of national action plan against AMR in alignment with the global action plan
3. To coordinate, supervise and guide subsequent implementation of national action plan
4. To project financial needs and facilitate their sustained flow from national government and other sources
5. To establish various technical advisory and subgroups to develop national activities for implementation of NAP
6. To periodically review the progress made in implementation of NAP and suggest course corrections, if needed
7. To approve the national technical, administrative and financial protocols for implementation of NAP
8. To keep a continuous follow up and apprise national leadership on progress made

Technical Working Groups

Composition

These can be goal specific and should comprise of senior technical experts from related sectors/departments. Must meet every three months.

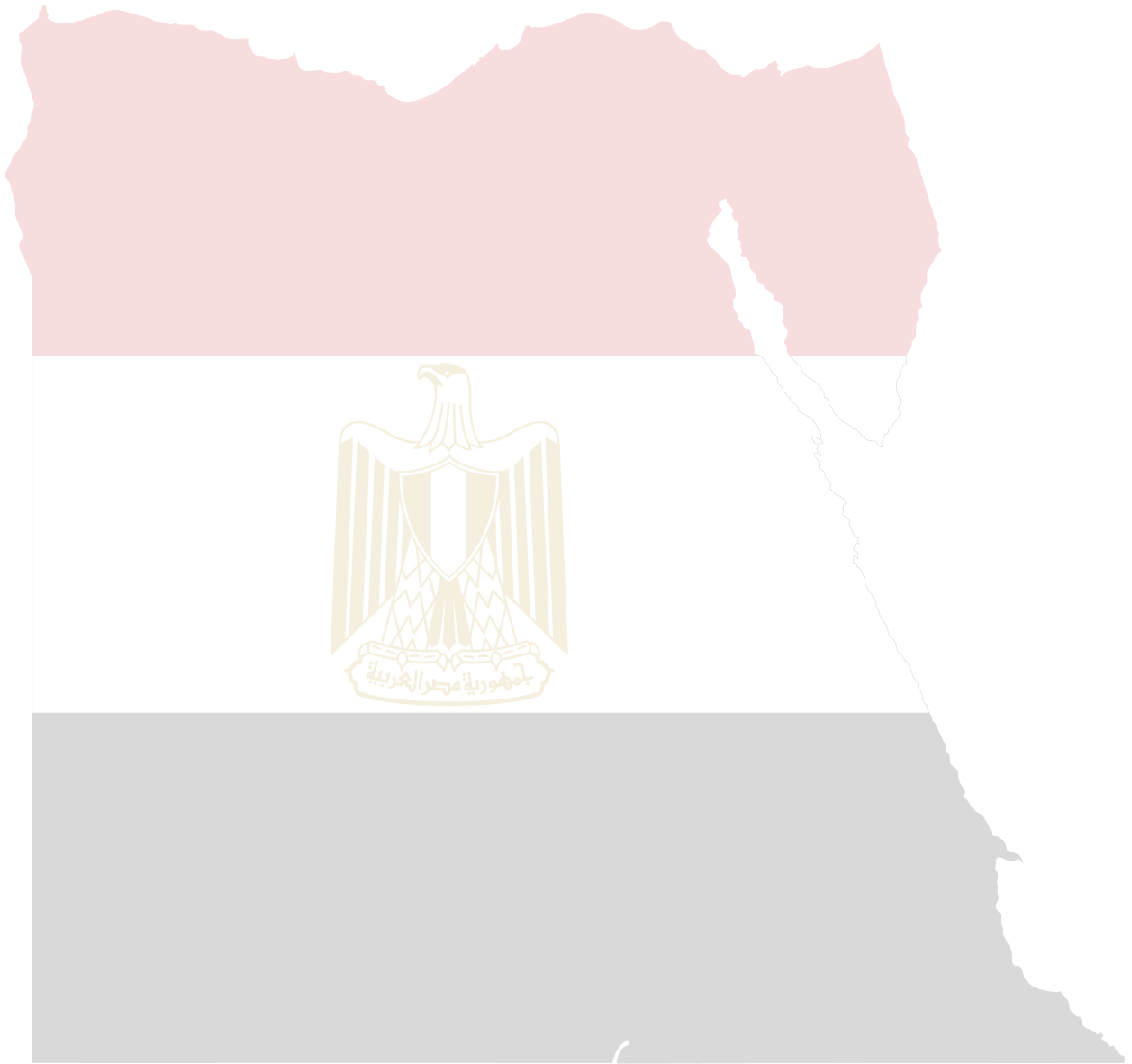
Terms of reference

1. Provide technical advice and reports to the National Steering Committee on Antimicrobial Resistance;
2. Technically review and revise the draft national action plan of AMR;
3. Identify available technical resources and institutions in the country
4. Provide technical oversight for initiatives to combat AMR
5. Develop standard protocols and technical documents related to NAP
6. Plan, organize and review the training/ capacity building activities
7. Launch and coordinate awareness campaigns
8. Identify and map stakeholders for AMR-related activities and promote their collaborative activities;
9. Ensure regular data collection and information sharing through effective communication and coordination amongst all stakeholders;
10. Coordinate national activities for establishing/ strengthening/ linking surveillance systems for AMR, antimicrobial use and HAIs;
11. Develop and disseminate national AMR reports annually;
12. Facilitate and monitor/ evaluate the overall implementation of NAP-AMR and initiate corrective measures

Annex 3

References

1. The antimicrobial resistance: tackling a crisis for the health and wealth of countries. The review on antimicrobial resistance. (2014, December). Available from https://amrreview.org/sites/default/files/160525_Final%20paper_with%20cover.pdf
2. World Bank. By 2050 drug resistant infections could cause global economic damage on par with 2008 financial crisis. (2016, September 20th). Available from <http://www.worldbank.org/en/news/press-release/2016/09/18/by-2050-drug-resistant-infections-could-cause-global-economic-damage-on-par-with-2008-financial-crisis>
3. Lauri Hicks and Maha Talaat. Protecting the Power of Antibiotics: Lessons from Egypt. (2015, November 13th). Available from https://www.cdc.gov/globalhealth/stories/protecting_power_antibiotics.htm
4. Kathleen L. Dooling, Amr Kandeel, Lauri A. Hicks, Waleed El-Shoubary, Khaled Fawzi, Yasser kandeel, et al. Understanding Antibiotic Use in Minya District, Egypt: Physician and Pharmacist Prescribing and the Factors Influencing Their Practices. *Antibiotics*. 2014; 3(2), 233-243.
5. El Kholy A, Baseem H, Hall GS, Procop GW, Longworth DL. Antimicrobial resistance in Cairo, Egypt 1999-2000: a survey of five hospitals. *J Antimicrob Chemother*. 2003 Mar;51(3):625-30.
6. Lamyaa Shaban and Rania Siam. Prevalence and antimicrobial resistance pattern of bacterial meningitis in Egypt. *Annals of Clinical Microbiology and Antimicrobials*. 2009; 8:26.
7. Hossam M Ashour and Amany El-Sharif. Species distribution and antimicrobial susceptibility of gram-negative aerobic bacteria in hospitalized cancer patients. *J Transl Med*. 2009; 7: 14.
8. Talaat M, El-Shokry M, El-Kholy J, Ismail G, Kotb S, Hafez S, et al. National surveillance of health care-associated infections in Egypt: Developing a sustainable program in a resource-limited country. *American J Infection Control*. 2016; 44:1296-1301.
9. Maha Talaat, Tamer Saied, Amr Kandeel. A Point Prevalence Survey of Antibiotic Use in 18 Hospitals in Egypt. *Antibiotics*. 2014;3(3): 450-460;
10. Global antimicrobial resistance surveillance system (GLASS) report: early implementation 2016-2017. Geneva: World Health Organization; 2017. Available from <http://apps.who.int/iris/bitstream/10665/259744/1/9789241513449-eng.pdf?ua=1>.
11. El-Sharkawy H, Tahoun A, El-Gohary AEA, El-Abasy M, El-khayat F, Gillespie T, et al. Epidemiological, molecular characterization and antibiotic resistance of *Salmonella enterica* serovars isolated from chicken farms in Egypt. *Gut Pathog*. 2017 Feb 10;9:8.
12. Ombarak RA, Hinenoya A, Elbagory AM, Yamasaki S. Prevalence and Molecular Characterization of Antimicrobial Resistance in *Escherichia coli* Isolated from Raw Milk and Raw Milk Cheese in Egypt. *J Food Prot*. 2018 Feb;81(2):226-232.



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