FAQS - Frequently asked questions on Antimicrobial Resistance

Q 1: What are antibiotics and how do they differ from antimicrobial agents?

Antibiotics are antimicrobial agents or medicines used to fight organisms that cause infection; they are prepared from other living organisms. However, not all antimicrobial agents are antibiotics because some of them are synthesized chemically and not obtained from a living organism. Nevertheless, for ease of communication, “antibiotics” and “antimicrobial agents” are used interchangeably. Antibiotics have been known for at least 80 years, from the time penicillin was discovered by Sir Alexander Fleming in 1928. The 1970s and 1980s saw the rapid emergence of a number of antibiotics and agents that could be used to treat infections caused by organisms or microbes.

Infections in human beings leading to illness and disease are caused by microorganisms (or germs, as they are colloquially called). These organisms, also called microbes, may be bacteria, viruses, fungi or parasites. Antimicrobials, as the name suggests, are medicines used to treat infections caused by these microbes. These medicines (such as penicillin, streptomycin and 150 others) have been useful to mankind for the past 70 years in combating the severity and spread of many of these diseases.

Q 2: What do we understand by the term antimicrobial resistance?

Antimicrobial resistance (AMR) is resistance of a microorganism to an antimicrobial agent to which it was originally sensitive. Resistant organisms are able to withstand attack by antimicrobial agents so that standard treatments become ineffective and infections persist, increasing the risk of spread to others. Organisms which are resistant to a number of agents, are often called multidrug-resistant organisms. Microorganisms that develop resistance to antimicrobials are sometimes referred to as “superbugs”.

The emergence of resistance to these drugs is a natural biological phenomenon that happens when the microorganisms are exposed to antimicrobial drugs. The use of antibiotics for any infection, in any dose or for any period of time, causes a selective pressure on the microbial population. Under optimal conditions, the majority of the infecting microbes will be killed and the body’s immune system can deal with the rest. However, if a few resistant mutants exist in the population, and the treatment is insufficient or the patient is immunocompromised (i.e. has a weakened immune system), the mutant can flourish. Thus treatment may fail and resistant microbes multiply.

Q 3: What are the factors that contribute to rapid emergence of AMR?

Some of the common factors contributing to emergence of AMR are the misuse of antimicrobial medicines and poor infection control practices. A predominant consumption of broad-spectrum antibiotics in hospital settings is postulated as a possible factor behind the documented high rate of bacterial resistance to antibiotics in hospitals.

Initially, multiple-drug resistant organisms were encountered mostly in hospitals, where antimicrobials are used most extensively. However, at present, bacterial resistance is found almost as frequently in the community.

Q 4: Why is resistance to antibiotics a problem?

AMR threatens the effective prevention and treatment of an ever-increasing range of infections. Problems associated with bacterial resistance include; reduced effectiveness of treatment, increased morbidity and mortality, longer duration of patient hospital stay, requirement of more intensive care, increased cost of health care, spread of multi-drug resistant bacteria. Without effective antimicrobials for prevention and treatment of infections, medical procedures such as organ transplantation, cancer chemotherapy, diabetes management and major surgery (for example, caesarean sections or hip replacements) become very high-risk.

A patient admitted to hospital is expected to be cured of illness and be discharged. If during the course of hospitalization the patient is infected with an organism that is resistant to a number of antibiotics, his/her stay in the hospital could be prolonged. Such organisms could cause devastating infections, which fail to respond to any or all of the agents used to treat these infections. Failed treatment could lead to secondary complications, with the infection spreading to all systems in the body. Such patients require constant medical and nursing attention and are housed in closed units called intensive care units. They also have a greater risk of death caused by such infections.

When these patients harbouring multidrug resistant organisms continue to stay in the intensive care unit of a hospital, it gives an opportunity for the organism to spread from one patient to another. Soon many or all patients admitted to the unit seem to harbour the same multidrug-resistant organism. Thus, these organisms not only cause life-threatening infections and pose a challenge for treatment, but also jump from one patient to another, leading to an outbreak of infections in a unit. These are often called health care-associated infections. New resistance mechanisms are emerging and spreading globally, threatening our ability to treat common infectious diseases and resulting in prolonged illness, disability and death.

Q 5: How serious is this problem of AMR ?

AMR is s serious problem all over the world. The discovery of a number of antibiotics in the last 40–50 years offered scope for the longer survival of critically ill patients, bringing gains in life expectancy and human health. However, all these gains offered by the newly discovered disease-fighting agents have been threatened because of multidrug resistant organisms that have emerged over the last 20–30 years. It may become increasingly difficult to manage life-threatening infections caused by these organisms. In recent years, since the rate at which resistance occurs has outpaced the development of new drug replacements, it has become necessary to take measures to contain AMR.

Q 6: How can a multidrug-resistant organism spread from one patient to another?

Most multidrug-resistant organisms spread from one patient to another through the hands of doctors, nurses and other staff. The various staff (such as x-ray technicians, dialysis technicians, etc) are required to observe good hand hygiene (i.e. to wash or rub their hands with an approved disinfectant solution) before and after contact with a patient. This ensures that they do not pick up any organisms from patients they examine or care for. But if they do

not follow hand hygiene practices, microbes get a chance to move from an infected patient to the hands of staff, and then on to the next patient the doctor or nurse touches or examines. In this manner, the organisms get transferred from one patient to another. There are other modes of transfer from one patient to another, but the one described above is the commonest, and also accounts for a majority of serious health-care associated infections.

Q 8: What are the other medical reasons, besides poor hand hygiene practices, for the transfer of multidrug-resistant organisms from one patient to another?

Weak infection control practices and poor general hygiene in several health-care facilities, especially in resource-limited settings, facilitate emergence and spread of resistant organisms. In some cases, the pressure to get the patient up and about along with the fear of losing the patient to another professional colleague (especially in the private sector) have encouraged the use of a combination of antibiotics to treat minor or nonexistent infections. Consequently, such patients are known to harbour multidrug-resistant organisms in their body, which can be easily passed on to others through poor infection control practices. On the whole, overcrowding, poor sanitation and wrong prescription practices, along with weak waste management, facilitate breeding of organisms and their unwanted spread to other patients or communities.

Q 9: Have patients admitted to hospital also contributed to this problem of antimicrobial resistance?

The patient population in many hospitals today includes those afflicted with serious infections such as tuberculosis, hepatitis, conditions that predispose (pose a greater risk to) infections such as organ transplantation, severe forms of malaria and typhoid fever. These patients require prolonged medication with potent antibiotics, which favours selection of resistant strains in the hospital environment. With the passage of time, several species of multidrug resistant microorganisms establish themselves in the hospital environment and pose a risk to all those who come there for treatment. International travel and trade also facilitate movement of resistant organisms from one nation and one part of the world to another. This has led to the spread of multidrug-resistant organisms to parts of the world where they were hitherto largely unknown.
Another dangerous trend that one sees today is aggressive relatives of a critically ill patient prevailing upon the treating doctor and directing him about the antibiotic to be given to the patient.

Q 10: “Inappropriate use of antibiotics” is an often heard term in the media. What does this mean?

This is a term applied to all forms of antibiotic misuse and abuse. Inappropriate use occurs when antibiotics are taken for too short a time, at too low a dose, at inadequate potency, or for the wrong disease. It starts with the incorrect antibiotic being prescribed for a condition. Some conditions do not even warrant an antibiotic; however, innocent patients and relatives are coaxed into believing that taking an antibiotic medicine for just two days would work miracles for the condition. Wrong doses, incomplete schedules and inadequate timing of the intake of an antibiotic are all examples of how an antimicrobial agent can be abused by medical practitioners. High-end (and expensive) antibiotics are usually given to patients with a serious or critical illness admitted to the intensive care unit of a hospital. However, it is

common to find such medicines given to patients being treated for a minor ailment on an outpatient basis in a clinic.

Q 11: How do people themselves contribute to the emergence of antibiotic resistance and to the abuse of antibiotics?

There are some patients who hope to get rid of their ailment, however minor it may be, almost instantly. While it is known that this is not possible with the usual antibiotics, anxiety and impatience prevails upon them to pressure or even "window shop" for a physician or doctor who would prescribe a "strong" antibiotic to rid them of their condition in record time. A little knowledge is a dangerous thing, as the saying goes; this is exemplified by people walking into a pharmacy and asking for half a strip of ciprofloxacin or azithromycin without having a proper diagnosis or prescription from a physician.

Pharmacy practices in our country are also partly responsible for the abuse, as it is possible for a person to purchase any antibiotic, as just described, over the counter. The dose (i.e. the number of tablets or vials purchased) is never audited or questioned by the head of the pharmacy as the immediate financial gain from selling the antibiotic is more important than the correct use of the antibiotic for the correct indication by the patient. In the past, it was erroneously thought that the socioeconomic status of a patient had a lot to do with over-the-counter sales of antibiotics. It is now understood that this is a myth. Patients belonging to all strata of society have been known to buy antibiotics from a pharmacy in improper or inappropriate ways.

Q 12: Does the economic status of a patient impact the emergence of antibiotic resistance?

In localities where a huge population of patients are economically disadvantaged, this can pose problems when selecting antibiotics for the treatment of infections. Critically ill patients are often discharged against medical advice and taken away prematurely for want of funds to treat the serious infectious condition of the patient. This economic burden compels patients to abort their treatment half way and stop taking their medicines, as they cannot afford to buy the full schedule of an antibiotic. Organisms inadequately treated have a fertile ground for developing resistance to these antibiotics. On the other hand, patients who are not economically disadvantaged are also known to stop their treatment well before the prescribed duration since they "feel better" and do not find reason to complete the full course of the antibiotic as prescribed by the doctor. This does not kill all the organisms causing the infection nor eradicate it completely. Those that survive reproduce, thus helping to propagate resistant strains.

Q 13: What is the role of the pharmaceutical industry in propagating antibiotic resistance?

Incorrect marketing strategies, giving incentives to the doctor who writes the maximum number of antibiotic prescriptions, coupled with an understanding with pharmacists and other dealers for personal gain and profit are an impediment to proper prescription of antibiotics. The production of quality drugs with recommended antibiotic potency is also critical in preventing resistance. Effective regulatory mechanisms can ensure that the pharmaceutical industry produces high-quality drugs.

Q 14: Is antibiotic resistance seen only in developing nations of the world?

No, it is as much a problem in many developed nations. The situation is probably made worse in developing nations of the world due to overcrowding, poverty, and lack of public education and awareness about various aspects of antibiotic use. The situation does exist in other countries, but legislation on the use of antibiotics has led to some control over the situation in a few developed countries.

Q 15: How has poverty and lack of awareness aggravated the problem of antibiotic resistance?

Poverty plays a role in two ways. The average person cannot afford the expensive antibiotics prescribed to them; hence they buy whatever antibiotic concoctions are sold to them over the counter in a pharmacy. They also do not finish a full course of an antibiotic as prescribed by the doctor as it may be too expensive for them to buy the complete course. In addition, a sizeable proportion of the population in our country — particularly those residing in small towns and outlying districts — may not have access to good health-care facilities and do not have the means or opportunity to see a qualified physician. This has led to the emergence of unqualified doctors, who are not aware of the basics of medicine. These unqualified doctors may prescribe suboptimal doses and schedules of antibiotics. Bacteria and other organisms have developed mechanisms to counter these small inadequate doses of antibiotics and become resistant to antibiotics commonly used in such concoctions.

Q 16: Which common ailments or illnesses for which antibiotics are prescribed should not usually be treated with antibiotics?

Undoubtedly, respiratory illnesses (the common cold, cough with or without fever, bronchitis, wheezing, a running nose, sore throat) and diarrhoeas are the most common ailments for which antibiotics are misused. Almost every episode of gastroenteritis is treated with varying doses of antibiotics for different lengths of time for different patients. The situation is worse in the case of small children, who are given far too much antibiotics by doctors.

Q 17: Why is it said that the common cold, a running nose and diarrhoeas cannot be cured by antibiotics?

The common cold, a running nose and sneezing are usually symptoms of viral infections. These organisms are smaller than bacteria and are often seasonal (though some of them can cause infection throughout the year). Most diarrhoeas are self-limiting and may be caused by viruses. Antibiotics are effective against bacteria but have no effect on these viruses. Hence the common cold, a running nose and diarrhoeas are not cured by antibiotics. In fact, use of antibiotics in diarrhoeas may kill the bacteria normally present in the intestine which produce several useful products (viz. vitamins) for the body.

Q 18: If a person suffering from a running nose emits watery material or mucus from the nose, and if the mucus from the nose turns yellow, does the infection need an antibiotic?

No, the infection does not necessarily need an antibiotic; yellow or green mucus does not always mean that you have a bacterial infection. It is possible that the mucus has thickened and it could also change colour during a cold.

Q 19: Antibiotic are used in the animal industry for various purposes. Does this have an impact on antibiotic resistance in human beings?

Antibiotics have been used in animals both as a growth-promoting agent as well as for treating infections. The antibiotics used to treat infections in animals, such as tetracycline, quinolones, etc. are much the same as those used to treat human infections, and these agents accumulate in the tissues of animals. Bacteria exposed to these low concentrations of antimicrobial agents tend to develop resistance to them. Close and continuous contact between animals and humans in developing countries facilitates easy spread of resistant organisms from animals to humans.

Q 20: How does the problem of antibiotic resistance in animals contribute to antibiotic resistance in human infections?

Some bacteria such as salmonella (the causative organism of typhoid fever) and campylobacter (an important organism, causing bacterial dysentery in children) are associated with the consumption of contaminated food and water. These organisms are passed on from animals to humans through food and unhygienic practices. Human beings could also acquire organisms directly from animals by contact.

Q 21: How do we overcome this problem of antibiotic resistance, both in the hospital and the community?

In the hospital it is important for doctors to investigate a case completely before giving any antibiotic. This will ensure that only patients who require antibiotics will get them. It is also important to diagnose an infection fully before a decision is made as to the most appropriate antibiotic, the dose required and the duration for which it is given. Hospital antibiotic policy and standard treatment guidelines are effective tools to encourage rational use of antibiotics. In the community, it is important to go to a qualified doctor for consultation. This helps to ensure proper diagnosis of the illness, which itself will determine whether an antibiotic is required to cure the infection. Many infections do not require antibiotics.

Q 22: How could the general public contribute to this fight against antibiotic resistance and resistant organisms?

It is as much the responsibility of the public as it is the doctor's to help prevent antibiotic resistance in organisms and the spread of these organisms in the general population. The following points should be kept in mind:

(a) Try to prevent infections by observing healthy and hygienic habits.
(b) Always follow the advice of a doctor before you start taking an antibiotic.
(c) Only use a doctor's prescription to procure antibiotics from a pharmacy, and do not take whatever the pharmacy doles out to you.
(d) Do not store any antibiotic after its expiry or after the course of antibiotics is over. Do not reuse any antibiotic without a valid prescription from a doctor.
(e) Ask your pharmacist or doctor about the correct method to dispose of leftover medicines.

(f) Never reuse a medicine with an old prescription on yourself or prescribe it to others based on your previous experience. Do not try to play the role of a doctor.
(g) Follow good hand hygiene: Wash hands well with soap and water and dry them before touching other surfaces. This will help prevent the spread of antibiotic-resistant organisms.
(h) Do not stop an antibiotic course just because you or your child feels or looks better. The medicine needs to be administered for a full course in the correct dosage to act on the organism and eradicate the infection. Incomplete courses will only contribute to antibiotic resistance.

Q 23: What is the role of the doctor in preventing or curtailing antibiotic resistance?

We are at a stage where it may be impossible to prevent antibiotic resistance completely. Our arsenal of antimicrobial agents has been weakened to a great extent. But it is still possible to reduce antibiotic resistance and the spread of resistant organisms by observing these good practices:

(a) Patients need to be examined completely and the exact nature of an infection needs to be established before any antibiotic is given to the patient.
(b) The doctor needs to be confident about the exact dose and duration and possible side effects, of any medicine administered to a patient. Explaining what to expect to a patient helps prevent them from prematurely stopping antibiotic treatment.
(c) It is not always beneficial (and usually unsafe) to give two or more antibiotics in combination to cure infections that can easily be cured with a single antibiotic.
(d) It is important not to give antibiotics to cure upper respiratory tract infections such as colds, minor coughs, bronchitis and running nose that are usually viral in origin.

Q 24: How could nurses help to reduce the spread of resistant organisms within hospitals and nursing homes?

Nurses are the backbone of patient care in any hospital or nursing home. The basic principles of hand hygiene and good health care, such as hand-washing and applying a disinfectant hand rub before visiting the next patient, are of paramount importance to prevent the spread of infections. In addition, a nurse could also gently enforce the practice of hand hygiene by talking to and reminding doctors (at all levels) about such practices. This will ensure adherence to hand hygiene and help prevent the spread of infections.

Q 25: How can useful information on antibiotic resistance be communicated to the public?

The use of the media and responsible reporting of the possible health hazards of antibiotic misuse is in order. It is very important to convey the effects of antibiotic misuse at a broad level. Isolated instances and cases may not have an impact unless the potential threat of such resistance to human life in hospitals and the community as a whole is emphasized. Both print and electronic media could be used for this purpose. While television is the commonest medium used, the value and reach of radio communication is underestimated. These means should be used to convey messages to the public to make everyone aware of antibiotic resistance and the threat it poses.

Q 26: What are the important points that the media can convey to the general population about the dangers of antibiotic misuse and ways to prevent it?

It is important for the public to know about the dangers of the misuse and abuse of antibiotics and their own role in it. The main points are:

(a) Do not take an antibiotic if it can be avoided.
(b) Do not buy an antibiotic over the counter at a pharmacy without visiting a doctor or without a valid prescription from a qualified doctor.
(c) Do not visit an unqualified doctor just because he or she claims immediate cure from all ailments and charges less than a qualified medical practitioner.
(d) Do not use medicines left over from a previous episode of illness just because it worked the last time.
(e) Do not give medicines to another person for what seems to be a similar illness to yours. The same medicine may not help all ailments in all people the same way.

The media is the best channel to carry these messages to the general public. The medium used can either be print or electronic, and the choice rests with individual agencies.

Q 27: Who needs to take action?

Many organizations and individuals can help — national authorities, consumers, prescribers and dispensers, veterinarians, the pharmaceutical industry, hospital administrators, professional societies and international agencies and patients. Government of India has been advocating for rational use of antibiotics. A comprehensive national strategy for prevention and containment of antimicrobial resistance has been developed i.e National action Plan fpr containment of AMR (NAP-AMR) and is also uploaded on the NCDC portal and can be viewed at http://www.nicd.nic.in/writereaddata/mainlinkFile/File645.pdf. This strategy addresses all issues related to resistance in antibiotics and suggests possible actions at country level.

Q 28: Why is vaccination important for addressing antibiotic resistance?

Vaccines can help limit the spread of antibiotic resistance. Vaccinating humans and animals is a very effective way to stop them from getting infected and thereby preventing the need for antibiotics. Making better use of existing vaccines and developing new vaccines are important ways to tackle antibiotic resistance and reduce preventable illness and deaths.

Q 29: How can existing vaccines have an impact?

Expanding the use of existing vaccines will reduce the use of antibiotics and the development of resistance. For example, if every child in the world received a vaccine to protect them from infection with *Streptococcus pneumoniae* bacteria (which can cause pneumonia, meningitis and middle ear infections), this would prevent an estimated 11 million days of antibiotic use each year. Vaccines against viruses, such as the flu, also have a role to play, because people often take antibiotics unnecessarily when they have symptoms such as fever that can be caused by a virus.

Q 30: How can new vaccines have an impact?

Developing and using new vaccines to prevent bacterial diseases can further reduce the development of resistance. Antibiotics are currently the standard medical intervention for common diseases such as Group A *Streptococcus* (which causes “strep throat”), for which we

do not yet have vaccines. We also need vaccines to stop people from catching diseases caused by bacteria that are now frequently antibiotic-resistant. For example, there is an alarming spread of multi-drug resistant tuberculosis (MDR-TB). In 2015, an estimated 480 000 people were infected with MDR-TB.
Similarly, new vaccines targeting *Staphylococcus aureus* (which causes skin and soft tissue infections), *Klebsiella pneumoniae* (which causes pneumonia and infections of the blood stream and urinary tract), *Clostridium difficile* (which causes diarrhoeal disease), and many others could protect people against diseases that are increasingly difficult to treat. Developing new vaccines and getting them used appropriately is lengthy and complex. The scientific community needs to prioritise which new vaccines would have the greatest impact on antibiotic resistance, and promote investment in these.

Q 31: Does stopping a course of antibiotics early lead to antibiotic resistance?

There has been a lot of research into how long antibiotic courses should be, to determine the shortest possible length of course needed to completely kill all bacteria. If you are being treated for an infection, the kind of antibiotics your doctor prescribes and the length of the course should be based on the best evidence. Feeling better, or an improvement in symptoms, does not always mean that the infection has completely gone. Your doctor has had years of training and has access to the latest evidence – so always follow their advice. Evidence is emerging that shorter courses of antibiotics may be just as effective as longer courses for some infections. Shorter treatments make more sense – they are more likely to be completed properly, have fewer side effects and also likely to be cheaper. They also reduce the exposure of bacteria to antibiotics, thereby reducing the speed by which the pathogen develops resistance.