ANTIBIOTICS AND ANTIBIOTIC RESISTANCE

Antibiotics

Antibiotics are powerful drugs, but they are not the cure for all the diseases. Antibiotics, also known as antimicrobial drugs, are drugs that fight infections caused by bacteria. They are not effective against viral infections caused by bacteria. They are not effective against viral infections like the common cold, most sore throats, and the flu.

Antibiotic Resistance

Antibiotic resistance is the ability of a microorganism to withstand the effects of an antibiotic.
Today, almost all important bacterial infection in the India and throughout the world are becoming resistant to antibiotics. Antibiotic resistance has been called one of the world's most pressing public health concerns. The rational use of antibiotics is the key to controlling the spread of resistance.

Rational use of antibiotics

Development and spread of antimicrobial resistance (AMR) is commonly due to overuse, misuse, and indiscriminate use of antimicrobials by doctors, nurses and pharmacists, non-compliance and self medication by patients and use in animal husbandry and agriculture. It is estimated that 70-80% of prescriptions for antimicrobials are probably advised unnecessarily by the health professionals. In spite of the fact that most common colds and diarrheal episodes are viral in origin, yet, antimicrobials are used indiscriminately. Reasons for over prescribing are often lack of confidence, peer pres-sure, patient pressure and pharmaceutical company pressure. Antimicrobial use is a key driver of the resistance. Poverty and inadequate access to antibiotics constitute a major factor in the development of resistance. Another common cause of developing resistance is improper diagnosis. In many instances death of an adequately equipped diagnostic laboratory in the vicinity compels the physician to prescribe antibiotics empirically, thus, increasing the likelihood of the patient receiving a wrong antibiotic. Furthermore, ready availability of antibiotics over-the-counter and sales promotion schemes by the pharmaceutical manufacturers also leads to the promotion of indiscriminate use, thus, increasing the likelihood of development of resistance. Counterfeit drugs are also a problem contributing to development of resistance. These contain either the wrong ingredient, or lesser amount of the active ingredient. In some instances, the medication poisons are capable of causing disability or even death. The impact of the media has also contributed to the development of resistance. Patients often demand antibiotics for their ailment on the basis of advertisements read or seen. Unwitting use of more active drugs at sub therapeutic doses leads directly to the development of multi drug resistance. Irrational use of antimicrobials is widespread throughout the world. This is harmful in terms of increased cost of therapy, unnecessary adverse drug reactions, therapeutic failure, reduced quality of care and worst of it is AMR.
The bacterial infections which contribute most to human mortality and morbidity are also

those in which emerging antimicrobial resistance is most obvious: diarrhoeal diseases, respiratory infections, meningitis, sexually transmitted diseases, and hospital-acquired infections. Some important 626NFI-2011examples include penicillin-resistant Streptococcus pneumoniae, vancomycin-resistant enterococci, methicillin-resistant Staphylococcus aureus, multi-resistant Salmonella typhi, Shigella dysenteriae, Neisseria gonorrhea, Pseudomonas aeruginosa and multi-resistant Mycobacterium tuberculosis. The development of resistance to drugs commonly used to treat P. falciparum malaria is of particular concern, as is the emerging resistance to antiretroviral drugs.

Established mechanisms of AMR

For an antibiotic to be effective, it must reach the target site in an active form, bind to the target, and interfere with its function. Thus, bacterial resistance to an antimicrobial agent can occur due to three general mechanisms:

The drug does not reach its target

In Gram negative bacteria, many antibiotics enter the cell through protein channels called porins. Mutations or loss of these channels can prevent/slow the rate of antibiotic entry into a cell, effectively reducing drug concentration at the target site. If the drug target is intracellular and the drug requires active transport across the cell membrane, a mutation that interferes with the transport mechanism can confer resistance e.g. aminoglycosides. Bacteria can also transport antimicrobial drugs out of the cell through efflux pumps. Resistance to numerous drugs, including fluoroquinolones, macrolides, tetracyclines and beta lactam antibiotics, is mediated by this mechanism.

The drug is inactivated

Bacterial resistance to aminoglycosides can be due to a plasmid encoded aminoglycoside-modifying enzymes. Similarly, β-lactamase production is the most common mechanism of resistance to penicillins and other β-lactam drugs. Many hundreds of different β-lactamases have now been identified. A variation of this mechanism is failure of the bacterial cell to activate a prodrug e.g. loss of ability of M. tuberculosis to activate isoniazid (INH).

The target site is altered

This may be due to mutations in drug binding region of target enzyme e.g. fluoroquinolones, target modification e.g. ribosomal protection type of resistance to macrolides and acquirement of a resistant form of the susceptible target e.g., methicillin resistance in Staphylococcus Spp. due to production of a low-affinity penicillin-binding protein (PBP).

Strategies to prevent AMR in healthcare settings

Prudent antibiotic use: Antibiotics should be used only when they improve patient outcome. Not all infections need anti-biotic treatment e.g. in patients with sore throat,

benefit from antimicrobial therapy is small and is counterbalanced by the risk of adverse events like rash. Narrow spectrum agents should be used whenever possible. Broad spectrum agents should not be used as a cover for lack of diagnostic precision. Antibiotics should be prescribed in optimal doses, regimens, and should be stopped when the infection is treated. Restrict the use of last line antibiotics for serious infections and only when simpler agents are likely to be ineffective. Whenever used for prophylaxis, antibiotics should be used for short courses and at appropriate times (e.g. during surgical prophylaxis, antibiotics should be given within an hour prior to incision).

Prevention of infection: Use of antimicrobials can also be reduced if infections are prevented in the first place. This can be achieved by improved use of vaccines and improved hygiene and infection control practices like compliance with hand washing protocols and aseptic techniques for catheterization. Catheters and drains should be removed when no longer needed.

Clinicians should be familiar with local antibiotic sensitivity profiles and should comply with the local antibiotic guide-lines. A hospital antibiotic policy should be formulated based on local antimicrobial resistance data. Prescribers should be educated about the use of antibiotics, when not to use them and also the infection control strategies.

Hospitals should carry out surveillance of resistance patterns- how much, where, in which organisms and to what antibiotics. Similarly antibiotic use pattern can be studied and these data can be used to devise targeted interventions to minimize antimicrobial use.

The intent of giving this write up is to encourage rational prescribing of antimicrobials and minimize the development of resistance to antimicrobials in India.

Links for related resource

- http://www.cdsco.nic.in/NFI_2011.pdf
- http://www.who.int/drugresistance/en/