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SURVEY ON RATIONAL USE OF ANTIBACTERIALS INCLUDING MRSA ANTIBIOTICS IN A RURAL AREA OF BANGLADESH

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Abstract

Antibiotics including antibacterials are most commonly used in the present world against pathogenesis. The present study was aimed to analyse the current status of rational use of antibiotics in the prescriptions surveyed in a rural area named Gazipur of Bangladesh and threat against MRSA (methicillin resistant *streptococcus aureas*) antibiotics misuse in rural area. Antibiotic resistance has increasingly been recognized as a major issue in healthcare. Antibiotic use is viewed as a key driver for the increase and spread of antibiotic resistance. To examine the level of rational use about antibiotic treatment and awareness of antibiotic resistance among the general public in Bangladesh. The records were collected for the people suffering with different type of infections. Generally, Antibiotics are used against bacterial infections and the rational use of antibiotic 54%, Less rational use 25%, Irrational use 17%, Misuse 4 % were found in this area selected here. Antibiotics are good medicine in infectious diseases and it should be prescribed and monitored carefully by registered pharmacist. However, it is so costly and difficult to continue long time for a rural people. The result of this survey indicates that the antibiotics are used among the doctor in improper way. To overcome this situation physician should be aware and careful about the safety of antibiotics. People must be following the prescription strictly to avoid antibiotic resistances. It is high time that the professional bodies should take up the project of increasing awareness about antibiotic use among the practicing physicians to dispel the inappropriate information caused by pharmaceuticals and initiate necessary steps to deliver the latest advances of the knowledge to every practicing physician through academic activities in order to check over this emerging problem of antibiotic resistance.

Keywords: *Antibacterial drugs, drug-resistant, antibiotics, MRSA antibiotics, prescription survey*

Introduction

An antibiotic or antibacterial is an agent that inhibits bacterial growth or kills bacteria. Antibiotic is any substance produced by a microorganism that is antagonistic to the growth of other microorganisms in high dilution. Rational use of a drug means when the patients receive the drug which is appropriate, in doses that meet their individual requirement, for an adequate period of time at the lowest cost both to them and the community and irrational use of Medicine is that when one or more of the above condition is not met .This is very much a medical-model definition.

The definition implies that rational use of drugs, especially rational prescribing, should meet certain criteria as follows:

- Appropriate indication: The decision to prescribe drug(s) is entirely based on medical science
- Appropriate drug: The selection of drugs is based on efficacy, safety, suitability, and cost considerations.
- Appropriate patient: No contraindications exist, the likelihood of adverse reactions is minimal, and the drug is acceptable to the patient.
- Appropriate patient information: Patients are provided with relevant, accurate, important and clear information regarding their conditions and the medication(s) that are prescribed.
- Appropriate evaluation: The anticipated and unexpected effects of medications are appropriately monitored and interpreted.

Unfortunately, in the real world, prescribing patterns do not always conform to these criteria and can be classified as inappropriate or irrational prescribing. Irrational prescribing may be regarded as "pathological" prescribing when the above-mentioned criteria are not fulfilled. It has calculated that half of the drugs are sold, dispensed inappropriately and also half of the patient fails to take the medicines as prescribed by the physician. Irrational use may include Poly pharmacy, over use of antibiotics and injection failure to prescribe in accordance with clinical guide lines or wrong guideline. It is a global problem of wrong use of drugs, some countries taking action to make correct the problem.

Over use or miss use of antibiotics has significant consequences such as increased cost , bacterial resistance, therapeutic failure drug toxicity and drug inter action .Excessive use of antibiotic is a well-documented risk factor for the selection of resistant bacteria and in general a close association exists between the rate of resistance development and the quantities of antimicrobial agents used. The modern age of antibiotic therapeutics was launched in the 1930s with sulfonamides and the 1940s with penicillin .Since then, many antibiotic drugs have been developed, most aimed at the treatment of bacterial infections .These drugs have played an important role in the dramatic decrease in morbidity and mortality due to infectious diseases .While the absolute number of antibiotic drugs is large, there are few unique antibiotic targets.

Increasing antimicrobial resistance is now a worldwide problem, compounded by the lack of development of new antimicrobial medicines. This leaves the prudent use of antimicrobial medicines, along with infection control, as the major strategies to counter this emerging threat.

A safe and effective strategy for antibiotic use involves prescribing an antibiotic only when it is needed and selecting an appropriate and effective medicine at the recommended dose, with the narrowest spectrum of antimicrobial activity, fewest adverse effects and lowest cost.

General principles of antibiotic prescribing

1. Only prescribe antibiotics for bacterial infections if:

- Symptoms are significant or severe
- There is a high risk of complications
- The infection is not resolving or is unlikely to resolve

2. Use first-line antibiotics first

3. Reserve broad spectrum antibiotics for indicated conditions only

We have undertaken the work to find out some vital information about antibiotic and the rational use of antibiotics in a rural area of several conditions. The specific objectives of the work were:-

- To provide the public with a better understanding of the natural course of an infection
- To understand whether the proper use of antibiotics is going or not
- To determine the risks associated with the rapid emergence of resistance to antibiotics

To aware the patient for a useful discussion with his/her doctor on the need to use antibiotics appropriately.

Classification of antibiotics and antibacterials

Antibiotic can be classified according to the following way:

A. According to Chemical Structure:

1. Sulfonamides and related drugs

- Mafenide
- Sulfacetamide
- Sulfadiazine
- Sulfamethizole
- Co-trimoxazole

2. Diaminopyrimidines

3. Quinolones

- First generation: Nalidixic acid
- Second generation
  Ciprofloxacin, Levofloxacin, Ofloxacin
- Third generation: Gatifloxacin
- Fourth generation: Moxifloxacin, Gemifloxacin

4. Beta lactam

5. Tetracycline:

- Demeclocycline
- Doxycycline
- Minocycline
- Oxytetracycline

6. Nitrobenzene Derivatives

7. Aminoglycosides:

- Amikacin
- Gentamicin
- Kanamycin
- Neomycin
- Spectinomycin

8. Macrolides:

- Azithromycin
- Clarithromycin
- Dirithromycin
- Erythromycin
- Spiramycin

9. Polypeptide

10. Glycopeptide

11. Oxazolidinone

12. Nitrofuran derivatives

13.Nitroimidazoles

14. Nicotinic acid derivatives

15. Polyene

15. Azole derivatives

B. According to mechanism of action:

1. Inhibit cell wall synthesis:

- Penicillin's
- Amoxicillin
- Flucloxacillin
- Oxacillin
- Nafcillin
- Penicillin G
- Penicillin V

2. Cephalosporin's

3. Inhibit protein synthesis: Tetracycline, Chloramphenicol

4. Inhibit DNA gyrase: Ciprofloxacin

5. Interfere with DNA function: Metronidazole, Rifampin

6. Interfere with DNA synthesis: Acyclovir

7. Cause leakage from cell membranes: Polymyxins, Bacitracin

C. According to spectrum antibiotic:

1. Broad Spectrum: Tetracycline, chloramphenicol

2. Narrow Spectrum: Penicillin G, Erythromycin

D. According to mode of action:

1. Bacteriostatic: Sulfonamide, Tetracycline, and chloramphenicol

2. Bactericidal: Penicillin, Rifampin, and Cephalosporin

E. Antibiotics are obtained from:

1. Fungi: Penicillin, Griseofulvin

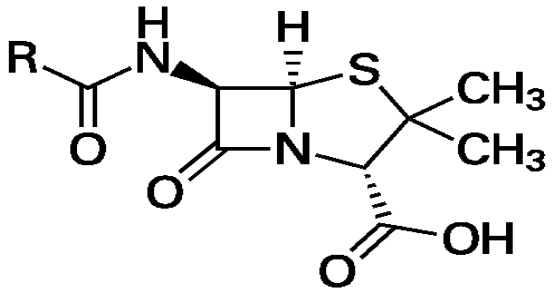
2. Bacteria: Tyrothricin

3. Actinomycetes: Aminoglycosides, Macrolides

The Penicillin

Penicillin is a group of antibiotics that are commonly used to treat different types of gram (+) and gram (-) bacterial infection. Penicillin antibiotics were among the first medications to be effective against many bacterial infections caused by staphylococci and streptococci. They are still widely used today, though many types of bacteria have developed resistance following extensive use. About 10% of people report that they are allergic to penicillin; however, up to 90% of this group may not actually be allergic Serious allergies only occur in about 0.03%. All penicillin are β-lactam antibiotics.

Penicillin was discovered in 1928 by Scottish scientist Alexander Fleming. People began using it to treat infections in 1942. There are several enhanced penicillin families which are effective against additional bacteria; these include the anti-staphylococcal penicillin, aminopenicillins and the anti-pseudomonal penicillin. They are derived from Penicillium fungi.



Chemical structure of the Penicillin core

Classification of Penicillin

Penicillin can be classified into the following groups:

1. Natural Penicillin
2. Beta Lactamase resistant penicillin
3. Aminopenicillins
4. Carboxypenicillins
5. Ureidopenicillins
6. penicillin / inhibitor combination

1. Natural penicillin:

- Penicillin V
- Penicillin G
- Penicillin VK

2. Beta Lactamase Resistant penicillin:

- Methicillin
- Nafcillin
- Oxacillin
- Cloxacillin
- Dicloxacillin

3. Aminopenicillins:

- Ampicillin
- Amoxicillin
- Pivampicillin
- Hetacillin
- Bacamcillin
- Metampicillin
- Talampicillin
- Epicillin

4. Carboxypenicillins:

- Carcenicillin
- Ticalcillin

5. Ureidopenicillins:

- Mezlocillin
- Piperacillin

Mechanism action of penicillin

Bacteria constantly remodel their peptidoglycan cell walls, simultaneously building and breaking down portions of the cell wall as they grow and divide. β-Lactam antibiotics inhibit the formation of peptidoglycan cross-links in the bacterial cell wall; this is achieved through binding of the four-membered β-lactam ring of penicillin to the enzyme DD-transpeptidase. As a consequence, DD-transpeptidase cannot catalyze formation of these cross-links, and an imbalance between cell wall production and degradation develops, causing the cell to rapidly die.

The enzymes that hydrolyze the peptidoglycan cross-links continue to function, even while those that form such cross-links do not. This weakens the cell wall of the bacterium, and osmotic pressure becomes increasingly uncompensated—eventually causing cell death (cytolysis).

In addition, the build-up of peptidoglycan precursors triggers the activation of bacterial cell wall hydrolases and autolysins, which further digest the cell wall's peptidoglycans. The small size of the penicillin's increases their potency, by allowing them to penetrate the entire depth of the cell wall. This is in contrast to the glycopeptide antibiotics vancomycin and teicoplanin, which are both much larger than the penicillin.

Gram-positive bacteria are called protoplasts when they lose their cell walls. Gram-negative bacteria do not lose their cell walls completely and are called spheroplasts after treatment with penicillin. Penicillin shows a synergistic effect with aminoglycosides, since the inhibition of peptidoglycan synthesis allows aminoglycosides to penetrate the bacterial cell wall more easily, allowing their disruption of bacterial protein synthesis within the cell. This results in a lowered MBC for susceptible organisms.

Penicillin, like other β-lactam antibiotics, block not only the division of bacteria, including cyanobacteria, but also the division of cyanelles, the photosynthetic organelles of the glaucophytes, and the division of chloroplasts of bryophytes. In contrast, they have no effect

on the plastids of the highly developed vascular plants. This supports the end symbiotic theory of the evolution of plastid division in land plants.

The chemical structure of penicillin is triggered with a very precise, pH-dependent directed mechanism, affected by a unique spatial assembly of molecular components, which can activate by protonation. It can travel through bodily fluids, targeting and inactivating enzymes responsible for cell-wall synthesis in gram-positive bacteria, meanwhile avoiding the surrounding non-targets.

Penicillin can protect itself from spontaneous hydrolysis in the body in its anionic form, while storing its potential as a strong acylation agent, activated only upon approach to the target trans-peptidase enzyme and protonated in the active center. This targeted protonation neutralizes the carboxylic acid moiety, which is weakening of the β-lactam ring N–C (=O) bond, resulting in a self-activation. Specific structural requirements are equated to constructing the perfect mouse trap for catching targeted prey.

Side effecst of penicillin

Common (≥ 1% of people) adverse drug reactions associated with use of the penicillin include diarrhoea, hypersensitivity, nausea, rash, neurotoxicity, urticarial, and super infection (including candidiasis). Infrequent adverse effects (0.1–1% of people) include fever, vomiting, erythema, dermatitis, angioedema, seizures (especially in people with epilepsy), and pseudomembranous colitis. Penicillin can also induce serum sickness or a serum sickness-like reaction in some individuals. Serum sickness is a type III hypersensitivity reaction that occurs one to three weeks after exposure to drugs including penicillin. It is not a true drug allergy, because allergies are type I hypersensitivity reactions, but repeated exposure to the offending agent can result in an anaphylactic reaction. Anaphylaxis will occur in approximately 0.01% of patients.

Pain and inflammation at the injection site is also common for parentally administered benzathine benzyl penicillin, benzyl penicillin, and, to a lesser extent, procaine benzyl penicillin.

The Cephalosporin

Cephalosporin is a beta lactam antibiotic that inhibits the cell wall of bacteria. Cephalosporin was first isolated from a fungus named as *Cephalosporium acremonium* by Dr.Abraham in 1948. The aerobic mould which yielded cephalosporin was found in the sea near a sewage outfall in Su Siccu, by Cagliari harbour in Sardinia, by the Italian pharmacologist Giuseppe Brotzu in July 1945.

Cephalosporins mainly used in general practice are; cefaclor, cephalexin and ceftriaxone (injection). Other cephalosporin's available on the Pharmaceutical Schedule are; cefazolin, cefoxitin and cefuroxime – these medicines are usually prescribed for patients undergoing dialysis and for patients with cystic fibrosis.

Classification of Cephalosporin

Cephalosporin can be classified by different way such as classification based upon:

- Spectrum
- Generation
- Chemical structure
- Resistance to beta lactamases
- Clinical Pharmacology

But most renowned type of classification is based on generation. Cephalosporin drugs are divided into five generations depending upon their microbial spectrum.

1. First generation: It is active against gram (+) positive bacteria such as staphylococci and

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streptococci. It also have little gram (-) negative spectrum.

- Cephelexin
- Cephalothin
- Cephradine
- Cefazolin
- Cefadroxil

2. Second generation: It is active against gram (-) negative bacteria (Haemophilus influenza, Enterobacter aerogenes).

- Cefaclor
- Cefuroxime
- Cefonicid
- Cefoxitin
- Cafotetan
- Cefmetazole
- Loracarbef

3. Third generation: It is active against gram (-ve) negative bacteria but has less activity against gram (+ve) positive bacteria.

- Cefotaxime
- Cefixime
- Moxalactam
- Ceftazidine
- Cefoperazone
- Cefiazidime
- Ceftriaxone

4. Fourth generation: It is active against gram (-ve) negative bacteria and also effective against streptococci and staphylococci.

- Cafepime
- Cefpirome
- Flomoxef
- Cefclidine
- Cefluprenam
- Cefoselis

5. Fifth generation: It is extended spectrum antibiotic.

- Ceftobiprole
- Ceftaroline fosamil
- Ceftolozane

Mechanism action of Cephalosporin

Cephalosporins are bactericidal and have the same mode of action as other β-lactam antibiotics (such as penicillin's), but are less susceptible to β-lactamases. Cephalosporins disrupt the synthesis of the peptidoglycan layer forming the bacterial cell wall. The peptidoglycan layer is important for cell wall structural integrity. The final transpeptidation step in the synthesis of the peptidoglycan is facilitated by penicillin-binding proteins (PBPs). PBPs bind to the D-Ala-D-Ala at the end of muropeptides (peptidoglycan precursors) to crosslink the peptidoglycan. Beta-lactam antibiotics mimic the D-Ala-D-Ala site, thereby irreversibly inhibiting PBP crosslinking of peptidoglycan.

Cephalosporins side effects

Cephalosporins generally cause few side effects. Common side effects associated these drugs include: diarrhoea, nausea, mild stomach cramps or upset. Approximately 5-10% of patients with allergic hypersensitivity to penicillin's will also have cross-reactivity with cephalosporins.

Thus, cephalosporin antibiotics are contraindicated in people with a history of allergic reaction (Urticaria, anaphylaxis, interstitial nephritis, etc.) to penicillin or cephalosporins. Cephalosporin antibiotics are classed as pregnancy category B.

Macrolides

The macrolides are a class of natural products that consist of a large macrocyclic lactone ring to which one or more deoxy sugars, usually clad nose and desosamine may be attached. The lactone rings are usually 14-, 15-, or 16-membered. Macrolides belong to the

polypeptides class of natural products. Some macrolides have antibiotic or antifungal activity and are used as pharmaceutical drugs. There are a couple of new relatives of erythromycin (azithromycin and clarithromycin) that work the same way, but kill more bugs and have slightly fewer side effects. The erythromycin-like antibiotics are also known as macrolides.

Macrolide antibiotics are:

- Erythromycin
- Clarithromycin
- Azithromycin
- Dirithromycin
- Roxithromycin
- Troleandomycin

Mechanism action of macrolides

Macrolides are protein synthesis inhibitors. The mechanism of action of macrolides is inhibition of bacterial protein biosynthesis, and they are thought to do this by preventing peptidyltransferase from adding the growing peptide attached to tRNA to the next amino acid (similarly to chloramphenicol) as well as inhibiting ribosomal translation. Another potential mechanism is premature dissociation of the peptidyl-tRNA from the ribosome.

Macrolide antibiotics do so by binding reversibly to the P site on the 50S subunit of the bacterial ribosome. This action is considered to be bacteriostatic. Macrolides are actively concentrated within leukocytes, and thus are transported into the site of infection.

Quinolone

A quinolone antibiotic is any member of a large group of broad-spectrum bactericides that share a bicyclic core structure related to the compound 4-quinolone. They are used in human and veterinary medicine to treat bacterial infections, as well as in animal husbandry.

Nearly all quinolone antibiotics in use are fluoroquinolones, which contain a fluorine atom in their chemical structure and are effective against both Gram-negative and Gram-positive bacteria. One example is ciprofloxacin, one of the most widely used antibiotics worldwide.

Fluoroquinolone group includes:

- Ciprofloxacin
- levofloxacin
- Lomefloxacin
- Norfloxacin
- Sparfloxacin
- Clinafloxacin
- Gatifloxacin
- Ofloxacin
- Trovafloxacin

Mechanism action of Fluoroquinolone

The mode of action of quinolones involves interactions with both DNA gyrase, the originally recognised drug target, and topoisomerase IV, a related type II topoisomerase. In a given bacterium these 2 enzymes often differ in their relative sensitivities to many quinolones, and commonly DNA gyrase is more sensitive in gram-negative bacteria and topoisomerase IV more sensitive in gram-positive bacteria. Usually the more sensitive enzyme represents the primary drug target determined by genetic tests, but poorly understood exceptions have been documented. The formation of the ternary complex of quinolone, DNA, and either DNA gyrase or topoisomerase IV occurs through interactions in which quinolone binding appears to induce changes in both DNA and the topoisomerase that occur separately from the DNA cleavage that is the hallmark of quinolone action. X-ray crystallographic studies of a fragment of the gyrase A subunit, as well as of yeast topoisomerase IV, which has homology to the subunits of both DNA gyrase and topoisomerase IV, have revealed domains that are likely to constitute quinolone

binding sites, but no topoisomerase crystal structures that include DNA and quinolone have been reported to date. Inhibition of DNA synthesis by quinolones requires the targeted topoisomerase to have DNA cleavage capability, and collisions of the replication fork with reversible quinolone-DNA-topoisomerase complexes convert them to an irreversible form. However, the molecular factors that subsequently generate DNA double-strand breaks from the irreversible complexes and that probably initiate cell death have yet to be defined.

Tetracycline

Tetracycline got their name because they share a chemical structure that has four rings. They are derived from a species of Streptomyces bacteria. Tetracycline antibiotics are broad-spectrum bacteriostatic agents and work by inhibiting the bacterial protein synthesis. Tetracyclines may be effective against a wide variety of microorganisms, including rickettsia and amoebic parasites. Tetracyclines are used in the treatment of infections of the respiratory tract, sinuses, middle ear, urinary tract, skin, intestines. Tetracyclines also are used to treat Gonorrhoea, Rocky Mountain spotted fever, Lyme disease, typhus. Their most common current use is in the treatment of moderately severe acne and rosacea.

Tetracycline antibiotics are:

- Tetracycline
- Doxycycline
- Minocycline
- Oxytetracycline

Mechanism of Action Tetracycline

Tetracycline antibiotics are protein synthesis inhibitors, inhibiting the binding of amino acyl-tRNA to the mRNA-ribosome complex. They do so mainly by binding to the 30S ribosomal subunit in the mRNA translation complex.

Tetracyclines also have been found to inhibit matrix metalloproteinase. This mechanism does not add to their antibiotic effects, but has led to extensive research on chemically modified Tetracyclines or CMTs (like incyclinide) for the treatment of rosacea, acne, diabetes and various types of neoplasms. Incyclinide was announced to be ineffective for rosacea in September 2007.

Several trials have examined modified and unmodified tetracyclines for the treatment of human cancers; of those, very promising results were achieved with CMT-3 for patients with Kaposi Sarcoma.

Factors Underlying Irrational Use of Drugs

Many different factors affect the irrational use of drugs. In addition, different cultures view drugs in different ways, and this can affect the way drugs are used. The major forces can be categorized as those deriving from patients, prescribers, the workplace, the supply system including industry influences, regulation, drug information and misinformation, and combinations of these factors.

- **Patients** - drug misinformation
  -misleading beliefs
  -patient demands/expectations
- **Prescribers** - lack of education and training
  -inappropriate role models
  -lack of objective drug information
  -generalization of limited experience
  -misleading beliefs about drugs efficacy
- **Workplace -** heavy patient load
  - pressure to prescribe
  - lack of adequate lab capacity
  - insufficient staffing
- **Drug Supply System**
  - unreliable suppliers
  -drug shortages
  -expired drugs supplied
- **Drug Regulation**
  - nonessential drugs available
  -informal prescribers
  -lack of regulation enforcement
- **Industry**

-promotional activities
-misleading claims

All of these factors are affected by changes in national and global practices. For example, the frequent use of injections is declining in many African countries because of the fear of AIDS. In some countries, however, the use of injectable remains high due to false assumption of prescribers that injections will improve patient satisfaction and that they are always expected by the patients.

Antibacterial Indications

Definitive Therapy: This is for accurate diagnose bacterial infection. Antibiotic are effective against bacteria and it is important to restricted only for treatment of bacterial infections. So, it is important that first take the sample either blood, fluid secretion and tested it on the basis of clinical testing i.e. cyst testing microorganisms should be recognized and narrow spectrum, least toxic and cheap antibiotics should be prescribed.

Empirical Therapy: Blind or empirical therapy of antibiotics should be given in certain critical condition where immediate use of antibiotics is very necessary before any laboratory findings available for example sepsis syndrome, becterimia, raise ESR, neutrophil leucocytosis, hectic temperature etc. in such critical condition the most appropriate class of antibiotic should be prescribed mostly broad spectrum antibiotics should be use such is combination of amoxicillin gentamicin both gram positive and gram negative microorganism are covered.

Prophylactic Therapy: Prophylactic antibiotic should be given to patient having risk of infection for example antiburcular drugs to T.B patient, propylacsis such is antirheumatic, propylacsis for patient having heart deases.

Use of Antibiotic Treatment:

Bacterial infection:

• **Protozoan infection**, e.g., metronidazole and Bactrim are effective against several parasitic

• **Immunomodulation,** e.g., tetracycline, which is effective in periodontal inflammation, and dapsone, which is effective in autoimmune diseases such as oral mucous membrane pemphigoid

• **No operative resource** for patients who have non-complicated acute appendicitis. Treatment with antibiotics has proven to work, with almost no cases of remission.

Prevention of infection:

• Surgical wound

Antibiotic Resistance

Antibiotic resistance occurs when an antibiotic has lost its ability to effectively control or kill bacterial growth; in other words, the bacteria are "resistance" and continue to multiply in the presence of therapeutic levels of an antibiotic.

There are three main ways by which resistance can occur:

- by natural resistance in certain types of bacteria
- by genetic mutation
- by one species acquiring resistance from another

Diagram showing the difference between non-resistant bacteria and drug resistant bacteria. Non-resistant bacteria multiply, and upon drug treatment, the bacteria die. Drug resistant bacteria multiply as well, but upon drug treatment, the bacteria continue to spread.

Why do bacteria become resistance to antibiotics?

Antibiotic resistance is a natural phenomenon. When an antibiotic is used bacteria that can resist that antibiotic have a greater chance of survival than those that are "susceptible". Susceptible bacteria are killed or inhibited by an antibiotic , resulting in a selective pressure for the survival of resistant strains of bacteria.

Some resistance occurs without human action, as bacteria can produce and use antibiotics against other bacteria, leading to a low-level of natural selection form resistance to antibiotics. However
The current higher-levels of antibiotic-resistant bacteria are attributed to the overuse and abuse of antibiotics.

Developing Resistance

Dates are based upon early reports of resistance in the literature. In the case of pan drug-resistant (PDR)-Acinetobacter and Pseudomonas, the date is based upon reports of healthcare transmission or outbreaks. Note: penicillin was in limited use prior to widespread population usage in 1943.

Antibiotic resistance indentified

- Penicillin-R Staphylococcus -1940
- Tetracycline-R Shigella-1959
- Methicillin-R Staphylococcus- 1962
- Penicillin-R pneumococcus -1965
- Erythromycin-R Streptococcus -1968
- Gentamicin-R Enterococcus -1979
- Ceftazidime-R Enterobacteriaceae-1987
- Vancomycin-R Enterococcus -1988
- Levofloxacin-R pneumococcus -1996
- Imipenem-R Enterobacteriaceae-1998
- XDR tuberculosis -2000
- Linezolid-R Staphylococcus -2001
- Vancomycin-R Staphylococcus -2002
- PDR-Acinetobacter and Pseudomonas -2004/5
- Ceftriaxone-R Neisseria gonorrhoeae-2009
- PDR-Enterobacteriaceae
- Ceftaroline-R Staphylococcus -2011

Methicillin-resistant Staphylococcus aureus

Methicillin-resistant Staphylococcus aureus (MRSA) refers to a group of gram-positive bacteria that are genetically distinct from other strains of Staphylococcus aureus. MRSA is responsible for several difficult-to-treat infections in humans. MRSA is any strain of S. aureus that has developed, through horizontal gene transfer and natural selection, multiple drug resistance to beta-lactam antibiotics. β-lactam antibiotics are a broad spectrum group which includes some penams – penicillin derivatives such as methicillin and oxacillin, and cephems such as the cephalosporins. Strains unable to resist these antibiotics are classified as methicillin-susceptible S. aureus, or MSSA.

What Causes a MRSA Infection?

MRSA bacteria can be transmitted by direct (though skin and body fluids) and indirect contact (from towels, diapers, and toys) to uninfected people. Also, some individuals have MRSA on their body (on their skin or in their nose or throat) but show no symptoms of infection; these people are termed MRSA carriers (see above) and can transmit MRSA to others. CA-MRSA is the predominant MRSA type found in the population. Most carriers are best detected by culturing MRSA from nasal swabs.

Signs and symptoms of MRSA

In humans, S. aureus is part of the normal macrobiotic present in the upper respiratory tract, and on skin and in the gut mucosa. aureus, along with similar species that can colonize and act symbiotically but can cause disease if they begin to take over the tissues they have colonized or invade other tissues, have been called "pathobionts"

After 72 hours, MRSA can take hold in human tissues and eventually become resistant to treatment. The initial presentation of MRSA is small red bumps that resemble pimples, spider bites, or boils; they may be accompanied by fever and, occasionally, rashes. Within a few days, the bumps become larger and more painful; they eventually open into deep, pus-

filled boils. About 75 percent of CA-MRSA infections are localized to skin and soft tissue and usually can be treated effectively

MRSA tests and diagnosis

Healthy people are sometimes tested to identify if they have MRSA on their skin before being admitted to the hospital. The test involves swabbing the inside the patient's nostrils or skin.

If the person is found to be colonized with MRSA, removal (decolonization) of the bacteria is possible by using:

- antibacterial body wash or powder for the skin (Chlorhexidine baths)
- cream for inside the nose (intranasal mupirocin)
- antibacterial shampoo for the scalp (Chlorhexidine soap shower/bath procedure)

Germ-killing soaps and ointments used in intensive care units (ICU) have been found to reduce cases of MRSA by 40 percent.

Top 5 MRSA antibiotic therapies for skin infections

Below are the five commonly prescribed antibiotics for MRSA skin infections, which are commonly picked up in communities as community type MRSA or CA-MRSA.

1. Clindamycin

It has been successfully and widely used for the treatment of soft tissue and skin infections as well as bone, joint and abscesses caused by Staph and MRSA. MRSA is becoming increasingly resistant to clindamycin in the United States.

- **Resistance:** MRSA is becoming increasingly resistant to clindamycin in the United States.
- **Side Effects and Precautions:** Diarrhea is the most common side effect, and it can promote *C. difficile* overgrowth infections in the colon. C. difficile infections appear to occur more frequently with clindamycin than other antibiotics. Other side-effects are pseudomembranous colitis, nausea, vomiting, abdominal cramps, skin rashes and more.

2. Linezolid (Brand Names: Zyvox, Zyvoxid or Zyvoxam)

Approved for use in the year 2000, Linezolid is FDA approved for treating soft tissue and skin infections, including those caused by MRSA. It is often prescribed for CA-MRSA pneumonia and in particular, HA-MRSA pneumonia. It's commonly prescribed to people of all ages and is one of the most expensive treatment options, for a single course costing upwards of $1-2,000 for 20 tablets.

- **Resistance:** To minimize resistance, this is a "last resort" antibiotic and is not usually prescribed unless Vancomycin or other antibiotics don't work.
- **Side Effects and Precautions:** Common adverse events when used for short durations are: diarrhea, vomiting, headache, dizziness, and nausea. Long-term use has led to serious effects including bone marrow suppression, myelosupression, low platelet counts, peripheral neuropathy, optic nerve damage and lactic acidosis. It's also associated with C. difficile infections in the colon.

3. Mupirocin (Brand Name: Bactroban)

Commonly used as a topical cream for minor skin infections and skin lesions for Staph aureus, MRSA and Streptococcus infections. Mupirocin ointment is applied to reduce or eliminate MRSA colonization in the nose (see also "MRSA carriers"). It's commonly used before surgical procedures to help prevent the surgical site from becoming infected with MRSA. It is commonly prescribed for children and adults and there is limited safety data for pregnant and nursing mothers.

- **Resistance:** It has been reported that MRSA resistance to mupirocin is occurring in some communities.
- **Side Effects and Precautions:** Possible side effects include headache, rash and nausea as well as burning, dizziness and secondary wound infection. Like other antibiotics, prolonged use may result in overgrowth of bacteria that are not susceptible to it, as well as an overgrowth of fungal organisms (such as yeast infections).

4. Trimethoprim-Sulfamethoxazole (Brand Name: Septra or Bactrim)

It is not FDA-approved for the treatment of Staphylococcal infections (including MRSA). However, laboratory tests have shown most CA-MRSA strains are susceptible and so this drug has become a treatment option for Staph and MRSA. It is commonly used for skin and wound infections, urinary tract infections, lung infections, ear infections, septicemia, and other types of infections.

- **Side Effects and Precautions:** Not recommended for women in their third trimester of pregnancy or infants less than 2 months old. Side effects can include mild allergic reactions, fever, sore throat, skin rashes, cough, diarrhea, and serious adverse effects can include myelosupression, acute renal failure, severe liver damage and more.

5. Tetracyclines (Doxycycline and Minocycline)

Data suggests these drugs are effective in treatment of soft tissue and skin infections, but not for deeper or more severe infections.

- **Side Effects and Precautions:** Not recommended during pregnancy or lactation. Not recommended for children under 8 years old because of potential decreased bone growth and tooth discoloration. Doxycycline side effects can include an increased risk of sunburn when exposed to sunlight, diarrhea, and allergic reactions. Minocycline side effects can include risk of sunburn (like doxycycline), upset stomach, diarrhea, dizziness, headache, tinnitus, vomiting, allergic reaction and more. Serious but rare side effects for minocycline can include fever, yellowing of the eyes or skin, vision changes and more

Antibiotic resistant pathogens inBangladesh

- Salmonella typhi
- S typhimurium
- Shigelladysenterae type 1
- Neisseria gonorrhoeae
- Staphylococcus species
- Enterococcus species
- Mycobacterium tuberculosis
- Streptococcus pneumonia
- Plasmodium species
- Nosocomial pathogens
- Pseudomonas spp.
- Acinetobacter spp.
- Klebsiella spp.

In Bangladesh, misuse and waste of antibiotics appear to be frequent. Over the-counter availability of all types of Plasmodium SI

antibiotics makes the situation worse. Antibiotic prescribing by the physicians appears to be less than ideal. The widespread and inappropriate use of antibiotic results in the development of a progressively antibiotic-resistant microbial ecosystem in Bangladesh. This is clearly indicated by the high prevalence of antibiotic resistance. Salmonella, Vibriocholerae, Escherichiacol, Neisseriagonorrhoe, Mycobacterium tuberculosis, Streptococcus pneumonia and Haemophilus influenza infections in Bangladesh. For example, more than 98% of 243 recent isolates of Shigella dysenterictype 1 in Bangladesh were simultaneously resistant to ampicillin, cotrimoxazole, nalidixic acid and 12% of them were also resistant to pivmecillinum.And more than 78% of Salmonella typhimuriumisolates from faecal samples were also resistant to ampicillin, chloramphenicol ,cotrimoxazole and ceftriaxone. A study on children from a rural community of Bangladesh showed that 50% of children has enteric flora resistant to ampicillin, cotrimoxazole and streptomycin throughout the year. A high prevalence of resistant gut flora in healthy human and probably in animals appears to be the source of antimicrobial resistance genes, the dissemination of which is enhanced by extensive use.

Impact of Inappropriate Use of Drugs

The impact of this irrational use of drugs can be seen in many ways:

- Reduction in the quality of drug therapy leading to increased morbidity and mortality
- Waste of resources leading to reduced availability of other vital drugs and increased costs
- Increased risk of unwanted effects such as adverse drug reactions and the emergence of drug resistance, e.g., malaria or multiple drug resistant tuberculosis
- Psychosocial impacts, such as when patients come to believe that there is —a pill for every ill. This may cause an apparent increased demand for drugs.

Importance of limited use of antibiotics

The use of all medicines should be limited. But this is especially true of antibiotics, for the following reasons:

1. Poisoning and reactions. Antibiotics not only kill bacteria, they can also harm the body, either by poisoning it or by causing allergic reactions. Many people die each year because they take antibiotics they do not need.
2. Upsetting the natural balance. Not all bacteria in the body are harmful. Some are necessary for the body to function normally. Antibiotics often kill the good bacteria along with the harmful ones. Babies who are given antibiotics sometimes develop fungus or yeast infections of the mouth (thrush, p. 232) or skin. This is because the antibiotics kill the bacteria that help keep fungus under control. For similar reasons, persons who take ampicillin and other broad-spectrum antibiotics for several days may develop diarrhoea. Antibiotics may kill some kinds of bacteria necessary for digestion, upsetting the natural balance of bacteria in the gut.
3. Resistance to treatment. In the long run, the most important reason the use of antibiotics should be limited due to resistance.

Methods

The study was carried out some people who had used antibiotic. Most people used antibiotics are Cephalosporin's and Quinolone. But their knowledge of antibiotic resistance very low. Some people use antibiotic in case of viral fever. Others use in case of GI tract infection, vomiting. But preferable use in Bacterial infection

Results and Discussion

From the selected prescription report it was found that significantly about various prescription containing antibiotic prescribed by Physician in several diseases. I found that antibiotics were prescribed frequently. It is a common problem for antibiotic resistance. Antibiotics used only for bacterial disease not for viral disease. The Physician prescribed antibiotics the condition of cold and fever, skin infection, respiratory tract infection. Cephalosporins (40%), Quinolone (19%), Penicillins (27%),Macrolides (10%) and MRSA (4%) antibiotics were prescribed. Second and third generation Cephalosporins were also used , All this type antibiotics have side effect that is very dangerous .MRSA antibiotics are preserve antibiotic and it should not prescribed easily.

The result of this survey indicates that the antibiotics are used among the prescription frequently. To overcome this situation the physician should have taken some necessary steps to rational use of antibiotics.

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The result of this survey indicates that the antibiotics are used among the prescription frequently. To overcome this situation the physician should have taken some necessary steps to rational use of antibiotics.

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Table 1: Antibiotics that are used from the Essential Drug List in Bangladesh

Drugs	Dosage form
Ampicillin	Cap
Chlorhexidine	Cream
Tetracycline	Cap
Aminophylline	Inj
Cotrimoxazole	Tab
Metronidazole	tab/elixir/Inj
Amoxicillin Ciprofloxacin	tab /cap
Azithromycin	tab /cap
Levofloxacin Cotrimoxazole	tab /cap Tab/cap
Cloxacillin Salbutamol	Cap Inj
Benzyl penicillin	Inj
Cephalosporin's 1st, 2nd , 3rdgeneration	Cap

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Table 2: Survey report on Rational use of antibiotic

Patient	Pathological condition	Used antibiotic	Class of Antibiotics	Rationality	Comment
Patient-1	Fever and Cough for 6 days	Tab.Evo (500mg)	Quinolone(Levofloxacin)	+ - -	Irrational use
Patient-2	Fever and nasal obstruction	Tab. Levox 500mg	Quinolone(Levofloxacin)	+ - -	Irrational use
Patient-3	Fever, Nausea, Swelling around the affected bone	Cap. Cafexta 300mg	Third generation Cephalosporins	+ + +	Rational use
Patient-4	Fever ,burning feeling when urinate	Tab. Furoclav 500mg	Second generation Cephalosporins	+ + -	Less rational use
Patient-5	Fever and cough, nasal obstruction	Tab.Asilee 500mg	Quinolone(Levofloxacin)	+ - -	Irrational use
Patient-6	Sharp Chest Pain , Increased Shortness of Breath	Tab. Gembax 320 mg	Quinolone (Gemifloxacin)	+ - -	Irational use
Patient-7	Swelling around the affected bone	Tab. Cefaclav 500mg	Second generation Cephalosporins	+ + -	Less rational use
Patient-8	Switch therapy after surgery	Tab. Cerox CV 500mg	Second generation Cephalosporins	+ + -	Less rational use
Patient-9	Fever and Cough for 6 days, nasal obstruction, sore throat,	Tab. Levox 500mg Tap	Quinolone(Levofloxacin)	+ + +	Rational use
Patient-10	Fever, Sharp Chest Pain , Increased Shortness of Breath , Changes in Mucus	Tab. Gembax 320 mg	Quinolone (Gemifloxacin)	+ + +	Rational use
Patient-11	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucloxacillin sodium	+ + -	Less rational use

Patient-12	Fever for 5 days, throat pain , cough , ear problem	Tab.Moxaclav 375mg	Penicillin (Amoxicillin)	+ + +	Rational use
Patient-13	Fever, skin rushes and irritating, acne produced in skin and allergy	Cap, Cleodin 300 mg	Clindamycin(Miscellaneous Antibiotics)	- - -	Misuse
Patient-14	mild pain or discomfort inside the ear, hearing loss,	Tab Amoclav 500mg	penicillin (Amoxicillin)	+ - -	Irrational use
Patient-15	Fever and Cough for 6 days	Tab. Evo (500mg)	Quinolone(Levofloxacin)	+ + +	Irrational use
Patient-16	Fever, Nausea, Swelling around the affected bone	Tab. Furoclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-17	Switch therapy after surgery	Tab. Cerox CV 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-18	Fever for 5 days, throat pain , cough , ear problem	Tab.Moxaclav 375mg	penicillin (Amoxicillin)	+ + +	Rational use
Patient-19	Headaches, sore throat, runny or blocked nose	Tab. Gembax 320 mg	Quinolone (Gemifloxacin)	+ + -	Less rational use
Patient-20	mild pain or discomfort inside the ear, hearing loss,	Tab.Demoxiclave Forte 375mg	penicillin (Amoxicillin)	+ + -	Less irrational use
Patient-21	Throat infe - ction , pain in throat, tonsillitis, fever.	Cefotil plus 250mg	Second generation Cephalosporins	+ + +	Rational use
Patient-22	Fever for 5 days, throat pain , cough , ear problem	Tab.Moxaclav 375mg	penicillin (Amoxicillin)	+ + +	Rational use
Patient-23	Headaches, sore throat, runny or blocked nose	Tab. Levox 500mg Tap	Quinolone(Levofloxacin)	+ + -	Less rational use

Patient-24	Fever, Nausea, Swelling around the affected bone	Tab. Cefaclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-25	Throat infe - ction , pain in throat, tonsillitis, fever.	Cefotil plus 250mg	Second generation Cephalosporins	+ + +	Rational use
Patient-26	Fever, diarrhea, nausea, vomiting	Axim CV 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-27	Switch therapy after surgery	Axim CV 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-28	Fever for 3 days, burning feeling when urinate, Pain or pressure in the back or lower abdomen,	Cap. Cafexta 300mg	Third generation Cephalosporins	+ + +	Rational use
Patient-29	Fever, Nausea, Swelling around the affected bone	Tab. Cefaclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-30	Fever, Sharp Chest Pain , Increased Shortness of Breath , Changes in Mucus	Tab. Gembax 320 mg	Quinolone (Gemifloxacin)	+ + +	Rational use
Patient- 31	Fever, diarrhea, nausea, vomiting	Axim CV 500mg	Second generation Cephalosporins	+ + -	Less rational use
Patient-32	Fever for 5 days, throat pain , cough , ear problem	Tab.Moxaclav 375mg	penicillin (Amoxicillin)	+ + +	Rational use
Patient-33	neck tenderness due to swollen lymph nodes	Cap.Acos 500mg	Macrolides	+ - -	Less rational use

Patient-34	Fever, Nausea, Swelling around the affected bone	Tab. Cefaclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-35	Pain or pressure in the back or lower abdomen, stomachaches	Cap. Cafexta 300mg	Third generation Cephalosporins	+ + -	Less rational use
Patient-36	Fever, sore throat, a scratchy-sounding voice,	Cap. Acos 500mg	Macrolides	+ + +	Rational use
Patient-37	Throat infe - ction , pain in throat, tonsillitis, fever.	Tab. Furoclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-38	Fever for 3 days,burning feeling when urinate, Pain or pressure in the back or lower abdomen,	Cap. Cafexta 300mg	Third generation Cephalosporins	+ + +	Rational use
Patient-39	Fever and Cough for 6 days	Tab. Evo (500mg)	Quinolone(Levofloxacin)	+ + +	Rational use
Patient-40	mild pain or discomfort inside the ear, hearing loss,	Tab.Demoxiclave Forte 375mg	penicillin (Amoxicillin)	+ + -	Less rational use
Patient- 41	Rocky Mountain spotted fever, Rashes, Fatigue, unexplained pain, heart problem	Cap. Tetracycline 500mg	Tetracycline (MRSA)	- - -	Misuse
Patient-42	Fever for 5 days, throat pain , cough , ear problem	Tab.Moxaclav 375mg	penicillin (Amoxicillin)	+ + +	Rational use

Patient-43	cough with increase mucus and blood, chest pain , shortness of breath	Cap. Flux 500mg	Penicillinase-resistant penicillin (Flucloxacillin sodium	+ + +	Rational use
Patient-44	Fever, diarrhea, nausea, vomiting	Tab. Cerox CV 500mg	Second generation Cephalosporins	+ - -	Irrational use
Patient-45	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucloxacillin sodium	+ + +	Rational use
Patient-46	Fever , dental pain , Runny nose	Azimex 500mg tablet	Macrolides	+ - -	Irrational use
Patient-47	Fever, sore throat, a scratchy-sounding voice,	Cap.Acos 500mg	Macrolides	+ + -	Less rational use
Patient-48	Fever, cough with increase mucus and blood,	Cap. Fluclox 500mg	Penicillinase-resistant penicillin (Flucloxacillin sodium	+ + +	Rational use
Patient-49	Fever, skin rushes and irritating, acne produced in skin and allergy.	Cap, Cleodin 300 mg	Clindamycin(Miscellaneous Antibiotics)	- - -	Misuse
Patient-50	neck tenderness due to swollen lymph nodes	Cap.Acos 500mg	Macrolides	+ + -	Less rational use
Patient- 51	Switch therapy after surgery	Tab. Cerox CV 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-52	mild pain or discomfort inside the ear, hearing loss,	Tab.Demoxicla ve Forte 375mg	Penicillins (Amoxicillin)	+ + -	Less rational use
Patient-53	Fever and Cough for 6 days	Tab. Evo (500mg)	Quinolone(Levofloxacin)	+ - -	Irrational use

Patient-54	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucloxacillin sodium)	+ + -	Less rational use
Patient-55	Fever , dental pain , Runny nose	Azimex 500mg tablet	Macrolides	+ + -	Less rational use
Patient-56	Throat infe - ction , pain in throat, tonsillitis, fever.	Cefotil plus 250mg	Second generation Cephalosporins	+ + +	Rational use
Patient-57	Fever , dental pain , Runny nose	Azimex 500mg tablet	Macrolides	+ + -	Less rational use
Patient-58	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucloxacillin sodium)	+ + -	Less rational use
Patient-59	Fever, Sharp Chest Pain , Increased Shortness of Breath , Changes in Mucus	Tab Asilee 500mg	Quinolone(Levofloxacin)	+ + +	Rational use
Patient-60	Fever, Nausea, Swelling around the affected bone	Tab. Cefaclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient- 61	mild pain or discomfort inside the ear, hearing loss,	Tab.Demoxicla ve Forte 375mg	Penicillins (Amoxicillin)	+ + +	Rational use
Patient-62	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucoxacillin sodium)	+ + -	Less rational use
Patient-63	fever, cough with increase mucus and blood,chest pain ,	Cap. Flux 500mg	Penicillinase-resistant penicillin (Flucoxacillin sodium)	+ + +	Rational use
Patient-64	Headaches, sore throat, runny or blocked nose	Tab. Levox 500mg Tap	Quinolone(Levofloxacin)	+ + -	Less rational use
Patient-65	pain in throat, tonsillitis, fever.	Tab. Furoclav 500mg	Second generation Cephalosporins	+ + +	Rational use

Patient-66	chest pain , shortness of breath	Cap. Flux 500mg	Penicillinase-resistant penicillin (Flucoxacillin sodium)	+ - -	Irrational use
Patient-67	Rocky Mountain spotted fever, Rashes, fatigue, unexplained pain, heart problem	Cap. Tetracycline 500mg	Tetracycline (MRSA)	- - -	Misuse
Patient-68	Fever for 3 days, burning feeling when urinate	Cap. Cef-3 500mg	Third generation Cephalosporins	+ + +	Rational use
Patient-69	Fever, diarrhea, nausea, vomiting	Axim CV 500mg	Second generation Cephalosporins	+ - -	Irrational use
Patient-70	painful swallowing, a scratchy-sounding voice, bad breath, fever, chills, earaches,	Cap. Emixef 200mg	Third generation Cephalosporins	+ + +	Rational use
Patient- 71	Fever for 5 days, throat pain , cough , ear problem	Tab Amoclav 500mg	Penicillins (Amoxicillin)	+ + -	Less rational use
Patient-72	Fever for 3 days, burning feeling when urinate	Cap. Cef-3 500mg	Third generation Cephalosporins	+ + +	Rational use
Patient-73	Fever, Nausea, Swelling around the affected bone	Tab. Cefaclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-74	painful swallowing, a scratchy-sounding voice, bad breath, fever, chills, earaches,	Cap. Emixef 200mg	Third generation Cephalosporins	+ + +	Rational use
Patient-75	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucoxacillin sodium)	+ - -	Irrational use

Patient-76	Fever, Sharp Chest Pain , Increased Shortness of Breath , Changes in Mucus	Tab. Gembax 320 mg	Quinolone (Gemifloxacin)	+ + +	Rational use
Patient-77	Switch therapy after surgery	Tab. Cerox CV 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-78	Fever for 5 days, throat pain , cough , ear problem	Tab Amoclav 500mg	Penicillins (Amoxicillin)	+ + -	Irrational use
Patient-79	throat and nose infections, chest pain	Cap. Flustar 500mg	Penicillinase-resistant penicillin (Flucoxacillin sodium)	+ + +	Rational use
Patient-80	Fever, diarrhea, nausea, vomiting	Axim CV 500mg	Second generation Cephalosporins	+ - -	Irrational use
Patient- 81	painful swallowing, a scratchy-sounding voice, bad breath, fever, chills, earaches,	Cap. Emixef 200mg	Third generation Cephalosporins	+ + +	Rational use
Patient-82	Fever for 5 days, throat pain , cough , ear problem	Tab Amoclav 500mg	Penicillins (Amoxicillin)	+ + +	Rational use
Patient-83	Fever , dental pain , Runny nose	Azimex 500mg tablet	Macrolides	+ - -	Irrational use
Patient-84	Fever and Cough for 6 days	Tab. Evo (500mg)	Quinolone(Levofloxacin)	+ - -	Irrational use
Patient-85	Fever, Nausea, Swelling around the affected bone	Tab. Furoclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-86	mild pain or discomfort inside the ear, hearing loss,	Tab.Demoxiclave Forte 375mg	Penicillins (Amoxicillin)	+ + -	Less rational use

Patient-87	Fever , dental pain , Runny nose	Azimex 500mg tablet	Macrolides	+ - -	Less rational use
Patient-88	Throat infe - ction , pain in throat, tonsillitis, fever.	Tab. Furoclav 500mg	Second generation Cephalosporins	+ + +	Rational use
Patient-89	Fever, Sharp Chest Pain , Increased Shortness of Breath , Changes in Mucus	Tab Asilee 500mg	Quinolone(Levofloxacin)	+ + +	Rational use
Patient-90	Fever for 5 days, throat pain , cough , ear problem	Tab Amoclav 500mg	Penicillins (Amoxicillin)	+ + -	Less rational use
Patient- 91	Fever for 3 days, burning feeling when urinate, Pain or pressure in the back or lower abdomen,	Cap. Emixef 200mg	Third generation Cephalosporins	+ + +	Rational use
Patient-92	Throat infe - ction , pain in throat, tonsillitis, fever.	Cefotil plus 250mg	Second generation Cephalosporins	+ + +	Rational use
Patient-93	Fever for 3 days,burning feeling when urinate, Pain or pressure in the back or lower abdomen,	Cap. Cafexta 300mg	Third generation Cephalosporins	+ + +	Rational use
Patient-94	Throat infe - ction , pain in throat, tonsillitis, fever.	Tab. Furoclav 500mg	Second generation cephalosporin	+ + +	Rational use
Patient-95	Fever , dental pain , Runny nose	Azimex 500mg tablet	Macrolides	+ - -	Irrational use

Patient – 96	Fever for 5 days, throat pain , cough , ear problem	Tab Amoclav 500mg	penicillin (Amoxicillin)	+ + +	Rational use
Patient-97	Fever, Nausea, Swelling around the affected bone	Tab. Furoclav 500mg	Second generation cephalosporin	+ + +	Rational use
Patient-98	Fever for 3 days, burning feeling when urinate, Pain or pressure in the back or lower abdomen,	Cap. Cef-3 500mg	Third generation Cephalosporin	+ + +	Rational use
Patient-99	mild pain or discomfort inside the ear, hearing loss,	Tab.Demoxiclave Forte 375mg	penicillin (Amoxicillin)	+ + -	Less rational use
Patient-100	Fever, Sharp Chest Pain, Increased Shortness of Breath, Changes in Mucus	Tab. Gembax 320 mg	Quinolone (Gemifloxacin)	+ + +	Rational use

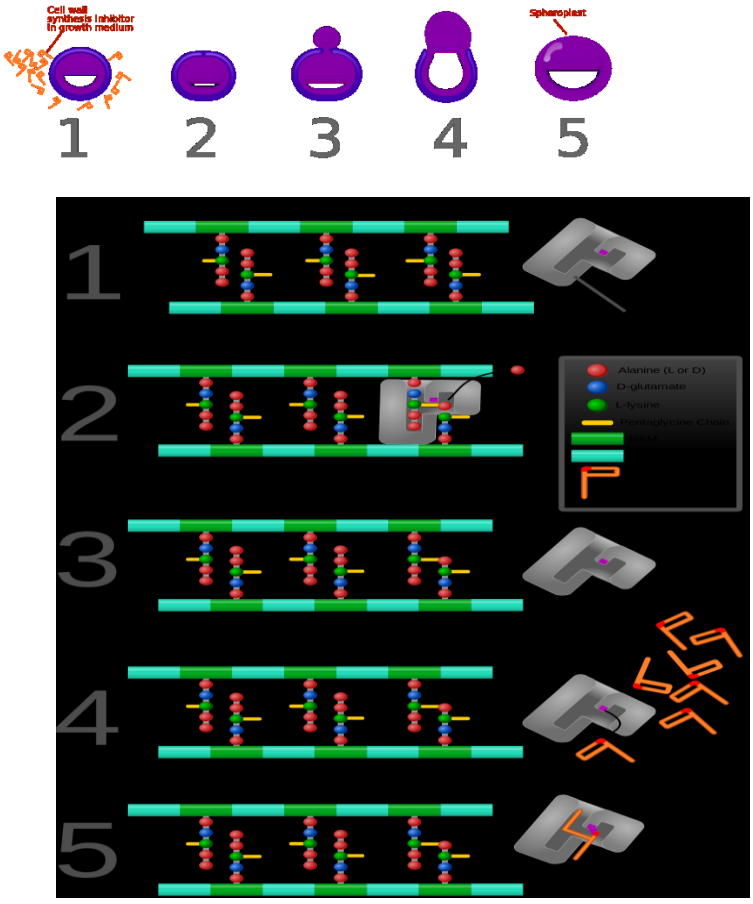

Figure 1. Common mechanism of Penicillin

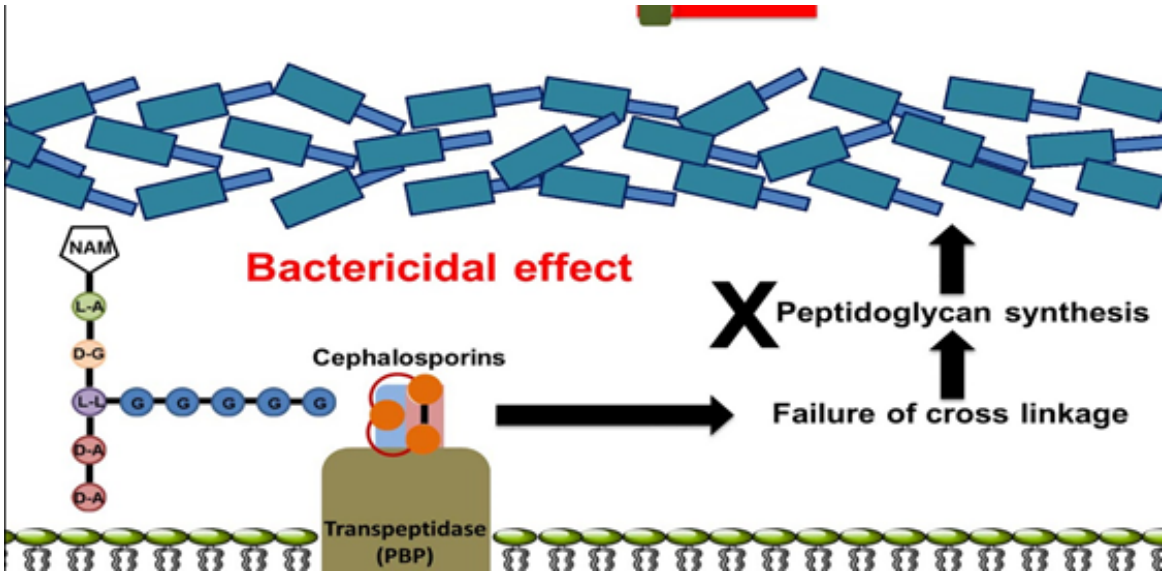

Figure 2. Common mechanism of Cephalosporins

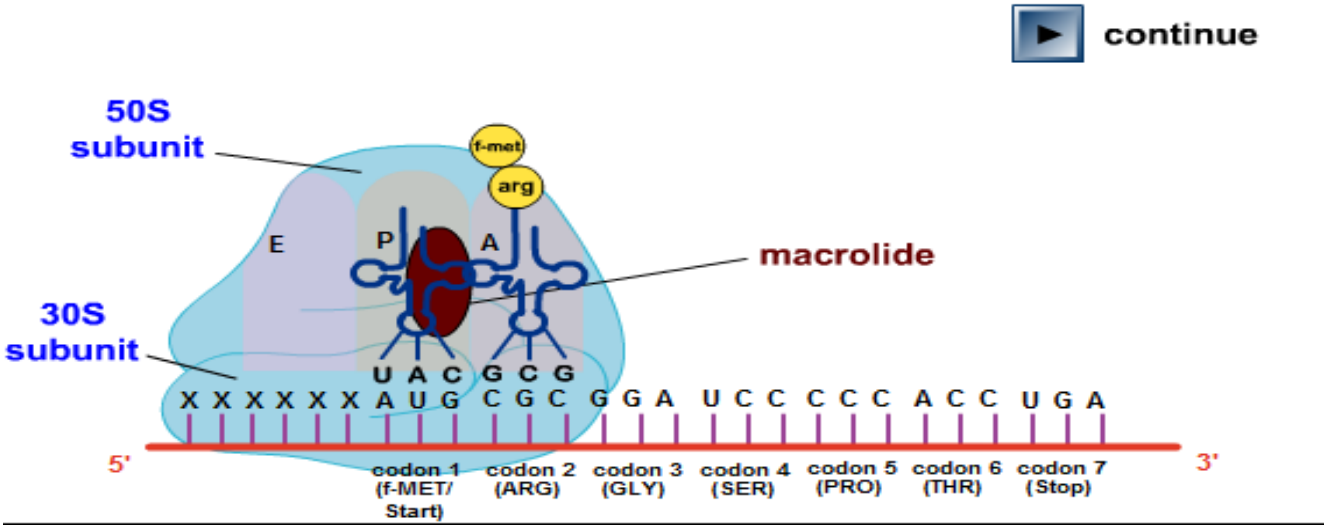

Figure 3. Common mechanism of Macrolides

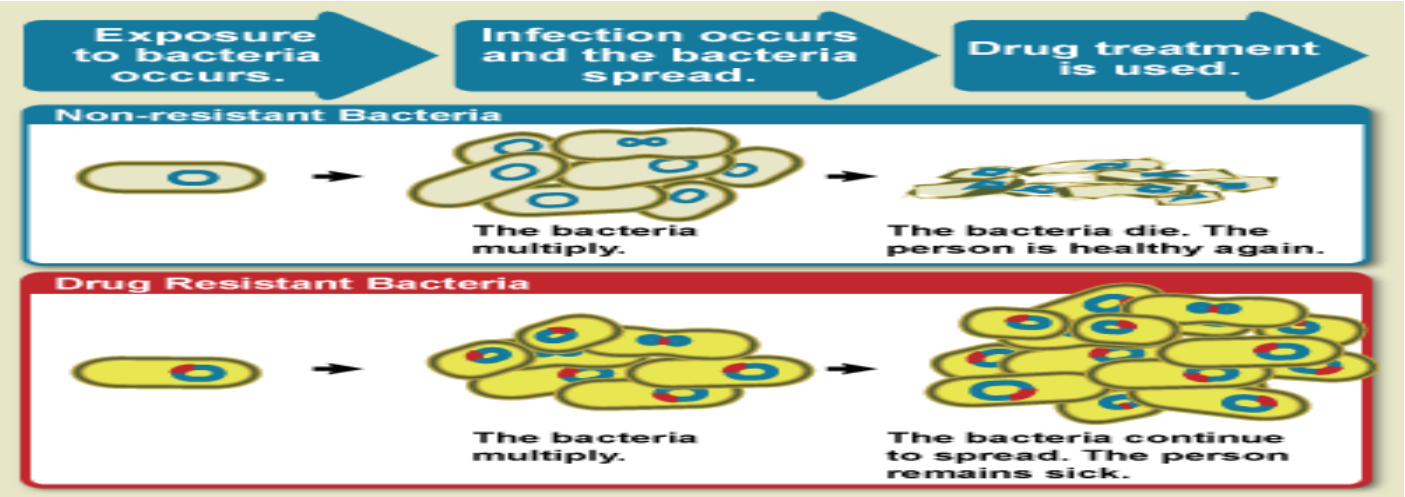

Figure 4. Mechanism of antibiotic resistance development

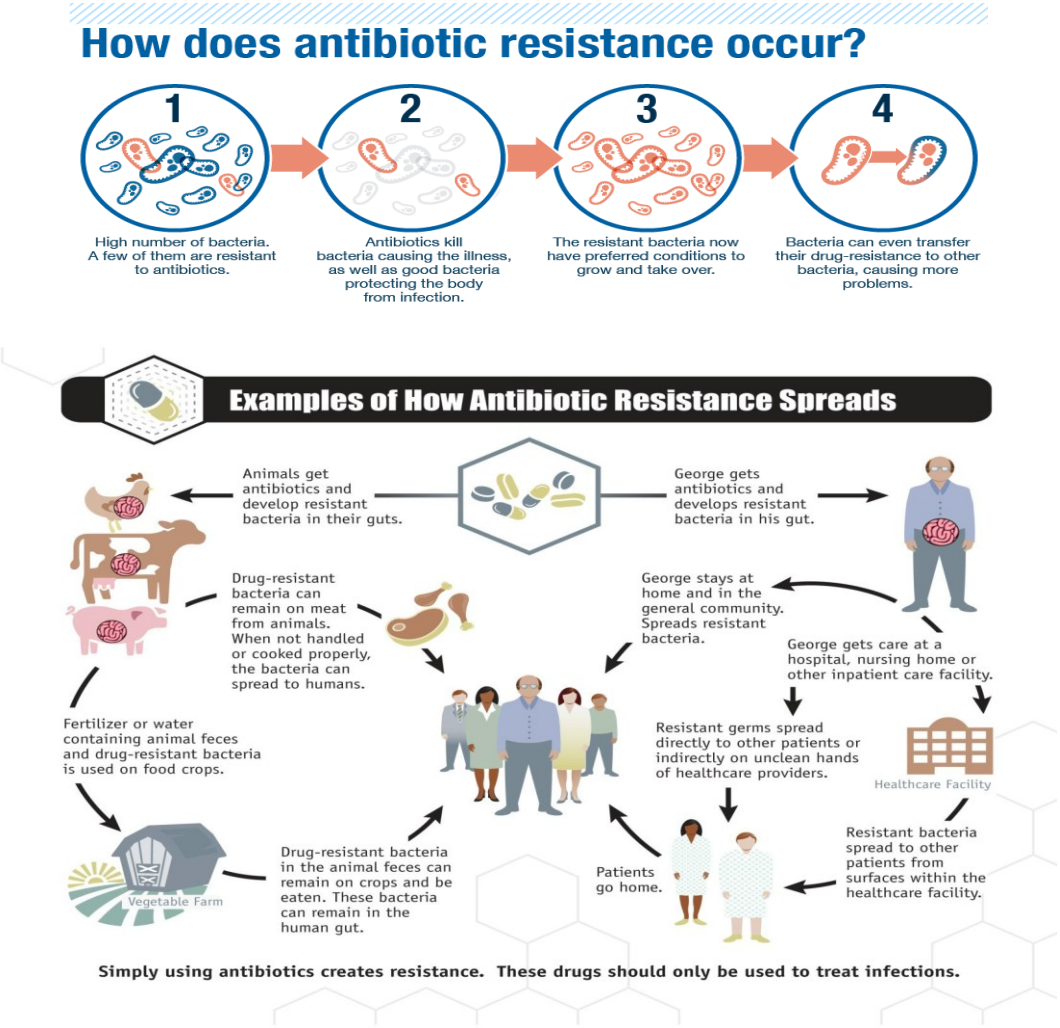

Figure 5. Mechanism of Antibiotic spread