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Original Article

Antibiotic Resistance: The Global Crisis

Corresponding author: Dr. Manas Chakraborty * Arindam Chakraborty¹, Payel Mukherjee²

*Calcutta Institute of Pharmaceutical Technology and AHS ¹Calcutta Institute of Pharmaceutical Technology and AHS ²Gurunanak Institute Of Pharmaceutical Science and Technology * mchakraborty115@gmail.com

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ABSTRACT

Antibiotics are secondary metabolites microorganism effective against other microorganisms. For decades antibiotics are used for therapeutic purpose. Excess use, inappropriate use of antibiotics causes antibiotic resistance. It affects on public health as well as economy. Positive efforts needed to minimize or overcome these global issue through studying the mechanism of action of antibiotics, awareness through healthcare system and social awareness also. Alternative approaches should be introduced like vaccines, Probiotics and antibiotics in the future to avoid antibiotic resistance.

Keywords: Antibiotic, Antibiotic resistance, Awareness, Alternative approaches.

1. INTRODUCTION:

1.1. **ANTIBIOTICS**:

Antibiotics are chemical substances that's are able to inhibit or kill microorganisms. Antibiotics are originally prepared by fermentation technology using culture of bacteria or fungus or yeast under appropriate condition. Now a days synthetic and semisynthetic antibiotics are prepared using chemical method. It is considered as a "Wonder remedies" to cure critical disease. So antibiotics are the essential part of medication to treat human as well as animal health. Antibiotics are also used in better agricultural production. ^[1]

1.2. **MECHANISM OF ACTION OF ANTIBIOTICS:** To avoid antibiotic resistance it is important to know about mechanism of action of antibiotics. The most common mechanism of action is targeting the cell wall of bacteria. ^[2]

Corresponding author:

Dr. Manas Chakraborty, Calcutta Institute of Pharmaceutical Technology and AHS Email: <u>mchakraborty115@gmail.com</u> DOI: <u>https://doi.org/10.5281/zenodo.3833718</u>

1.3 ANTIBIOTIC RESISTANCE: Antibiotic resistance the ability of a microorganism to resist the effects of an antibiotic. Basically it is a specific type of drug resistance caused by genetic mutation of microorganisms as a result of different factors like UV exposer, exposed to chemical agents and different other factors as listed below. This is causing a great economic impact globally threatening a vast majority of human life. ^{[3][4]}

ANTIMICROBIAL	TYPES OF	GROUP	MECHANISM OF ACTION
AGENTS	ORGANISMS		
Amoxicillin,	Gram positive	Penicillin	Inhibit cell wall synthesis
Augmentin		(Narrow	
		spectrum)	
Cefpodoxime,	Gram positive and	Cephalosporin	Inhibit cell wall synthesis
Cefadroxil	gram negative	(Broad	
		spectrum)	
Chloramphenicol	Gram positive and	Chloramphenicol	Inhibit the protein synthesis
	gram negative	(Broad	
		spectrum)	
Azithromycin,	Gram positive	Macrolides	Inhibit the protein synthesis
Erythromycin		(Broad	
		spectrum)	
Streptomycin,	Gram negative	Aminoglycosides	Inhibit the protein synthesis
Gentamycin		(Broad	
		spectrum)	
Ofloxacin,	Gram positive and	Quinolones	Inhibit DNA synthesis
Ciprofloxacin	gram negative	(Broad	
		spectrum)	
Sulfamethoxazole	Gram positive and	Sulfonamides	Competitive inhibitor of folic acid
	gram negative	(Broad	synthesis
		spectrum)	

Table no: 1- Different Antimicrobial agents and their mechanism of action

2. CAUSES OF ANTIBIOTIC RESISTANCE:

2.1 IRRATIONAL USE: In the year of 1945, Sir Alexander Fleming warned about antibiotic overuse when he warned that the "public will demand [the drug and] ... then will begin an era ... of abuses.". The irrational use of antibiotic causes antibiotic resistance. The epidemiological study proves that irrational use of antibiotics are directly proportional to antibiotic resistance. For the antibiotic resistance genetic mutation occurs and changes in base pair through the substitution of one or few amino acid in microorganisms, changes in chromosomal structure and makes antibiotic resistance.^{[5][6]}

In India, antibiotics are easily available over the counter without any prescription. Not only can that anyone easily purchase antibiotics through online service without showing any prescription. These type of rule breaking and lack of regulation promotes irrational use of antibiotic. This tendency is causing rapid antibiotic resistance amongst a major group of population in India. ^[7, 8, 9,10]

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2.3 **INAPPROPRIATE PRESCRIBING**: Inappropriate prescribing is one of the prime reason for resistance. Proper choice of agent or duration of

therapy is not proper in 30% to 50% of cases, most of cases patients do not complete antibiotic course. Inappropriate prescription causes genetic alteration, HGT as well as mutagenesis. Change of antibiotics very often causes resistance in which gene expression occurs, which increase virulence. As a result of this first second generation of antibiotics are not being used now a days. In critical diseases 3rd and 4th generation antibiotic is more used in the treatment of infections. [11,12,13]

- 2.4 BIOFILM AND ANTIBIOTIC RESISTANCE: Microbes form a biofilm in response to various different factors which include cellular recognition of specific or nonspecific attachment site on a surface, Nutritional cues or in some cases exposer of planktonic cells to sub inhibitory concentration of antibiotics. The cell producing biofilm under goes a phenotypic shift in behavior in which genes are diffentially regulated. This may be one of the major causes of antibiotic resistance. The examples of biofilm producing organisms are *Streptococcus* Pneumoniae, Pneumococcus, E.Coli etc. They are termed as "Superbugs" due to rapid spread of antibiotic resistance amongst themselves. [14,15]
- 2.5 EXCESS USE IN POULTRY, FISHING AND ANIMAL HUSBANDRY: From the year of 1950 using antibiotics as promoter of growth started a trend. Drug like procaine penicillin tetracycline applied on animals like cows and pigs on that time. In the poultry farm antibiotic used as a growth promotor now a days .in case of fish farming now a days antibiotics are given in the water, which helps to leading to transmission of resistance among microorganisms. Veterinarians, slaughterhouse people and farmers those are closely in contact with animals they are also a mode of transmitter in antibiotic resistance. ^[16,17]
 - **2.6 OVERPOPULATION:** Overpopulation is one of the prime reason for antibiotic resistance. Country like India where population are almost 133.92 crores, here lots of unhygienic issues like unavailability of proper sanitary system, hygienic food, purified water proper drainage system . People from lower middle class they are unable to maintain these parameter. These problems are indirectly associated with antibiotic resistance. ^[18]
- 2.7 MULTIDRUG RESISTANT OF Mycobacterium Tuberculosis: Recently from last few year the

spread of tuberculosis is creating an alarming situation. It is found that *Mycobacterium Tuberculosis*, the causative organism of TB has become resistant to most of the anti-tubercular drug like Rifampicin, Isoniazid etc. The organism has become multidrug resistance, so a proper public awareness is required for creating hygienic atmosphere or environment to get rid of these dreaded disease. ^[19,20]

- 2.8 UNAVAILABILITY OF NEW ANTIBIOTIC: In the pharmaceutical industries the development of new antibiotics had essentially slowdown due to economic crisis. In between 18 largest companies 15 abandoned the antibiotics field. Most of pharmaceutical company reduced their funding in antibiotic research purpose. Office of health economics in London reported that the net present value (NPV) for antibiotics is only around \$50 billion whereas \$1 billion used for neuromuscular disease. According to leading pharmaceutical company they are more interested in chronic disease section because chronic disease section are more profitable. ^[21,22]
- 3. GLOBAL ECONOMIC SCENARIO OF ANTIBIOTIC **RESISTANCE:** In the recent report from Interagency coordination group on antimicrobial resistance in April 2019, shows that in about 3 decades now antimicrobial resistance will result in World economic shock like 2008-2009 financial crisis. Drug resistance diseases already causes at least 700000 death globally in a year. The figure could increase to 10 million deaths per year globally in 2050. This is the most alarming scenario for these world. Around 2.4 million people could die in between 2015-2050 because of antibiotic resistance in high income countries, it also says that the healthcare cost as well as food production cost also increased that's why income inequality also increased and world will lose an annual GDP 3.8% by 2050, so that the economic growth also slowdown in the world economical perspective and 24 million people are pushed into poverty level by 2030.

In the year of 2010 India comes with a broad outline against antibiotic resistance through establishment of National task force on antibiotic resistance issue in the country. In India around 5% of GDP spent on healthcare sector, 0.9% comes from public sector and huge percentage of money comes from private sector. [17,18,23,24]



4. ACTION TAKEN AND PROPSED AGAINST CONTROLLING OF ANTIBIOTIC RESISTANCE: World health organization (WHO) declares antibiotic resistance as one of the "Biggest global threat" to global health and food security. Antibiotic resistance can affect anyone, any of age, in any country. WHO proposed some advices to control antibiotic resistance, "The biggest global threat".

4.1. WHO GUIDELINE FOR INDIVIDUALS:

- Only use antibiotics when it prescribed by certified health professional.
- Always follow the health worker's instruction.
- Never left out before the course duration of antibiotic completed.
- Prevent infection by regularly washing hands, maintain proper hygiene.

4.2. WHO GUIDELINE FOR HEALTH PROFESSIONALS:

- Only prescribe and dispense antibiotic when it requires for patients better treatment.
- Provide all the information about antibiotic to the patients.
- Maintain proper hygienic condition during treatment.

4.3. WHO GUIDELINE FOR POLICY MAKERS:

- •Prepare a national action plan against antibiotic resistance.
- Proper surveillance of antibiotic resistance infection.
- •Make information available to the public about antibiotic resistance through campaigning.

In India several actions are taken from several authority. The central drug standard control organization (CDSCO) introduced schedule H1 in India for the restriction in the use of Carbopenam, Class III, Class IV and antibiotic tuberculosis drug. The ministry of health and agriculture are advised to health professionals as well as farmers about antibiotics and its proper use and antibiotic resistance. For maintain proper hygiene and sanitation problem National health mission started "Clean India movement".^[17,18,24,25]

5. **DICUSSION AND CONCLUSION:** Based on the above findings it is observed that several factors are responsible for the acute global crisis of antibiotic resistant. The rapid average increase in temperature plays a vital role in developing multi drug resistant organism as a result of random genetic mutation. A comprehensive public awareness in rational use of antibiotic could seriously prevent such resistance giving

a new era in use of conventional antibiotics. Development of newer third & fourth generation antibiotic involve huge cost in pharmaceutical research. So conventional antibiotic therapy in eradication of microbial infection could only be possible by rational use of prescribed antibiotics and avoidance of misuse of antibiotics when it is actually not needed in patients.

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