

# A Review on Crisis of Antibiotic Resistance

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## ABSTRACT

The current challenges and crisis related to antibiotic use and its resistance are unique and differ from the past challenges, as there is a lot of novel pathogens involved in the emergence of antibiotics resistance. Antibiotic resistance has become a major concern and challenge, hindering the usage of antibiotics. Crisis of antibiotic resistance is the increasing global incidence of infectious diseases affecting human population making it untreatable with any known antibiotic or antimicrobial agent.

Newer resistance mechanisms are emerging and spreading globally thereby, imposing a major threat to the treatment of common infectious diseases. This has consequently led to an increase in the morbidity and mortality rates and thereby the rise in cost of the treatment as well. The process of antibiotic resistance has become an evolutionary response due to factors like widespread, extensive, and unnecessary use of antibiotics and unavailability of newer drugs attributable to exigent regulatory requirements. The situation in developing countries is expected to worsen unless governments become more stable, major advances occur in standards of living, preventive measures and in providing adequate medical care. Comprehensive and coordinated efforts are required to minimize the pace of resistance by implement new policies, researches and pursue steps to manage crisis.

**Keywords:** antibiotics, resistance, crisis micro-organisms.

## INTRODUCTION

Since time immemorial, infections caused by various microorganisms have been a threat to human life. With the discovery of penicillin by Sir Alexander Fleming in 1928, began the modern era of

antibiotics and a remarkable decrease in infections among the people. Since then, antibiotics have transformed the modern medicine and saved millions of lives. Antibiotics have revolutionized medicine in many respects and are a pre-requisite for high technological health care. Factors like poor infection control practices, negligent antibiotic use and the consistent dismissal of warnings against overuse of antibiotics often result in a condition where the body becomes more vulnerable to diseases and thereby making the treatment of the disease difficult as the pathogens develop immunity against the antibiotic drugs that are administered more often than required.<sup>[1]</sup> The Center for Disease Control and Prevention (CDC) has classified a number of bacteria for developing multidrug resistance overtime against antibiotic drugs as a result of which an individual is exposed to greater risk of infection and a lack of treatment options make the recovery process difficult and dangerous. These antibiotic resistant bacteria can spread to humans or animals. Some common antibiotic resistant pathogens are Methicillin-Resistant *Staphylococcus aureus* (MRSA), Glycopeptide-Resistant *S. aureus*, Toxin Hyper producing *Clostridium difficile*, Extended-Spectrum b-lactamase and carbapenemase-producing coliforms.<sup>[2]</sup> Awareness of the current crisis in antimicrobial resistance (AMR) is widespread. What is to be done about this is not clear yet.

### **Crisis of antibiotics**

The crisis of antibiotic resistance is worsening throughout the world and has become a serious public safety problem endangering human and animal health as well the ecological environment. Since few years, various reports have published the potential risk of antibiotic resistance in pathogens. The present situation is comparatively dangerous as the resistance at present is different from the previous ones. According to recent studies, several different microbials are involved in antibiotic resistance and the available medicines to treat these new infections are limited considering the fact not many new discoveries of antibiotics have been made to combat the antibiotic resistant pathogens<sup>[3]</sup>. In spite of antibiotic resistance turning into a severe global health crisis, people are not completely aware of the threat this crisis poses to an individual as well as in community level. According to the surveys, in developing countries, approximately 23,000 people die due to lack of treatment options left for the patients as well the fatal symptoms caused by the resistant microbial which are quite difficult to diagnose. Cost or expenditure of the treatment of antibiotic resistant infection is also a major matter of concern. In developing countries, where the healthcare system is not much advanced and economies are not powerful, the costs would be comparatively high. Self-medication is considered to be one of the main causes of antibiotic resistance. This may be due to lack of patient knowledge, low economic condition, scarcity of healthcare facilities etc. Another cause might be the dispensing of antibiotics as an OTC (over the counter) medication.<sup>[4]</sup>

According to screening of many articles published in Europe, Asia and North America to assess the quantitative and qualitative public beliefs and knowledge about antibiotic resistance, it was observed that majority of them believed antibiotic resistance as some sort of changes in the body, while rest believed it as a consequence of excessive or incomplete use

of antibiotics<sup>[5]</sup>. As per the qualitative data, people considered this crisis as a consequence of other's action and suggested clinicians to find a remedy for the issue. This indicates unawareness of the public regarding the crisis of antibiotic resistance.

### **Current challenges and prevention of antibiotic resistance**

The management of hospital acquired infection (HAI) has become challenging over the years due to the prevalence of antibiotic resistance, increased number of immunocompromised patients and severely ill patients. The optimization of infection related outcome focuses of three inter-related factors i.e., patient/host factors, pathogen factors and drug related factors. Due to increase in number of multiple drug resistant (MDR) organisms, the selection of empiric and directed/definitive treatment after pathogen identification in both nosocomial as well as community acquired infection has become difficult.

The development of resistance involves various mechanisms and is seen in gram negative as well as gram positive micro-organisms<sup>[8]</sup>. Some of the gram negative bacteria which are multidrug resistant include gram negative bacilli, *Acinetobacter baumannii*, *P. aeruginosa* etc and the gram positive bacteria that are MDR are *S. aureus*, methicillin resistant *S. aureus* (MRSA). MRSA was initially confined to nosocomial infections but an increase in number of patients treated as out-patients has led to development of MRSA infection in the community as well. An increase in the number of MDR pathogens is a challenge not only to the patients but also the development of newer antibiotics clearly indicating a need of novel mechanisms to treat the infections caused by such bacteria and thereby preventing the morbidity and mortality rate<sup>[9]</sup>.

Another challenge faced by the health sector is to educate the public about antibiotics, its usage, and consequences of its misuse. Apart from this, the

pharmaceutical companies face the challenge of overcoming the lack of new drug development to treat infections.

### **Prevention of antibiotic resistance**

An important goal while prescribing antibiotics during a treatment is to prevent the emergence of antibiotic resistance. The antibiotic resistant bacteria emerge in three main ways – the accession of new genes by horizontal or transposons gene transfer, selection of naturally resistant strains and by selection of resistant variants<sup>[10]</sup>. Thus the main objective in prevention of resistance would be to avoid the ways causing the same, but the implementation of the objective would be difficult. The prevention of accession of resistance and selection of antibiotic-resistant variants and interrupting the mechanisms by which person-to-person spread can occur would therefore be the two ways followed in the prevention of emergence of resistance.

Apart from this, health professionals should educate the patients, caretakers etc about the use of antibiotics and the consequences of its misuse in order to improve the patient compliance and medication adherence<sup>[11]</sup>.

### **Future prospects – what should be done?**

As there is high increase in the rate of development of antibiotic resistant pathogens, studies should be focused on the development of new antibiotics along with other measures to minimize the resistance crisis.

To treat the infections caused by MDR pathogens with the present antibiotics is quite difficult. Hence the researchers now focus on the usage of antibiotics with nanoparticles i.e., Nano antibiotics. Nanoparticles are capable of acting as nanoscale molecule that interacts with bacterial cells, regulating cell membrane penetration, and interfering with molecular pathways. These nano-antibiotics are a coup in medicine and health representing that the nanoparticles either possess an antimicrobial action or has the ability to enhance the

action of antibiotics to treat different infections. They have comparatively more absorption, controlled release and targeted delivery.

At present the doses of nanoparticles causing cell damage of the organisms are too high to be used in humans and hence an appropriate study should be done to obtain accurate doses of nano-antibiotics to overcome the antibiotic resistant crisis to an extent.<sup>[12]</sup>

### **CONCLUSION**

In essence, our misuse of antibiotics accelerates the emergence and spread of antibiotic-resistant bacteria.<sup>[13]</sup> Today we also see an alarming increase in new bacterial strains resistant to several antibiotics together (known as multidrug-resistant bacteria or superbugs). This eventually leads the bacteria to be resistant to all the existing antibiotics thereby rising a higher chance to enter the post-antibiotic era. Other challenges that follow are difficulty in educating the patients about drug resistance, lack of development of new drug etc. Though preventive measures can be followed, it does not work completely in the present scenario and further studies would be needed. Development of nano-antibiotics may help to prevent the increase in resistance to an extent but as of now the doses are too high to be used in humans and clinical trials are being conducted regarding the same.

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