Historians have documented that the ancient Greeks used mould to treat infections. This fact was proven by Dr. Alexander Fleming who in 1928, isolated penicillin from the fungus, \textit{Penicillium notatum}. The benefits of this discovery were witnessed during the time of World War II, which led Dr. Fleming to receive the Noble Prize in 1945. Since then, antibiotic use for pre- and post-operative infection control has been of great value helping reduce morbidity and mortality to a great extent.\cite{1}

Only a few years after the introduction of antibiotics for the treatment of infections in 1944, the emergence of new strains of bacteria was observed which were resistant to the action of penicillin. The antibiotic that was effective on 94\% of the \textit{Staphylococcus aureus} in 1944, was effective on only half of the bacterial species by 1950.\cite{2} Based on this observation researchers over the years formulated numerous categories of antibiotics to fight against these increasingly resilient strains of bacteria. It is believed that the constant evolution of more resilient bacterial species is due to the transfer of genetic and chromosomal material between the bacteria,\cite{3} placing researchers into a race of formulating antibiotics that are more effective against this resilient foe.

A diverse array of factors comes into play which may hold significant importance in the development of antibiotic resistance. One common factor is the association with the antibiotic consumption behavior of the global population. Antibiotics are routinely used in various disciplines. Inappropriate or injudicious use of these agents in disciplines like medicine, dentistry, veterinary medicine, food industry and agriculture are just a few of the factors that may be considered to play a role in the emergence of multi-resistant bacterial strains.\cite{4}

Researchers believe that antibiotic resistance has emerged due to the imbalance created in the microbial ecosystem caused by changes in the selective pressures applied by antibiotics on microbes.\cite{5} The causes of this ecological imbalance are the “non-degradable anti-

bacterial compounds” created by the wastes and sewages along with antibiotics used in bio-industry.\cite{6}

Perhaps the most important is the role played by medical and dental professionals. The use of antibiotics for the treatment of various conditions has been on the rise for past few decades.\cite{7} An increase in antibiotic consumption has only become more alarming since increasing evidence have concluded that a significant amount of this consumption maybe based on inappropriate or incorrect prescriptions; for example a fifth of the total antibiotic prescription in the US was found to be for upper respiratory tract infections, even though these infections are almost always viral.\cite{8} In UK, 80\% of all antibiotic prescriptions were made by general practitioners, with a majority of the prescriptions made for conditions related to oropharynx.\cite{9} These alarming observations highlight the need to explore the factors that influence the prescribing habits of medical practitioners which may have been guided by patient’s demands and beliefs regarding the therapeutic effects of antibiotics,\cite{10} or the practitioner’s habit of prescribing antibiotics due to the lack of updated knowledge regarding prescription guidelines.

Dentists rely on antibiotics for the treatment of a wide variety of odontogenic and non-odontogenic conditions where the purpose of these prescriptions can be preventive or therapeutic. It is, however, important to note that 6-10\% of all antibiotic prescriptions have been found to be made by dentists.\cite{11} With evidence suggesting that a lot of prescriptions made by dentists might be on empirical basis,\cite{1} and not supported by scientific knowledge, this small percentage of the total antibiotic prescription can play a significant role in the development of antibiotic resistance.

Drug prescribing habits have found to be effected by the practitioner’s level of knowledge, patient’s knowledge or lack of cultural beliefs, past experiences, pharmaceutical incentives, economic factors and use of diagnostic aides such as microbial testing.\cite{10}

Misuse and over prescription of antibiotics is considered to be the most important cause in the development of antibiotic resistance.\cite{12} In this universal challenge that is faced by all the countries and communities, the role of developing countries is believed to be crucial since a majority of the world’s population belong to these countries. In addition to establishing a better understanding of the factors that guide or promote the
injudicious use of antibiotics, it is equally important to develop effective and well-targeted strategies to change this trend.

The development of strategies requires a comprehensive work plan that incorporates all the elements that may play a role in the over-consumption of antibiotics, providing a holistic approach to the problem at large. Conducting clinical audits to record the number of antibiotic prescriptions made in a developing country might not represent the true magnitude of the problem of over consumption if strategies are not in place to prevent the sale of antibiotics without a prescription. Over the counter sales of drugs including antibiotics, is a common observation in developing countries such as Pakistan. The impact of these sales is seen as an increase in antibiotic resistance in such communities where self medication is a routine behavior.

The importance of microbial testing cannot be overlooked for prescribing an appropriate antibiotic either. Unfortunately, a significant number of doctors and dentists in developing countries do not use laboratory services for microbial testing. This may be due to the increase in the cost of treatment by the state or by unwilling patients who cannot afford to pay for the tests. A strategy can only be effective when targeted in the right direction. The factors affecting prescription behavior are complex and interlinked. For example, the specificity of laboratory results for microbial testing is almost always affected by any antibiotics administered before the test. This might play a significant role in the practitioners’ habit of avoiding microbial testing since the certainty of the patient self medicating, as part of the home remedy is almost certain. Therefore, a campaign to promote microbial testing for antibiotic selection or to subsidize it for consumers or health care providers will be ineffective, unless a parallel campaign to ban over the counter sales of antibiotics is also implemented. At the same time the importance of parallel programs focusing on the development of new antibiotics, dissemination of knowledge in print and electronic media creating awareness among the masses regarding the use or misuse of antibiotics and its implications on the society and continuing education courses for practitioners to improve their prescribing patterns cannot be overlooked.

Although this multifaceted challenge needs an equally multifaceted solution, bringing about a behavioral change in practitioners and consumers can only be successful if it is backed by strong policy support and strict legislative regulations.

Globalization is taking place in every domain of world economy. Air traffic, immigration patterns and global food and pharmaceutical market are just a few of the vectors that are increasingly capable of disrupting the microbial ecosystem responsible for antibiotic resistance. With global economies in the worst recession, developing societies with infectious diseases as a major cause of morbidity and mortality, world population with an increasing life expectancy requiring geriatric care and natural disasters such as earthquakes and floods on the rise; the world is yet to see bacterial resistance against antibiotics spread from being localized epidemics to a global pandemic.

The global concern of antibiotic resistance is, therefore, a challenge for modern medicine. A public health dilemma which threatens to return to the “pre-antibiotic era” where no effective or timely cure against bacterial infections was available. The window for action is small but with synchronized global efforts involving national, regional and international leadership the chances of improvement are not scarce.

REFERENCES


