REVIEW ARTICLE ISSN: 2467-9151 OPEN ACCESS

ANTIMICROBIAL RESISTANCE

Santosh Khanal[1], Uddav Khadka[2], Laxmi Dhungel[2]

[1]Department of Microbiology, National College, Nayabazar, Khusibu

[2]Department of Biotechnology National College, Nayabazar, Khusibu

INTRODUCTION

In the golden age of discovery of antibiotics, these potent "miracle" drugs saved millions of lives. Antibiotics not only saved patient lives but they have played a pivotal role in achieving major advances in medicine and surgery. Antibiotics have also helped to extend expected life span by changing the outcome of bacterial infections (Ventola 2015a). In contrast, we are entering an era where bacterial infections such as bloodstream infections and ventilator-associated pneumonia might no longer be successfully treated with antibiotics. We now face a dramatic challenge resulting from two combined problems: first, microorganisms are becoming extremely resistant to existing antibiotics and second, the antibiotic pipeline has become extremely dry (Hart and Kariuki 1998). The global consumption of antibiotics has recently been estimated at more than 70 billon doses per annum (Woolhouse et al 2016). The emergence of resistance to antimicrobial agent is becoming a major public health problem worldwide as it can easily cross international boundaries and spread between the continents with ease in a great speed (Richet et al 2001). For several decades antimicrobial resistance has been a growing threat to the effective treatment of an ever increasing range of infections caused by bacteria, parasites, viruses and fungi. Antimicrobial resistance results in reduced efficacy of antibacterial, antiparasitic, antiviral and antifungal drugs (WHO 2014).

Antimicrobial resistance is natural phenomenon that occurs when microorganisms are exposed to antibiotic drugs. Under the selective pressure of antibiotics, susceptible bacteria are killed or inhibited, while bacteria that are naturally (or intrinsically) resistant or that have acquired antibiotic-resistant traits have a greater chance to survive and multiply (Prestinaci et al 2015). Resistance can be defined as the temporary or permanent ability of an organism and its progeny to remain viable or multiply under environmental conditions that would destroy or inhibit them (Denyer et al 2005). Antimicrobial resistance makes it harder to eliminate infections from the body as existing drugs become less effective. A wide range of biochemical and physiological mechanisms may be responsible for resistance (Davies and Davies 2010) some of which may be due to the multidrug efflux system, enzyme production, quorum sensing, presence of antibiotic resistance genes in bacteria (Frieri et al 2017) and alteration of chromosomal DNA (Aly and Balkhy 2012). Resistance mechanism is pandemic and creates an enormous clinical and financial burden on healthcare system worldwide. There are no simple solutions to this problem.

The most important cause of this frightening evolution of antimicrobial resistance is that there has been a massive overuse of antibiotics, worldwide across all ecosystems over the past decades including humans, animals, aquaculture and agriculture. Many countries and healthcare facilities still lack effective antibiotic steward programs. Antibiotics continue to be considered as "ordinary drugs" and are prescribed freely by many different physicians, both in the community and hospitals (Carlet et al 2012). Likewise availability of few new antibiotics and regulatory barriers are also the causes for emergence of antimicrobial resistance (Ventola 2015a).

Antibiotic resistant infections are already widespread in the U.S. and across the globe. Many public health organizations have described the rapid emergency of resistant bacteria as a "crisis" or "nightmare scenario" (Viswanathan 2014). The CDC declared in 2013 that the human race is now in the "post-antibiotic era" and in 2014, the World Health Organization (WHO) warned that the antibiotic resistance crisis is becoming dire (Michael et al 2014). Multi-Drug Resistance (MDR) have been declared a substantial threat to U.S. public health. Some of the major pathogens with antimicrobial resistance are Methicillin-Resistant *Staphylococcus aureus* (MRSA), Vancomycin-Resistant Enterococci, Drug-Resistant *Streptococcus pneumoniae*, Drug-resistant *Mycobacterium tuberculosis*, Carbapenem-Resistant Enterobacteriaceae, MDR *Pseudomonas aeruginosa*, MDR *Acinetobacter*, Extended-Spectrum Beta Lactamase (ESBL)-producing Enterobacteriaceae and Drug-resistant *Neisseria gonorrhoeae* (Ventola 2015b). Among all the Gulf Corporation Council (GCC) countries, 37,295 bacterial isolates were studied for antimicrobial resistance and the most prevalent microorganism was *Escherichia coli* (44%), followed by *Klebsiella pneumoniae* (20%), *Pseudomonas aeruginosa* (18.7%), MRSA (5.4%), *Acinetobacter* (5%) and *C. difficile* and *Enterococcus* (>1%) (Aly and Balkhy 2012).

The US center for Disease Control and Prevention (CDC) conservatively estimated that, in U.S., more than two million people every year are affected with antibiotic-resistant infections, with at least twenty-three thousand dying as a result of the infection (CDC 2013). In Europe each year, the number of infections and deaths due to the most frequent MDR bacteria (*S. aureus, E. coli, K. pneumoniae* and *P. aeruginosa*) was estimated to be 40000 and 25000, respectively, in 2007 (ECDC 2009).

Many alarming facts regarding antimicrobial resistance have accumulated, particularly over the last few years some of which includes an increase in global resistance rates in many bacterial species responsible for both community- and healthcare-related infections, emergence and dissemination of new mechanisms of resistance, rapid increase in multi-resistance, propensity to use last line therapy to treat nosocomial and community acquired infections, reuse of old drugs with poor efficacy profile and uncertain pharmacokinetics/pharmacodynamics characteristics due to lack of alternative drugs, high morbidity and mortality attributable to multi-resistant bacteria in critically ill patients and serious financial consequences of bacterial resistance (Hart and Kariuki 1998).

The importance and value of antibiotics cannot be overestimated; we are totally dependent on them for treatment of infectious diseases and they should never be considered mere commodities. In addition to their use in the treatment of infectious diseases, antibiotics are critical to the success of advanced surgical procedures, including organ and prosthetic transplants (Davies and Davies 2010). Antimicrobial resistance is a clear and present danger. Immediate and co-ordinated measures must be taken worldwide to safeguard remaining antimicrobials and facilitate the development of novel antimicrobials. Conservation programs must be further optimized and implemented in other non-acute health-care setting such as long-term care facilities. Educational programs targeting both antimicrobial prescribers and consumers must be further developed and supported. The general public must continue to be aware of the current state of antimicrobial resistance threat. International collaboration among researchers and policy makers must solidify to effect lasting reductions in spread of antimicrobial resistance (Huttner et al 2013). So, in order to manage the antibiotic resistance crisis the CDC as well as other organizations and experts recommends various steps that health care practitioners and facilities can pursue to reduce antibiotic resistance such as adopting an antibiotic stewardship program, improving diagnosis, tracking and prescribing practices, optimizing therapeutic regimens and preventing infection transmission (Ventola 2015b).

REFERENCES

1. Aly M and Balkhy HH 2012. The prevalence of antimicrobial resistance in clinical isolates from Gulf Cooperation Council countries. Antimicrobial Resistance and Infection Control 1: 26.
2. Carlet J, Jarlier V, Harbarth S, Voss A, Goossens H and Pittet D 2012. Ready for the world without antibiotics? The pensieres antibiotic resistance call to action. Antimicrobial Resistance and Infection Control 1:11.
3. Centers for disease control and prevention, US Department of Health and Human Services. Antibiotic resistance threat in the United States Atlanta: CDC; 2013.
4. Davies J and Davies D 2010. Origin and evolution of antibiotic resistance. Microbiol and Mol Biol Revs 74 (3): 417-433.
5. Denyer SP, Hodges NA and Gorman SP (2005). Hugo and Russell's Pharmaceutical Microbiology, 7th edition, Blackwell Scientific publications UK.
6. European Centers for Disease Control and Prevention, The bacterial challenge time to react. Stockholm; ECDC; 2009.
7. Frieri M, Kumar K and Boutin A 2017. Antibiotic resistance. J of Infect and Public Health 10: 360-378.
8. Hart CA and Kariuki S 1998. Antimicrobial resistance in Developing countries. British Medical Journal 317: 647-650.
9. Michael CA, Dominey-Howes D and Labbate M 2014. The antibiotic resistance crisis: causes, consequences and management. Front Public Health; 2: 145.
10. Prestinaci F, Pezzotti P and Pantosti A 2015. Antimicrobial resistance: a global multifaceted phenomenon. Pathogens and Global Health 109 (7).
11. Ventola CL 2015a. The antibiotic resistance crisis, Part I: Causes and threats. Pharmacy and Therapeutics 40 (4): 277-283.
12. Ventola CL 2015b. The antibiotic resistance crisis, Part II: Management strategies and new agents. Pharmacy and Therapeutics 40 (5): 344-352.
13. Viswanathan VK 2014. Off-label abuse of antibiotics by bacteria. Gut Microbes; 5(1): 3-4.
14. Woolhouse M, Waugh C, Perry MR and Nair H 2016. Global disease burden due to antibiotic resistance-state of the evidence. J Glob Health (6)1: 010306.
15. World Health Organization, Antimicrobial resistance: global report on surveillance. Geneva, Switzerland: WHO; 2014.