EDITORIAL

Oman Medical Journal [2017], Vol. 32, No. 4: 267-268

Antibiotics Resistance: When the Armamentarium Gets to the Verge of Being Empty

Abdullah Balkhair*

Infectious Diseases Unit, Department of Medicine, Sultan Qaboos University Hospital, Muscat, Oman

ARTICLE INFO

Article history:

Received: 7 May 2017

Accepted: 8 May 2017

Online:

DOI 10.5001/omj.2017.53

Antibiotics are arguably considered as one of the greatest milestones and one of the foremost lifesaving interventions in modern medicine. This is best exemplified by the impact of antibiotics on treatment of common, devastating, serious, and life threatening infections.[1] More than 150 antibiotics have been found since the discovery of penicillin and in the last 75 years.[2] Unfortunately, this golden era is being threatened by development of resistance hindering the efficacy of antibiotics and making them victims of their own success (and our abuse of them).

Striping the world of effective antibiotics is an impending unwelcomed halt to a wide range of antibiotic reliant medical advances from organ transplant and cancer therapy to implantation of life saving devices and prosthetic surgeries. We are sadly observing once-treatable infections becoming difficult to treat and at times incurable. This state of antibiotics ineffectiveness has resulted in an enormous global economic burden to both individuals and societies.

Overuse, inappropriate prescribing, and extensive use of antibiotics in agriculture and animal feeds are core driving forces for today's mounting rate of antibiotic resistance.[3] Globalization, international trade and travel, medical tourism, and poor infection control practices can facilitate the movement and spread of antibiotic resistant pathogens adding to the complexity of antibiotics resistance. Research on antibiotic resistance over the past few years has provided us with evidence contrary to our beliefs, suggesting that resistance is not a modern event and may have predated our modern antibiotics use.[4] We also now know that antibiotics resistant genes are ubiquitously present among the gut, microbiota, and their transfer between these gut bacteria is a relatively frequent event.[5] The latter is now believed to contribute to the emergence and spread of antibiotics resistance. These antibiotic resistance genes in the gut microbiota are known as gut antibiotic resistome.

Simultaneous to this unprecedented rise in antibiotic resistance, global antibiotics research, development, and approvals, particularly antibiotics with novel mechanisms of action, has fallen over the past 30 years.[6] Increasing scientific challenges to discover new antibiotics coupled with an inadequate investment return on antibiotic research and development, and the increased expense of clinical trials are examples of bottleneck obstacles that have led to today's troublesome decline in the development of novel antibiotics. Consequently, we now have a severely deprived antibiotic arsenal and dreadfully dry antibiotic pipeline. This painful reality is evidenced by the emergence of only two new classes of antibiotics in the past three decades, and none of them is against Gram-negative bacteria. This severe disparity is being appropriately described as a "crisis" that could have "catastrophic consequences".[7]

In 2014, the World Health Organization (WHO) warned that the antibiotic resistance crisis is becoming dire.[7] The WHO recently published its first ever list of antibiotic-resistant "priority pathogens" consisting of 12 bacterial families with the greatest threat to human health.[8] Three of the 12 pathogens (carbapenem-resistant *Acinetobacter baumannii*, carbapenem-resistant *Pseudomonas aeruginosa*, and carbapenem-resistant *Enterobacteriaceae*) were given a critical level priority with frequently and severely limited antibiotic options. Common to these organisms is their capacity to accumulate multiple antibiotic resistance genes and/or foster multidrug efflux pumps making them resistant to several

*Corresponding author: balkhair2020@gmail.com

classes of antibiotics, and severely limit available antibiotic options (sometimes none is available). This propensity for multidrug resistance further escalates the problem of antibiotic resistance and potentially dries up the already stretched antibiotics armamentarium. Unfortunately, carbapenem-resistant *A. baumannii*, carbapenem-resistant *P. aeruginosa*, and carbapenem-resistant *Enterobacteriaceae* are prevalent in Oman[9,10] and pose significant challenges to patients, healthcare providers, hospitals, and health policy makers.

To backtrack antibiotic development, scientific challenges need to be overcome through embracing creative and innovative means, developing new business models for antibiotic development, encouraging strategic public-private partnership, and undertaking regulatory reforms.[1] We must also strive to preserve current antibiotics and extend their functional life and effectiveness through rational use, rigorous implementation of effective evidence-based stewardship programs, and enhanced infection prevention and control practices. In accordance with this antibiotic conservation strategy, the WHO in 2015 adopted a comprehensive global action plan on antimicrobial resistance with a focus on five strategic objectives principally aiming to extend the functional life of existing antibiotics. These strategies include: improving awareness and understanding of antimicrobial resistance, strengthening knowledge, reducing incidence of infection, optimizing antimicrobial use, and increasing investment in new antibiotics.[11] In line with the WHO strategic objectives to combat antibiotic resistance and in recognition of the threat antibiotic resistance poses to public health, the Gulf Cooperation Council Centre for Infection Control (GCC-IC) recognizes the emergence of antibiotics resistance as top priority for the region and recently developed the first GCC strategic plan addressing antimicrobial resistance in all GCC countries including Oman.[12]

Living in a world without antibiotics is hard to envision. However, the truth is that the world is regrettably approaching an era in which effective antibiotics can no longer be taken for granted. When this happens, medical advances over more than half a century will, for the most part, be in jeopardy. We are obliged to avert a post antibiotic epoch and we must act now before it's too late.

REFERENCES

1. Spellberg B, Blaser M, Guidos RJ, Boucher HW, Bradley JS, Eisenstein BI, et al; Infectious Diseases Society of America (IDSA). Combating antimicrobial resistance: policy recommendations to save lives. Clin Infect Dis 2011 May;52(Suppl 5):S397-S428.
2. Lobanovska M, Pilla G. Penicillin's Discovery and Antibiotic Resistance: Lessons for the Future? Yale J Biol Med 2017 Mar;90(1):135-145.
3. Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. P T 2015 Apr;40(4):277-283.
4. D'Costa VM, King CE, Kalan L, Morar M, Sung WW, Schwarz C, et al. Antibiotic resistance is ancient. Nature 2011 Aug;477(7365):457-461.
5. van Schaik W. The human gut resistome. Philos Trans R Soc Lond B Biol Sci 2015 Jun;370(1670):20140087.
6. Shlaes DM, Sahm D, Opiela C, Spellberg B. The FDA reboot of antibiotic development. Antimicrob Agents Chemother 2013 Oct;57(10):4605-4607.
7. Michael CA, Dominey-Howes D, Labbate M. The antimicrobial resistance crisis: causes, consequences, and management. Front Public Health 2014 Sep;2:145.
8. WHO media centre. WHO publishes list of bacteria for which new antibiotics are urgently needed [cited 2017 May 6]. Available from: http://www.who.int/mediacentre/news/releases/2017/bacteria-antibiotics-needed/en/.
9. Balkhair A, Al-Farsi Y, Al-Muharrmi Z, Al-Rashdi R, Al-Jabri M, Neilson F, et al. Epidemiology of multi-drug resistant organisms in a teaching hospital in Oman: A one-year hospital-based study. Scientific World Journal 2014 Jan;2014:157102.
10. Al-Yamani A, Khamis F, Al-Zakwani I, Al-Noomani H, Al-Noomani J, Al-Abri S. Patterns of Antimicrobial Prescribing in a Tertiary Care Hospital in Oman. Oman Med J 2016 Jan;31(1):35-39.
11. World Health Organization. Antimicrobial resistance: a global epidemic [cited 2017 May 6]. Available from: https://www.wto.org/english/news_e/news16_e/heal_29aug16_e.pdf.
12. Balkhy HH, Assiri AM, Mousa HA, Al-Abri SS, Al-Katheeri H, Alansari H, et al; at the workshop. The strategic plan for combating antimicrobial resistance in Gulf Cooperation Council States. J Infect Public Health 2016 Jul-Aug;9(4):375-385.