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SOCIAL RESPONSIBILITY IN THE POST-ANTIBIOTIC ERA

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Antibiotic-resistant microbes – bacteria and other microscopic entities that have acquired a complete or near-immunity to standard antimicrobial treatments - have gone under the radar for a dangerously long time.[1,2] As a result we are facing a future where it is entirely possible that infections may once again become the leading cause of mortality worldwide.[1,2] In the 21st century, it is no longer sufficient to look to health care professionals and health policy decision-makers as the sole caretakers of health. More than ever, there is a social responsibility for the correct usage of medication, for the implementation of healthy lifestyle adjustments, and for self-education on the importance of former practices.[2]

Although antibiotic resistance is a natural phenomenon, its acquisition is sped up through the misuse of medications.[3] And while many factors contribute to improper usage of medication, scientific literacy is arguably the easiest to resolve. As medication adherence is partially determined by scientific literacy through an understanding antibiotic resistance, we must strive to understand the role of scientific literacy as a factor in proper medication use.[4] In this piece it will be argued that the misuse of antibiotics is an ever-increasing public health problem and that one of the key factors implicated in this misuse is a lack of knowledge. Further, potential avenues of improving both medication adherence and scientific literacy will be explored. Overall, educating the populace towards better understanding of key public health concepts must become a major goal of healthcare policy unless we wish to risk living in a world where microbes once again determine the longevity of our lives

Medication Adherence and Selection of Resistant Bacteria

Medication adherence according to the World Health Organization is "The extent to which a person's behavior – taking medication, following a diet, or making healthy lifestyle changes – corresponds to agreed-upon recommendations from a healthcare provider."[4] Although adherence is a term generally reserved for chronic conditions, it will be applied here for the use of antibiotics. For antibiotics, adherence is taking the required dose for the required duration. 20-30% of patients do not take their medications for the full duration of prescription, and for medications requiring a re-fill, misuse rates increase to 50%.[4] This non-adherence to medication puts bacteria in a favorable environment for the selection of antibiotic resistance.[1,2,5] This occurs mainly through "selecting" for bacteria that have elements in their genes that allow them to survive an incomplete course of antibiotics.[4] These bacteria then pass their resistant genes across generations to their offspring.[5] Ultimately, the survival of resistant bacteria can lead to the spread of resistance to common treatments.[5] As a result of the repeated occurrence of the above scenario, there has been an increase in the use of second and third-line antibiotic treatments.[5] In fact, the use of second-line medications has been increasing at an unabated upward trajectory since 2000.[1,2] A further misuse of suboptimal medications, amongst other factors, can ultimately lead to complete drug resistance, as is the case for several common infections. [5-7]

Infection with resistant microbes consistently leads to increased mortality – up to a 64% increase for several infectious agents.[1,7] Infections with microbes such as those that cause tuberculosis and E.coli-related diseases have been reported as completely drug-resistant in several regions.[3]

Some bacteria have become completely immune and have the potential to emerge as severe health burdens in upcoming years. Increased mortality rates can be attributed to prolonged illness, increased severity of symptoms, more toxic treatment regimens, and increased incidence of comorbidity.[1,2] Proper use of antibiotics, while they are still effective, would be a pragmatic method of inhibiting the spread of complete resistance and thus keeping mortality rate to a minimum.

So what?

> *"WHO's 2014 report on global surveillance of antimicrobial resistance reveals that antibiotic resistance is no longer a prediction for the future; it is happening right now, across the world, and is putting at risk the ability to treat common infections in the community and hospitals. Without urgent, coordinated action, the world is heading towards a post-antibiotic era, in which common infections and minor injuries, which have been treatable for decades, can once again kill."*[3]

As put succinctly above by the WHO, urgent and coordinated action is required to manage the spread of antibiotic resistance, to prolong use of current treatment options, and to preserve the health of individuals and the global community.[1,2] Alongside the policy, practice and innovative changes that are required for management of future of healthcare crises – not just antibiotic resistance – education is of paramount importance.[1,2] It is key to therefore relay basic knowledge of mechanisms of antibiotic action, why it is important, how to complete full treatment courses, and when and when not to take medication. Ultimately, it is the responsibility of both the individual and the system to make a concerted effort to disseminate essential material throughout the populace.

Education Initiatives

Several courses of action are currently in place to educate people on proper medication usage. The Centres for Disease Control and Prevention (CDC) recommends patient education, collaborative team-based care and telecommunication systems for monitoring and counseling.[2] Specifically, on the topic of adherence, the US Surgeon General states that "nurses, doctors, pharmacists and other healthcare professionals can help prevent many serious health complications by initiating conversations with their patients about taking medication as directed."[2] Patient education involves conversations with healthcare providers in order to educate patients on the importance of correct usage of medication. Col-

laborative team-based care seeks to have multiple lines of reinforcement of basic concepts of responsible medication usage.[2] And monitoring and counseling systems seek to remind patients to take medication and reconcile difficulties encountered with that goal.2 Clearly, of the main initiatives proposed, scientific literacy and personal accountability are the basis. However, patients must also assume the mantle of responsibility as limited healthcare resources (time, money, staffing) all act to limit effectiveness of the above interventions. [1,2]

Overall

Although antibiotic resistance has gone under the radar for nearly a decade, it is now being put under the microscope. The determinants of antibiotic adherence and efficacy are numerous, however the most easily controlled are on the policy and decision-making level. Social and personal accountability for education and proper adherence to prescriptions is a step in the right direction to curb the spread and development of antibiotic resistant microbes. To spare overwhelming costs, prevent loss of life, and to preserve the integrity of medical practice as we know it, education will be an essential component of the toolbox of international medical organizations. It is now the role of science and education to reduce further preventable loss of life.

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