Impact of Vaccine on Antimicrobial Resistance

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Abstract: **- The antimicrobial agents and vaccines are playing a critical role in fighting infectious diseases. The impact of both the vaccines and antimicrobial agents has been phenomenal across the globe in reducing mortality and morbidity rate, thus being hailed as the greatest accomplishments of modern medicine. Both the vaccines and the antimicrobial agents commonly known as the antibiotic act against causative agents of the infectious disease in different ways. The antimicrobial agents are therapeutic tools while the vaccines are the preventive tools thus the latter is more of benefits since the prevention is better than the cure. Antibiotics are short acting tools while the vaccines have the long term impact and memory. The combination of these tools are beneficial in containing and fighting antimicrobial drug resistances incidences. Antimicrobial resistance is one of the major challenge of the public health globally, many people dies everyday due to antimicrobial resistance which is based on the two major mechanism that is the survival instinct of bacteria and indiscriminate use of antibiotics. The survival tactic of the bacteria generates several mechanism in bacteria that conferred resistance to the antimicrobial agents. This may also happen rapidly and cumulatively giving rise to multi- antibiotic resistance variance. The study paper aimed to identify antimicrobial resistance, its public health implications and the role played by vaccines in reducing antimicrobial resistance. It was noted that vaccines play a critical role in reducing the impact of the antimicrobial resistance thus the appropriate use of the vaccines has successfully demonstrated the reduction incidences of antimicrobial resistance, however, Multi-disciplinary approach is required for progressive alternative strategies including probiotics, antibodies, and vaccines that have shown promising results in trials that suggest the role of these alternatives as preventive or adjunct therapies in future.**

Keywords: **antimicrobial resistance, vaccines, antibiotics.**

I. INTRODUCTION

The antimicrobial resistance has been recognized as one of the major challenge of our time by the World Health Organization, antimicrobial agents also known as the antibiotics are designed to kill or inhibit the growth of disease causing pathogens, however many of these antimicrobial agents have become increasingly ineffective due to emerging resistance by the targeted bacteria, viruses, protozoa or fungi. It has been evident that the selection pressure naturally contributes to the emergence of resistance whenever pathogens are exposed to agents which are meant to kill them or stop their growth, the resistance can be spread to other pathogens or pathogens can also develop resistance to multiple microbial agents.

The antimicrobial resistant is a leading global threat of the 21st century, even though there has been tremendous efforts by scientist to developed improved and novel antibiotics the problem still persist. Antibiotics are always accepted as an essential part of everyday health care not only in hospitals but also in the communities we live in. many medical procedures such as the major surgery, cancer therapy, organ transplant, neonatal care are not possible without the use of antibiotics. Currently antimicrobial resistance incidences are increasing globally at an alarming pace. It has been documented that in many instances resistance often occurs within months of the introduction of new antibiotic, the resistance incidences rates normally surpass drug discovery and development of novel antibiotics. The globe is now faced with the real possibility of a return to era of non-treatable infections and escalating healthcare cost.

The antimicrobial resistance is not a recent phenomenon, however it is a critical health concern issue globally. Over several decades pathogens causing diseases have developed resistance to each new antibiotic thus with the dearth of new antibiotics coming to the market, the need for immediate action to avert the crisis is increasingly urgent. The ever increasing threat that the antimicrobial resistance presents to humanity is demonstrated by published international data which are validating an increasing incidences of antimicrobial resistance pathogens responsible for infections in the healthcare facilities and in the community, this increment is at an alarming rate at varying levels in different parts of the World. The situation is exacerbated by the potential of microbes to share genetic material and pass on the resistance genes.

The introduction of antimicrobial resistance is determine by a complex interaction of environmental, epidemiological, clinical and behavioral factors, there is overwhelming evidence that the use or overuse of antibiotics has been a powerful contributor of resistance. When antibiotics were first introduced in the 1930s, they were regarded as miracle drugs because they brought about significant reductions in mortality due to bacterial diseases that had high fatality rates, offered faster recovery from infectious illnesses and were used extensively during World War II to treat injuries. Antibiotic use then expanded into prophylactic applications, where antibiotics are given to prevent an infection – for example, during surgery, when normally sterile body tissues are exposed to non-sterile areas such as the mouth or gut. With the advent of transplant surgery that requires artificial immunosuppression of the patient to prevent rejection of the transplant, antibiotics became essential for preventing and treating infections in people with poor immunity. However, within several years of the introduction of antibiotics, bacteria began to develop mechanisms to combat the antibiotics in use. In the presence of the antibiotic, these bacteria gained a selective advantage and then became predominant in the

changed environment. Bacteria have a number of mechanism of sharing genetic material, this may also happen between unrelated species, thus further expansion of the resistant strains.

II. IMPACT OF ANTIMICROBIAL RESISTANCE ON PUBLIC HEALTH

The antimicrobial resistance has been defined as unresponsiveness or ineffectiveness of the antibiotic or antimicrobial agents when administered in standard doses. The antimicrobial resistance has serious implications for a patient, medical practitioners and health system, the negative impact are also huge at the globally, and adversely impacting human development (1).

The antimicrobial resistance is rising to dangerously high level in many parts of the continents. It has also been noted by researchers that new resistance mechanisms are emerging globally, thus threatening our ability to treat common infectious diseases. Some of these disease incidences are becoming harder and more difficult to treat as antimicrobial agents are becoming less effective (2). The another bigger challenge associated with antimicrobial resistance in developing country is the usage of medicine procured for human and animal use, this is due to lack of standard treatment guidelines thus antibiotics are often over-prescribed by health practitioners. This may lead us to a post antimicrobial agent's era.It is noted that the crisis of antimicrobial resistance has been associated with the misuse of the antibiotics, comprehensive efforts are needed to minimize the pace of resistance by researching on the emerging microorganism, resistance mechanism, and antimicrobial agents (4). Combating antimicrobial resistance has been recognized as a priority for global public health, WHO, in 2015 issued a global action plan on antimicrobial resistance and urged countries to formulate their own plan to help fight the scourge. One of the key aspect of the WHO action plan is that information about antimicrobial resistance such as the incidence, prevalence rate, geographical distribution is still inadequate therefore, urgently needed(5).The global action plan on antimicrobial resistance call for a strategic road map to combat antimicrobial resistance. This incorporated surveillance, awareness, rational use of antibiotics, infection prevention and control and research. It also emphasizes on implementing all those measures that reduce the burden of infectious diseases thus vaccines can play a critical role in reducing the burden of diseases as well as that of resistant pathogens.

III. POTENTIAL ROLE OF VACCINES IN COMBATING ANTIMICROBIAL RESISTANCE

The vaccines have a potential in combating antimicrobial resistance and this can be directly or indirectly by reducing the burden of pathogens, diminishing virulence of pathogens, transfer of genetic material encoding resistanceand conferring herd protection even in unvaccinated populace thus the spread of antimicrobial resistance infections are restricted (6). Through these initiatives, vaccines significantly reduce the use of antibiotics by prevention of both bacterial and viral infections such as measles, influenza, varicella and many others for which bacterial secondary infections are predominant. Vaccines have also played significant impact by reducing the misuse of antibiotics by preventing viral diseases; in which antibiotics are inappropriately prescribed.To mention some of the few instances where vaccines have played a significant role in combating antimicrobial resistance; bacterial meningitis and related diseases due to Neisseria meningitidis, Haemophilusinfluenzae and Streptococcus pneumoniae have been dramatically reduced in several countries with significant coverage with respective polysaccharide vaccines that have been conjugated with products of diphtheria or tetanus bacteria to induce longer and stronger immunity (7). A vaccine was created using the diseases causing strain of meningococcussero group A and used extensively in several African countries. It reduced meningitis due to the serogroup A, N. meningitidis by 99% in the countries that opted to use it to immunise younger children (8). Rigorous work has also been done and documented to demonstrate the impact of pneumococcal conjugate vaccines (PCVs) in reducing the prevalence of diseases due to this organism, reduction in the use of antibiotics and drug-resistant pathogens. With a vaccine coverage of 94%, Iceland showed a high efficacy of the vaccination on vaccine serotypes. It also demonstrated a milder effect on vaccine-associated-serotype 6A. Importantly, there was a significant herd effect on vaccine types in older non-vaccine-eligible children (9).

Typhoid fever continues to be a major global public health problem, especially in developing countries. Appearance and accumulation of resistance to commonly used and affordable antibiotics are making its management challenging. It is estimated that around 15 million cases of typhoid fever occur every year and multidrug resistance has been rampant in typhoid bacilli and is likely to accentuate in days to come. The WHO opines that the multidrug-resistant typhoid bacilli cause more severe illness, greater mortality and prolonged asymptomatic carrier status, the three vaccines are currently available against typhoid fever. These include an oral Ty21a vaccine and an injectable which comprises Vi polysaccharide thus there is a dire need to deploy these vaccines in the national immunization programmes in enteric fever endemic countries to reduce the burden of typhoid fever as well as drug resistance associated with it.Measles has been responsible for significant morbidity and mortality, mainly because of secondary bacterial infections of the gastrointestinal and respiratory tract, many of which may be due to antibiotic-resistant pathogens. It's also evident that without measles vaccination which is considered to be one of the most effective health interventions ever developed, five million children would die each year from measles (10).

Viral ARIs influenza vaccines not only prevent viral pathogenesis but also prevent secondary bacterial infections as well as the administration of antibiotics. A study conducted

in Canada demonstrated that influenza-associated antibiotic prescriptions declined by >64% after the introduction of influenza vaccination in Ontario, Similarly, in a multicentric trial in Europe, 50% reduction in antibiotic use was observed in children receiving influenza vaccine vis-a-vis unvaccinated controls (11). Thus the role of vaccines in reducing the burden of infectious diseases and antibiotic-resistant pathogens has been well established. However, vaccines are not available for several important pathogens.

IV. CONCLUSION

The United Nation Sustainable Development Goals having recognized the importance of antimicrobial resistance and articulated it in the sustainable development goals, governments need to develop and harmonize national policies and plans that are implemented through sustainable financing and are based on the WHO global action plan on antimicrobial resistance. The national action plans should aim at improving awareness, strengthening of critical national capacities, such as surveillance, infection prevention and control, optimal use of antibiotics and immunization for both people and animals. Lastly the battle to combat antimicrobial resistance requires countries to allocate adequate financial resources to sustained and implement effective strategies to combat antimicrobial resistance.

CONFLICTS OF INTEREST

There were no conflicts of interest in reproduction of this review article.

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