Vaccination as an Approach to Combat Antibacterial Resistance

Mini Review

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The discovery of antibiotics is considered a significant event in the medical history saving millions of lives. The application of antibiotics extents from antibacterial activity to immuno suppressive agents, cardiovascular disease as well as anticancer [1]. It is also used widely in agricultural and animal husbandry. More than 100,000 tons of antibiotics are produced globally per year [2]. For decades efforts have been taken to control the wide over-usage of antibiotics such as through regulatory control on the availability of Over the Counter (OTC) antibiotics. However, such measure are still infective and antibiotic are available without prescription online and through self medication [3,4]. In addition, there are reports that certain pharmaceutical companies from industrialized nation distributes the drugs which are no longer approved by their home nation [5]. The increased use of antibiotics can also be attributed to the greed for revenue by pharmaceuticals sales. In developing countries, the revenue generated on drugs sale are often shared between the seller and the doctor [6]. The wide usage of antibiotics increases the selective pressure for the multi-drug resistant bacteria [5,7,8]. *B-lactamases* are enzymes which renders resistant to β-lactam antibiotic to the bacteria expressing the enzyme. At present, there are about a thousand types of resistance-related β-lactamases [5,9-13].This give a rough picture of the diversity that bacteria possess to fight against the drugs we currently use. Intense and regular usage of antibiotics in hospitals have led to nosocomial (hospitalacquired) infections which has turned into a global health challenge. One such infectious agent is *Staphylococcus aureus (S. aureus)* which has developed resistance rapidly to many antibiotics. By 1944, just four years after the introduction of penicillin, *S. aureus* strains resistant to penicillin had emerged and were prevalent by 1950s [14]. So far, *S. aureus* has developed resistance to Erythromycin, chlortetracycline and chloramphenicol, methicillin (MRSA), vancomycin (VRSA) and daptomycin [15-18]. Streptomycin was initially used to treat Tuberculosis; however, multi-drug resistant *Mycobacterium tuberculosis* strain in the current days ranges from XDR (Extremely drug-resistant) strains to TDR (totally drug resistant) strains [19]. Bacteria has been shown to acquire resistance to antibiotics is a very short time period; *Escherichia coli* was shown to gain resistance to ciprofloxacin in a matter of 10 hours [20] Novel metabolites such as Gepotidacin [21], cathelicidin [22], Rhodethrin [23], Rubrivivaxin [24], etc were discovered in the recent past showing promising antimicrobial activity. However, as discussed previously, resistance to any antibiotic is only a matter of time. Hence, there isa nurgent need to tackle the current multidrug resistant pathogens. Vaccines are of biological origin which provides acquired immunity to the body. It relies on body's ability to remember how to defend itself against foreign agents from a previous attack by the same pathogen. Application of vaccines can directly reduce the need of antibiotics against the pathogen and indirectly against other pathogens by avoiding super-infections [25]. The ability of vaccines to provide herd immunity has eradicated polio and other deadly diseases such as measles [26]. Unlike antibiotics, there have been no reports on bacterial resistance to vaccines. Vaccines also does not exert massive selective pressure on the environment [27]. However, those serotypes not covered by the vaccines could spread at a higher rate such as the seven-valent pneumococcal conjugate vaccine (PCV7) against *Streptococcus pneumonia* [28-30].The advent of the omics field has given rise to vaccinomics [31,32] which is based on high throughput Next Generation Sequencing (NGS) and robust bioinformatics pipelines technologies. Such technologies aims to solve the problem related to hyper variable virus and to developed personalized based vaccines. In addition, the human gut micro biome project [33] could lead to other therapeutic options [34]. The advent of new technology could help to reduce the cost of vaccines. Hence, the possibility to combat against the disease previously failed and affordable to the undeveloped countries with the aim to eradicate deadly Vaccine-preventable diseases (VBDs) [35-38].

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