Evolution: Mankind with Microbes

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Dear Sir,

"Nothing in Biology Makes Sense Except in the Light of Evolution"

Today the foundation of the neo-Darwinian synthesis that Dobzhansky helped engineer has grown into one of the central pillars of modern biology and underlines the essentiality of considering biological processes from an evolutionary viewpoint [1]. Mankind and microbes have coexisted in competitive equilibrium since long before recorded history. Every part of the body in contact with the environment possesses a thriving population of bacteria that normally cause no harm. About 100 thousand billion bacteria live in or on the average adult human [2]. In fact, microbial cells outnumber human's own cells. The collective genome of the microbiota, the 'microbiome', contains 100–150 times as many genes as the human genome [3]. The microbiome plays important roles in multiple core aspects of human biology, including digestion and energy metabolism, immune development, neurological function and infectious disease susceptibility [4]. In spite of this, humans are always at risk for the various fatal and non-fatal infections; sometimes sporadic, sometimes causing many people to suffer in epidemics and in devastating pandemics. Outbreaks of influenza, plague, cholera are some of the examples from the history. It was much difficult at that time to control morbidity and deaths due to these infections. But in recent times, we have evolved much by the extensive research in pharmacology. Discovery of antimicrobial drugs revolutionized the modern medicine. Vaccination gave novel approach to use microbes and their products to develop immunity against them. Implementation of public health measures like pasteurization of milk, purification of water, hand hygiene, avoidance of high risk behaviour significantly decreased burden of infections on humanity. Unfortunately, shortly after the clinical introduction of antibiotics, microbial resistance began to appear in literature [2].

Nowadays, multidrug resistant organisms like MRSA, ESBLs, XDR-TB etc. are emerging which proves that microbes are evolving fast for their survival. Our irrational use of antibiotics not only in human disease but also in agriculture, veterinarian and industrial area is also responsible for this resistance problem up to much extent. Of course, as like we humans are evolving to face the microbial disasters, the microbes also evolve to face the antibiotic disaster. It was never

surprising, it rather rationalize the situations in which the survival of the fittest microbe is obvious. Their various ways to inactivate antibiotics are inactivation through enzymatic attack, enhanced production of target enzymes, self-modification of pathways & structures, decrease in uptake and increase in expulsion of drugs and many more. The diversity of these modes makes finding a universal solution to the resistance problem extremely difficult. Moreover, rapidity with which bacteria reproduce is an important factor in their evolution. This growth rate makes them adjust much more rapidly to threatening changes in environment than mankind [2].

Considering all these aspects, battle with them by using these armours will not be fruitful in long term. Along with implementing antibiotic stewardship, we need new approaches. Coexistence with them rather than competitive existence with them will solve the problems to some extent. Research on the factors responsible for disturbing the co-equilibrium between man and microbe might be fruitful. The human microbiome is recognized as a powerful vector for therapeutic interventions because it is easily manipulated and highly responsive. Moreover, in addition to playing an important role in maintaining general health, the microbiome also impacts drug efficacy and the effectiveness of chemotherapy treatments [4]. Human microbiome project is a big step towards this new approach which will invent a lot of novel unforeseen approaches [5].

New approaches in developing good immunity at early life stages are needed so that from the beginning of life, we establish good coexistence with microbes. Vaccination, probiotic intake and hygiene hypothesis [6] are some of the approaches regarding that. Many unforeseen approaches we can search on for this. Refining our gene pool by various modern genetic technologies will also be the revolutionary approach. Many researches are on-going for modifying our immune cells, and stem cells. Survival of the fittest is the only evolutionary mechanism in microbes. But we, mankind as most intelligent species can study, research, explore and develop new approaches for the survival. But, as we know microbial cells on our body outnumber our own cells, research on modifying the gene pool of our "friend" microbe to combat with our "enemy" microbe will be better option to face these problems. We can let their evolution help in our evolution. We can make them produce good products for us to kill or to rather modify their notorious friends. As like in the history, war will be beneficial neither to mankind nor to microbes. This war will never cease. To deal with this, microbiologists', molecular biologists', evolutionary biologists' and biotechnologists' collaboration and intensive exploration of co-evolution of man and microbe is the need of time.

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