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A POSSIBLE MODELLING OF PARAMETERS INTERACTION OF ENVIRONMENT IMPACT AND HEALTH

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ABSTRACT

Microbial pathogens include bacteria, viruses, fungi, and parasites and together account for a significant percentage of acute and chronic human diseases. In addition to understanding the mechanisms by which various pathogens cause human disease, research in microbial pathogenesis also addresses mechanisms of antimicrobial resistance and the development of new antimicrobial agents and vaccines. Answering fundamental questions regarding host-microbe interactions requires an interdisciplinary approach, including microbiology, genomics, informatics, molecular and cellular biology, biochemistry, immunology, and epidemiology. erplay between host and microbe. Studies investigated the direct effects of pollutants on respiratory tract infections are very vast, but those interested in the role of a pre-existing disease and effects of the exposure on the response to secondary stresses are few. In an experimental study at concentrations of air pollutants found in urban environments, frank toxicological responses are rarely observed; however, exposure to a secondary stress like respiratory challenge with infectious bacteria can exacerbate the response of the experimental host.

KEYWORDS: Microbial pathogens, antimicrobial agents and vaccines, epidemiology.

Life and Environment

Environmental pollution is defined as the undesirable change in physical, chemical and biological characteristics of our air, land and water. According to the essential concepts of ecology, any form of life could be called as “an ecosystem” provided that the two domains of factors are present: the first part named as the “ biotic factors”, this include: producers, consumers and decomposers. The second part of an ecosystem is the "abiotic factors" representing chemical and physical factors.[1]

Organisms interact among themselves. Hence, all organisms, such as plants, animals and human beings as well as the physical surroundings with whom we interact form a part of our environment. All these constituents of the environment are dependant upon each other, thus, they maintain the balance in nature.[2] As the environment is the supplier of all forms of resources and the wastes are cleaned up by the environment itself, it maintains the genetic diversity stabilizes the ecosystem.[3]

The environmental imbalance gives rise to various environmental problems. Some of the environmental problems are pollution, soil erosion leading to floods, salt deserts and sea recedes, desertification, landslides, change of river directions, extinction of species, depletion of natural resources, waste accumulation, deforestation, thinning of ozone layer and global warming[4] The environmental problems are visualized in terms of pollution, growth in population, development, industrialization, unplanned urbanization etc. As a result of over-populations, rapid industrializations, heavy industries, and other human activities like agriculture and deforestation etc.(Figure 1), earth became loaded with diverse pollutants that were released as by-products.[5]

Self Purification of Environment and Balance of Nature

In spite of receiving large quantities of pollutants, which some times strongly affected the stability of ecosystems, most of times, nature have the ability to get back it's previous stable state via multiple mechanisms, this recovery often depends on kind and rate of pollutants, generally, pollutants are grouped under two classes.[6]

a-Non-Biodegradable pollutants: Non-biodegradable pollutants are stronger chemical bondage, do not break down into simpler and harmless products. These include various insecticides and other pesticides, mercury, lead, arsenic, aluminum, plastics, radioactive waste etc.[7]

b- Biodegradable pollutants: Biodegradable pollutants are broken down by the activity of micro-organisms and enter into the biogeochemical cycles. Examples of such pollutants are domestic waste products, urine and faecal matter, sewage, agricultural residue, paper, wood and cloth and even oil.[8] The process by which organisms act to breakdown oil spillage is called “bioremediation”. It is the process done by many kinds of living organisms like plants, fungi, and bacteria. In the recent years, new techniques applied to get rid of hazardous pollutants, for example: spots of oil leaked through oil transporting or production processes can be treated by distinct genera of bacteria which have been collected, bred in vast quantities and stored in powder form to be used to clean up oil spills.[9] On the other hand, presence of heavy metals in air, water or in soil at ratios more than allowable levels could be considered as one of the most dangerous kinds of pollution due to their carcinogenic properties beside accumulation in living organisms. As microorganisms represent the heaviest ring in the chain of living organisms.[10] It becomes very logical to focus on the effect of such pollutants on this kind of organisms, especially, large number of bacteria causing serious disease to the human and his domestic animals and plants. As the high levels of heavy metals known to be toxic to microorganisms, they develops different mechanisms to resist higher concentrations of such metals ,thus they defend their existence in the nature, eventually , they kept their role in the environment.[11]

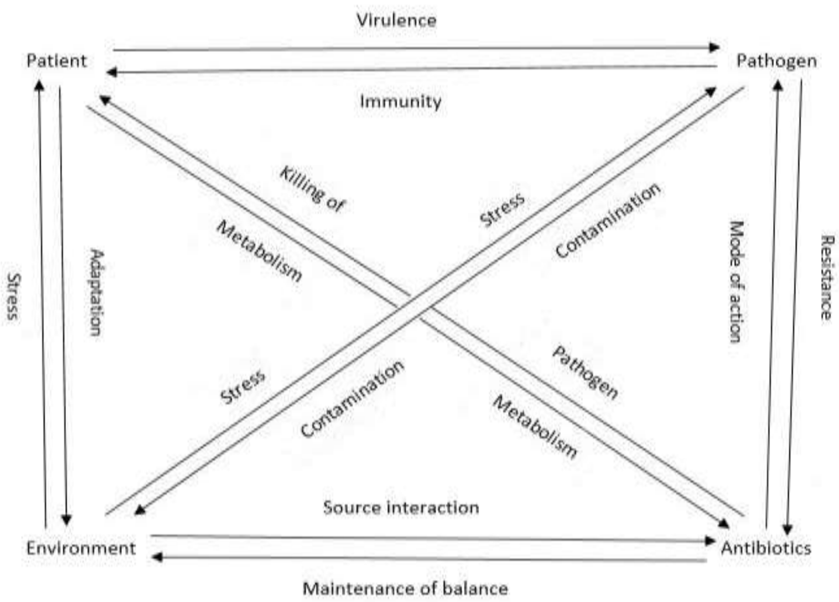

Figure 1.Modeling of pathogenecity parameters.

Interrelationship between Respiratory Tract Infections and Oil Refinery Pollutants

Studies investigated the direct effects of pollutants on respiratory tract infections are very vast, but those interested in the role of a pre-existing disease and effects of the exposure on the response to secondary stresses are few. In an experimental study at concentrations of air pollutants found in urban environments, frank toxicological responses are rarely observed;

however, exposure to a secondary stress like respiratory challenge with infectious bacteria can exacerbate the response of the experimental host.[12]

The relationship between exposure to air pollutants and the resistance to respiratory infections has been investigated on mice. The gaseous pollutants included in that study are ozone and nitrogen dioxide, and the experimental group is artificially infected with *Streptococcus pyogenes* and *Klebsiella pneumoniae* and previously they are exposed to different concentration of those gases, while the control group also infected with bacteria but let to breathe filtered air. The results showed higher rates of death and shorter time of survival in the experimental group.[13]

Chronic inhalation of metal particles leads to a lower respiratory tract response characterized by an accumulation of mononuclear and polymorphonuclear phagocytes, epithelial cell damage, and interstitial fibrosis.[14] Other study shows that sheep obligated to inhale inorganic dust for 2 weeks/ month for 18 months results in priming lung inflammatory cells and markedly enhanced their capacity to release toxic oxygen radicals.[15] Mononuclear phagocytes (MPs) recovered from healthy subjects are strongly inhibitory for cytotoxic lymphocytes, thus, natural killer (NK) cells and several phenotypes of T cells become dysfunctional after contact with autologous MPs and eventually enter a suicidal program of apoptosis.[16] NK cells are more sensitive to this suppressive signal than other subsets of cytotoxic lymphocytes.[17] Studies on the mechanisms responsible for the triggering of lymphocyte dysfunction by MPs have demonstrated a pivotal role for reactive oxygen species.[18] Although phagocyte derived oxidants play an essential role in defending the lung against inhaled microorganisms, they can also inactivate extracellular proteins such as alpha-i-antitrypsin induce lipid peroxidation in cell membranes cause cytogenetic injury and mediate cell death.[19]

Bacterial Resistance to Antimicrobial Agents

Antimicrobial agent: A general term for drugs, chemicals, or other substances that either kill or slow the growth of microbes. Among the antimicrobial agents are antibacterial drugs, antiviral agents, antifungal agents, and antiparisitic drugs.[20] The two domains of most frequent in studies are the antibiotics and heavy metals. Many of them have shown a correlation between metal tolerance and antibiotic resistance in bacteria because of the likelihood that resistance genes to both (antibiotics and heavy metals) may be located closely together on the same plasmid in bacteria. Thus more likely to be transferred together in the environment.[21] The bacterial resistance against heavy metals will be discussed in the next item.

The intensive use and misuse of antibiotics have resulted in antibiotic resistance among several human pathogens. They reduce the possibilities for infections treatment and jeopardizing medical procedures such as organ transplantations or implants of prostheses where infective complications are common and antibiotic therapy is needed to prevent or treat those infections.[22] There are two main mechanisms involved in the development of antibiotic resistance, namely mutation[23] and acquisition of resistance genes[24] by horizontal gene transfer (HGT). Human pathogens are susceptible to antibiotics before the use of these drugs for the treatment of infections. The origin of antibiotic resistance determinants acquired by HGT must necessarily lay in the non-pathogenic microbiosphere. In some instances, human commensals can provide antibiotic resistance to pathogens.[25] However, in most cases, the antibiotic resistance genes have originated in the environmental microbiota.[26] The term antibiotic is originally coined to the name of those compounds produced by micro-organisms and capable of inhibiting bacterial growth.[27] Although any type of drug (natural or synthetic) used for treating bacterial infections is frequently termed as an antibiotic nowadays. Since several antibiotics are produced by environmental bacteria, it is conceivable that antibiotic-producing organisms could be the origin of HGT-acquired antibiotic resistance genes because these micro-organisms must have systems to avoid the activity of the antimicrobials they produce.[28] It is clear that antibiotic resistance genes originated in environmental bacteria so that changes in natural ecosystems may impact upon antibiotic resistance and consequently human health. Among those changes, the release of antibiotics together with human-linked microbiota eventually containing antibiotic resistance genes can be particularly important for the future evolution of antibiotic resistance in pathogenic bacteria.[29] Because of the prevalence of antibiotic resistant pathogenic bacteria, infectious diseases are becoming more difficult and more expensive to be treated.[30]

Environmental monitoring of microbial contaminants is important for crew health and assessing functionality of engineering systems. Routine monitoring of air and surfaces on the International Space Station found *Staphylococcus spp*. to be the most common bacterial species whereas *Aspergillus spp*. were the most common fungi. The levels of microbial contaminants in the air and surfaces were typically low and within the acceptability limits. Bacterial levels in the potable water from the hot water port were uniformly low. Levels in water from the warm port and the SVO-ZV water distribution system exceeded acceptability limits on occasion. *Methylobacterium* spp. And *Ralstonia spp*. was the bacteria most commonly isolated from the potable water systems. The space environment, stress, and other factors may also diminish the host immune system. The status of antimicrobial functions of neutrophils and monocytes was determined by flow cytometry. Shuttle astronauts had decreased functionality of NK cells, neutrophils, monocytes, and changes in other elements of immunity. Latent virus reactivation is an important new approach to assessing immunity and can be monitored in body fluids collected during space flight. Reactivation of Epstein-Barr virus (EBV), cytomegalovirus (CMV), and varicella-zoster virus (VZV) was determined by a polymerase chain reaction assay to detect viral DNA. Space flight resulted in increased incidence of EBV and CMV shedding and an increased number of copies of EBV DNA, and the incidence of VZV reactivation increased in astronauts during and after flight. Increased plasma levels of virus-specific antibodies substantiated reactivation of EBV, CMV, and VZV. Increases in cortisol and catecholamines were consistent with elevated stress levels. Cytokines indicative of viral reactivation were elevated. These data indicate that space flight is a unique stress environment that may produce stress- induced changes in immunity that jeopardize the host-microbe relationship induced changes in immunity that jeopardize the host-microbe relationship.[31]

Fresh water bodies particularly rivers always considered as a main source of drinking and relevant human uses for maintenance of life. These natural water bodies usually under stress of environmental pollution including chemical, physical and biological aspects that might turn the nature of these waters to be risky for human beings uses. Environmental stress as well as human population growth associated with an increased industrial and civilian activities can all cause a damage for the natural water quality that might be necessary for human needs which lead to continuous environmental survey and assessment to reveal the degree of pollution impact particularly on raw water sources like rivers, lakes, springs and deep wells waters i.e. ground waters . Raw water quality can be assessed using various parameters particularly the bacterial indicators of biological pollution . Chemical and physical factors affecting water quality have been utilized for evaluation of degree of pollution and these included oxygen biological demand, turbidity, electrical conductivity, temperature, and pH of waters under investigations.[32]

CONCLUSION

It was quite clear from the proposed modelling that microbial pathogenicity was a complex process including pathogen, immunity, environment and antimicrobial agents. There were secondary factors related and interacted with pathogenicity primary factors as pollution, disturbance of environmental balance, stress of both man and pathogens and any defect in immunity or inactivation of antibiotics.

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