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Short Communication

# Changing Landscape of Infectious Diseases - Challenges Ahead

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The Dutch botanist van Leeuwenhoek (1632-1722) revealed the presence of microorganisms through his miniature lenses with a resolution of 1.5μm and this evidence was subsequently realized when Robert Heinrich Herman Koch, a German physician and microbiologist, made some postulations (Koch's postulates) in 1880s and tested those while working with slow growing *Mycobacterium tuberculosis* using guineapig as the model. He conclusively proved microorganisms as the cause of infectious diseases. By 20th century, most of the scientific work by various scientists essentially concentrated in deciphering the nature of infectious diseases and their modes of transmission that led to discovery of increasing number of pathogens. Viruses, chlamydiae and ricketssiae were also identified those were not possible to propagate in pure culture. Since then infectious diseases have been responsible for the largest global burden with several global pandemics of smallpox, influenza and cholera. Subsequently, both intellctual and technologic advances paved the way for increased capacity in detecting, diagnosing and monitoring of many infectious diseases. Serological testing offered an indirect approach for the diagnosis of many infectious diseases. However, the most significant advances since the time of Koch's postulates were the development of molecular assays that used nucleic acid as the source of genetic information to characterize microorganisms. The use of nucleic acid based tests and sequencing techniques have not only made it possible to characterize the causative agents of previously unknown diseases (e.g., Hepatitis C, Hantavirus) but also have the capacity to track the transmission of new threats. Development of cell culture in the 1930s paved the way for large-scale production of live or heat-killed viral vaccines and global commitment to immunize children against the major infections has certainly reduced under-five mortality. Adult immunizations have also made its presence felt in recent times. Strategic vaccination campaigns have virtually eliminated diseases like small pox and wild poliovirus. The success of vaccine-preventable diseases has in turn provided impetus for developing vaccines against immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), tuberculosis (TB), malaria and many other diseases.

The success story of infectious diseases was hampered in due course due to many emerging factors. Industrialization and globalization, trade and travel have connected most points on the globe in a matter of hours. All these led to immigration, overcrowding especially in developing countries and resulted in repeated outbreaks of cholera, dysentery, TB, typhoid fever, influenza, yellow fever, and malaria. Further, living along with companion birds (Chicken, ducks) and animals (pigs) have further created the ideal scenario for creating and spreading dangerous microbes duly assisted in many cases by man-made factors (land use) and climate change (temperature, rainfall, humidity).

Antibiotics have been in use for many years, however, the emergence of drug resistance in many organisms have made therapeutic agent inefficacious. Antimicrobial Resistance (AMR) and in particular bacterial resistance has surfaced as the major challenge and multidrug-resistant (MDR) pathogens are spreading very rapidly. Well known resistance carriers with high clinical impact include the Gram-positive organisms (*Staphylococcus aureus* and *Enterococcus* spp). Gram-negative bacteria especially have developed resistance to most or all available antibiotics. The problem of resistance and the paucity of new antibiotics has led to the nearly pan-resistant gram-negative infections (*Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa and Acinetobacter* spp.) Risk factors for infectious diseases in patients with immunocompromised conditions and in individuals receiving immunosuppressant therapy

has been progressively increasing; Emergence of new pathogens (Ebola and Zika), emergence of pandemic zoonotic vial infections severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and co-infections are other associated tenet of infectious diseases. Frequency and importance of emerging co-infections (*Pneumocystis jirovecii* and Cytomegalovirus: *Legionella pneumophila* species and *Acanthomoeba* species) must be understood as these infections can modulate immunity and course of the disease.

With theses changing landscape, for continued success in controlling infectious diseases, all countries must prepare to address diverse challenges, including drug resistance, the emergence of new infectious diseases, re-emergence of old diseases and preparedness for epidemics and outbreak response. These can be achieved by improved capacity for disease surveillance at all levels of health care system. It has been envisaged that drug-resistant infections may (will) kill more people by 2050 than cancer and diabetes combined by the year 2050, worldwide. Ongoing research on development of effective therapeutic agents, vaccine and possible immunotherapies are warranted. For viral infections relatively few antiviral drugs have been developed hence it is necessary to break the chain of transmission.

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