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## A Review about Emerging Infectious Diseases

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### Review Article

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### ABSTRACT

Infection is the invasion of an organism's body tissues by disease-causing agents, their multiplication, and the reaction of host tissues to these organisms and the toxins they produce. Infectious diseases are disorders caused by organisms — such as bacteria, viruses, fungi or parasites.

### INTRODUCTION

Infectious diseases are also known as transmissible disease or communicable disease, is illness resulting from an infection. An emerging infectious disease (EID) is an infectious disease whose incidence has increased in the past 20 years and could increase in the near future. EIDs are caused by newly identified species or strains. The common emerging and re-emerging diseases are Acanthamebiasis, Australian bat lyssavirus, Bartonella henselae, Ehrlichiosis, Drug resistant tuberculosis, Nosocomial infections etc. [1-3].

Emerging infectious diseases may be waterborne diseases, vector borne diseases, air borne diseases etc.

#### Waterborne diseases

Water and climate are very closely linked. The excessive precipitation results in flooding which is a major cause of water-borne diseases viz. cholera, diarrhoea, typhoid, leptospirosis, hepatitis and even tetanus [3,4].

#### Vector borne diseases

The vectors are the insect carriers' viz. mosquitoes, ticks, lice, fleas and flies etc. that spread the germs to the humans or animals. These vectors transmit a number of deadly diseases viz. malaria, dengue fever, yellow fever, equine encephalitis, Japanese encephalitis, west Nile fever, rift valley fever, louping ill, three day sickness, blue tongue, Q fever, ehrlichiosis, endemic thypus, bubonic plague, anaplasmosis, babesiosis, theleriosis, trypanosomiosis, leishmaniosis, tularemia, vesicular stomatitis, lyme disease etc.

Emerging infectious disease is an important concern in medicine. It usually causes problem in diagnosis and treatment. Emerging infectious disease can be seen at any time. However, in some specific situations, emerging infectious disease becomes more complicated. Infectious diseases emerging throughout history have included some of the most feared plagues of the past.

## NEUROINFECTIOUS DISEASES

Neuroinfectious Diseases is a medical specialty journal which facilitates scientific research on neurophysiology, prognosis, diagnosis and treatment of neurological infections that are caused by bacterial or viral infection that affects the nervous system. There are four main causes of infections of the central nervous system (CNS): bacterial, viral, fungal and protozoal.

Fungal: Cryptococcal meningitis, Brain abscess, Spinal epidural infection

Protozoal: Toxoplasmosis, Malaria, Primary amoebic meningoencephalitis

Bacterial: Tuberculosis, Leprosy, Neurosyphilis, Bacterial meningitis, Late stage Lyme disease, Brain abscess, Neuroborreliosis

Viral: Viral meningitis, Eastern equine encephalitis

St Louis encephalitis, Japanese encephalitis, West Nile encephalitis, Herpes simplex encephalitis, Rabies, California encephalitis virus, Varicella-zoster encephalitis, La Crosse encephalitis, Measles encephalitis, Poliomyelitis, Slow virus infections, which include: Subacute sclerosing panencephalitis, Progressive multifocal leukoencephalopathy, Acquired immunodeficiency syndrome (AIDS).

The host response to pathogens has 2 parts, the innate and adaptational responses. The innate system includes anatomical defenses that prohibit infectious agent invasion, the complement system and myeloid cells that initial sense and attack to pathogens. Neutrophils, monocytes, basophils, eosinophils and MCs are cells of myeloid lineage and beside natural killer cells, they're concerned in innate immune responses. These cells find and reply to pathogens inside the blood. On the opposite hand, tissue macrophages that are of myeloid origin residing inside tissues, could also be the primary to encounter pathogens. These cells unleash chemotactic signals as a determinant of infectious agent activity therein tissue and promote the transition of current leukocytes into the realm of infected tissue. In fact, resistance, by itself, could also be scarce to guard a number against Associate in Nursing invasive infectious agent or to forestall unwellness from occurring. However, if resistance fails, the organism could also be detected and attacked by the mechanisms of adaptational immunity.

On the opposite hand, the adaptational immune responses involve lymphocytes that target to destroy pathogens and their toxicant molecules. It's crucial that they attack solely in response to molecules that are foreign to the host and to not the molecules of the host itself. The flexibility to tell apart 'foreign' from 'self' during this manner may be an elementary feature of the adaptational system. There are 2 categories of such responses: 1- protein responses that are administered by B lymphocytes, 2- cell-mediated immune responses that involve T cells. In protein responses, B lymphocytes are activated to secrete antibodies, known as immunoglobulins. The antibodies flow into within the blood and permeate the opposite body fluids, wherever they bind specifically to the foreign matter that aroused their production. protein binding inactivates viruses and microorganism toxins (i.e. tetanus toxin) by interference their ability to bind to receptors on host cells. Binding of protein conjointly marks invasive pathogens for destruction, primarily by creating it easier for vegetative cell cells of the innate system to ingest them.

Indeed, the innate and adaptational immune responses each perform to guard the body against invasive organisms, however they take issue in an exceedingly range of ways:

1. The innate system is constitutively active and reacts now to infection, whereas the adaptational immunologic response takes a while to develop. The innate system isn't specific in its response, however, the adaptational system is antigen-specific and reacts solely with the organism that evoked the response.
2. The adaptational system exhibits immune memory, remembers that it's encountered an antigen in a nursing matter, and reacts sooner on subsequent exposure to identical organism, whereas the innate system doesn't possess a memory.

Infection and injury induce a physiological response known as inflammation so as to get rid of damaging stimuli and initiate tissue healing. Within the central nervous system, this method is termed neuroinflammation. In acute neuroinflammation, glia become activated and phagocytose dying cells and unleash pro-inflammatory cytokines, therefore they forestall the dissemination of the realm of injury.

However, prolonged neuroinflammation causes injurious effects through activating pro-inflammatory cytokines which ends up in magnified aerobic stress, and vegetative cell death. The cytokines discharged by death neurons induce more activation of glia and astrocytes, leading to regeneration loops operating severally within which the initial pro-inflammatory molecules aren't any longer required.

Neuroinflammation may be a common mechanism influencing the severity, progression, and complications of neuroinfectious diseases, and is a vital candidate target for neuroprotective therapies. To illustrate, sustained neuroinflammation is involved in HIV-associated neurocognitive disorder. Neuroinflammation is additionally a key feature in alternative system. On the opposite hand, neuroinflammation might also increase the sensitivity of the brain to stress, therefore effecting stress-related medical specialty disorders. And contrariwise is additionally true: particularly, stress could stimulate inflammation. Corticotropin-releasing factor (CRF), that is secreted from the neural structure below stress, beside neurotensin (NT), will stimulate brain MCs to unleash inflammatory and toxin mediators that disrupt the barrier (BBB), stimulate glia and cause focal inflammation. As a result, brain MCs could also be concerned within the pathologic process of "brain fog," headaches, and syndrome spectrum disorders (ASDs), that worsen with stress.

MCs were initially delineated by bacteriologist in 1878 on the idea of their staining characteristics and enormous living substance granules, and have long been recognized as key cells of sort I immunoglobulin (Ig E) - associated hypersensitivity reactions. Though MCs share similarities with WBC granulocytes in blood, different with basophils, MCs flow into blood in an immature type as committed precursors till they migrate to a tissue website to settle and complete their differentiation in tissues.

MCs in most tissues within the locality of blood vessels, notably close to surfaces exposed to the surroundings. Thereby, they're distributed in most organs and vascularized tissues within the duct, skin, and also the metabolic process tracts, wherever they're in shut contact with the skin surroundings. MCs are traditional resident cells of the hair follicles, peritoneum, synovium, and plenty of alternative organs.

Although they need long been involved within the pathologic process of allergic diseases and inflammatory disorders, and well-studied with their protecting responses to parasites, their practical role has been found to be additional complicated than recognized. MCs play key practical roles in distinct nonimmunological activities, adore wound healing following injury, tissue physiological state or transforming, fibrosis, carcinogenesis, and maturation. MCs are found to be essential protagonists in host defence against microorganisms.

Indeed, MCs are effector cells of the innate system and are concerned in numerous cell-mediated immune reactions and in infectious diseases as an element of the host reaction to microorganism, parasite, fungi, and even virus infections. Often accomplished through the secretion of cytokines and alternative soluble mediators. In response to microorganism infection, MCs were found to extend the achievement of neutrophils and aid in microorganism clearance. Recent studies have shown that MCs will modulate the host's innate immunologic response to gram negative microorganism by tributary to the method of bodily function through the discharge of pro-inflammatory mediators and presentation of microorganism antigens to T cells. MCs are shown to phagocytose and kill eubacteria, and are capable of process microorganism antigens for presentation through category I MHC molecules to T lymphocyte hybridomas once vegetative cell uptake of live microorganism.

### **Macrophage Polarization in Infectious Diseases**

The macrophages have a vital role in each innate and adjustive immune responses as these cells acquire alternative ways to sense the presence of pathogens in each tissue of the organism [22]. The Toll-like receptors (TLRs) and different pattern recognition receptors (PRRs) area unit determinant to discriminate the presence of Pathogen-associated molecular patterns (PAMPs), that area unit molecules related to teams of pathogens [23-30]. These elements are often remarked as molecular motifs preserved at intervals a category of microbes and recognized by the innate TLR and PRR receptors gift within the scavenger cell and different cells of the system similarly [31-33]. Once engaged by their ligands, the innate receptors promote the acquisition of macrophage`s microbicidal activity against the pathogens [34-36].

Given the crucial role of macrophages within the host defense, many pathogens evolved ways to subvert the scavenger cell differentiation program by sterilization the M1 and money supply composition commitment in their favor. microorganism that infect the host animate thing compartment corresponding to salmonella and mycobacteria tuberculosis area unit custom-made to avoid the classically activated M1 cells by subverting the pro-inflammatory differentiation program of macrophages so as to reinforce their own survival [37,38]. The end result of this interference within the host vegetative cell system has been well studied throughout murine pneumonic infection with staph aureus. These moribific microorganism activate the PI3K pathway to market SOCS1 signal therefore avoiding the differentiation of AN medicine M1 composition [39].

The M1 scavenger cell differentiation program is overall correlative with protection against animate thing pathogens. This can be the case of typhoid that is caused by infection with the microorganism Salmonella typhi. This microorganism induces M1 polarization throughout protective-mediated response against the infection. The assembly of reactive chemical element species corresponding to gas (NO) in M1 cells is additionally legendary to play a crucial role within the animate thing killing mediated-responses against enteric bacteria infection [40]. Any studies have additionally incontestible a crucial role of IFN $\gamma$  depended-M1 polarization responses on the host protecting immune responses against mycobacteria and Cupid's disease infections [41-44].

Other pathogens corresponding to viruses will use completely different ways exerted by species to extend the sickness severity by promoting the inflammatory activity of M1 macrophages. Chronic viruses corresponding to viral hepatitis virus establish persistent infections with sustained inflammatory responses on the sickness. The mechanism underlined during this event partly depends on the expression of the microorganism supermolecule NS3 in conjunction with recombinant GP96 that will increase IL-12 and TNF- $\alpha$  secretion profile of differentiating M1 scavenger cell [45]. Additionally, this polarization result are often seen in craniate H5N1 respiratory illness infection within which increased levels of the pro-inflammatory cytokines IL-1 $\beta$ , IL-6, TNF $\alpha$  and IFN $\gamma$  are unit concerned in M1 polarization and exacerbation of the infection [46-48].

### Factors of Emerging Infectious Diseases

1. Changes in rendering processes - Bovine spongiform encephalopathy
2. Transportation, travel, and migration; urbanization - Dengue, dengue hemorrhagic fever
3. Unknown (in Europe and the United States, importation of monkeys - Ebola, Marburg)
4. Ecological or environmental changes increasing contact with rodent hosts - Hantaviruses
5. Transfusions, organ transplants, contaminated hypodermic apparatus, sexual transmission, vertical spread from infected mother to child - Hepatitis B, C
6. Migration to cities and travel; after introduction, sexual transmission, vertical spread from infected mother to child, contaminated hypodermic apparatus (including during intravenous drug use), transfusions, organ transplants - HIV
7. Contaminated hypodermic apparatus, other - HTLV
8. Probably long widespread, now recognized (associated with gastric ulcers, possibly other gastrointestinal disease) - Helicobacter pylori
9. Mass food processing technology allowing contamination of meat - Hemolytic uremic syndrome
10. Contaminated surface water, faulty water purification - Cryptosporidium, other waterborne pathogens.

### Ecological Changes

Ecological changes, including those due to agricultural or economic development, are among the most frequently identified factors in emergence. They are especially frequent as factors in outbreaks of previously unrecognized diseases with high case-fatality rates, which often turn out to be zoonotic introductions. Ecological factors usually precipitate emergence by placing people in contact with a natural reservoir or host for an infection hitherto unfamiliar but usually already present (often a zoonotic or arthropod-borne infection), either by increasing proximity or, often, also by changing conditions so as to favor an increased population of the microbe or its natural host [5,6].

Responsible organisms derive from all infectious disease categories: Bacterial, fungal, rickettsial, viral, parasitic and even prions. Escherichia coli outbreaks have been observed in chimpanzees; Campylobacter and Salmonella in gorillas; Streptococcus pneumoniae and Pasturella multocida in chimpanzees; Schistosoma mansoni in olive baboons and scabies in gorillas.

The impact of world global climate change on the event of infectious diseases is delineated well by the classic "disease triangle." during this paradigm, the infective agent, with its virulence factors and substance impact, is a

part cause for illness solely within the presence of a inclined host via immune modulation and behavioural changes, and a good setting.

### **Emerging Infectious Disease and Bioterrorism**

To set a preventive action, setting of the public free available online database of the new pathogen is the new action to fight with the possible bioterrorism. Setting of the good “public health legislation” to the possible episode is also needed [7].

### **Assessing the Risk of Zoonotic Exposures**

Certainly, zoonotic infection plays a clear and defined role in many illnesses. Occupations such as farming and agricultural work that place individuals in direct contact with animals and their excretions/ secretions increase the risk for infection. However, the ease by which viruses and bacteria readily cross species as newly defined emerging infections among humans’ likely remains low. Among chicken farm laborers regularly in contact with infected chickens and wildfowl, only 2 in a sample of 27 persons tested positive for antibodies to Rous Sarcoma Virus-Bryan (RSV-B). Similarly, wildlife workers who handle wild ducks when they are shedding high levels of virus consistently have negative viral and serologic assay.

### **Risk Assessment of Infectious Diseases**

In response to major zoonotic and economic problematics rose in the zootechnics systems and subsequent serious concern by civil society, the national and international organizations competent for animal health developed accordingly, and in parallel to environmental, global agro food system and consumers demand modifications. This induced changes of strategy to combat infectious diseases in animals, passing from therapeutically based control to preventive approach and reasoned control.

### **Pharmacogenomics**

Information obtained from whole genome sequencing of pathogens could, in principle, contribute to answering all of these questions. The application of pharmacogenomics to infectious diseases requires consideration of the genomes of both the pathogen and the host [8].

The therapeutic management of infectious diseases has been challenged by the soaring phenomenon of antibiotic resistance, the high rate of which is mainly due to improper and/or a specific prescription and use of antimicrobials.

### **Application of Metagenomics in the Management of Infectious Diseases**

#### **Viral infectious disease**

##### ***AIDS***

It was found that the semen microbiome of HIV-infected men decreased in diversity and richness as compared with that of HIV-uninfected men. Since semen serves as an important vector for HIV transmission, this suggests that semen microbiome may play a role in sexual transmission process of HIV.

##### ***Hepatitis B***

It is a very common infectious disease in the world, with the total number of infected people reaches approximately 240 million. Sometimes, current detecting methods such as direct PCR sequencing, clonal sequencing, and point mutation assays could fail because of the high variability of HBV genome. By using ultra-deep pyrosequencing (UDPS), Margeridon-Thermet et al. were able to detect low-prevalence HBV variants at a high level of sensitivity.

### ***Viral diarrheal diseases***

Diarrheal diseases, the worldwide incidence of which is estimated to be about 1.7 billion in 2010, remain to be a leading cause of mortality for children under 5 years old. First, minimal fecal samples were collected, and then nucleic acids were extracted and PCR amplified from each sample. Sample libraries were constructed and then sequenced, generating 2, 013 qualified and unique sequences in total.

### ***Influenza***

Influenza is an acute viral infection that spreads easily and occurs globally. Each year, influenza attacks nearly 5%–10% of adults and 20%–30% of children around the world. Influenza is caused by influenza viruses, which is characteristic of highly antigenic shift and drift and can be classified into three types-influenza virus A, B and C.

### ***Condylomas***

Condylomas is a sexually-transmitted disease that is caused human papillomavirus (HPV) detect both known and novel putative HPV types in “HPV-negative” condylomas using metagenomic sequencing.

### ***Tuberculosis (TB)***

TB is a widespread infectious disease that mainly affects the lungs and occasionally other sites of our body. TB ranks second in terms of global mortality. It was reported that in 2012, the worldwide tuberculosis incidence was 8, 6 million, and the deaths number was 1.3 million. TB is caused by *Mycobacterium tuberculosis* and other closely associated species in the *M. tuberculosis* complex.

### ***Chlamydia trachomatis***

*Chlamydia trachomatis* is an obligate pathogen which causes infection to the eyes or genital tracts. The sequence analysis showed that a great number of SNPs from *C. trachomatis* were identified and that sequences from *Prevotella melaninogenica*, *Gardnerella vaginalis*, *Clostridiales* genomosp were also present abundantly in the sample.

### ***Pneumonia***

It is a leading cause of death in children, causes 15% of all deaths of children under 5 years old. First, unbiased sequencing of total RNA and DNA were performed. Second, 16S rRNA gene amplicon sequencing was performed and the produced sequences data were analyzed. Finally, *Chlamydophila psittaci* infection was confirmed by quantitative real-time PCR (qPCR). The above procedures were completed in less than 50 hours. Sequence analysis result identified *Chlamydophila psittaci* to be the potential disease-causing agent, which is so rare that is normally excluded in conventional diagnostic panels. This strongly suggests that metagenomics has great potential in rapid diagnostics of diseases outbreaks.

### Surveillance of Infectious Diseases

The ample quantity of information has accumulated over the past decades on relationship of the surroundings and sickness, however times demands the identification of the foremost sturdy environmental correlates of (animal sickness|disease) and accurately linking it with remote sensing technology so as to develop early and effective disease warning system [16-20]. Recently, scientists have created efforts in victimization remote sensing technology in predicting the few vector- and waterborne sicknesses of humans and animals and it's expected that the role of remote sensing technology in developing emergency programs for disease police work, treatment and management can increase in close to future. a short review on the applications of satellite imaging in sickness transmission, management and interference is conferred as underneath [21].

### Eradication of Infectious Diseases

Measles is a highly contagious viral illness. The aetiological agent belongs to the genus Morbillivirus, closely related to the Rinderpest virus [49-55]. Evolutionary history investigations suggest a common virus ancestor evolved in an environment where cattle and humans lived in close proximity, and genetic divergence occurred around the 11th to 12th centuries. Worldwide, measles is a significant cause of morbidity and mortality [56-60]. In 2000, measles was estimated to cause approximately 31 to 39.9 million illnesses worldwide with an estimated 733,000 to 777,000 deaths, making it the fifth most common cause of death in children under 5 years of age [61-64]. Control efforts have substantially altered the global distribution. Measles incidence has decreased substantially in regions where vaccination has been instituted, and measles in the developing world has been attributed to low vaccination rates. The World Health Assembly adopted the WHO/UNICEF Global Immunization Vision and Strategy, which included a goal of 90% reduction in global measles mortality [65-67].

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