Emerging Infections and Zoonotic Diseases (MMD-992)

Credit Hours 3 (3-0)

Course Description

The world is presently facing one of its greatest challenges i.e. emerging and re-emerging infectious and zoonotic diseases. Greater proportion of these infections is viral in nature which therefore calls for more proactive measures in order to ensure prevention and control of these infections. Understanding the viruses and their mode of operation is a key to its control and prevention. The understanding acquired from this course will equip the students for advanced research in the field of Emerging Infectious and zoonotic Diseases and also sensitize the students on the need for prevention and control.

Educational Objective

The objective of the course is:

- To provide a generalized conceptual understanding of the nature of viruses, their interaction with their hosts and their impact on human society specifically emphasizing important infectious diseases which are either newly emergent (e.g. HIV, avian & swine influenza, West Nile virus) or re-emerging in various parts of the world after a period of relative treatment (malaria, dengue).
- The principles of detection, diagnosis, prevention and control of these infectious diseases will also be discussed in a public health context.
- At the end of this course the students will be able to critically evaluate major historical viral pandemics (e.g. AIDS, smallpox, and influenza), emerging viral threats and socioeconomic losses due to virus infections along with viral control strategies.

Course Outcomes

At the end of the course the student will have an;

- Understanding of the differences between bacteria, viruses, eukaryotic parasites, and their hosts.

- Understanding the function of the human immune system in protecting against disease and in causing some of the damages associated with disease.
- Read and analyze data on the health status of populations.
- Assess environmental, medical and political strategies for controlling infectious diseases
- Identify the evolutionary processes that lead to adaptation and biological diversity
- Understand the genetic and behavioral reasons why there are increasing numbers of antibiotic resistant infections.
- Formulate a research hypothesis, implement a study, and evaluate the results.
- Demonstrate an acceptable level of competency in laboratory procedures, including sterile technique, using a microscope, and detecting and observing microbial specimens.
- Evaluate and communicate news reports from the CDC on newly emerging infections, contrasting incidence and prevalence, and potential for control.
- Develop expertise about one specific emerging infectious disease.
- Critically evaluate and effectively use textbooks, current research literature, and online information.

Course Contents

1. An Introduction to Emerging Infectious and Zoonotic Diseases
    - How does WHO define Emerging Infectious Diseases (EIDs)? What are re-emerging infectious diseases? EIDs include antimicrobial resistance
    - What are zoonotic diseases? Different zoonotic cycles, the history of the devastating bubonic plague, why has the incidence of zoonoses increased now? One-health approach
2. An Introduction to Basic Microbiology
    - Innate vs adaptive immunity
    - Gram-positive and Gram-negative bacteria
    - Intracellular bacteria
    - Viruses and their replication cycles

- Prions

BACTERIAL INFECTIONS

3. *Escherichia coli* 0157:H7
    - A Shiga-toxin producing strain of *E. coli*, causes hemorrhagic diarrhea
4. Cholera
    - One of the oldest known diseases that is still a pandemic, 2016 – 2019 Yemen Cholera Outbreak
5. Tuberculosis
    - The notorious issue of drug-resistant tuberculosis, MDR, XDR, and PDR tuberculosis, non-pulmonary tuberculosis
6. Legionnaires' Disease
    - A severe pulmonary disease caused by Legionella
7. Other Exotic Bacterial Pathogens
    - *Ehrlichia* and *Rickettsia:* Two intracellular bacteria of the same order, cause several complicated infections including typhus, rocky mountain spotted fever and Ehrlichiosis
    - *Borrelia* (Lyme's disease) and *Bartonella* (cat scratch fever)
8. Antibiotic Resistance
    - Main classes of antibiotics and their modes of resistance

VIRAL INFECTIONS

1. Emerging Orthomyxoviruses
    - Antigenic shift and drift, emergence strains of Influenza virus
2. Emerging Coronaviruses
    - Severe acute respiratory syndrome and Middle-east respiratory syndrome, less familiar coronaviruses
3. Viral Hemorrhagic Fever
    - Ebola, Marburg, Lassa, Crimean-Congo, and Dengue Hemorrhagic fever Lesser-known American Hemorrhagic Fevers
4. Viral Encephalitis
    - Hendra, Nipah, Saint Louis, Murray Valley, California, and Rocio encephalitis
5. Emerging and Re-emerging Flaviviruses and Bunyaviruses
    - Flaviviruses: Zika fever and West Nile fever

- Bunyaviruses: Hantaviruses-associated syndromes and Severe fever with thrombocytopenia syndrome

6. Monkey-pox
    - Monkey-pox is the new threat after smallpox
7. The Antivaccination Movement
    - The infamous anti-vaccination movement and re-emergence of measles, mumps, rubella, and polio

OTHER PATHOGENS

8. Emerging Parasitic Diseases
    - Cryptosporidiosis (*Cryptosporidium*), Chagas Disease (*Trypanosoma cruzi*), and primary amoebic meningoencephalitis (brain-eating amoeba)
9. Emerging Fungal Infections
    - Microsporidiosis, emerging issue of antimycotic resistance, fungi and mass extinction of amphibians
10. Infectious Proteins
    - Creutzfeldt-Jakob Disease and spongiform encephalopathy
11. Bacterial Zoonoses
    - This topic would be divided into different subtopics, each focusing on a bacterial pathogen. The general outline of the subtopics would cover the introduction and history of the zoonotic infection, the mode of transmission, symptoms in humans and susceptible animals, treatment, how people can reduce the risk of infection, how the disease can be controlled in wildlife/domesticated animals, and how the disease can be eradicated from a region.
12. Viral Zoonoses
    - This topic would be divided into different subtopics, each focusing on a viral family, viral pathogen, or a viral disease. The subtopics would follow the same outline as discussed above.

- Monkeypox, Herpes B, Rabies , Influenza , Ebola and Marburg haemorrhagic fever
- Flavivirus-associated zoonoses , Japanese encephalitis ,West Nile Infection, St. Louis encephalitis, Omsk haemorrhagic fever, Tick-borne encephalitis, Alkhurma fever, Kyasanur Forest disease, Usutu virus infection
- Bunyavirus-associated zoonoses, Hantavirus haemorrhagic fever with renal syndrome, Hantavirus cardiopulmonary syndrome ,Crimean Congo haemorrhagic fever, Rift Valley fever, Sever fever with thrombocytopenia syndrome , Bwamba fever
- Arenavirus-associated zoonoses , Lassa fever , Lymphocytic choriomeningitis, American haemorrhagic fevers
- Equine encephalitis

13. Fungal and Parasitic Zoonoses
    - The subtopics would follow the same general outline as discussed above.

SPECIAL CONSIDERATIONS

14. Bioterrorism and Emerging Infectious Diseases
15. Emerging Infectious Diseases of Pakistan
    - Dengue, Chikungunya, Crimean-Congo, polio, Drug-resistant tuberculosis, XDR typhoid, and Brain-eating amoeba

Recommended Books

1. Prescott, L. M., Harley, J. P., & Klein, D. A. (2002). Microbiology. 5th International Edition.
2. Rifai, N. (2019). *Clinical Microbiology Elsevier EBook on Vitalsource*. Elsevier Health Sciences.
3. Mims, C., Dockrell, H., Goering, R., Roitt, I., Wakelin, D., & Zuckerman, M. (2004). Medical microbiology. *Structure*, *7*, 7.
4. Brooks, G. F., Butel, J. S., Morse, S. A., & Jawetz, M. (2007). Adelberg's medical microbiology. *Sultan Qaboos Univ. Med. J*, *7*, 273.
5. Brooks, G. F., Butel, J. S., & Morse, S. A. (2004). *Jawetz, Melnick, & Adelberg's medical microbiology*. Lange Medical Books/McGraw-Hill, Medical Pub. Division.

6. Conover, M. R., & Vail, R. M. (2014). *Human diseases from wildlife*. CRC Press.