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Review Article

An Introduction to Microbiology Designed for Allied Health Majors

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Abstract

Microbiology is a backbone of clinical diagnosis as it has a great importance in diagnosis of epidemological infections both emerging, re-emerging infections, biowarfare agents etc. Journey of medical microbiology was starting from invention of lenses to inventions of sterilization and disinfection process,asepsis techniques to managing hospital acquired infections and community outbreaks of infectious diseases. In allied sections like food, air, water, milk industries, its role is very challenging to control epidemiological outbreaks of infections. Probiotics, microbiota transplantation, gene gun, Nano-therapy, monoclonal antibodies, vaccines and newer antibiotics inventions mainstream the role of microbiology in front of world sciences.

Keywords: Microbiology; Allied Health; Infections

Medical microbiology deals with study of microbes that infects human; so its diagnosis, prevention and treatment is utmost important [1]. Infection continues to be major killer in India having role in infectious diseases, infection control areas. Integrated Disease Surveillance Project (IDSP) is doing surveillance of several communicable diseases. This programme was launched in 2004, which controls spread of various communicable diseases before it takes its fatal and dreadful epidemiological outbreak. In food, air, water, milk industries, its role is not the least to discover the probiotics, faecal microbiota transplantation and else.

Origin of medical microbiology

Microbes are ancient of human being, they over number the human populations. They are invisible to the naked eye but Antony von Leeuwenhoek, a draper in Holland who first observed it under the grinding lenses and first saw the microbe. Louis Pasteur called the father of microbiology. He not only developed steam steriliser, hot air oven, and autoclave but also coined the vaccines against anthrax, cholera and rabies. A German scientist Robert Koch called the father of bacteriology who picks the feather in microbiology by discovering the Tuberculosis bacillus and cholera vibrio [1].

Current status of medical microbiology training and practice in India

In today's era, microbiology footprints its roots outside the laboratory and research and get worked in clinical settings and achieved its utmost importance in the field of infection control management. Molecular microbiology detects the genetic sequence, which further help to understand the rapid identification and treatment. It also explains the mechanism of antibiotic resistance and developed huge vaccine production research, which help to control vaccine preventable diseases.

Role of allied microbiology in clinical settings

Clinical microbiology plays its role mainly in controlling patient's infectious diseases, by its proper diagnosis, treatment, and antibiotic stewardship and hospital infection control (HIC) practices. A microbiology results have immense therapeutic and diagnostic value. ICU is an integral part of hospital care and provides a higher level of monitoring and treatment for patients admitted. These patients are already critically ill, most of them are on organ support systems like (ventilation, catheterised with IV catheter or central line catheter etc.), and have higher comorbid conditions.

They spend much of money on medicine and hospital stay. Multidrug resistant infections like surgical site tissue infections ventilated associated pneumonia, Catheter Associated Urinary tract infections are major cause of ICU admission. Keeping a track of ICU infections is important for outbreak surveillance. These are common in ICUs and early detection is vital. Data on ICU infections collected prospectively also give an idea of success or failure of infection control programs. Further, it is essential to have an awareness of the prevailing infections in the ICU, the antibiotic likely to work against these infections, a good awareness of any newly emerging pathogen and the early detection of outbreaks [2]. Infection to be assessed and diagnostic tests and therapy to be augmented or optimized. It is reported that ICU patients have been receiving significantly more antibiotics than other hospital inpatients (as measured by the Defined Daily Dose - DDD) so antimicrobial resistance [including ESCAPE group of organisms] [3] are commonly encountered in these patients. Re-emerging multidrug resistant (MDR) superbugs like are metallo-beta-lactamase (MBL) Acinetobacter, Carbapenems producing Enterobacteriaceae (CRE) beginning to appear in Indian hospitals including ICUs. These superbugs are responsible for various types of healthcare associated infections like catheter associated urinary tract infections (CAUTI), Central line associated blood stream infections (CLABSI), and ventilator associated events (VAE) and surgical site tissue infections (SSTI) which significantly endanger the patients' life [2]. So daily infectious disease consultant should do ICU, ward round, curb the nosocomial infections before it spreads its wings to other patients, and reduced the cross infections. The proper antibiotic stewardships programme will prevent the future loss of antibiotics, as antibiotics are less speedily produced compared to its resistance development, so we have to preserve our available antibiotic stocks.

Infection Control team and its duties

Infection control team consist of microbiologist and heads of institution, medical superintendent, heads of all clinical departments and nursing in charge. Every fortnightly or monthly multidisciplinary team (MDT) meetings should be conducting to facilitate communication between clinicians and microbiologists in areas where infection is a major cause of morbidity and mortality. These meetings should take the appropriate actions to manage the emerging and re-emerging infections that may cause local epidemics like swine flu or nipa virus haemorrhagic fever etc. Microbiologist should emphasize the role of microbe and its resistance to antibiotics regularly to reduce the upsurge usage of antibiotics. Team should inspect whether proper sterilization disinfections policies are maintained in the hospital or not. They should make the antibiotic policies for working doctors, which prevent the random use of antibiotics. Biomedical waste management policies for healthcare worker staff. Emerging superbugs in hospital like methicillin resistant staphylococcus aureus, vancomycin resistant enterococcus, extended spectrum beta lactam Enterobacteriaceae and MBL producing no fermenters must have the special importance to control the drug resistance in hospital settings. Infection control is everyone responsibility in hospital which can be successfully maintained by appropriate planning, policy making [3].

Role of clinical microbiologist in Community

Clinical microbiologists can play a very important role in controlling the spread of infection in the community by communizing the community and family medicine department by early reporting communicable diseases, which can curb in future outbreaks. Diseases like polio, diphtheria, tetanus, dengue, chikungunya, rabies, tuberculosis, swine flu, cholera; early reporting through IDSP can control food-borne Salmonellosis, viral hepatitis, etc. As the emerging and newly emerging infections are now a days are rising due to urbanization, increased encroachment of human in wild life forest, industrialization [4,5].

Blood donor screening

A major goal of transfusion medicine is to reduce the risk of transfusion-associated infection to as low a level as possible [blood transfusion guideline]. Blood donors screened for HIV, syphilis, malaria, Hepatitis B, Hepatitis C to control the blood borne pathogen infection, which leads to the fatal diseases [6].

Food industry and medical microbiology

The use of microbes for fermentation is known since ancient time like in preparation of curd and beverages. Microbes like geobacillus, lactobacillus not only give a good taste, texture and smell to the foods by fermentation, but also produce certain inhibitory compounds that which prevent food spoilage thus increasing the storage and safety of food.

Lactobacilli are important in the production of foods that require lactic acid fermentation, notably dairy products [yogurt and cheese], fermented vegetables [olives, pickles, and sauerkraut], fermented meats [salami], and sourdough bread [1].

Dental infections

Anaerobes like *Peptostreptococcus, Bacteroides, Fusobacterium, Prevotella, Porphyromonas* are responsible for causing periodontal infections, dental caries so its role in microbiology is important to early identify this infection [1]. *Streptococcus mutans, mitis, salivarius* cause dental caries and periodontal infections and lead to bacterial endocarditis in chronic infection [1].

Bioterrorism

Bioterrorism, as defined by the centre of disease control and prevention, is the deliberate release, by attacker, of an agent that causes one or more different kinds of diseases. Anthrax, smallpox, plague, tularemia, viruses causing hemorrhagic fevers such as ebola, marbug, lassa and macchupo, etc are high risk agents posing major threat to national security and important re-emerging infections now a day [1].

Role of microbiology in water, air, milk and food industries

Drinking water must be visually acceptable, clean and colourless. It should be free of any pathogen causing water borne diseases like typhoid, cholera etc. For that water testing is must, it can be done by presumptive coliform count. In ICU, OTs etc. bacterial content of air is very essential as indoor air can transmit infections like tuberculosis, MRSA infections so bacterial load of air is needed. Contaminated milk can transmit the tuberculosis, brucellosis so pasteurization of milk is essential, Foodborne infections may transmit through faeces, sewage, flies. So bacteriological analysis of food prepared in food industries, railways are necessaries [1].

Insight of laboratory microbiology

The practice of clinical microbiology does not necessarily have to begin with a high investment on physical infrastructure or high technology. But automated and molecular technologies have played a great role in improving patient care in critically ill patient and sick patient by giving rapid diagnosis. Even the most basic reports based on microscopy, culture or serology give a better patient health by application of clinical-microbiological principles

Conclusion

Clinical microbiologist can build up good clinical practices by proper clinic-microbiological collaboration, improving infection control practices and may give a enlightened future to our children and future generation by combating multidrug resistance superbugs.

Apart from infection control, he does support, complement and augment the diagnostics, and prognostic modalities. Microbiologist does improve per capita income and serve the nation.

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