

ADVANCED TOPICS IN SCIENCE AND TECHNOLOGY IN CHINA



Lanjuan Li *Editor*

# Infectious Microecology

Theory and Applications



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IN SCIENCE AND TECHNOLOGY IN CHINA**

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Lanjuan Li *Editor*

# Infectious Microecology Theory and Applications

With 17 figures, 6 of them in color



*Editor*

Prof. Lanjuan Li

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## Preface

The first edition of *Infectious Microecology* was published in 2002. After 10 years of basic research and clinical practice, microecology, especially infectious microecology, has made great progress in the world, which confirms the innovative and clinical value of this theory. The development of infectious microecology is based on the progress in molecular biology, metagenomics, metabolomics, proteomics, and it is also a supplement to existing theories and practice in the field of infectious diseases.

With the progress of human civilization and medical technology, the spectrum of diseases has greatly changed. The aging population is increasing in the world. These people have a relatively low immune function and this is often accompanied by one or more underlying diseases, such as hypertension, diabetes, chronic kidney disease, etc. In addition, with the wide use of antibiotics, immunosuppressants, radiochemotherapy, organ transplants and interventional therapy, the life of critically ill patients has been prolonged. Drug-resistant strains, especially multi-drug resistant strains, are prevalent throughout the world. These strains may be the normal flora for healthy people, but they can lead to severe or even fatal infections in the above mentioned populations. The research and development of new antibiotics are far from able to meet the needs of clinical practice, and antibiotics alone cannot solve this problem. Therefore, prevention and treatment of infectious diseases has become a major issue in the new century. It is against this backdrop and in need of new theoretical guidance that infectious microecology has emerged.

Microecology sprouted at the end of the 19th century. Since the 1970s the development of gnotobiology, anaerobic culture techniques, electron microscopy techniques and cellular molecular biology have promoted the development of microecology. In the past 10 years, microecology research in humans has gained extensive attention at home (China) and abroad. Studies have shown that the microecological system is like a human organ with physiological functions, and microecological flora plays an important role in the body's immune system, metabolism and nutrition, especially in the prevention and occurrence of



infections. American scholar, Professor Hannah Gordon, said, “To ignore our microbial side would be to ignore an important contributor to our health and our biology.” In the book *Infectious Microecology* published in 2002, we proposed the theory of “infectious microecology”, which was highly praised by Professor Jeremy K. Nicholson from Imperial College London. Our study “Infectious Microecology: Theory and Application” won second prize nationally for progress in science and technology in 2007, and another study titled “Intestinal Microecology and Infection” was sponsored by the National Basic Research Program of China (“973” Program). The latter has attracted a high degree of international attention, and the magazine *Science* gave a comprehensive introduction to it. The results of this project were published on *Hepatology* and it also attracted Professor Dusko S. Ehrlich to join in, who is in charge of the European human gut metagenomics project. With further research into microecology, people know more about both the useful and harmful effects that microecology brings to the host. What’s more, infectious microecology enriches the connotation of the theory of infectious diseases, so that people can look at the incidence, progression and prognosis of infection from the point of view of microecology. It improves the anti-infection strategy, proposing a new idea that the treatment of infection should be to “kill and promote bacteria” rather than only “kill bacteria”. In recent years a wider body of evidence has shown that microecology therapy is indeed an effective weapon in the prevention and treatment of bacterial infection.

Utilizing 10 years worth of research and clinical practice, referring to recent literature about the relationship between infection and microecology, and combined with the latest research findings of liver microecology, we updated the theory, knowledge and techniques in the field of infectious microecology. We hope this edition can provide new information for medical students and clinicians.

The book is divided into 23 chapters. Chapters 1 to 5 introduce the origin and development background of the concept “infectious microecology”, as well as the composition, physiological and immunological functions of normal microflora. It also details the relationship between normal microbiology host shift, translocation and infection; between normal microflora variation, microecology disturbance and infection, especially nosocomial infection. Chapters 6 to 9 introduce the latest research and technology platforms for infectious microecology. Chapters 10 to 21 systematically dissect the characteristics of infectious microecology, and detail the prevention and treatment of diseases in various systems from the infectious microecology viewpoint. Chapter 22 introduces types and functions of the microecological modulator and its development. Chapter 23 is about the future development of infectious microecology.

Even with the careful contributions of our friends and colleagues, errors of source and misinterpretation may have found their way into the book, so suggestions for improvement will be gratefully received.

Lanjuan Li  
Hangzhou, China  
May, 2014

## Lanjuan Li

Professor Lanjuan Li, a M.D. supervisor, academician of the CAE (Chinese Academy of Engineering) and chief physician of the First Affiliated Hospital of Zhejiang University, is a famous infectious disease specialist in China and she has been engaged in clinical, teaching and scientific research work in the field of infectious diseases for 40 years. She has made great achievements in microecology research by developing new infectious microecology theories that explore the occurrence, development, and outcome of infection from the microecological perspective, and by proposing new strategies for the prevention and control of infections. Prof. Li is also a pioneer in the study of artificial



liver in China and established a special and effective artificial liver system (Li's artificial liver system [Li-ALS]), which was a momentous breakthrough in the treatment of severe hepatitis. In addition, she has undertaken more than 10 key research projects such as the national science fund project, National 863 Program and National 973 Program and so on. She has 22 authorized invention patents and has published more than 360 papers, over 150 collected by SCI academic journals including *The Lancet* and *The New England Journal of Medicine*. Served as the first completed, she has won several prizes including first prize of National Science and Technology Progress, and second prize of National Science and Technology Progress twice, first prizes of Science and Technology Progress of Zhejiang Province five times, and the second prize of Popularization and Application of Award in Colleges and Universities granted by the Ministry of Education. Presently, she holds the post of director of the Collaborative Innovation Center for Diagnosis and Treatment of Infectious Diseases, director of the State Key Laboratory for the Diagnosis of Infectious Diseases, the Leader of State Key Discipline Department of Internal Medicine (Infectious Diseases), and also director of the Zhejiang Infectious Disease Key Laboratory.

Meanwhile, she is also the chairman of the International Human Microbiome Consortium (IHMC), director of the Department of Bio-Medicine of the Ministry of Education, vice chairman of the Chinese Medical Association (CMA), vice president of the Chinese Health Information Society (CHIA), deputy chairman of the Chinese Society of Biomedical Engineering (CSBE), and director of the National Artificial Liver Training Base, Division Chief of the Microecology Branch of Chinese Preventive Medicine Association (CPMA), division chief of the Infectious Diseases Branch of Chinese Medical Doctor Association (CDMA), a vice-chairman member of the Third Cloud Computing Expert Committee of Chinese Institute of Electronics (CIE), Board trustees of the International Society for Apheresis (ISFA), President of Zhejiang Medical Association, editor-in-chief of the *Chinese Journal of Clinical Infectious*

*Diseases, Chinese Journal of Microecology and Zhejiang Medical Journal*, vice editor-in-chief of the *Chinese Journal of Infectious Diseases* and *International Journal of Epidemiology and Infectious Disease*. She has edited and published 28 monographs including the first edition of “*Artificial Liver*” and “*Infectious Microecology*” of China; and planned textbooks of Epidemiology. Furthermore, she also holds the position of vice chief engineer of the “Twelfth Five-Year Plan” — a major science-technology project titled “Prevention and Treatment of AIDS and Viral Hepatitis and Other Major Infectious Diseases” and is the expert team leader of “Field Study at Comprehensive Prevention and Control Demonstration Area”. In 2010, she won the title of “National Excellent Science and Technology Workers” for her great contribution to the diagnosis and treatment of infectious disease.

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