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FRONTIERS IN VIRAL IMMUNITY: MOLECULAR MECHANISMS, THERAPEUTICS, AND EMERGING PATHOGENS

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Internationally recognized virologist, immunologist, and biomedical scientist whose career spans more than three decades of groundbreaking research, teaching, and academic service. Born in November, 1968, Dr. Zheng earned his **B.Sc. in Veterinary Medicine** from China Agriculture University in 1991 and completed his **Ph.D. in Clinical Medicine** at Chongqing Medical University in 2001.

Following his doctoral studies, Dr. Zheng pursued extensive postdoctoral training in Canada. He completed fellowships at the **Vaccine and Infectious Disease Organization (VIDO), University of Saskatchewan (2001-2005)**, and at the Institute of Inflammation, Infection, and Immunity, University of Calgary (2005-2007), supported by prestigious fellowships from the **Canadian Institutes of Health Research (CIHR)** and the **Saskatchewan Health Research Foundation**.

Throughout his career, Dr. Zheng has held senior academic positions at leading institutions. He served as a Professor and Senior Scientist at the Wuhan Institute of Virology, Chinese Academy of Sciences (2007-2012), and later as a Professor and Principal Investigator at Soochow University (2013-2017). Since 2013, he has also been an Adjunct Professor at the Department of Microbiology, Immunology & Infectious Diseases, University of Calgary, Canada.

Dr. Zheng's scientific contributions focus on host-virus interactions, antiviral innate immunity, herpesvirus pathogenesis, and emerging infectious diseases. He has published more than 200 peer-reviewed journal articles, many in high-impact international journals, and has edited influential scientific books, including *Antiviral Innate Immunity*, *Molecular Virology and Antiviral Adaptive Immunity and Viral Immune Evasion*, in the Methods in Molecular Biology series (2024/2025/2026). His fourth scientific book is under writing, which will be published in late 2026, and his fifth (*Virus-host Interaction*) and sixth books (*Oncolytic Viruses*) are scheduled to be published in 2027.

Dr. Zheng is widely recognized as one of the world's foremost researchers on antiviral innate immunity and viral immune-evasion mechanisms. As a native of Fujian Province, China, Dr. Zheng rose from humble rural beginnings to become an adjunct professor at the University of Calgary and an international leader in virology. His career spans more than three decades and includes pioneering discoveries about how **herpes simplex viruses (HSVs)** and other pathogens evade host immune defences, the identification of host factors that restrict viral replication, and translational work on emerging viruses such as SARS-CoV-2. His scholarly impact is reflected in more than 200 peer-reviewed publications, more than 10,000 citations, and an H-index of 55.

He served on editorial boards of more than a dozen journals; his global reputation is reflected in numerous honors. He has consistently been ranked among **Elsevier's global 1.0% of scientists** in 2021 and 2022, **top 0.5 % of scientists** in 2023, 2024 and 2025; **Elsevier's global career top 1.5% of scientists (2024, 2025)**; and recognized in the **top 100k Global Scholars Academic Elite Ranking**. He has received multiple editorial awards, including **the Publons (Now Web of Sciences) top 1% peer reviewers, an outstanding mBio Editor (2024), the Springer Nature Editor of Distinction Award (2022), and an outstanding Frontiers associated editor (2021)**. In addition, he has been acknowledged as a **top 25 reviewer** by the *Journal of Virology* for five consecutive years. However, he remains grounded in the values shaped by his upbringing, dedicating his work and books to family members and colleagues who have supported his journey.

A committed member of the international scientific community, Dr. Zheng, has been invited to give more than **300 lectures and keynote talks** at major conferences and universities worldwide. He has also contributed to scientific leadership through service on the **Scientific Advisory Committee of the International Herpesvirus Workshop** and editorial boards of more than a dozen international journals.

Dr. Zheng's research has been supported by major funding bodies, including the **National Natural Science Foundation of China (NSFC)** and national "973" programs, securing millions in grant support to advance the understanding of viral immune evasion mechanisms. It is worth mentioning that he defended his application for the NSCF Outstanding Young Scholars Fund twice and the NSCF Key Fund three times; unfortunately, he was ultimately unsuccessful.

Today, Dr. Zheng continues to inspire the global research community with his pioneering

insights at the intersection of **virology, immunology, and translational medicine** while mentoring the next generation of biomedical scientists.

This biography provides an in-depth look at Dr. Zheng's life and career. It chronicles his early years in rural China, his academic formation and research training, the establishment of his research programs in China and Canada, and the scientific contributions that have earned him international acclaim. This article also explores the thematic areas of his research—host innate immune pathways, herpesvirus immune evasion, emerging pathogens, and molecular methods—and describes his editorial leadership, teaching, mentorship, and service to the scientific community.

PREFACE

Viruses continue to challenge humanity because of their ability to evolve, adapt, and evade immune defences. From long-studied pathogens such as herpesviruses to newly emerging threats such as SARS-CoV-2 and Marburg virus, the study of viral infections has revealed both the ingenuity of pathogens and the resilience of the host immune system. Understanding this dynamic interplay is not only essential for advancing science but also critical for protecting public health in an era of pandemics, climate-driven outbreaks, and expanding global connectivity.

Over the course of my research career, I have had the privilege of contributing to the exploration of these complex interactions. My work spans the fundamental mechanisms of innate antiviral immunity, including STING/MAVS signalling pathways, inflammasome activation, and viral antagonism, as well as translational areas such as vaccine design, antiviral therapeutics, and cancer gene therapy. This book reflects those contributions, drawing upon a wide body of publications to present a structured overview of viral immunity, therapeutic strategies, and emerging global challenges.

The chapters collected here are organized to move from molecular insights to clinical applications. We begin with the foundational principles of viral immune evasion and host defence; advance through breakthroughs in mRNA vaccines, CRISPR-based strategies, and peptide therapeutics; and conclude with perspectives on coinfections, climate change, and the trajectory of future pandemics. Each chapter is rooted in peer-reviewed research while also being framed for accessibility to a broader scientific readership.

The aim of this book is twofold: first, to serve as a reference for researchers, students, and clinicians seeking to understand the molecular and immunological landscape of viral infections; second, to inspire continued innovation in the fight against viral diseases. By linking mechanisms with applications and past discoveries with future directions, I hope that this work contributes to a clearer and more integrated view of how we can anticipate, confront, and ultimately overcome viral challenges.

I would like to express my gratitude to my collaborators, colleagues, and students who have shared this scientific journey and to the wider scientific community, whose collective efforts continue to push the boundaries of virology and immunology.

It is my sincere hope that this volume will not only consolidate current knowledge but also serve as a catalyst for new ideas and discoveries in the field of viral immunity.

Dr. Chunfu Zheng

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CHAPTER - 1

AUTOBIO



Dr. Chunfu Zheng (郑春福)— Scientist of Viral Immunity Research and Scientific Editor

1.1 Early Life and Education

1.1.1. Rural Roots and Family Influence



Dr. Zheng was born on 7 November 1968 in Wushi Village, Daji Town, Xianyou County, a small farming community in Fujian Province. At the time, rural China remained underdeveloped, and educational opportunities were scarce; many families prioritized agricultural labor over schooling. Dr. Zheng's father worked in the provincial capital and was seldom home, leaving his mother, **Mrs. Jinli Zhuang** (庄金利), to raise him and his siblings. She juggled farm work with

child-rearing, teaching her children diligence, thrift and resilience—qualities that would become hallmarks of Dr. Zheng's scientific career. The young boy spent weekends and school vacations helping with farm chores and learning to balance responsibility and study.

Despite limited resources, education was highly valued in the family. Dr. Zheng credits his success to his mother's emphasis on learning and the encouragement of his teachers. Two early mentors, **Mrs. Xinying Lin (林新瑛)** and **Mr. Jinfu Zheng (郑进富)**, enlightened him and cultivated his self-confidence, recognized his curiosity and guided him in developing a love for science. Under their tutelage, he excelled academically and earned a place at **Xianyou No. 1 Middle School**, the best school in the county. This achievement was remarkable because the competition for limited school slots was intense, and most children in his village did not attend higher-level schools.

Zheng's high-school years were demanding. He maintained a rigorous study schedule while continuing to help with farm work. He later reflected that the discipline required to juggle school and agricultural labor prepared him for the long hours of laboratory research. He ranked first in his class and top 5 in his grade on the provincial graduation exam, but he underperformed in the **Gaokao** (National College Entrance Examination), and his scores were only modest; he was admitted to **China Agricultural University** in Beijing—a testament to his perseverance and the support of his mentors. He majored in **laboratory animal sciences** and graduated with a **B.Sc.** in 1991.

He mentioned that he suffered bully from taller classmates, he was in great pain, and he never talked to his mom and teachers. He will not bother his mom, as he understands his mother's hardships, including a lot of farm work to do and three children to raise. The worst thing was that the teachers and class head teachers never cared about it, which was responsible for at least 50% of the death of his younger brother. To add one more thing, his class head teacher, Mr. Ni Songnan, is a useless person.

I remember very clearly that an English teacher who had just graduated and joined the school. She left our class less than a semester later because he was bullied by taller and nasty students.

1.1.2. Veterinary Work and Decision to Pursue Research

After graduating, Dr. Zheng returned to Fujian and worked at the **Nonhuman Primate Experimental Center** of the Fujian Provincial Institute of Family Planning Science and Technology. Serving as a veterinarian, he cared for nonhuman primates used in biomedical research. This experience exposed him to infectious diseases and sharpened his observational skills. He observed firsthand how viruses could devastate animal colonies and observed the importance of preventive measures and scientific research in disease control. These experiences ignited his interest in virology and immunology.

Driven by this interest, Dr. Zheng enrolled at **Chongqing Medical University**, one of China's leading medical institutions. He pursued graduate studies in infectious diseases and received his **Ph.D. in Medical Sciences** in 2001. During his doctoral training, he investigated malaria-

host interactions and learned molecular techniques that were emerging in China. His dissertation explored DNA vaccines against malaria infection and proposed potential therapeutic strategies. This early work laid the foundation for his later focus on antiviral innate immunity.

1.1.3. Postdoctoral training in Canada

Zheng recognized that to become an internationally competitive scientist, he needed exposure to advanced research environments. In 2001, he moved to Canada, joining the **Vaccine and Infectious Disease Organization (VIDO)** at the **University of Saskatchewan** as a postdoctoral fellow under the **Saskatchewan Health Research Foundation (SHRF)**. VIDO offered state-of-the-art facilities and a collaborative environment that was very different from the resource-strained labs of his home country. He has investigated bovine herpesvirus type I pathogenesis and host immune responses and is developing expertise in animal models, immunological assays, and vaccine development.

In 2005, he transferred to the **University of Calgary**, where he completed a second postdoctoral fellowship under the **CIHR (Canadian Institutes of Health Research) Training Program in Inflammation, Infection and Immunity**. Calgary's program emphasized interdisciplinary research, integrating immunology, microbiology, and clinical sciences. Dr. Zheng collaborated with clinicians to examine host responses to a fungus (*Cryptococcus neoformans*) and learned to communicate across disciplines. These experiences enriched his scientific perspective and prepared him to establish his own lab.

During his postdoctoral years, he also improved his English proficiency and became comfortable presenting and writing in an international context. He credits his colleagues (especially Robert Brownlie) and mentors in Canada for nurturing his development and for demonstrating how to balance scientific rigor with creativity.

1.2 Launching an Independent Research Program

1.2.1. The Hundred-Talent Program and Return to China

In late July 2007, after being selected for the **Hundred Talent Program of the Chinese Academy of Sciences (CAS)**, Dr. Zheng returned to China. The program sought to attract and retain leading scientists capable of building world-class research teams. As part of the program, he was appointed **Professor/Senior Scientist and Principal Investigator** at the **Wuhan Institute of Virology (WIV) of CAS**. WIV is China's premier virology institute and houses high-containment laboratories. The appointment marked a turning point: Dr. Zheng could now direct his own research agenda and train students.

He focused on **herpes simplex virus type 1 (HSV-1)**, a neurotropic alphaherpesvirus that causes oral and genital lesions, keratitis and life-threatening encephalitis. HSV-1 also establishes lifelong latency in sensory neurons and reactivates periodically. Despite decades of research,

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大湾区规划 · Introduction

《粤港澳大湾区发展规划纲要》明确了澳门“一个中心、一个平台、一个基地”的三个定位，即：建设世界旅游休闲中心、中国与葡语国家商贸合作服务平台，**打造以中华文化为主流、多元文化共存的交流合作基地。**

It further clarified the three orientations of "one center, one platform and one base" of Macao, namely, to build a world tourism and leisure center, a business and trade cooperation service platform between China and Portuguese-speaking countries, and to build an exchange and cooperation base with Chinese culture as the mainstream and multicultural coexistence.

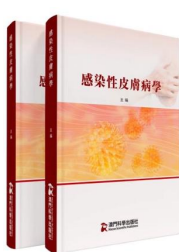


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- 實用小兒內科學 Practical pediatric internal medicine
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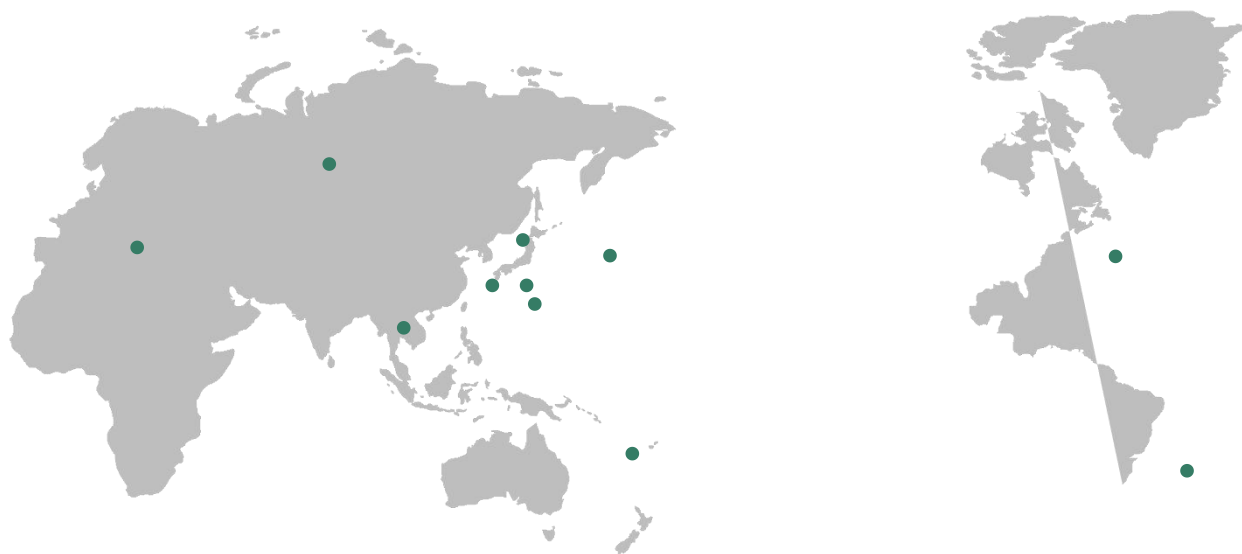
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