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Modeling Infectious Diseases in Humans and Animals

By [Matthew James Keeling](#)
and [Pejman Rohani](#)

Princeton, NJ: Princeton University Press,
2008.

408 pp., Illustrated. \$65.00 (hardcover).

Mathematical modeling of infectious diseases has progressed dramatically over the past 3 decades and continues to flourish at the nexus of mathematics, epidemiology, and infectious diseases research. Now recognized as a valuable tool, mathematical models are being integrated into the public health decision-making process more than ever before. However, despite rapid advancements in this area, a formal training program for mathematical modeling is lacking, and there are very few books suitable for a broad readership. To support this bridging science, a common language that is understood in all contributing disciplines is required.

Modeling Infectious Diseases in Humans and Animals is a timely and successful attempt to fill this gap. In this volume, Keeling and Rohani cover many important topics in mathematical modeling of infectious diseases epidemiology and introduce a number of classic and modern techniques, with a vigilant approach that introduces and emphasizes the concepts but avoids the inclusion of extensive mathematical details. This recipe is ideal for a multidisciplinary field of research like infectious diseases epidemiology. To introduce basic modeling concepts to readers

who may not be familiar with mathematical modeling literature, Keeling and Rohani begin with simple deterministic models. In addition, they establish fundamental notions, such as the basic reproductive number, epidemic curve, dynamic equilibrium, age of infection, and oscillatory dynamics. They further introduce more-refined and advanced models by incorporating heterogeneity with behavior or age, which accounts for variability in transmission risk in real populations.

An important feature of this book is its attempt to connect models with real-world outbreaks and/or epidemics and to parameterize each model with relevant disease-notification data. Throughout the book, various examples are used, including childhood respiratory infections and influenza, HIV and other sexually transmitted infections, foot-and-mouth disease, and West Nile virus.

The book also deals with more-advanced concepts, such as the circulation of multiple pathogens in a population and multihost transmission—ranging from vector-borne infections, which require persistent exchange of the pathogen between ≥ 2 species (such as malaria or West Nile virus infection), to infections that are spread throughout an animal population until they are eventually transmitted to humans (such as avian influenza, severe acute respiratory syndrome, and rabies). The book also devotes a complete chapter to another feature of import to several diseases—that is, the characteristic oscillatory pattern of disease spread (as seen in the case of measles, chickenpox, and rubella). This oscillatory behavior may arise from variability in contact rate among individuals (e.g., contacts among school children may vary during the school year vs. during summer holidays), seasonal variability in the size of the host population for vector-

borne infections (e.g., malaria or dengue), or other environmental factors.

Furthermore, the book addresses the role of chance and randomness in disease transmission. The transmission of disease is probabilistic in nature; when an infectious person comes into contact with a susceptible person, there is a probability (not certainty) that the infection will be transmitted to the susceptible person. These models are used in mathematical epidemiology to capture realistic aspects of disease transmission. However, *Modeling Infectious Diseases in Humans and Animals* deals with the stochasticity in a limited way, by expanding the use of simple compartmental models with randomly chosen parameters (noise). It also highlights other techniques, such as event-driven approaches and individual-based modeling, and discusses important features of stochasticity, such as spontaneous disease extinction. The book also gives an account of various techniques that are employed to understand the spatial distribution of disease and the corresponding phenomenon of synchrony in epidemics between neighboring geographic areas.

Overall, the book covers the application of classic compartmental models—and their more recent variants—extremely well. However, the book is less inclusive when it comes to the application of network models to the understanding of infectious diseases epidemiology. Despite recent advances in this area and increases in the application of network-based techniques to address disease spread, only 1 subsection of the book is allocated to the topic; this section is very brief and much less coherent than other sections of the book.

To make the book accessible to a broad range of readers, the authors encountered the difficult task of striking the right balance between including an adequate number of mathematical formulas, to justify

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quantitative and qualitative reasoning, and avoiding a deep examination of the mathematical aspects of the models. Although the content of the book is a good testimony of the authors' commitment to achieve this objective, it seems that the mathematical rigor sometimes overshadows the delivery of conceptual elements to readers who have different levels of familiarity with mathematics.

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Bennett & Brachman's Hospital Infections

Edited by William R. Jarvis

Philadelphia: Wolters Kluwer/Lippincott
Williams & Wilkins, 2007.
832 pp., Illustrated. \$210.00 (hardcover).

A lot has happened in the field of infection control since Bennett and Brachman produced the last edition of this classic textbook. A continuous parade of pathogens has emerged that could conceivably be introduced into health care settings and become widespread. In 1998, resistance to vancomycin in *Staphylococcus aureus* was possible only in theory. Recent transmission of avian influenza from birds to humans did not result in efficient spread from human to human, which raised hopes that such an event would not recur in one's lifetime. The coronavirus was a common cause of mild self-limited upper respiratory tract infections. Smallpox had become a pathogen of historical interest. Although the use of anthrax for purposes of bioterrorism was well recognized, preparation for such an attack was low on the list of local and national priorities. In hindsight, we recognize only too well that increased vigilance to detect and contain these organisms is required from a health care system that has limited resources.

Changes in medical technology and

treatments have facilitated the emergence of these infectious agents. More patients receive care in nonhospital settings, and rates of infection continue to rise as the population ages and survives illnesses that were previously fatal. Transmission of infection has become an issue of much wider scale and reaches beyond the walls of hospitals and, in some instances, assumes global proportions. Epidemiologists and infection-control practitioners can no longer confine their practices to within acute care hospitals.

A bright new cover announces that the latest edition of this textbook has been extensively revised to meet the needs of the 21st century. The new editor, Dr. William Jarvis, has taken the helm and has conscripted an impressive list of experts with national and international perspectives. Although the book title remains *Hospital Infections* by necessity, the content of the 5th edition clearly focuses on the bigger picture of health care epidemiology and infection control.

New chapters discuss important topics that range from hand hygiene, antimicrobial stewardship, sterilization, and disinfection to global issues. Public reporting of rates of health care-associated infection and patient safety and making a business case for infection control are also included as areas of recent and significant concern for the field. Not surprisingly, there is also a proliferation of electronic resources for infection-control surveillance and regulatory issues.

The index provides an exhaustive listing of potential pathogens, new and old, that have been associated with health care-associated infection; metapneumovirus, severe acute respiratory syndrome, and West Nile virus are just a few of the newer agents listed. The chapter about blood-borne infections is extended well beyond a discussion of HIV. Fungi have also assumed their rightful place as the cause of increasingly important infections that occur in compromised hosts.

This book is well written and organized, with up-to-date references and graphics

that help to amplify points made in the text. Overall, a "how to do it" format for the neophyte is liberally interspersed with "pearls" for the experienced epidemiologist and practitioner.

Needless to say, there is always room to improve even the best textbook. Omissions from this textbook are few. In recent years, acts of terrorism and natural disasters have prompted health care facilities to develop disaster and epidemic preparedness plans. This new and time-consuming challenge for the infection-control community is mentioned all too briefly. In future editions, a chapter providing some practical guidance would be most welcome.

There is some overlap of information between chapters that could be more extensively cross-referenced; mechanisms of antimicrobial resistance and infection-control definitions are some examples of redundancy. In addition, there are only so many ways that infections can be clinically defined, transmitted, and prevented, even if they occur in different health care settings. However, when areas of controversy arise, discussion of a topic from multiple viewpoints is always welcome.

In summary, *Hospital Infections* is a most worthy successor to the previous 4 editions. This authoritative textbook will continue to educate newcomers and to provide advice to both experienced epidemiologists and practitioners as they anticipate new challenges in the ever-changing field of health care epidemiology and infection control.

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New Books Received

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Manifestations of Pediatric Infectious Dis-
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Totowa, NJ: Humana Press, 2008. 409

pages. \$139.00 (hardcover). ISBN: 978-1-588-29-967-3.

Dembek ZF. Medical Aspects of Biological Warfare. Washington, DC: Office of the Surgeon General at TMM Publications, 2007. 694 pages (hardcover). ISBN: 978-0160797316.

Dodet B. Vaccination: A Tool for the Control of Avian Influenza. Basel, Switzerland: Karger, 2008. 196 pages. \$188.00 (soft cover). ISBN: 978-3-8055-8484-5.

Gisselquist D. Points to Consider. London, UK: Adonis & Abbey Publishers, 2008. 223 pages. \$25.00 (soft cover). ISBN: 978-1-90568-45-6.

Glasziou PP, Irwig L, Aronson JK. Evidence-Based Medical Monitoring. Malden, MA: Blackwell Publishing/BMJ Books, 2008. 356 pages. \$100.00 (soft cover). ISBN: 1405153997.

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Nachamkin I, Szymanski CM, Blaser MJ. Campylobacter. Washington, DC: American Society for Microbiology, 2008. 732 pages. \$159.95 (hardcover). ISBN: 978-1-55581-473-3.

Skolnik NS, Albert RH. Essential Infectious Disease Topics for Primary Care. Totowa, NJ: Humana Press, 2008. 300 pages. \$89.95 (hardcover). ISBN: 978-1-588-29-520-0.