

VOLUME 15 - NO 1 - 2008



Suivez l'évaluation
de votre manuscrit

RECHERCHE ECOSCIENCE

DIECKMANN, U., J. A. J. METZ, M. W. SABELIS & K. SIGMUND, 2002. ADAPTIVE DYNAMICS OF INFECTIOUS DISEASES: IN PURSUIT OF VIRULENCE MANAGEMENT.

Cambridge University Press, xviii + 532 p., 15 ¥ 23 cm, hardcover, US\$75.00, ISBN 0-521-78165-5.
le Thursday 06 March 2008
dans Revue des livres

Disease and war share many symbols and analogies. Biomedical specialists refer to the eradication, annihilation, and obliteration of disease; the military conducts surgical strikes; doctors and soldiers operate in the "theatre" of surgery or battle. Until the late 20th century, military concepts applied to infectious diseases were considered appropriate, because the inevitable outcome of our arsenal against pathogens seemed to be the utter vanquishing of the enemy. Clearly, this has not happened, and the human toll from infectious diseases continues to rise. If diseases can't be obliterated, can they be managed? This book demonstrates that the answer to this question is a resounding 'Yes', and that one key to managing disease lies in the reduction in virulence of pathogens. Virulence refers to the detrimental effects of parasites and pathogens on their hosts, including, but not limited to death. Although virulence is determined by the interactions between pathogen and host, it is typically considered a function of pathogen multiplication and transmission. In essence, virulence management is to disease what diplomacy is to human conflict. Only through an intimate understanding of the mechanisms underlying the conflict between pathogen and host can one forestall the need for abrupt remedial action in response to a crisis.

Adaptive Dynamics of Infectious Diseases attempts to unify key concepts from epidemiology, ecology, microbiology, genetics, and immunology in exploring virulence management. Virtually all disease-causing organisms are small, plentiful, have explosive intrinsic rates of increase, and are subject to repeated dispersal events followed by discrete population dynamics within individual hosts. Therefore, their potential for rapid evolution, particularly with respect to traits that influence virulence, is extraordinarily high, and accordingly, most chapters employ a strong Darwinian perspective. Because virulence is influenced by so many processes -including transmission mode, the presence of competing pathogens, and host immunology, behavior, and population density- the exploration of key interactions almost of necessity involves mathematical modeling. And indeed, the book is filled with pages of equations and some resulting figures that resemble Rorschach Tests. Nevertheless, the writing that accompanies the math is typically quite clear and understandable. A series of integrated boxes is devoted to introducing the major tools employed by chapter authors.

The book is rich and dense, and, at 532 (thin) pages, is deceptively slender. Its 33 chapters are divided into seven Parts that focus, respectively, on Setting the Stage, Host Population Structure, Within-Host Interactions, Pathogen-Host Coevolution, Multilevel Selection, Vaccines and Drugs, and Perspectives for Virulence Management. These Parts are introduced with short essays that lay essential foundations for what is to come. A logical progression is pursued that begins with a simplified notion of a host population that is infected by a single type of pathogen with a given virulence; then, layers of complexity are added to provide a series of expectations or hypotheses. Only rarely are the expectations testable with published empirical data, emphasizing the degree to which theory has outpaced empirical studies in this field. Some of the complexities that add richness to the study of the evolution and management of virulence are as follows. High virulence is free to evolve, and indeed is favored, when the pathogen is assured of dispersing to new hosts quickly via diarrheal discharge to drinking water or via mobile vectors like mosquitoes irrespective of host morbidity or mortality. As a corollary, lower virulence could be induced by curtailing these transmission routes, which would select for parasite genotypes that can only disperse to new hosts if the current host survives. Similarly, when multiple types of pathogens co-occur within a host, high virulence is a likely result of pathogens competing to be the first to flee a rapidly sinking ship; with the corollary that eliminating all but one pathogen strain will reduce virulence. The use of antibiotics, while having obvious positive effects on individual patients, is likely to entail a heavy cost to other members of the population because the antibiotics will select for pathogen genotypes that reproduce and transmit very quickly, before they are killed by the antibiotic. Another interesting insight concerns emerging diseases of humans that are caused by pathogens transmitted from other animals (i.e., zoonoses). If the human host is a habitat "sink" for the pathogen, such that local adaptation is swamped by a high rate of immigration from the non-human animal (source) population, then very high virulence in human victims can evolve even when the pathogen is not highly

virulent in the source species.

A crucial assumption that underlies many of the chapters in this book is that virulence management can be achieved by applying selective pressures on correlated traits such as transmission rate. In essence, virulence itself appears difficult to manage, but if virulence is highly correlated with transmission rate, then by reducing transmission rates we can cause the evolution of lower virulence. A recent opinion piece (Ebert & Bull, 2003) calls into question this basic assumption, arguing that the rapid evolution of reduced virulence is unlikely to be achieved by selecting against high transmission, because genetic correlations might not be sufficiently strong.

Virulence management will continue to be a hot topic that will undoubtedly be subject to much refinement. This book provides an outstanding treatment of the ecological, evolutionary, and physiological richness of this active area of research. Ecologists will find it richly rewarding and stimulating, and if health professionals give it a try, they will find much to guide health policy.

Literature cited

Ebert, D. & J. J. Bull, 2003. Challenging the trade-off model for the evolution of virulence: Is virulence management feasible? *Trends in Microbiology*, 11:15-20.

Richard S. Ostfeld



Institute of Ecosystem Studies

Box AB, 65 Sharon Turnpike

Millbrook, NY 12545, U.S.A.

e-mail: rostfeld@ecostudies.org

2007© Ecoscience. Pavillon Charles-Eugène Marchand, 1030 avenue de la Médecine, Local 0165, Université Laval, Québec G1V 0A6, Québec, Canada

Téléphone :  (418) 656-3188 , **Télécopieur :**  (418) 656-2346 , **Courriel :** ecoscience@ecoscience.ulaval.ca