

Theoretical epidemiology: Outcomes and issues of the researches on infectious disease spread by population dynamic models

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理論疫学—感染症流行の個体群動態モデルによる研究のこれまでと今後の課題

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The relationship with pathogens is a critical issue to all organisms including humans. Disease and parasitism are one of the most interesting aspects from ecological view point. Especially, to humans, they are also important from the view point of public health. These may be the leading reasons that theoretical researches of infectious disease spread have been forming a large area of research in mathematical biology, and also are the goals of research. Moreover an advantage of research on human diseases is an accumulation of records of the spread of infectious diseases in human populations. Although they are stored under the motivation of public health, they are quite helpful in drawing and verifying hypotheses by mathematical and statistical models.

In this session, first the overview of development of mathematical models of infectious disease spread was presented. Mathematical models of infectious disease spread have developed to cover various problems modifying the classic SIR model. In the analysis of the effect of vaccination, model studies guided policy making of prevention. Using an age structured model, age specific vaccination strategies can be analyzed. Heterogeneity is focused especially in sexually transmitted infection. From an evolutionary view point, the evolution of virulence was focused and analyzed in various aspects. Recently, to simulate more realistic and complex society, individual based models became often used. Mathematical models in epidemiology are still facing to the challenges of emerging infectious diseases such as pandemic influenza. More effort is required to achieve the goal.

According to some of the above aspects, following three articles were suggested for voluntary review by the participants. Haagenaars *et al.* investigated implication of spatial heterogeneity to persistence using a meta-population model. Alexander *et al.* studied the effect of booster (second dose vaccination) to eradicate infectious disease completely. Finally Choo *et al.* discussed the evolutionary consequence of host mortality to parasite virulence.

Excellent reviews were performed and found very helpful to deeply understand the models in epidemiology. The author appreciates the cooperation of all the participants and the organizing staff.

References

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Alexander ME, Moghadas SM, Rohani P, Summers AR (2006) Modelling the effect of a booster vaccination on disease epidemiology. *J Math Biol* 52 (3): 290-306.
Choo K, Williams PD, Day T (2003) Host mortality, predation and the evolution of parasite virulence. *Ecological Letters* 6 (4): 310-315.