2014 Biomath Seminar

Epidemic Disease Modeling

Date/Time September 4 2014, 4:00 p.m.

Place Room 221, Science building, Konkuk Univ.

4:00 – 4:50	Gerardo Chowell Arizona State Univ.	**Quantifying the transmission potential of emerging infectious diseases using mathematical modeling**
5:00 – 5:20	Hee-Dae Kwon Inha Univ.	**Free terminal time optimal tracking control problem of a HIV model**
5:20 – 5:40	Sunhwa Choi Konkuk Univ.	**Modeling the joint epidemics of tuberculosis and smoking in South Korea**
5:40 – 6:10		**Discussion**

Supported by Korea centers for Disease control & Prevention (KCDC)

contact Eunok Jung (junge@konkuk.ac.kr)
+82 (10) 9973-4163

KU KONKUK UNIVERSITY

Quantifying the transmission potential of emerging infectious diseases using mathematical modeling

Gerardo Chowell- Puente
Associate Professor, ASU
School of Human Evolution and Social Change,
College of Liberal Arts and Sciences
Email: gchowell@asu.edu
Homepage: http://chowell.lab.asu.edu/

Abstract

I will present two mathematical and estimation approaches to estimate the transmission potential of novel outbreaks of A/H7N9 influenza in China and Middle East Respiratory Syndrome (MERS-CoV) in the Arabian Peninsula. For novel A/H7N9 influenza, we employed a Bayesian approach combined with a transmission model to estimate the reproduction number of A/H7N9 influenza among humans during February-May 2013. For the MERS-CoV outbreaks, we used branching process analysis and a compartmental stochastic model in a Markov-Chain Monte-Carlo (MCMC) estimation framework to clarify the contribution of zoonotic (index) cases and secondary (human-to-human) cases to the reproduction number of MERS-CoV.

Publications (selected papers out of 108)

Dávila, J., Chowell, G., Borja-Aburto, V. H., Viboud, C., Muñiz, C. G., & Miller, M. (2013). Substantial Morbidity and Mortality Associated with Pandemic A/H1N1 Influenza in Mexico, Winter 2013-2014: Gradual Age Shift and Severity. *PLoS currents*, *6*.

Chowell, G., Simonsen, L., Towers, S., Miller, M. A., & Viboud, C. Transmission potential of influenza A/H7N9, February-May 2013, China: Supplementary information.

Lee, S., Golinski, M., & Chowell, G. (2012). Modeling optimal age-specific vaccination strategies against pandemic influenza. *Bulletin of mathematical biology*, *74*(4), 958-980.

Lee, S., Chowell, G., & Castillo-Chávez, C. (2010). Optimal control for pandemic influenza: the role of limited antiviral treatment and isolation. *Journal of theoretical biology*, *265*(2), 136-150.

Free terminal time optimal tracking control problem of a HIV model

Hee-Dae Kwon
Associate Professor
Inha University
Department of Mathematics
Email: hdkwon@inha.ac.kr
Homepage:
http://math.inha.ac.kr/~hdkwon/index.htm

Abstract

Minimum duration of treatment periods and optimal multidrug therapies for human immunodeficiency virus (HIV) type 1 infection are considered. We formulate an optimal tracking problem attempting to drive the states of the model to the ”healthy” steady state in which the viral load is low and the immune response is strong. We study an optimal time frame as well as HIV therapeutic strategies by analyzing the free terminal time optimal tracking control problem. The minimum duration of the treatment and optimal therapies are found by solving the corresponding optimality systems with the additional transversality condition for the terminal time. We demonstrate by numerical simulations that optimal dynamic multidrug therapies can lead to long-term control of HIV by the strong immune response after discontinuation of therapy.

Publications

Kwon, H. D., Lee, J., & Yoon, M. (2014). An Age-Structured Model with Immune Response of HIV Infection: Modeling and Optimal Control Approach. *Discrete and continuous dynamical systems-series B*, *19*(1), 153-172.

Lee, J., Kim, J., & Kwon, H. D. (2013). Optimal control of an influenza model with seasonal forcing and age-dependent transmission rates. *Journal of theoretical biology*, *317*, 310-320.

Jang, T., Kwon, H. D., & Lee, J. (2011). Free Terminal Time Optimal Control Problem of an HIV Model Based on a Conjugate Gradient Method. *Bulletin of mathematical biology*, *73*(10), 2408-2429.

Adams, B. M., Banks, H. T., Kwon, H. D., & Tran, H. T. (2004). Dynamic multidrug therapies for HIV: Optimal and STI control approaches. *Mathematical Biosciences and Engineering*, *1*(2), 223-241.

Modeling the joint epidemics of tuberculosis and smoking in South Korea

Sunhwa Choi
Ph.D candidate
Konkuk University
Department of Mathematics
Email: ssunhwa.choi@gmail.com

Abstract

Tuberculosis (TB) is the top three fatal infections of man worldwide and it has been considered one of the most serious problems facing South Korea. Moreover, smoking has long been associated with tuberculosis. In this article, we formulate a TB-smoking model to determine possible TB transmission mechanisms and to explore the effect of smoking on TB infection dynamics. The least-squares fitting has been used for estimating model parameters to the observed data of active-TB incidence and relapse, and data of smoking rate in South Korea. We have applied the optimal control theory to the developed mathematical model, in order to propose optimal treatment strategies. The five controls representing "TB distancing control, TB case finding control, TB case holding control, smoking distancing control, and quit-smoking control" are considered, with purpose of minimizing the numbers of infectious and exposed individuals and costs of implementing the control treatment.

Publications

Whang, S., Choi, S., & Jung, E. (2011). A dynamic model for tuberculosis transmission and optimal treatment strategies in South Korea. *Journal of theoretical biology*, *279*(1), 120-131.

Choi, S., & Jung, E. (2014). Optimal Tuberculosis Prevention and Control Strategy from a Mathematical Model Based on Real Data. *Bulletin of mathematical biology*, 1-24.

CHOI, S., LEE, J., & JUNG, E. (2014). Optimal Strategies for Prevention of Ecstasy Use. *Journal of the Korean Society for Industrial and Applied Mathematics*, *18*(1), 1-15.

찾아오시는 길

지하철 이용시

2호선	건대입구역 2번 출구
7호선	건대입구역 4번 출구 / 어린이대공원역 3번 출구

버스 이용시

건대역	240, 721, 2222, 2223, 2224
건국대학교병원 (청담대교 방향)	240, 721, 2222, 3220, 4212
건국대학교앞	2223, 2224, 3220
건대앞	302, 3216