

**FA13 BIOS 40427**  
**Topics in Epidemiology – Modern Infectious Disease Epidemiology**  
Debartolo 228  
15:30 PM-16:45 PM Tuesday and Thursday  
Fall 2013

**Instructor**

Edwin Michael, PhD  
University of Notre Dame  
emichael@nd.edu  
349 Galvin Life Sciences Building  
Notre Dame, IN 46556 USA  
+1-574-631-2234

Please note that there will be a number of different instructors who will provide students with training in specific skill areas.

This course is to introduce students to the field and methodology for researching modern infectious disease epidemiology. The emphasis will be on the important need to take an inter-disciplinary approach, combining different analytical methods, in the study of the transmission ecology and control of infectious diseases. Students will be introduced to a range of topics and modern methods relevant to understanding and investigating the population biology, epidemiology, and control of diseases, ranging from transmission modeling to spatial ecology, host immunity and parasite genetics, socio-epidemiology of infection, intervention modeling, and health economics and management.

**Learning goals**

This course is designed to accomplish skill development in the following primary areas:

1. Appreciation of the burden and impact of infectious diseases on human populations
2. Gain understanding of modern theories of transmission dynamics, parasite immunity, population genetics, socio-ecology, epidemiological investigation, health economics, intervention design and management
3. Capacity to use modern methods for investigating infectious disease epidemiology, including transmission modeling, mapping and spatial analysis, surveillance analysis, meta-analysis, economic and decision analysis and querying molecular databases.
4. Capability to develop and apply inter-disciplinary approaches to investigating and intervening against major categories of infectious diseases

**Office Hours**

I welcome the opportunity to meet with students individually. I prefer speaking with you after class or by appointment. To set up a time, I can be reached at 574-631-2234 or by e-mail emichael@nd.edu

## Academic Integrity

Students are expected to uphold the Academic Code of Honor described in the Graduate School's Bulletin of Information (online at <http://graduateschool.nd.edu/assets/29023/bulletin.1011.pdf>), p. 18.

## Attendance

Students are expected to attend all class sessions. If you cannot make a class, please obtain advanced approval from the instructor. The class participation grade will be lowered by one partial unit (i.e. from a B+ to a B) for each unexcused absence. More than three unexcused absences will lead to a failure of the course.

## Course components and assessments

- Core course content will be introduced in **lectures**. Handouts will be available for each class, but will only outline the lecture topic and must be supplemented by notes taken in class and by reading of required texts
- Lectures will be followed by major **practicals** in mathematical modeling, mapping and spatial analysis, online molecular database queries/analysis, meta-analysis and economic analysis
- Students will present a **group seminar** presenting results of either a systematic review or meta-analysis on any topic of their choice in global health.
- 2 short pieces of **assignment** work will also be carried out by students and assessed.

**Assessment** of this course will be by:

1. Assignments (20%)
2. Practical (40%)
3. Meta-analysis/systematic review seminar (10%)
4. End of term Exam (30%)

## Required Texts

Anderson, R.M. & May, R.M (1991) *Infectious Diseases of Humans: Dynamics and Control* (Oxford University Press). A general readable introduction to the development and role of models in infectious disease epidemiology with many examples.

Cox, F.E.G., ed (1993) *Modern Parasitology* (Blackwell Science). A very good introduction to topics in Parasitology, including immunology, genetics and epidemiology.

Pettiti, D.B. (2000) *Meta-analysis, Decision analysis, and Cost-effectiveness Analysis: Methods for Quantitative Synthesis in Medicine* (Oxford University Press). An excellent overview and introduction to methods for analysing public health interventions.

Thacker, S.B. (2000) *Principles and Practice of Public Health Surveillance* (Oxford University Press). Comprehensive introduction to the development of the science of public health surveillance.

Keeling, M.J. & Rohani, P. (2007) *Modeling Infectious Diseases in Humans and Animals* (Princeton University Press). Good overview of different types of models.

Powell, J.E. (2007) Economics in public health. In Orme, J. et al. eds *Public Health for the 21<sup>st</sup> Century: New Perspectives on Policy, Participation and Practice* (McGraw-Hill/Open University Press). A highly readable introduction to health economics.

Pfeiffer, D.U. et al. (2008) *Spatial Analysis in Epidemiology* (Oxford University Press). A good introduction to methods, software and analysis frameworks for carrying out mapping and spatial modelling of epidemiological data.

Tibayrenc, M., ed (2011) *Genetics and Evolution of Infectious Diseases* (Elsevier Science).

### **Optional Books**

Michael, E. & Spear, R.C., eds (2010) *Modelling Parasite Transmission and Control* (Springer Science/Landes BioScience). Quite mathematical but points to latest work and methods in parasite transmission modeling.

### **Schedule**

#### ***Tuesday, August 27***

Introductions and discussion of course objectives.

#### ***Thursday, August 29***

*The global burden of infectious diseases.*

Approaches to burden estimates, composite summary measures of population health, comparisons and trends in disease burden.

#### ***Tuesday, September 3***

*Principles of infectious disease epidemiology.*

Overview of infectious agents, life cycles, routes of transmission, host exposure and responses, basic epidemiological patterns, and primary interventions.

#### ***Thursday, September 5***

*Epidemiological methods in health research I*

Introduction to the Scientific Method in Epidemiology

#### ***Tuesday, September 10***

*Epidemiological methods in health research II*

Study designs in epidemiological research

#### ***Thursday, September 12***

*Epidemiological surveillance.*

Principles, rationale, history, methods, and types of modern surveillance systems.

**Tuesday, September 17**

*Outbreak investigations.*

*Practical on applying statistical algorithms to detect outbreaks in surveillance data.*

**Thursday, September 19**

*GIS and remote sensing in epidemiology.*

*Introduction to GIS and remote sensing in mapping of infectious diseases.*

**Tuesday, September 24 (BM, Q, EM)**

*Hands-on computer practicals on using GPS, R and Google Map for mapping and analyzing disease spatial distributions I*

**Thursday, September 26 (BM, Q, EM)**

*Hands-on computer practicals on using GPS, R and Google Map in mapping and analyzing disease spatial distributions II*

**Tuesday, October 1 (KBS)**

*Parasite population genetics*

*Principles of parasite population genetics, molecular genetics of viruses, bacteria and protozoa, population structure, adaptive mechanisms, host-pathogen co-evolution, evolution of drug resistance*

**Thursday, October 3 (RP, SB)**

*Hands-on introduction to online genomic databases and clustering analysis I*

**Tuesday, October 8**

*Immunity to Parasites*

*Components and types of immunity to parasitic infection, immunity and population dynamics, vaccinations, immunity and dynamics of parasite control.*

**Thursday, October 10**

*Mathematical models in epidemiology: microparasitic infections I*

*Introduction to modeling directly-transmitted microparasitic infectious diseases: derivation and implementation of compartmental models, parameterization and predictions.*

**Tuesday, October 15 (BS)**

*Mathematical models in epidemiology: macroparasitic infections II*

*Introduction to modeling helminth infections: continuous models, impact of worm burden, density dependences and aggregation; derivation and implementation of simple macroparasite models, parameterization and predictions.*

**Thursday, October 17 (BS,SL,Q)**

*Hands-on mathematical modeling of a directly-transmitted microparasitic infection I*

October 19-27--Mid-term break

**Tuesday, October 29 (BS, SL, Q)**

*Hands-on mathematical modeling of a directly-transmitted microparasitic infection II*

**Thursday, October 31 (BS, SL, Q)**

*Hands-on mathematical modeling of a vector-borne microparasitic infection*

**Tuesday, Nov 5**

*Epidemiological methods in health research III*

Data, and basic types of analyses in modern epidemiology

**Thursday, November 7**

*Design and implementation of Systematic Reviews/Meta-Analysis in infectious disease epidemiology.*

Introduction to research synthesis: concepts and methods

**Tuesday, November 12 (MN, DL)**

*Design and implementation of Systematic Reviews/Meta-Analysis in infectious disease epidemiology.*

*Computer Practicals in R.*

**Thursday, November 14**

*Economic Methods for evaluation of health programs I*

Principles of health economics, cost menus, discounting, cost-effectiveness and cost-benefit analysis, economics and health interventions.

**Tuesday, November 19 (NP)**

*Social epidemiology of infectious diseases*

Role of social disparities and inequalities on disease risk.

**Thursday, November 21 (NP)**

*Culture, Behaviour and Health*

Concepts of medical anthropology, cultural views of health and illness, theories of health behaviour and change, methodologies for understanding culture and health behaviour, case study of HIV/AIDs in sub-saharan Africa.

**Tuesday, November 26**

*Economic Methods for evaluation of health programs II*

Conducting a cost-effectiveness analysis using Excel/R

November 27 – Dec 1 – Thanksgiving Holiday

**Tuesday, December 3 (ZS)**

*Interventions in infectious diseases I*

Interventions against infectious diseases : innovations in controlling vectors

**Thursday, December 5**

*Interventions in infectious diseases II*

Program theory, complexity, and intervention design and management

***Tuesday, December 10***

*Group seminar preparations*

***Thursday, December 12***

*Group presentations*

***December 13-15--Reading days***

***December 16-20--Final examination days***

Course Tutors:

BS: Brajendra Singh

BM: Benjamin Mayala

DL: Diana LaTorre

KBS: Katrina Button-Simons

MN: Michelle Ngai

NP: Naomi Penny

Q: Quirine ten Bosch

RP: Richard Pinapati

SB: Susanta Behura

SL: Sarah Lukens

ZS: Zainulabeuddin (Zain) Syed

EM: Edwin Michael