
Biology of Emerging Infectious Diseases

BIOL 469

Fall 2014 Syllabus

Instructor: Dr. Kathryn A. Hanley

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Class meetings: MWF 10:30-11:20 Foster Hall 146

Office Hours: Tuesdays 11:00-12:00; Wednesdays 11:30-12:30

Date	Day	Topic	Readings†
8/22	F	Plagues and History; Syllabus and Organization	
8/25	M	Evolution, epidemiology & emergence: terms and concepts I	• Greenberg et al. 2005 Ch. 2*
8/27	W	Evolution, epidemiology & emergence: terms and concepts II	• Brown et al. 2006 (skip Box 1)
8/29	F	Evolution, epidemiology & emergence: terms and concepts III	• Alizon et al. 2013
9/1	M	Labor Day: No class	
9/3	W	Ebola: The Plague Fighters (Film and Discussion)	• Feldmann and Geisbert 2011
9/5	F	Bats and bleeding fevers I: Ebola	• Groseth et al. 2007
9/8	M	Bats and bleeding fevers II: Henipaviruses	• Greenberg et al. 2005. Ch. 9* • Rahman et al. 2012
9/10	W	Problems from Primates: How SIV became HIV	• Sharp & Hahn 2011
9/12	F	<i>Discussion: Spillover of primate zoonoses</i>	• Calattini et al. 2007
9/15	M	Amplification and Evolution of HIV	
9/17	W	HIV: Strategies for Control, and Cure?	• Lewin et al. 2014

9/19	F	<i>Discussion: Circumcision for HIV prevention</i>	<ul style="list-style-type: none"> • Greenberg et al. 2005. Ch 7* (skip meta-analysis and the Cochrane collaboration subsections) • Auvert et al. 2005
9/22	M	Malaria I: Million murdering death	<ul style="list-style-type: none"> • Greenwood et al. 2008
9/24	W	Malaria II	<ul style="list-style-type: none"> • Hisaeda et al. 2004 • Arama and Troye-Blomberg 2014
9/26	F	<i>Discussion: Can evolution of drug-resistant malaria be prevented?</i>	<ul style="list-style-type: none"> • Goldberg et al. 2012 (Malaria section only) • Pollitt et al. 2014
9/29	M	<i>Discussion: Impact of immunosuppression on evolution of malaria virulence</i>	<ul style="list-style-type: none"> • Barclay et al. 2014
10/1	W	Three wrongs don't make a right: HIV, Poverty and TB	<ul style="list-style-type: none"> • Dye et al. 2010
10/3	F	Influenza I: the Quick Change Artist	<ul style="list-style-type: none"> • Webster and Govorkova, 2014
10/6	M	Influenza II	
10/8	W	Influenza: Strategies for Control	<ul style="list-style-type: none"> • Lambert and Fauci, 2010
10/10	F	<i>Discussion: Influenza research and the "dual use" controversy</i>	<ul style="list-style-type: none"> • Herfst et al. 2012
<i>5:00 pm: Evening Review Session (Voluntary; Bring Your Questions!)</i>			
10/13	M	<i>No Class -Study Day</i>	
10/15	W	Midterm Exam	
10/17	F	Arboviruses: The Bad Bite	
10/20	M	Dengue: The Evil Spirit that Vacations In Key West	<ul style="list-style-type: none"> • Kyle & Harris 2008
10/21	Tu	<i>Last Day to Drop Course with a "W"</i>	
10/22	W	Sylvatic Arboviruses: When mosquitoes monkey around	<ul style="list-style-type: none"> • Hanley et al. 2013

10/24	F	<i>No Class: Work on Mini-Review Bibliography and Outline</i>	
10/27	M	Discussion: <i>Vector shift by chikungunya virus</i>	• Tsetsarkin et al. 2007
		<i>Mini-Review <u>Bibliography and Outline</u> Due</i>	
10/29	W	Mice, Monsoons and Maladies Climate Change and Hantaviruses	• Mills et al. 2010
10/31	F	Effect of EID's on biodiversity: Emerging fungal diseases	• Blehert et al. 2012 • Fisher et al. 2012
11/3	M	<i>No Class: Work on Mini-Review</i>	
11/5	W	<i>No Class: Work on Mini-Review</i>	
11/7	F	Discussion: <i>Effect of biodiversity on emergence: Lyme disease</i>	• Dobson et al. 2006 • LoGiudice et al. 2003
11/10	M	Vector Control I	
		<i>Mini-Review Due</i>	
		<i>Movie Night (Movies!) Voluntary Evening Viewing of "Contagion" Specific time and place TBD</i>	
11/12	W	Vector Control II	
11/14	F	Discussion: <i>Use of genetically modified mosquitoes for vector control</i>	• Iturbe-Ormaetxe et al. 2011 • Walker et al. 2011
11/17	M	The Clap Heard 'Round the World Antibiotic resistance in gonorrhea	• Smith et al. 2013
11/19	W	Antivirulence Therapies	• Cegelski et al. 2008 • Allen et al. 2014
11/21	F	Discussion: <i>Evolutionary Amelioration of Fitness Costs of Resistance</i>	• Skurnik et al. 2014

Course Overview: In recent decades, infectious diseases such as “swine flu”, chikungunya virus and Ebola virus (the latter two in 2013 and 2014, respectively) have jumped species and geographic boundaries to emerge in new populations. At the same time established pathogens, like gonorrhea, have evolved resistance to drugs and vaccines. These emerging diseases have had a substantial impact on biodiversity, economic prosperity, and of course human health. Disease emergence raises a number of intriguing questions:

- Why do certain diseases emerge and others remain stable or decline?
- How do diseases emerge?
- How much of a threat are emerging diseases to human health and biodiversity?
- What can be done to mitigate the impact of emergent diseases?
- What can be done to limit the emergence of new diseases?

This class will investigate the evolutionary and ecological drivers of disease emergence. The effect of emerging diseases on human health will be addressed throughout the class, but the class will also consider the consequences of disease emergence for the health of wildlife and plant populations. Additionally, the class will consider the mechanisms used to control disease emergence and why they succeed or fail.

Prerequisite courses: This is an upper-level course intended for juniors, seniors, and graduate students. While the only formal pre-requisites for the course are BIOL 111 and BIOL 211, in order to keep up with the material it will be necessary to have taken a genetics course and very helpful to have taken at least one course in some area of microbiology, evolution or ecology.

Required reading: There is no textbook for the class. Required readings from the primary and secondary literature are listed above and available through the Module section of Canvas, with the exception of designated handouts. Most are also easily accessible online through the NMSU library. *It is **critical** to read the required readings before the class for which they are listed. For discussion sections (see below), you must also print out each reading and bring it to class. Some readings have critical color figures; please try to access a color printer for these.*

Lecture outlines. Outlines of the powerpoint slides for each lecture will be posted in the evening (usually by 5:00) prior to the lecture. Please print these and bring them to class! Although they will not contain all of the information presented in my slides, they will contain complex graphs and images and especially wordy slides, freeing you to take notes at a reasonable pace and to answer questions.

Communication: Readings, useful websites, assignments, other important materials, and announcements about the class will be posted on Canvas, please check it regularly. The fastest way to contact me is via my nmsu email address (above) directly; otherwise I check Canvas email when I post lecture notes.

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of operation are from 8:00 AM until 5:00 PM Monday through Friday. Please feel free to contact them at 646-1840 or via e-mail at helpdesk@nmsu.edu.

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Class Format: After the first few weeks of introduction, there will generally be two lectures and one discussion section each week. The discussion section will be devoted to student-led discussion of a primary research paper, often coupled with a relevant review.

If the class size is too large, I may split the class into two sections on discussion days. Movement to a second section at a separate time on those days will be voluntary.

Questions and general discussion are encouraged throughout the lectures; you are graded on participation (see below).

Cell phones and beepers must be turned off during lecture and discussion.

Graded activities

(i) Class participation: You will be graded on your participation during lectures and during student-led discussions (see below). It is not sufficient to merely be present at lectures to attain a good class participation grade; you must be prepared to ask me questions and to answer questions when asked (and you will be asked; I call on students regularly during lectures).

(ii) Student-led discussion sections: Pairs (if needed, threesomes) of students will sign up for a discussion paper (see schedule above). *Each pair will meet with me at my office hours or at a scheduled time at least one week prior to their scheduled discussion section.* It is essential that both students read the discussion papers carefully prior to this meeting! Also, each will need a copy of the papers during the meeting.

When it is your turn to lead discussion, you will be responsible for presenting approximately ten to fifteen minutes of background on the topic at hand as well as a brief summary of the primary research paper, and leading a general discussion of its methods, results and conclusions. Here your job is not only to understand the research, but also to pick out its strengths and weakness, evaluate its importance in the field, and consider its implications for the future of emerging disease, and, perhaps most importantly, to elicit your fellow students' thoughts on these aspects of the study. To do this you will need to draw on what you have learned in the class and avoid being intimidated by statistics and scientific jargon. The liveliest discussions result when the presenter is prepared with several questions for the class that either

help it work through the paper systematically or help it to identify major weaknesses or strengths.

All other students should prepare every week at least one question or substantive comment (positive or negative) about the assigned paper. Pay careful attention to tables and figures; discussion will generally focus on these.

Some questions you should ask as you read papers are:

- What is the paper's primary objective?
- Does it attempt to test a specific hypothesis?
- Are the methods appropriate?
- If the methods are observational, are they free from bias?
- If experimental, are they properly designed?
- How are the data analyzed?
- What are the main results, and how do the authors interpret them?
- Do the data support their hypotheses? Have they considered alternative explanations?
- How do these results compare with previous work in the area?
- Do they advance our understanding of this field of research?
- What further work might be warranted?

(iii) Mini Review. Every student will be required to write a brief (4 page, double-spaced) review of a driver of infectious disease emergence that is not covered in the class. This will be described in more detail in a separate handout.

(iv) Exams: There will be one midterm and one final exam. Exam questions will be short answer in format and will include problem-solving and discussion. They will cover material presented in lectures, discussion and papers, and will encourage integration of information from these sources. I will hand out a list of questions drawn from this material once every two-three weeks. The exam itself will be composed of a subset of these questions and *variants* of these questions. Group study of the questions is encouraged, but all answers given on exams must be in the student's own words and no written materials are allowed in the exam. No makeup exams will be given without a **prior excused absence** from the instructor or verification of an unavoidable and dire emergency. Judgment of whether an emergency is dire or not falls to the instructor. An unexcused absence will result in failure of that exam.

Academic Honor

I expect each student to submit his or her own original work in every exercise.

The current Student Code of Conduct definition of plagiarism can be found at: <http://deanofstudents.nmsu.edu/student-handbook/1-student-code-of-conduct/>. Students

are expected to read it within the first week of class.

Even with a citation, failure to put quotation marks around direct quotations also constitutes plagiarism, because it implies that the writing is your own. Material should either be paraphrased or clearly designated as a quotation. Note that replacing words with synonyms, changing verb tense or other minor alterations do not qualify as paraphrasing.

Intentional or unintentional plagiarism or other cheating will result in a 0 on the specific exercise and, depending on the gravity of the plagiarism or cheating, and at the discretion of the instructor, failure of the class. If a student is unsure whether he or she is being academically dishonest, then he or she should ask me for clarification (in person or via email) prior to completing the exercise.

Withdrawals: It is the responsibility of the student to complete the necessary paperwork to withdraw from the class should they decide to do so.

Attendance: Lecture attendance is expected except for documented university business or extreme emergencies, and regular participation will greatly improve your success in the course. You will be graded on your participation in discussions (see below) and your participation during regular lectures (see below), thus unexcused absences will directly impact your final grade.

Grading: The association between point totals and letter grades will be determined at the conclusion of the course at the discretion of the instructor, with the stipulation that students who receive 90%, 80%, 70% and 60% of point totals will receive no less than an A, B, C and D respectively, and students who receive less than 50% of possible points will fail.

Discussion Section Leadership	20%
Participation (lectures & paper discussions)	20%
Midterm Exam	20%
Final Exam	20%
Mini Review	20%

Late Work: Assignments will lose 10% of total possible points for each day that they are turned in late.

Extra Credit – The ProMed eMail Challenge. If you wish to earn extra credit, sign up for email updates from ProMed Mail (go to <http://www.promedmail.org/> and hit subscribe). To gain extra credit (1.5 % of total points per extra credit, maximum three extra credits earned), all you have to do is print out a ProMed email that is sent < 48 hrs before a given lecture or discussion that is directly relevant (about the same organism or phenomenon) as the lecture. The instructor will determine whether or not an update is relevant. The email must be sent to your account (no sharing of emails; this is cheating),

with date received noted. Deliver a hard copy of the email to me in lecture and voila—extra credit.

Changes to the syllabus: Emerging infectious diseases arise constantly (hence the need for this class). Thus I reserve the right to modify the syllabus in order to address any new emerging diseases; to incorporate new emerging disease research; or simply to delve in to particular topics in more detail depending upon the interests of the class.

Disabilities and Accommodations: Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act Amendments Act (ADAAA) covers issues relating to disability and accommodations. If a student has questions or needs an accommodation in the classroom (all medical information is treated confidentially), contact:

Trudy Luken, Director
Student Accessibility Services (SAS) - Corbett Center, Rm. 244
Phone: (575) 646-6840 E-mail: sas@nmsu.edu
Website: <http://sas.nmsu.edu/>

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For more information on discrimination issues, Title IX, Campus SaVE Act, NMSU Policy Chapter 3.25, NMSU's complaint process, or to file a complaint contact:

Gerard Nevarez, Title IX Coordinator
Agustin Diaz, Title IX Deputy Coordinator
Office of Institutional Equity (OIE) - O'Loughlin House, 1130 University Avenue
Phone: (575) 646-3635 E-mail: equity@nmsu.edu
Website: <http://www.nmsu.edu/~eeo/>

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NMSU Police Victim Services:	(575) 646-3424
NMSU Counseling Center:	(575) 646-2731
NMSU Dean of Students:	(575) 646-1722
For Any On-campus Emergencies:	911

Bibliography**Articles:**

- ALIZON, S., DE ROODE, J. C. & MICHALAKIS, Y. (2013). Multiple infections and the evolution of virulence. *Ecol Lett*, 16(4), 556-567.
- ALLEN, R. C., POPAT, R., DIGGLE, S. P. & BROWN, S. P. (2014). Targeting virulence: can we make evolution-proof drugs? *Nat Rev Microbiol*, 12(4), 300-308.
- ANDERSSON, D. I. & HUGHES, D. (2010). Antibiotic resistance and its cost: is it possible to reverse resistance? *Nat Rev Microbiol*, 8(4), 260-271.
- ARAMA, C. & TROYE-BLOMBERG, M. (2014). The path of malaria vaccine development: challenges and perspectives. *J Intern Med*, 275(5), 456-466.
- AUVERT, B., TALJAARD, D., LAGARDE, E., SOBNGWI-TAMBEKOU, J., SITTA, R. & PUREN, A. (2005). Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. *PLoS Med*, 2(11), e298.
- BAJAJ, D., GEISSLER, J. R., ALLEN, M. R., BURR, D. B. & FRITTON, J. C. (2014). The resistance of cortical bone tissue to failure under cyclic loading is reduced with alendronate. *Bone*, 64, 57-64.
- BARCLAY, V. C., KENNEDY, D. A., WEAVER, V. C., SIM, D., LLOYD-SMITH, J. O. & READ, A. F. (2014). The Effect of Immunodeficiency on the Evolution of Virulence: An Experimental Test with the Rodent Malaria *Plasmodium chabaudi* *. *Am Nat*, 184 Suppl 1, S47-57.
- BART, M. J., HARRIS, S. R., ADVANI, A., ARAKAWA, Y., BOTTERO, D., BOUCHEZ, V., CASSIDAY, P. K., CHIANG, C. S., DALBY, T., FRY, N. K., GAILLARD, M. E., VAN GENT, M., GUIISO, N., HALLANDER, H. O., HARVILL, E. T., HE, Q., VAN DER HEIDE, H. G., HEUVELMAN, K., HOZBOR, D. F., KAMACHI, K., KARATAEV, G. I., LAN, R., LUTYLSKA, A., MAHARJAN, R. P., MERTSOLA, J., MIYAMURA, T., OCTAVIA, S., PRESTON, A., QUAIL, M. A., SINTCHENKO, V., STEFANELLI, P., TONDELLA, M. L., TSANG, R. S., XU, Y., YAO, S. M., ZHANG, S., PARKHILL, J. & MOOI, F. R. (2014). Global population structure and evolution of *Bordetella pertussis* and their relationship with vaccination. *MBio*, 5(2), e01074.
- BLEHERT, D. S. (2012). Fungal Disease and the Developing Story of Bat White-nose Syndrome. *PLoS Pathog*, 8(7), e1002779.
- BROWN, N. F., WICKHAM, M. E., COOMBES, B. K. & FINLAY, B. B. (2006). Crossing the line: selection and evolution of virulence traits. *PLoS Pathog*, 2(5), e42.
- CALATTINI, S., BETSEM, E. B., FROMENT, A., MAUCLERE, P., TORTEVOYE, P., SCHMITT, C., NJOUOM, R., SAIB, A. & GESSAIN, A. (2007). Simian foamy virus transmission from apes to humans, rural Cameroon. *Emerg Infect Dis*, 13(9), 1314-1320.
- CEGELSKI, L., MARSHALL, G. R., ELDRIDGE, G. R. & HULTGREN, S. J. (2008). The biology and future prospects of antivirulence therapies. *Nat Rev Microbiol*, 6(1), 17-27.
- CLARK, T. A. (2014). Changing pertussis epidemiology: everything old is new again. *J Infect Dis*, 209(7), 978-981.
- DOBSON, A., CATTADORI, I., HOLT, R. D., OSTFELD, R. S., KEESING, F., KRICHBAUM, K., ROHR, J. R., PERKINS, S. E. & HUDSON, P. J. (2006). Sacred Cows and Sympathetic Squirrels: The Importance of Biological Diversity to Human Health. *PLoS Med*, e231.
- DYE, C. & WILLIAMS, B. G. (2010). The population dynamics and control of tuberculosis.

- Science, 328(5980), 856-861.
- FELDMANN, H. & GEISBERT, T. W. (2011). Ebola haemorrhagic fever. *Lancet*, 377(9768), 849-862.
- FISHER, M. C., HENK, D. A., BRIGGS, C. J., BROWNSTEIN, J. S., MADOFF, L. C., MCCRAW, S. L. & GURR, S. J. (2012). Emerging fungal threats to animal, plant and ecosystem health. *Nature*, 484(7393), 186-194.
- FOLEY, J., CLIFFORD, D., CASTLE, K., CRYAN, P. & OSTFELD, R. S. (2011). Investigating and managing the rapid emergence of white-nose syndrome, a novel, fatal, infectious disease of hibernating bats. *Conserv Biol*, 25(2), 223-231.
- GOLDBERG, D. E., SILICIANO, R. F. & JACOBS, W. R., JR. (2012). Outwitting evolution: fighting drug-resistant TB, malaria, and HIV. *Cell*, 148(6), 1271-1283.
- GREENWOOD, B. M., FIDOCK, D. A., KYLE, D. E., KAPPE, S. H., ALONSO, P. L., COLLINS, F. H. & DUFFY, P. E. (2008). Malaria: progress, perils, and prospects for eradication. *J Clin Invest*, 118(4), 1266-1276.
- GROSETH, A., FELDMANN, H. & STRONG, J. E. (2007). The ecology of Ebola virus. *Trends Microbiol*, 15(9), 408-416.
- HALL, A. R. & MACLEAN, R. C. (2011). Epistasis buffers the fitness effects of rifampicin-resistance mutations in *Pseudomonas aeruginosa*. *Evolution*, 65(8), 2370-2379.
- HANLEY, K. A., MONATH, T. P., WEAVER, S. C., ROSSI, S. L., RICHMAN, R. L. & VASILAKIS, N. (2013). Fever versus fever: the role of host and vector susceptibility and interspecific competition in shaping the current and future distributions of the sylvatic cycles of dengue virus and yellow fever virus. *Infect Genet Evol*, 19, 292-311.
- HERFST, S., SCHRAUWEN, E. J., LINSTER, M., CHUTINIMITKUL, S., DE WIT, E., MUNSTER, V. J., SORRELL, E. M., BESTEBROER, T. M., BURKE, D. F., SMITH, D. J., RIMMELZWAAN, G. F., OSTERHAUS, A. D. & FOUCHIER, R. A. (2012). Airborne transmission of influenza A/H5N1 virus between ferrets. *Science*, 336(6088), 1534-1541.
- HISAEDA, H., YASUTOMO, K. & HIMENO, K. (2005). Malaria: immune evasion by parasites. *Int J Biochem Cell Biol*, 37(4), 700-706.
- ITURBE-ORMAETXE, I., WALKER, T. & SL, O. N. (2011). Wolbachia and the biological control of mosquito-borne disease. *EMBO Rep*, 12(6), 508-518.
- KYLE, J. L. & HARRIS, E. (2008). Global Spread and Persistence of Dengue. *Annu Rev Microbiol*.
- LAMBERT, L. C. & FAUCI, A. S. (2010). Influenza vaccines for the future. *N Engl J Med*, 363(21), 2036-2044.
- LEWIN, S. R., DEEKS, S. G. & BARRE-SINOUSI, F. (2014). Towards a cure for HIV--are we making progress? *Lancet*, 384(9939), 209-211.
- LIPSITCH, M., PLOTKIN, J. B., SIMONSEN, L. & BLOOM, B. (2012). Evolution, safety, and highly pathogenic influenza viruses. *Science*, 336(6088), 1529-1531.
- LOGIUDICE, K., OSTFELD, R. S., SCHMIDT, K. A. & KEESING, F. (2003). The ecology of infectious disease: effects of host diversity and community composition on Lyme disease risk. *Proc. Nat. Acad. Sci. U.S.A.*, 100, 567-571.
- MILLS, J. N., AMMAN, B. R. & GLASS, G. E. (2010). Ecology of hantaviruses and their hosts in North America. *Vector Borne Zoonotic Dis*, 10(6), 563-574.
- PLOTKIN, S. A. (2014). The pertussis problem. *Clin Infect Dis*, 58(6), 830-833.

- POLLITT, L. C., HUIJBEN, S., SIM, D. G., SALATHE, R. M., JONES, M. J. & READ, A. F. (2014). Rapid response to selection, competitive release and increased transmission potential of artesunate-selected *Plasmodium chabaudi* malaria parasites. *PLoS Pathog*, 10(4), e1004019.
- RAHMAN, M. A., HOSSAIN, M. J., SULTANA, S., HOMAIRA, N., KHAN, S. U., RAHMAN, M., GURLEY, E. S., ROLLIN, P. E., LO, M. K., COMER, J. A., LOWE, L., ROTA, P. A., KSIAZEK, T. G., KENAH, E., SHARKER, Y. & LUBY, S. P. (2012). Date palm sap linked to Nipah virus outbreak in Bangladesh, 2008. *Vector Borne Zoonotic Dis*, 12(1), 65-72.
- SHARP, P. M. & HAHN, B. H. (2011). Origins of HIV and the AIDS pandemic. *Cold Spring Harb Perspect Med*, 1(1), a006841.
- SKURNIK, D., ROUX, D., CATTOIR, V., DANILCHANKA, O., LU, X., YODER-HIMES, D. R., HAN, K., GUILLARD, T., JIANG, D., GAULTIER, C., GUERIN, F., ASCHARD, H., LECLERCQ, R., MEKALANOS, J. J., LORY, S. & PIER, G. B. (2013). Enhanced in vivo fitness of carbapenem-resistant oprD mutants of *Pseudomonas aeruginosa* revealed through high-throughput sequencing. *Proc Natl Acad Sci U S A*, 110(51), 20747-20752.
- SORCI, G., CORNET, S. & FAIVRE, B. (2013). Immunity and the emergence of virulent pathogens. *Infect Genet Evol*, 16, 441-446.
- VASILAKIS, N., CARDOSA, J., HANLEY, K. A., HOLMES, E. C. & WEAVER, S. C. (2011). Fever from the forest: prospects for the continued emergence of sylvatic dengue virus and its impact on public health. *Nat Rev Microbiol*, 9(7), 532-541.
- WALKER, T., JOHNSON, P. H., MOREIRA, L. A., ITURBE-ORMAETXE, I., FRENTIU, F. D., MCMENIMAN, C. J., LEONG, Y. S., DONG, Y., AXFORD, J., KRIESNER, P., LLOYD, A. L., RITCHIE, S. A., O'NEILL, S. L. & HOFFMANN, A. A. (2011). The wMel *Wolbachia* strain blocks dengue and invades caged *Aedes aegypti* populations. *Nature*, 476(7361), 450-453.
- WATANABE, Y., IBRAHIM, M. S., SUZUKI, Y. & IKUTA, K. (2012). The changing nature of avian influenza A virus (H5N1). *Trends Microbiol*, 20(1), 11-20.
- WEBSTER, R. G. & GOVORKOVA, E. A. (2014). Continuing challenges in influenza. *Ann N Y Acad Sci*.

Book chapters from:

Greenberg, R.S., Daniels, S.R., Flanders, W.D., Eley, J.W. and Boring, J.R. (2005) *Medical Epidemiology*. Lange Medical Books/McGraw Hill, New York.