Anthropological Sciences 170A/270A
Issues in Water, Health, & Development

Winter 2008
5 units

Instructor

Karen Levy, PhD, MPH
Lang Postdoctoral Scholar
Department of Anthropology

Office: Building 40, Room 42H
Phone: 650.725.6112
E-mail: klevy@stanford.edu
Office Hours: Tuesday 2-4pm or by appointment

Course Description

This course will explore the many ways that water flows through and affects human communities throughout the world, with a focus on developing countries. We will explore the impact of development projects related to water distribution and management on the health of human communities, with a special emphasis on infectious diseases such as malaria, schistosomiasis, and diarrheal disease. Topics include transmission and control of water-associated diseases, and the effect of pollution, dam-building, climate change, and the distribution and management of fresh water resources on human health. The course will address how epidemiological evidence is built to establish connections between water and health, and will explore both direct and indirect root causes of the current burden of water-associated disease.

Course Goals & Objectives

Students will gain an understanding of how biological, physiochemical, socioeconomic, and political characteristics of water affect human health at the individual, community, regional, and global scales. In this course, students will gain a perspective on how to build and evaluate evidence about causal relationships between water characteristics and human health.

Prerequisites

HumBio core or permission of the instructor.

Expectations

Students will attend all lectures, complete all assigned readings and assignments, and participate in class discussions. While not required, students will be informed about, and are encouraged to attend additional water-related seminars, including the weekly Water Seminar, held on Fridays from 10-11am (Y2E2 Bldg, Rm. 299), the "Troubled Waters" seminar series, held on Tuesday evenings in Kresge Auditorium (specific lecture titles indicated in the Course Outline, below), and other miscellaneous talks about issues related to water as they come up during the quarter. Students are expected to strictly follow the honor code. Students will not use any form of electronic communication device during class meetings.

Course Website

Assignments, readings, and various communications will be posted on the coursework website. Students should consult the site for announcements, readings, and

assignments on a regular basis. Powerpoint lecture slides will be posted after each lecture for future reference by students.

Grading

Grades will be based on midterm (30%), three problem sets (5% each), term paper (40%), student presentation (5%), and participation (10%). Late papers will not be accepted unless arrangements have been made in advance with the instructor (only for emergency or extreme circumstances).

Readings

Students will be responsible for all readings listed below, plus additional readings as announced during the course of the term. Efforts have been made to provide readings in a digital format online so they can be downloaded by students. Links have been provided to URLs for these readings. Additional readings not available online have been included in **2 required course readers**, available at the Stanford Bookstore. Students should purchase a binder and collate readings from the course reader with other printed readings, for a complete course reader for current and future reference. Readings listed for each lecture should be completed before coming to class.

Term paper

Students will be required to write a term paper of 15-20 pages. Term papers will focus on an issue related to water and health, and should address the biology and epidemiology of the water-associated disease, as well as how economic and political choices affect the burden of disease. Proposals for term paper topics will be due during Week 4 and must be approved by the instructor. Paper outlines will be due during Week 7, and students will make an appointment with the instructor to review their outline during office hours. More details about the term paper topic and requirements will be provided during the third week of the course. Final papers will be due at the end of the final examination period scheduled for this course.

Sample Topics Include:

- The science & politics of water quality standards
- How privatization of water affects community health
- Potential health risks & regulatory policies for bottled water
- Health impacts of desertification
- How health might be taken into account in building large water projects
- Model predictions for the impacts of climate change on health

Students will be expected to outline the broad issues related to their topic, but also more intensely research how the issue plays out in a particular location or case study.

Presentation

Each student will present the topics of their research papers to the entire class at the end of the quarter.

COURSE OUTLINE

Lectures are on Tuesdays and Thursdays from 11-12:30 in Bldg. 120, Room 59.

Approaches to the Study of Water, Health, and Development

Jan. 8	**The Importance of Water to Human Health**	
Jan. 10	**Cholera as a Model for the Study of Water, Health, & Development**	*Assign Water Diseases for Presentations 1/15
Jan. 15	**Overview of Water-Associated Diseases**	**In-Class Water Disease Summaries Due**
Jan. 17	**Approaches to Establishing Evidence of Water-Health Associations**	*PS 1 posted online

Waterborne Diseases & Interventions

Jan. 22	**Diarrheal Diseases I: Transmission Biology and Burden of Disease**	*Review term paper requirements

1/22: TROUBLED WATER LECTURE SERIES, 7:30pm, Kresge Auditorium
Peter Gleick, President, Pacific Institute for Studies in Development: "The World's Water"

Jan. 24	**Diarrheal Diseases II: Intervention Approaches**	**PS 1 Due** *PS 2 posted online
Jan. 29	**Interventions—The Good, The Bad, and The Ugly: River Blindness, Arsenic Wells in Bangladesh, and Guinea Worm Disease**	
Jan. 31	**Guest Speaker:** ***Approaches to the Study of Malaria*** (Manish Desai, UC Berkeley)	**PS 2 & Term Paper Proposals Due**

**Note: Feb. 3 is the Stanford course drop deadline*

Feb. 5	**Guest Speakers (Inspiring Undergraduates):** ***Point-Of-Use Water Disinfection in Mexico and Sri Lanka: Featuring the UV Tube*** (Amy Pickering, Stanford IPER) & ***Adventures of the Shuar Health Project*** (Lia Marshall and others, UC Berkeley)	
Feb. 7	**IN-CLASS MIDTERM**	

Diseases of Modernity

Feb. 12	**Diseases of Modernity**	

Feb. 14 **Guest Speaker:**
♥ ***The Salinas E.coli O157:H7 Spinach Outbreak***
(Robert Mandrell, USDA)

Feb. 19 **Guest Speaker:**
Water Quality in the Central Valley of California
(Laurel Firestone, Community Water Center)
Term Paper Outlines Due (Make Office Hrs. Appt. to Review)

2/19: TROUBLED WATER LECTURE SERIES, 7:30pm, Kresge Auditorium
Panel Discussion: "International Water"

Development and Disease

Feb. 21 **Large Dams and Health with Special Case Study of the Chixoy Dam in Guatemala** *PS 3 posted online

Feb. 26 **Guest Speaker:**
Irrigation Projects & Schistosomiasis in China
(Justin Remais, UC Berkeley)

Feb. 28 **Case Study: Diarrhea & Roads in Ecuador** **PS 3 Due**

Mar. 4 **Guest Speaker:**
Adventures of the AquaTest Project
(Ranjiv Khush, The Aquaya Institute)

Mar. 6 **The Future of Water: Water Scarcity & Climate Change**

Final Student Presentations

Mar. 11 **Final Student Presentations**

3/11: TROUBLED WATER LECTURE SERIES, 7:30pm, Kresge Auditorium:
Panel Discussion: "Water in the West"

Mar. 13 **Final Student Presentations**

Mar. 19 **(Final Examination Period – No in-class final)** **Final Term Papers Due, 10pm**

COURSE READINGS:

Jan. 8 The Importance of Water to Human Health

1. De Groot. 2001. Water Resources Management. Ch. 9 in Aron and Patz, eds. Ecosystem Change and Global Health: A Global Perspective. [In Course reader 1]
2. Bartram, J., K. Lewis, R. Lenton, and A. Wright. 2005. Focusing on improved water and sanitation for health. Lancet 365: 810-812. [http://download.thelancet.com/pdfs/journals/0140-6736/PIIS0140673605179914.pdf]
3. Joint Monitoring Program. 2006. Meeting the MDG Drinking Water and Sanitation Target: The Urban and Rural Challenge of the Decade. Pgs. 4-27. [http://www.who.int/water_sanitation_health/monitoring/jmpfinal.pdf]

Jan. 10 Cholera as a Model for the Study of Water, Health, & Development

1. Huq, Sack, and Colwell. 2001. Cholera and Global Ecosystems. Ch. 11 in Aron and Patz, eds. Ecosystem Change and Global Health: A Global Perspective. [In Course Reader 1]
2. Colwell, R.R. 1996. Global Climate and Infectious Disease: The Cholera Paradigm. Science 274: 2025-2031. [http://www.sciencemag.org/cgi/content/full/274/5295/2025]
3. Colwell, R.R., A. Huq, M.S. Islam, K.M.A., Aziz, M. Yunus, N.H. Khan, A. Mahmud, R.B. Sack, G.B. Nair, J. Chakraborty, D.A. Sack, and E. Russek-Cohen. 2003. Reduction of cholera in Bangladeshi villages by simple filtration. Proceedings of the National Academy of the Sciences 100(3): 1051-1055. [http://www.pnas.org/cgi/reprint/100/3/1051]
4. Levine, M.M. and O.S. Levine. 1994. Changes in human ecology and behavior in relation to the emergence of diarrheal diseases, including cholera. [http://www.pnas.org/cgi/reprint/91/7/2390]
5. Garcia-Marquéz, G. 1985. Love in the Time of Cholera. [excerpt] [Xerox copies passed out in class]
6. Peruse the following website for more information on John Snow: [http://www.ph.ucla.edu/epi/snow.html]

Useful for preparing disease presentations:
WHO Guidelines for Drinking Water Quality, 3rd Edition. Ch. 11: Microbial fact sheets.
http://www.who.int/water_sanitation_health/dwq/gdwq0506_11.pdf

Jan. 15 Overview of Water-Associated Diseases

1. Cairncross and Feachem. 1983. Engineering and Infectious Disease. Ch. 1 in Environmental Health Engineering in the tropics: An Introductory Text. John Wiley & Sons. [In Course Reader 2]
2. WHO Guidelines for Drinking Water Quality, 3rd Edition. Ch. 7: Microbial aspects. [http://www.who.int/water_sanitation_health/dwq/gdwq0506_7.pdf]
3. Montgomery, M.A. and M. Elimelech. 2007. Water and Sanitation in Developing Countries: Including Health in the Equation. Environmental Science & Technology 41(1): 17-24. http://pubs.acs.org/subscribe/journals/esthag/41/i01/pdf/010107feature_elimelech.pdf

Jan. 17 Approaches to Establishing Evidence of Water-Health Associations

Required:

1. Loomis and Wing. 2001. Theories of Causation. Ch. 3 in Thomas & Weber, eds. Epidemiologic Methods for the Study of Infectious Diseases. Oxford University Press.
   [In Course Reader 1]
2. Mathers, C.D., M. Ezzati, and A.D. Lopez. 2007. Measuring the Burden of Neglected Tropical Diseases: The Global Burden of Disease Framework. PLoS Neglected Tropical Diseases 1(2): 1-15.
   [http://www.plosntds.org/article/info:doi/10.1371/journal.pntd.0000114]
3. Hunter, P.R., P. Payment, N. Ashbolt, and J. Bartram. Assessment of Risk. Ch. 3 in in Dufour, Snozzi, Koster, Bartram, Ronchi and Fewtrell, eds. Assessing microbial safety of drinking water: Improving approaches and methods. IWA Publishing.
   [http://www.who.int/water_sanitation_health/dwq/9241546301_chap3.pdf].
4. Epidemiology Article(s) - TBA

Optional:

5. Weber and Rutala. 2001. Biological Basis of Infectious Disease Epidemiology. Ch. 1 in Thomas & Weber, eds. Epidemiologic Methods for the Study of Infectious Diseases. Oxford University Press.
   [In Course Reader 1]
6. Halloran. 2001. Concepts of Transmission and Dynamics. Ch. 4 in Thomas & Weber, eds. Epidemiologic Methods for the Study of Infectious Diseases. Oxford University Press.
   [In Course Reader 1]

Jan. 22 Diarrheal Diseases I: Transmission Biology and Burden of Disease

Required:

1. Byers, Guerrant, and Farr. 2001. Fecal-Oral Transmission. Ch. 11 in Thomas & Weber, eds. Epidemiologic Methods for the Study of Infectious Diseases. Oxford University Press.
   [In Course Reader 1]
2. Curtis, V. Cairncross, S., and R. Yonli. 2000. Review: Domestic hygiene and diarrhea—pinpointing the problem. Tropical Medicine and International Health 5(1): 22-32.
   [http://www.blackwell-synergy.com/doi/abs/10.1046/j.1365-3156.2000.00512.x]
3. Prüss, A., D. Kay, L. Fewtrell, and J. Bartram. 2002. Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level. Environmental Health Perspectives 110(5): 537-542.

[http://www.ehponline.org/members/2002/110p537-542pruss/EHP110p537PDF.PDF]

Optional:

4. Prüss, A. and A. Havelaar. 2001. The Global Burden of Disease study and applications in water, sanitation and hygiene. Ch. 3 in Fewtrell and Bartram, eds. *Water Quality: Guidelines, Standards and Health*. World Health Organization. IWA Publishing, London
   [http://www.who.int/water_sanitation_health/dwq/iwachap3.pdf]

Jan. 24 Diarrheal Diseases II: Intervention Approaches

Required:

1. WHO Guidelines for Drinking Water Quality, 3rd Edition. Ch. 3: Health-based targets. [http://www.who.int/water_sanitation_health/dwq/gdwq0506_3.pdf]
2. A Simple Solution. Time Magazine. October 16, 2006. [http://www.time.com/time/magazine/article/0,9171,1543876,00.html]
3. Fewtrell, L., R. B. Kaufmann, D. Kay, W. Enanoria, L. Haller, and J.M. Colford, Jr. 2005. Water, sanitation, and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis. Lancet Infectious Diseases 5: 42-52. [http://download.thelancet.com/pdfs/journals/1473-3099/PIIS1473309904012538.pdf]
4. Stanfield, G. M. Lechevalleir, and M. Snozzi. Treatment Efficiency. 2003. Ch. 5 in Dufour, Snozzi, Koster, Bartram, Ronchi and Fewtrell, eds. Assessing microbial safety of drinking water: Improving approaches and methods. IWA Publishing. [http://www.who.int/water_sanitation_health/dwq/9241546301_chap5.pdf]
5. Glass, R.I., U.D. Parashar, J.S. Bresee, R. Turcios, T.K. Fischer, M. Widdowson, B. Jiang, and J.R. Gentsch. 2006. Rotavirus vaccines: current prospects and future challenges. Lancet 368: 323-332. [http://www.thelancet.com/journals/lancet/article/PIIS0140673606688156/pdf]
6. Population Services International. What is Social Marketing? PSI Profile. Winter/Spring 2003. [http://www.psi.org/resources/pubs/what_is_smEN.pdf]

Optional:

7. Taylor, C.E. and W.B. Greenough, III. 1989. Control of Diarrheal Diseases. Annual Reviews of Public Health 10: 221-244. [http://arjournals.annualreviews.org/doi/pdf/10.1146/annurev.pu.10.050189.001253]
8. Victora, C.G., J. Bryce, O. Fontaine, and R. Monasch. 2000. Reducing deaths from diarrhoea through oral rehydration therapy. Bulletin of the World Health Organization 78(10): 1246-1255. [http://whqlibdoc.who.int/bulletin/2000/Number%2010/78(10)1246-1255.pdf]

Jan. 29 Interventions—The Good, The Bad, and The Ugly: River Blindness, Arsenic Wells in Bangladesh, and Guinea Worm Disease

1. Berry, M. 2007. The Tail End of Guinea Worm — Global Eradication without a Drug or a Vaccine. New England Journal of Medicine 365(25): 2561-2564. [http://content.nejm.org/cgi/reprint/356/25/2561.pdf]
2. Tayeh, A. and S. Cairncross. 2007. Editorial: Dracunculiasis eradication by 2009: will endemiccountries meet the target? Tropical Medicine and International Health 12(12): 1403-1408. [http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-3156.2007.01947.x]
3. Smith, A., E.O. Lingas, and M. Rahman. 2000. Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. Bulletin of the World Health Organization 78(9): 1093-1103. [http://whqlibdoc.who.int/bulletin/2000/Number%209/78(9)1093-1103.pdf]
4. Pearce, F. 2001. Bangladesh's Arsenic Poisoning: Who is to blame? UNESCO Courier. January 2001.

5. Õmura, S. and A. Crump. 2004. The life and times of ivermectin —a success story. Nature Reviews Microbiology 2(12): 984-989. [http://www.nature.com/nrmicro/journal/v2/n12/pdf/nrmicro1048.pdf]
6. Guderian, R.H., M. Anselmi, M. Espinel, T. Mancero, G. Rivadeneira, R. Proaño, H.M. Calvopiña, J.C. Vieira, and P.J. Cooper. 1997. Successful control of onchocerciasis with community-based ivermectin distribution in the Rio Santiago focus in Ecuador. Tropical Medicine and International Health 2(10): 982-988. [http://www.blackwell-synergy.com/doi/abs/10.1046/j.1365-3156.1997.d01-158.x]

Jan. 31 Approaches to the Study of Malaria

1. Aron, Shiff, and Buck. 2001. Malaria and Global Ecosystem Change. Ch. 12 in Aron and Patz, eds. Ecosystem Change and Global Health: A Global Perspective.
   [In Course Reader 1]
2. Cairncross and Feachem. 1983. Engineering Control of Arthropod Vectors. Ch. 15 in Environmental Health Engineering in the tropics: An Introductory Text. John Wiley & Sons.
   [In Course Reader 2]

Feb. 5 Inspiring Undergraduates

1. Conis, E. 2007. In Rural Ecuador, Undergraduates Make a Difference. University of California, Berkeley School of Public Health Alumni Magazine. Summer 2007.
   [posted on coursework]
2. Brownell, S.A., A.R. Chakrabarti, F.M. Kaser, L.G. Connelly, R.L. Peletz, F. Reygadas, M.J. Lang, D. Kammen, and K. Nelson. In Press. Assessment of a Low-Cost, Point-of-Use, Ultraviolet Water Disinfection Technology. Journal of Water and Health.

Feb. 12 Diseases of Modernity

1. Diez-Gonzalez, F. T. R. Callaway, M.G. Kizoulis, J.B. Russell. 1998. Grain Feeding and the Dissemination of Acid-Resistant *Escherichia coli* from Cattle. Science 281: 1666-1668.
   [http://www.sciencemag.org/cgi/reprint/281/5383/1666.pdf]
2. Flemmer, M. and E. C. Oldfield III. 2003. The agony and the ecstasy. The American Journal of Gastroenterology 98(9): 2098-2099.
   [http://www.blackwell-synergy.com/doi/abs/10.1111/j.1572-0241.2003.07672.x]
3. Garbe, P.L., P. L. Garbe, B. J. Davis, J. S. Weisfeld, L. Markowitz, P. Miner, F. Garrity, J. M. Barbaree and A. L. Reingold. 1985. Nosocomial Legionnaires' disease. Epidemiologic demonstration of cooling towers as a source. JAMA 254(4): 521-524.
   [Xeroxed copies passed out in class]
4. Gratz, N.G., R. Steffen, W. Cocksedge. 2000. Why aircraft disinfection? Bulletin of the World Health Organization 78(8): 995-1004.
   [http://whqlibdoc.who.int/bulletin/2000/Number%208/78(8)995-1004.pdf]

Feb. 14 ***The Salinas E.coli O157:H7 Spinach Outbreak***

1. Jay, M.T., M. Cooley, D. Carychao, G.W. Wiscomb, R.A. Sweitzer, L. Crawford-Miksza, J.A. Farrar, D.K. Lau, J.O'Connell, A. Millington, R.V. Asmundson, E.R. Atwill, and R.E. Mandrell. 2007. *Escherichia coli* O157:H7 in Feral Swine near Spinach Fields and Cattle, Central California Coast. Emerging Infectious Diseases 13(12): 1908-1911. [http://www.cdc.gov/eid/content/13/12/pdfs/1908.pdf]
2. Mandrell, R.E. 2007. Fruits and vegetables that make you sick… What's going on? Microbiology Today. August 2007. [http://www.sgm.ac.uk/pubs/micro_today/pdf/080702.pdf]
3. Ongoing Multistate Outbreak of *Escherichia coli* serotype O157:H7 Infections Associated with Consumption of Fresh Spinach --- United States, September 2006. Morbidity and Mortality Weekly Report 55(38): 1045-1046. [http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5538a4.htm]

Feb. 19 **Water Quality in the Central Valley of California**

Readings TBA

Feb. 21 **Large Dams and Health with Special Case Study of the Chixoy Dam in Guatemala**

1. *Water, Development, and Large Dams*. Ch. 1 in Dams and Development: A New Framework for Decision Making. Final Report of the World Commission on Dams. [http://www.dams.org//docs/report/wcdch1.pdf]
2. McCully, P. 1996. *Temples of Doom: The Human Consequences of Dams.* Ch. 3 in Silenced Rivers: The Ecology and Politics of Large Dams. [In Course Reader 2]
3. Roy, A. 1999. *The Greater Common Good.* In: The Cost of Living. New York: The Modern Library. [http://www.narmada.org/gcg/gcg.html]
4. Witness for Peace. A People Dammed: The Impact of the World Bank Chixoy Hydroelectric Project in Guatemala. [http://www.witnessforpeace.org/pdf/apd.pdf]

Optional:

5. *Human Health and Dams*. Submission by the World Health Organization to the World Commission on Dams [http://www.dams.org/docs/kbase/working/health.pdf]
6. *People and Large Dams: Social Performance*. Ch. 4 in Dams and Development: A New Framework for Decision Making. Final Report of the World Commission on Dams. [http://www.dams.org//docs/report/wcdch4.pdf]

Feb. 26 **Irrigation Projects & Schistosomiasis in China**

1. Cairncross and Feachem. 1983. Schistosomiasis. Ch. 17 in Environmental Health Engineering in the tropics: An Introductory Text. John Wiley & Sons. [In Course Reader 2]
2. Ross, A.G.P., A.C. Sleigh, Y. Li, G.M. Davis, G.M. Williams, Z. Jiang, Z. Feng, and D. McManus. 2001. Schistosomiasis in the People's Republic of China:

Prospects and Challenges for the 21st Century. Clinical Microbiology Reviews 14(2): 270-295.
[http://cmr.asm.org/cgi/reprint/14/2/270]

Feb. 28 Case Study: Diarrhea & Roads in Ecuador PS 3 Due

Required:

1. Eisenberg, J. N. S., W. Cevallos, K. Ponce, K. Levy, S. J. Bates, J. C. Scott, A. Hubbard, N. Vieira, P. Endara, M. Espinel, G. Trueba, L. W. Riley, and J. Trostle. 2006. Environmental change and infectious disease: How new roads affect the transmission of diarrheal pathogens in rural Ecuador. *PNAS* 103 (51):19460-19465.
[http://www.pnas.org/cgi/reprint/103/51/19460]

Optional:

2. Bates, S.J., J. Trostle, W.T. Cevallos, A. Hubbard, and J.N. S. Eisenberg. 2007. Relating Diarrheal Disease to Social Networks and the Geographic Configuration of Communities in Rural Ecuador. American Journal of Epidemiology 166(9): 1088-1095.
[http://aje.oxfordjournals.org/cgi/reprint/166/9/1088]

Mar. 4 Adventures of the AquaTest Project

1. Gundry, S., J. Wright, and R. Conroy. 2004. A systematic review of the health outcomes related to household water quality in developing countries. Journal of Water and Health 2(1): 1-13.
[http://www.iwaponline.com/jwh/002/0001/0020001.pdf]

Mar. 6 The Future of Water: Water Scarcity & Climate Change

1. Roberts, Confalonieri, and Aron. 2001. Too Little, Too Much: How the Quantity of Water Affects Human Health. Ch. 9 in Aron and Patz, eds. Ecosystem Change and Global Health: A Global Perspective.
[In Course Reader 1]
2. Epstein, P.R. 2005. Perspective: Climate Change and Human Health. New England Journal of Medicine 353(14): 1433-1436.
[http://content.nejm.org/cgi/reprint/353/14/1433.pdf]
3. Moe, C.L. and R. D. Rheingans. 2006. Global challenges in water, sanitation and health. Journal of Water and Health 4(Suppl): 41-57.
[http://www.iwaponline.com/jwh/004/S041/004S041.pdf]