Instructor:
Marilyn C. Roberts PhD
Professor, Department of Environmental and Occupational Health Sciences
Adjunct Professor, Department of Global Health
marilynr@uw.edu
phone:206-543-8001
Office: F161D HSB

Office hours: By arrangement

Meeting time: The course will meet 2 times a week for 110 minutes/session. Please note the different meeting locations: one on Tue another on Thur. First Class will be Tuesday Sept 30, 2014.

Credits: 4

Prerequisites: Open to all undergraduates who have taken ≥ 1 courses in one of the following: Microbiology 301, Epidemiology 320, Environmental & Occupation Health 433 or 451, Civil & Environmental Engineering 357, or by permission of instructor. Open to all graduate students who have taken ≥ 1 courses in one of the following: Microbiology, Molecular Biology, Epidemiology, Genetics, Immunology and/or Environmental Engineering or by permission of instructor.

Subject: An interdisciplinary approach to understanding the role that antibiotic resistance genes [ARGs] and antibiotic resistant bacteria [ARBs] play in One Health which includes the health of animals, humans and the environment and how they are interconnected.

Learning objectives: At the end of the quarter the students will be able to:
• Define and describe what antibiotic resistance genes and antibiotic resistant bacteria are and the origins of ARGs (resistome)
• Describe various mechanisms for resistance and important classes of resistance genes
• Describe and analyze controversial issues related to sources of ARGs/ARBs in relationship to humans, animals and the environment (One Health)
• Critique and discuss how different human practices influence the evolution/ecology of ARGs and ARBs
• Discuss differences in evolution between developed and developing countries and how the two are interconnected and how transmission of ARGs/ARBs move around the world
• Discuss and critique the role that agriculture, aquaculture, food animals and food plays in transmission or ARGs/ARBs; be able to give specific examples
• Discuss and describe how various modes of horizontal gene transfer occur and how they impact the evolution of ARGs/ARBs
• Discuss and describe what “growth promotion” and relationship of sub-therapeutic antibiotic
concentrations do in environments, agriculture and municipal wastewaters, receiving water streams, recreational waters etc.

**Format:** Lectures and discussion led by the instructor and guest lecturers, plus student-led panel discussions. Students will be expected to read assignments before class and develop questions that can be asked during class and participate in student led panel discussions. Short in-class and take-home quizzes will be given during the quarter. A final take home exam will given to all students. Graduate students will also have research paper due Nov. 25, 2014.

**Canvas Website:** Reading list, announcements etc. will be posted and updated on the website.

**Readings:** No textbooks for this class but there will be a list of required papers from the scientific literature which will be provided and which classes they are relevant for. It is expected that the students will read the material prior to class. *Students will be expected to write questions about the reading material or what is presented in class once each week. This is to ensure that students are reading and understand the material provided.*

General reading for the course
Antibiotic Resistant Threats in the United States, CDC 2013

CDC National Antimicrobial Resistance Monitoring System: Enteric Bacteria (NARMS), 2012 Report

http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf?ua=1

**Quizzes.** In class and take-home quizzes will be scheduled. For take-home quizzes students will turn in before the quizzes before the next class session.

**Student Panel discussions.** Teams of students will use the selected topic question which is related to what has been discussed in the lectures for the week. Dr. Roberts will pick the teams. For the panel discussions the students will work together to put on a presentations on the various opinions on the given question. Other students in the class will have prepared questions submitted prior to class to Dr. Roberts to ask the panel members. Students will be graded individually and based on scientific knowledge, background research and ability to define what is said and organizational level.

**Paper:** Graduate students will write a final research paper related to a topic from class. The paper must be 6-10 pages not counting references double spaced and paginated. At least 10 references must be included. References may include 1-3 websites if they are from places like CDC, WHO or US State Department reports. The other references must be classical, peer reviewed publications. The topic for the paper must be approved by Dr. Roberts by Oct. 23, 2014.

**Final Exam:** A take home final exam will be given to all students. Given out Dec 4 return Dec. 10, 2014
Grading: Grades will be based on the following.

Undergraduates (490)
Quizzes 25%
Final Exam 35%
Panel Discussion 25%
Class participation 15% which includes questions prepared weekly for in class discussion

Graduates (590)
Quizzes 15%
Final Exam 25%
Research paper 25%
Panel Discussion 20%
Class participation 15% which includes questions prepared weekly for in class discussion

Disclaimer: Insofar as possible, the course will adhere to the above plan and the speakers and topics listed in the class schedule. If there are any changes, the instructor will communicate them to the students as soon as possible.

Disability Resources for Students (DRS): Disability Resources for Students (DRS) offers resources and coordinates reasonable accommodations for students with disabilities. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. If you have not yet established services through DRS, but have a temporary or permanent disability that requires accommodations (this can include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or uwdrs@uw.edu or disability@uw.edu Requests for accommodations or services must be arranged in advance.

Academic Integrity:

Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity. The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120). We expect you to know and follow the university’s policies on cheating and plagiarism, and the SPH Academic Integrity Policy. Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the University of Washington Community Standards and Student Conduct website.
EH490/590
Antibiotic Resistance Bacteria/Genes and their Impact on Public Health and the Environment
Fall 2014 Course Syllabus

Instructor:
Marilyn C. Roberts PhD
Professor, Department of Environmental and Occupational Health Sciences
Adjunct Professor, Department of Global Health
marilynr@uw.edu
Phone: 206-543-8001
F161D

Office hours: By arrangement. Dr. Roberts is out of the country until Dec 6 limited e-mail access. Traveling to Washington DC. For AAM meeting Dec 8. Back late Dec. 9, 2014

Meeting time: The course will meet 2 times a week for 110 minutes

Dr. Roberts will not be in office Sept 23-25 and Dec. 1-9, 2014

NO CLASS SEPT 25, 2014

Week 1 Sept 30, Oct 2
Sept 30, 2014 Class introduction
Frontline PBS “Hunting the Nightmare Bacteria” DVD
Oct 2, 2014 History of antibiotic use since 1945
Mobile elements [plasmids, transposons, integrons], bacterial gene exchange
[conjugation, transformation, transduction]

Learning objectives:
- Define what the overview of the course will be and what is expected of students
- Define and describe what antibiotic resistant genes/bacteria [ARGs/ARBs] are and how mobile elements are important to the discussion of ARGs/ARBs

Week 2 Oct 7, 9
Oct 7, 2014 Basic overview of antibiotic resistance, differences between bacteria, viruses, fungi, parasites
Oct. 9, 2014 Linkage between antibiotic/ heavy metal resistance genes and virulence
In class quiz on first 2 weeks of lecture
Graduate students get approval by Oct 9 for topic of course paper from Dr. Roberts

Learning objectives:
- Define general mechanism of resistant found in bacteria ( mutations and acquired resistance) how they differ from viruses, fungi, parasites
- Define what other genes are associated with the mobile elements
- Define how bacterial resistance is detected

Week 3 Oct 14, 16
Oct. 14, 2014 Antibiotic classes and how they are targeted specifically for bacterial pathways
Mechanism of antibiotic resistance genes [ARGs] and antibiotics resistant bacteria [ARBs]

Oct 16, 2014 Mechanism of resistance selection, exposure to antibiotics directly or indirectly, exposure to heavy metals

**Student Panel** discussion “How mobile elements and multiple genes influence the stability of these elements in microbial communities”

Students: Dang, Klock, Ross

**Learning objectives:**
- Define and describe what antibiotic resistance genes work are and why they are generally non-toxic to humans
- Define how antibiotic resistant bacteria develop
- Be able to describe at least different mechanisms of antibiotic resistance (alter target, inactivation of antibiotic etc.)
- Define how mobile elements influence the stability of ARGs/ARBs in microbial communities

**Week 4 Oct 21, 23**

Oct 21, Dr. Peter Rabinowitz, One Health; how animal, humans, environment ARGs/ARBS interconnect

Oct. 23. Dr. Doug Call [WSU], Why does antimicrobial resistance persist?

**Student Panel** discussion “Role animals play in development and spread of ARGs/ARBs”

Students: Hollowman, Park

**Take-home quiz on first 4 weeks of lecture due before class on Oct. 28, 2014**

**Learning objectives:**
- Define and analysis controversial issues related to sources of ARGs/ARBs in relationship to humans, animals and the environment (One Health)
- Define how antibiotic resistance genes persist are transfers

**Graduate students get Dr. Roberts approval by Oct 23 for outline of course paper**

**Week 5 Oct 28, 30**

Oct. 28, Stewardship: Differences between develop/developing countries in prescription practices, availability of antibiotics

Oct. 30, Agriculture uses of antibiotics; comparison of US vs EU

Non-infections uses in man and animals [growth promotional use in agriculture]

**Student Panel** discussion “2013 FDA ruling volunteering eliminating use of antibiotics as growth promoters”

Students: Kearney, Kim, Wanjiku

**Learning objectives:**
- Define differences in how antibiotics are controlled in different countries and how different practices contributes to the spread and transmission of ARGs/ARBs
- Discuss and describe what “growth promotion” and relationship of sub-therapeutic antibiotic concentrations are in food animal production

**Week 6 Nov 4, 6**

Nov. 4, Role that agriculture, aquaculture, food animals and food plays in movement of ARGs/ARBs, routes of transmission, trade, globalization of food

Organic vs conventional grown food

Nov. 6, The environment and it’s role in ARG/ARB evolution and spread;
Location of ARGs/ARBS

**Student Panel** discussion “Agriculture’s role in ARG/ARB evolution and spread”

Students: Dela Cruz, Lazarus

**Learning objectives:**
- Define how and why ARGs/ARBs contaminate the environment and what roles food production plays in contamination.
- Define how different human practices influence the evolution/ecology of impact the evolution of ARGs/ARBs
- Define how various modes of horizontal gene transfer occurs and how they impact the evolution of ARGs/ARBs

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**Week 7 Nov 13**

Nov 11. Holiday

Nov. 13, Environmental contamination, where ARGs/ARBs are found [resistome]

**Learning objectives:**
- Define why ARGs/ARBs are not totally due to human activity

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**Week 8 Nov 18, 20**

Nov. 18, Dr. Scott Weissman, International spread of KPC, NDM, OXA-48

Nov. 20, How are developed and developing countries are interconnected and transmission of ARGs/ARBs move around the world

**Student Panel** discussion “What happens in the developing world directly affects ARGs/ARBs found in the rest of the world”

Students: Lara, Pazhempillil, and Altassan

**Take-home quiz on first 8 weeks of lecture due before class on Nov. 25, 2014**

**Learning objectives**
- Define how ARGs/ARBs are a global issue and provide examples to illustrate this

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**Week 9 Nov 25**

Nov. 25, How different human practices influence the evolution/ecology of ARGs and ARBs

Example VRE in USA vs EU; Ciprofloxacin resistant *Campylobacter*

**Graduate papers due Nov 25.**

**Student Panel** discussion “Linkage between ARGs/ARBs in agriculture/environment/man how do we change the dynamics?”

Students: Lee, Truong, and Zech

Nov. 27 Holiday

**Learning objectives**
- Be able to discuss controversial issues related to sources of ARGs/ARBs in relationship to humans, animals and the environment (One Health)

**Graduate student papers due Nov 25. 2014**

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**Week 10 Dec 2, 4:**


Dec. 4. Dr. Mike Dodd. Wastewater, subtherapeutic antibiotic concentrations, increase in ARGs/ARBs, role in receiving waters and biosludge

*Take home final exam handed out due back Dec 10. Must be typed can be sent to*
Learning objectives

- Be able to discuss how geography has played a role in ARBs/ARB transfer around the world
- Be able to discuss the potential for WWTP water to contaminate the environment with ARBs/ARGs
- Be able to discuss why ARGs/ARBs persist without drug pressures
- Be able to discuss alternative to using antibiotics and other ways to reduce the increase in ARGs/ARBs
- Define ARGs/ARBs are now a concern in the outflow of waste water treatment plants

Dec. 10 Take home exams due.
Reading list
Articles should be read before each class

Sept 24, Oct 2.


Oct 7, 9


Oct 14, 16

Oct 21, 23


Oct 28, 30
Policy Statement on Antimicrobial Stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS) Author(s): Society for Healthcare Epidemiology of America; Infectious Diseases Society of America; Pediatric Infectious Diseases Society http://www.jstor.org/stable/pdfplus/10.1086/665010.pdf?acceptTC=true&jpdConfirm=true

FDA Phasing out certain antibiotic use in farm animals http://www.fda.gov/downloads/ForConsumers/ConsumerUpdates/UCM378197.pdf

FDA Update on Animal Pharmaceutical Industry Response to Guidance #213 http://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/JudiciousUseofAntimicrobials/ucm390738.htm

Nov. 4, 6


