

PROMOTION RECOMMENDATION
The University of Michigan
School of Public Health
Department of Environmental Health Sciences

Chuanwu Xi, assistant professor of environmental health sciences, Department of Environmental Health Sciences, School of Public Health, is recommended for promotion to associate professor of environmental health sciences, with tenure, Department of Environmental Health Sciences, School of Public Health.

Academic Degrees:

Ph.D. 2000 Katholieke Universiteit Leuven, Belgium
M.S. 1996 Guangxi University, China
B.S. 1993 Anhui Normal University, China

Professional Record:

2010-present Faculty affiliate, The Center for Global Health, University of Michigan
2008-present Affiliate faculty, Program in the Environment and the Graham Environmental Sustainability Institute, University of Michigan
2007-present Affiliate faculty, The Risk Science Center, University of Michigan
2005-present Affiliate faculty, The Center for Molecular and Clinical Epidemiology of Infectious Diseases (MAC-EPID), University of Michigan
2005-present Assistant Professor, Department of Environmental Health Sciences (EHS), University of Michigan School of Public Health-Ann Arbor, MI
2003-2005 Research Assistant Professor, Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign
2001-2003 Post-doctoral Research Associate, Department of Civil and Environmental Engineering and Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign
2000-2001 Post-doctoral Research Fellow, Centre of Microbial and Plant Genetics, Katholieke Universiteit Leuven, Belgium

Summary of Evaluation:

Teaching: Professor Xi has taught EHS570, "Water Quality Assessment and Management," a required course for MPH students in the environmental quality and health sub plan that he co-created; EHS576, "Microbiology in Environmental Health," a new course that he created; EHS653, "Environmental Sampling and Analysis Lab" (co-taught); and EHS615, "Water quality and human health in the Great Lakes." Overall, these courses, as well as their instructor(s), have generally scored close to or above a 4 out of a possible 5. Professor Xi has also guest lectured on microbial exposure assessment for EHS502, "Exposure Assessment," on water quality for EHS500, "Principles of Environmental Health," on the current status of environmental health in China for EHS602, "Environmental Health in Developing Countries," and on *Helicobacter pylori* and gastric cancer for EPID631, "Topics in Cancer Prevention."

Professor Xi has been a primary or co-advisor to five Ph.D. students. He served on seven other student doctoral committees and co-advised a master's of science student. Professor Xi also hosted four visiting scholars, advised five post-doctoral fellows and supervised a dozen undergraduate students through the Undergraduate Research Opportunity Program at the UM.

Research: Professor Xi has concentrated his research on biofilms, water and human health in three areas: (a) molecular mechanisms of biofilm development; (b) characterization of biofilms in industrial and clinical settings and its impact on human health; and (c) development of novel approaches for biofilm control. Biofilms are a collection of sessile bacterial cells attached to surfaces in auto-secreted polymeric materials. They play a critical role in the survival of microbes in the environment and may be responsible for the ineffectiveness of most of the common hygienic and disinfection practices in the environment (for example, water distribution systems) as well as the human body (for example, intravenous catheters). The impact on morbidity and mortality is likely enormous, with potential economic impacts in the billions of dollars every year.

A number of Professor Xi's research accomplishments have already had major implications for public health. For example, Professor Xi and colleagues developed a method that can efficiently extract extracellular DNA (eDNA) from biofilm matrix to study its composition and function. The method was published in the Cold Spring Harbor Proceedings and has been widely adopted by other scientists for their studies. His lab confirmed that eDNA is required for *Acinetobacter baumannii* biofilm development and discovered that exogenous ATP can induce eDNA release and biofilm formation in *A. baumannii* and other tested bacterial species. In cross-disciplinary research in human tissue, Professor Xi and colleagues demonstrated that extracellular dATP/ATP stimulates bacterial adherence in vitro to human bronchial epithelial cells. His lab was the first to demonstrate that bacteria may sense extracellular dATP/ATP as a signal of "danger," and may form biofilms to protect themselves from host innate immunity. As an example of work related to occupational health, Professor Xi led a study that characterized biofilms in metalworking fluids in two automobile plants using molecular techniques. Biofilms were found to be a primary shield for *Mycobacterium immunogenum*, a potential etiological agent for hypersensitive pneumonitis among industrial workers. In work on biofilms in drinking water distribution systems, Professor Xi and colleagues from the College of Engineering were the first group to report that *E. coli* responds to monochloramine exposure by activating diverse defense responses rather than with a single antioxidant system. The induction of multidrug efflux pumps, specific antibiotic resistance genes and biofilm formation genes further suggests that exposure to monochloramine may contribute to reduced susceptibility to some antibiotics and increased biofilm formation in water distribution systems. These findings may lead to revisions in current disinfection practices in the water treatment industry. Professor Xi also collaborates on the use of mathematical models to evaluate the risk of residual concentration of antibiotics on the selection of antibiotic resistant bacteria in the environment. Finally, Professor Xi collaborated with colleagues to characterize biofilms formed on urinary catheters and amniotic membranes with major implications for understanding associated risks of urinary infection and preterm delivery.

Professor Xi's research has been supported by various sponsors including federal agencies, industry, foundations and some internal programs. Currently, he is the sole principal investigator of a new five-year \$1.5 million NIGMS R01 (R01GM098350; Extracellular ATP in Biofilm Formation and Wound Infection; 2011-2016) to investigate the role of extracellular ATP in bacteria-host interaction, biofilm formation and wound infection. He was a co-principal investigator on an NSF project (\$1.9 million, R01 equivalent) to investigate biofilms in the drinking water distribution systems, entitled, "Biocomplexity: Elucidating Mechanisms Responsible for the Persistence of Microorganisms in Drinking Water Distribution Systems via DNA Microarray." Professor Xi is also the sole principal investigator of a CDC R21 investigating prevalence of *Mycobacterium* and microbial ecology in metalworking fluids (R21OH009306; Prospective Study of Biofilms, *Mycobacteria* and *Pseudomonas* in metalworking fluids; 2009-2012). Recently he received a new grant from the HOPE Foundation to investigate the water contamination by *Helicobacter pylori* and gastric cancer in Lima,

Peru, in which both laboratory data and epidemiology data will be used to correlate the water quality and gastric cancer. Professor Xi also has an active NIDCR R21 grant (served as a MPI) to develop a smart coating material (STAMP, smart thermal detachable anti-biofilm polymers) to prevent biofilm development in dental unit water lines, entitled, "Thermo-detachable anti-biofilm polymer coatings."

Professor Xi has also been working to transform innovative aspects of his research into practical applications. One patent and one provisional patent have been filed from his research by the University of Michigan Technology Transfer Office that relates to the control of biofilms using ATP and apyrase. This technology has potential to be used in certain industrial settings and medicine for control of biofilm related infections such as wound infections. It also has the potential to treat certain multidrug resistant bacterial infections which are currently untreatable in practice.

With at least six active grants, several additional pending grants, and two primary Ph.D. student advisees in candidate status, Professor Xi's near-term agenda is to complete the work described in these grants, and mentor these and additional students on their dissertations. His long-term vision is to advance basic sciences of biofilm development and related impacts in the environment and on human health, and ultimately to develop innovative approach for biofilm control to improve public health.

Recent and Significant Publications:

- Song L, Wu J, Xi, C. (2012) Biofilms on Environmental Surfaces: Evaluation of the Disinfection Efficacy of a Novel Steam Vapor System. *American Journal of Infection Control*, In Press.
- Dai D, Holder D, Raskin L, Xi, C. (2011) Separation of the Bacterial Species, *Escherichia coli*, from Mixed-Species Microbial Communities for Transcriptome Analysis. *BMC Microbiology*, 11:59, doi:10.1186/1471-2180-11-59.
- Xi C, Wu J. (2010) dATP/ATP, a multifunctional nucleotide, stimulates bacterial cell lysis, extracellular DNA release and biofilm development. *PLoS ONE*, 5(10), e13355.
- Wu J, Xu H, Tang W, Philbert M, Kopelman R, and Xi C. (2009) Evaluation of the Eradication of Bacteria in Suspension and Biofilms using Methylene Blue-loaded Dynamic NanoPlatforms. *Antimicrobial Agents and Chemotherapy*, 53(7):3042-8. PMID:19414585.
- Xi C, Zhang Y, Ye W, Marrs C, Simon C, Foxman B, Niragu J. (2009) Prevalence of Antibiotic Resistance in Drinking Water Treatment and Distribution Systems. *Applied and Environmental Microbiology*, 75(17):5714-8. PMID: 19581476.
- Zhang Y, Marrs CF, Simon C, Xi C. (2009) Wastewater treatment contributes to selective increase of antibiotic resistance among *Acinetobacter* spp. *Science of the Total Environment*, 407(12), 3702- 3706.

Service: Professor Xi has served on the editorial board of *Applied and Environmental Microbiology* and as a peer reviewer for over 15 different scientific journals. In terms of service, he has served on his Department's executive committee, students and alumni affairs committee and website committee and the School's diversity task force committee. He also served on two junior faculty search committees, the SPH committees that organized three MAC-EPID symposia on Antibiotic Resistance, Bacterial Communities, and Biofilms, and on the University-wide committees that produced a proposal for establishing the Great Lakes Institute and that organized the 2007 National Summit on Coping with Climate Change.

External Reviewers:

Reviewer A: "He already has visibility with work done on antibiotic resistance in water-associated organisms."

Reviewer B: "...he has achieved international recognition. I would rank Dr. Xi in the top 5% of candidates at his level and would expect him to meet the high standards for tenure here at [my institution]."

Reviewer C: "He appears to be an accomplished and successful researcher, who can be expected to sustain a good level of productivity in the years ahead. In summary, my impression of Dr. Chuanwu Xi is that he is a talented researcher who has made some important contributions."

Reviewer D: "He has an unusual breadth to his scholarly writings which are extremely refreshing, however all of the areas he works in are those with a major impact, adding further value. He certainly has achieved above national recognition. And promotion to Associate Professor is, in my opinion now overdue."


Reviewer E: "Dr. Xi is exceptionally creative and capable. His work on using optical coherence tomography to study biofilm structures was highly innovative. His work on biofilm controls in wastewater treatment and drinking water systems are very significant, which has established him as a major player in the field. His publications are of high quality!"

Reviewer F: "Upon review of Dr. Xi's record, I believe he has proven himself to be a hard working, productive, innovative, and a valuable member for the Department of Environmental Health Sciences. Dr. Xi has also proven to be a reputable scientist in the area of biofilm research."

Reviewer G: "Particularly, his recent work on developing novel approaches for biofilm control is very interesting and I expect that it will have significant impacts on biofilm studies."

Reviewer H: "He has excellent success obtaining funding from national, competitive sources to support his research. His service on the editorial board of *Applied & Environmental Microbiology*, a top journal in his field, and requests to review manuscripts for a wide variety of other high quality journals provide evidence of his nationally-recognized expertise."

Summary of Recommendation: Professor Xi is an outstanding researcher and a dedicated teacher. His productivity has provided research and training opportunities to numerous students. I enthusiastically recommend Professor Chuanwu Xi for promotion to associate professor of environmental health sciences, with tenure, Department of Environmental Health Sciences, School of Public Health.



Martin A. Philbert
Dean, School of Public Health

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