DIMACS Highlight: CCICADA Graduate Fellow Begins Postdoctoral Fellowship at CDC

Brad Greening

[August, 2014] DIMACS extends its congratulations and best wishes to former graduate student Brad Greening (pictured) as he begins a postdoctoral fellowship at the Centers for Disease Control and Prevention (CDC) in Atlanta.

Greening was selected by the CDC as one of 10 recent PhDs to receive a Steven M. Teutsch Prevention Effectiveness Fellowship beginning in August, 2014. This competitive, two-year postdoctoral research fellowship focuses on the application of quantitative methods to the science of health protection, health promotion, and disease prevention. The Prevention Effectiveness (PE) Fellowship is the largest postdoctoral training program in the quantitative health decision sciences in the US with 23 current fellows and more than 120 program graduates since 1995. The fellowship program's ultimate goal is to establish a cadre of quantitative policy analysts whose work provides information for health policy decision-makers regarding allocation and use of resources to maximize health impact.

Work conducted at DIMACS and CCICADA helped position Greening to be a strong candidate for the PE Fellowship. He came to DIMACS in 2008 as a participant in our Research Experiences for Undergraduates program. At that time, his main interests were in Computer Science theory and related mathematics. His REU project with Professor Nina Fefferman combined these interests with a public health application: examining how the relative durations of social interactions and disease processes interact to shape epidemics. Inspired by the potential to apply computational and mathematical modeling to practical problems such as those in public health, Greening decided to do his graduate work in the Department of Ecology, Evolution and Natural Resources with Fefferman as his advisor (despite having no undergraduate courses in biology).

Greening's dissertation research extends traditionally pure mathematical concepts (rooted in topology) and applies them to generate a novel, practical model for analyzing the capacity for information sharing, learning, and knowledge building in any system that includes multi-way communication. His work generalizes graph and network models, which nicely capture pairwise communication, to more complex interactions within groups. It is especially concerned with instances in which the nuances of multi-way interactions are not adequately represented by the union of dyadic interactions. A simple example is the case of four people conversing around a table. The natural graph representation of this scenario is the complete graph on four nodes, but the same graph would also depict the six independent pairwise interactions that would occur if the four people had met individually. Greening's research asserts that there remain potentially important aspects of the interactions in this group that exceed the union of the pairwise relationships depicted, and thus exceed the representational capabilities of a simple network. In particular, the ability of a population to build collective knowledge from individually possessed information requires a more nuanced modeling of higher-order dynamics. This work offers the

flexibility to be of direct use in applications from diverse fields, including animal behavior, human education, corporate organizational structure, and emergency response.

Greening received a 3-year fellowship through DIMACS/CCICADA to support his graduate studies. The fellowship was funded by a grant to DIMACS/CCICADA from the Department of Homeland Security with the goal of introducing students to mathematical and computational applications in homeland security, including those in public health. The fellowship's internship requirement led Greening to the CDC, where he worked with Fefferman and CDC's Dr. Michael Washington developing models to help plan for response during heat-related emergencies. The ultimate goal of Greening's project was to develop optimization strategies to determine: 1) where to open temporary facilities for medical care in a city experiencing a heat emergency; and 2) how to assign individuals to those centers for treatment in order to minimize potential loss of life.

Greening at CDC in 2010 with Dr. Washington

As a PE Fellow, Greening joins the Health Economics and Modeling Unit (HEMU) that is part of the National Center for Emerging and Zoonotic Infectious Diseases, Division of Preparedness and Emerging Infections (DPEI). DPEI works to build and strengthen public health capacity by enhancing the ability of CDC and its public health partners to prepare for, prevent, and respond to infectious diseases, including outbreaks, bioterrorism, and other public health emergencies, through cross-cutting and specialized programs, technical expertise, and public health leadership. HEMU has led efforts in modeling cholera, anthrax, dengue, influenza, West Nile Virus and other emerging pathogens, including Ebola.

Greening's PE fellowship supervisor and mentor is Martin Meltzer, a distinguished health economist at the CDC. Projects Greening will work on during his fellowship include: Ebola modeling; developing mathematical models of the typhoid vaccine; supplemental vs. routing vaccines for such diseases as measles and polio in developing countries; and updating and enhancing mathematical models of public health laboratory capacity under a range of scenarios.

Related Links:

- DIMACS: dimacs.rutgers.edu/
- CCICADA: www.ccicada.org/
- Nina Fefferman: www.rci.rutgers.edu/~feffermn/
- CDC: www.cdc.gov/
- Prevention Effectiveness Fellowship: www.cdc.gov/pef