MITACS-MSRI-PIMS Special Program on Infectious Diseases

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The objectives of this special program were to continue the success of the MITACS-PIMS Health Canada Meeting on SARS (held in BIRS, Banff, September 6-7, 2003) in furthering the fruitful interplay among mathematical, statistical and epidemiological sciences and to provide effective training for graduate students and junior researchers on collaborative research and the mathematical modeling and qualitative analysis of infectious diseases.

The program, organized by the MITACS project "Transmission Dynamics and Spatial Spread of Infectious Diseases: Modeling, Prediction and Control", consisted of a Summer School (for graduate students and beginning postdoctoral fellows) June 19 - June 27 followed by a Research Workshop June 28 - July 2, 2004.

Admission to the Summer School was competitive since the maximum capacity of the BIRS lecture room was 43. All of the 43 students admitted attended the Summer School: 10 from USA, 32 from Canada and one from China as part of the MITACS exchange program with Chinese Ministry of Higher Education. We were very pleased to have 25 female students for the school. This is a very encouraging sign in our effort to build the interaction of mathematics and epidemiology. Although, several students came from the medical sciences (Health Canada and St. Michael Hospital, for example), most were from graduate programs in mathematical and statistical sciences since the required level of mathematical and statistical background was high. (However, see the comments below about a future course targeted at students and research scientists in the medical community.)

Dr. Yicang Zhou, a MITACS-Chinese Ministry of High Education exchange scholar, attended the school as an observer and took part in the workshop in order to obtain some ideas on organizing such a school at home.

The Summer School was taught by 11 leading and active researchers from Canada and USA. Most instructors were at BIRS during the entire Summer School, enhancing the direct interactions of all students with first-rate scientists in the field.

The Summer School lectures covered a wide range of topics central to the mathematical and statistical modeling of infectious diseases: topics ranged from deterministic and stochastic models to parameter identification, reporting delay adjustments and incubation period estimation; from general theory to specific case studies (of West Nile virus, childhood disease, and of spatial spreading of rabies, for example); from homogeneous mixing to spatial structures (global transportation, spatial dispersal), social networking, age structures and super-spreading events (of SARS). We also organized a computer tutorial and problem drop-in session.

The organizers and instructors believe that there is no single textbook or research monograph covering the wide range of topics included in the Summer School. Putting this material together as a book would be a valuable contribution if it could be done relatively quickly. Feedback from students also encourages such an effort.

Group projects were an important part of the Summer School. Students were divided into eight teams working on one of five projects: HIV/AIDS, SARS, Cholera, TB, Malaria. Since students ranged from recent PhD.'s to recent BA's, we made an effort to have each team contain a mixture of experienced and less experienced students and a mixture of students from mathematical, statistical and medical backgrounds. Every afternoon, all instructors made themselves available for advice and help on the projects. The students blended well, and everyone seemed to have benefited significantly from their participation. The group presentations were extremely impressive, and all teams managed very well (within five days) to put together their proposed models, some qualitative analysis, computer simulations, epidemiological background and applications. Two of the teams were later invited to give their presentations in the Workshop and one team (working on modeling Cuba's HIV/AIDS dynamics) had such a wonderful project complete that they were invited on the spot by Dr. Ping Yan to give a formal presentation at a Health Canada meeting. They were also encouraged to submit their work for a journal publication.

Despite the hard work and long hours spent on the projects, participants to the Summer School still found time for group recreational activities including hiking, basketball, volleyball, soccer, and water basketball and excursions to downtown Banff.

Before the Summer School, a list of general references was posted in the Special Program's web page. We also managed to have copies of some standard reference books in the reading room of BIRS during the entire Summer School. These, together with the electronic access to many research papers, provided a temporary library at BIRS.

The Workshop attracted participants from medical schools (UCLA, UC Berkeley/Yale), health research centers (USA CDC, UBC CDC, National Microbiology Laboratory, the National Research Council, Cadham Provincial Laboratory) and Health Canada and mathematical modelers from across Canada and worldwide. This provided a wonderful forum for intensive discussions on how mathematical modeling and analysis are and should be directly related to informed public health policy. Eleven relatively senior students from the Summer School were also invited to participate in the workshop.

During the Workshop, there were invited lectures on various issues including modeling and assessing control strategies and intervention measures, stochastic aspects of disease transmission, sensitivity and uncertainty analysis, vaccination planning and immunity control, drug resistance, social networking, global transportation and the analysis of the National Microbiology Laboratory SARS database. There were also organized discussion sessions on the current status and future directions of mathematics in epidemiology. These discussions focused on how mathematics can make significant contributions to public health policy and how to enhance communication between modelers and epidemiologists. There were also long discussions on how the MITACS team could sustain its current productivity and further its outreach and collaboration with epidemiologists and researchers in public health policy.

The MITACS team members held a joint informal meeting with participants from Canadian health research organizations. It was agreed that we should work closely to make a plan for a similar program targeted at the medical community and graduate students in medical schools.

During the workshop, Fred Brauer and Jianhong Wu were interviewed by Canwest and four newspapers: the Calgary Herald, the Edmonton Journal, the Ottawa Citizen and the Banff Crag & Canyon. Shortly after the Program, Troy Day (Queen's University) was also interviewed on QR77 Radio (Calgary). We believe the media coverage provided some healthy information to the general public why and how mathematical modeling can assist in the prediction and control of infectious diseases.

In summary, we believe

- The investment by the three funding institutes and BIRS on the Summer School is appreciated by all students and helps Canada build its national capacity for interdisciplinary research in infectious diseases;

- The Workshop, with participants from the applied mathematics community, medical schools and health research institutes, provided a timely and much needed forum to ensure the current effort in mathematical modeling be directed by the issues important for public health;
- There has been an increasing demand for the study of infectious diseases to become a predictive science, and there has been a growing need for mathematical modeling and analysis developed on a solid epidemiological and biological foundation. The Special Program represents a welcomed response to the call for closer collaboration between mathematical modelers and epidemiologists for the prediction, prevention and control of infectious diseases. There should be more such special programs.