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SACEMA NEWSLETTER

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NEWS:

Measles outbreak in Stellenbosch

Measles is a highly infectious disease that can cause severe illness but is preventable through vaccination. In late February 2017, a measles outbreak was confirmed in Stellenbosch. The initial cases occurred at a boys' high school situated <2 km from SACEMA. The school and the Western Cape Department of Health responded to the outbreak quickly by vaccinating over 90% of learners within about 3 weeks of the onset of the first case.

SACEMA's director, Prof Juliet Pulliam, and her Master's student, James Azam, who is currently working on outbreak response vaccination strategies, adapted an existing measles model to evaluate the impact of vaccination at the school. Their model predicted the number of cases to expect considering the total population of the learners at risk and the number already vaccinated. They also predicted the number of cases averted through the vaccination campaign.

The model results were communicated to the school community through an information sheet, and those wishing to learn more were directed to a web application that allows the user to explore the dynamics of measles outbreaks in schools by adjusting parameters that govern characteristics of the school and the vaccination response. The app also gives an

overview of epidemiological modelling and some of its advantages. The aim was to increase enthusiasm for mathematics among high school learners and make them aware of epidemiological modelling as a useful field of applied mathematics.

Information sheet: http://github.sacema.org/measlesOutbreak/info/
Web application: http://github.sacema.org/measlesOutbreak/app/

Graduations 2017

Congratulations to the following SACEMA-funded students who graduated in 2017:

Steve Cygu graduated *cum laude* from Stellenbosch University with an MSc in Mathematical Sciences. His thesis titled "Immune Biomarker Reference Range Estimation for Healthy Paediatric Patients in South Africa" was supervised by Prof Martin Nieuwoudt.

Welcome Dlamini graduated *cum laude* from the University of KwaZulu-Natal with an MSc in Statistics. His thesis titled "Statistical Models to Understand Factors Associated with Under-five Child Mortality in Tanzania" was supervised by Dr Sileshi Melesse and Prof Henry Mwambi.

Tokpa Jamah graduated from Stellenbosch University with an MSc in Mathematical Sciences. His thesis titled "Modelling the Economics of Trypanocide and Insecticide-Treated Cattle Interventions against Trypanosomiasis Disease within a Multi-host Situation using Delay Differential Equation" was supervised by Dr Rachid Ouifki and Prof John Hargrove.

We wish our graduates the very best in their future endeavours!

New faces at SACEMA

SACEMA welcomed the following new internal students:

Laurette Mhlanga joined SACEMA as a PhD student and is enrolled with the Faculty of Medicine and Health Sciences, under the Department of Global Health at Stellenbosch University. She graduated with an MSc in Mathematical Sciences from AIMS Tanzania in 2016. Laurette also holds an MSc in Operations Research from the National University of Science and Technology. For her undergraduate Laurette graduated with a double major in Statistics and Biochemistry and went on to do BSc special honours in Statistics, both at the University of Zimbabwe. Currently, she is working under the supervision of Prof Alex Welte on a project entitled "Survey data Smoothing and HIV Incidence Estimation". The key objectives of this project involve the construction of a comprehensive survey analysis benchmarking platform and developing guidance on the primary challenges of data smoothing faced by surveys intending to estimate HIV incidence using a simulation based analysis.

Emanuel Muema received a BSc in Mathematics (Statistics) from the University of Nairobi, Kenya. He then joined the African Institute for Mathematical Sciences-South Africa, where he obtained a Structured Master's degree in Mathematical Sciences. He is currently a Master's student at SACEMA, Stellenbosch University working on the analysis of age-mixing patterns and the association between age difference and relationship characteristics relevant for HIV transmission dynamics under the supervision of Prof Wim Delva.

STUDENT SCIENTIFIC ACTIVITIES:

Eva Liliane Ujeneza, a PhD student at SACEMA, was invited by the Next Einstein Initiative (NEI) to give a speech at the "Official Launch of AIMS-Rwanda". The event was held on 3rd April, at the Kigali Convention Centre (KCC) in Kigali, Rwanda. The event was attended by people from many countries, including Rwandan dignitaries, a Nobel laureate, and as the guest of honour, His excellence Paul Kagame, president of the Republic Rwanda.

Eva says: "This was not just the launch of a new centre but the launch of an AIMS knowledge ecosystem that will use scientific innovation to solve challenges of the African continent. Beside the Master's program, the ecosystem will consist of the first research centre in Quantum Science in Africa, a Teacher Training Program, the Next Einstein Forum, a Women in STEM initiative, and an Industry and Economy advancement program. It was such a wonderful experience and a great opportunity to be part of this amazing project. I was able to make new connections and discuss potential future collaborations that could help me build up my career and expand/grow the Rwandan Association for Women in Science and Engineering that I have co-founded with other amazing women." The association aims to

encourage and mentor young girls in STEM and provide a networking hub for Rwandan women in science.

During her visit in Rwanda, Eva also visited the AIMS Rwanda centre and gave a two hour joint-talk with Ms Savannah Nuwagaba, on “Basic communication skills in Science”.

Eva Ujeneza with dignatories at the Kigali Convention Centre (KCC) in Kigali, Rwanda

RShiny for App Development Course

SACEMA postgraduate students participated in the RShiny for App Development workshop held at the University of Cape Town on 22nd March. The objective of the workshop, presented by Oliver Celhay, was to provide an overview of the Shiny package. Participants were introduced to the most important concepts for building and deploying simple and effectively coded Shiny apps. The course was structured into three parts, each with a practical component which enabled participants to better understand and use the package. Part one focused on how to build a Shiny app, part two focused on how to customize reactions, and part three focused on how to use R Markdown, especially with regard to effectively organizing R code.

Fanuel Otieno, one of the Master’s students who attended the workshop reports: “For me the take home message was that as mathematicians, statisticians, and epidemiologists who rely on data visualization using R, knowing how to effectively use the Shiny package is vital for the communication of our work to colleagues and the public at large. Building a Shiny app allows users to interact with the data visualization techniques used by changing the parameters for better understanding the message being communicated”.

INTERNATIONAL MEETINGS:

International Papillomavirus Conference

SACEMA staff member and PhD student, Cari van Schalkwyk attended the 31st International Papillomavirus Conference from 28th February to 4th March 2017 at the Cape Town International Convention Centre. More than 1000 delegates attended the conference and sessions on public health, clinical and basic science aspects ran in parallel. Cari has a particular interest in human papillomavirus (HPV), its associations with HIV and its progression to cervical cancer. She is developing an individual based model that will address questions around HPV and HIV transmission dynamics and estimate the impact of several prevention strategies on cervical cancer incidence in South Africa. Cari reports, “I learned a lot from this conference, and it was good to put faces to the names on the papers in my literature review!”

Lecture on History of Relationships between Humans and Tsetse Flies

On 26th February 2017, Glyn Vale gave an invited lecture to 140+ members of the History Society of Zimbabwe, at St. Georges College, Harare. The talk started with a quote from Francis Bacon (1561-1626), *i.e.*, "Histories make men wise", and with the pun that historians become wise mainly by answering all of the "whys" about the purposes and causes of what has happened where and when. This raised many questions, including: (i) why tsetse flies and humans have close similarities in their means of reproduction and are the most blood-thirsty of their kinds, (ii) why the Cradle of Mankind was not also the Cradle of Civilisation, and (iii) why research into tsetse behaviour has succeeded in improving the cost-effectiveness and eco-friendliness of controlling the flies and the diseases they spread. In the latter regard, the main lesson for modern humans is the importance of friendly and constructive co-operation between persons of differing skills and opinions.

Visit to San Francisco

SACEMA researcher, Eduard Grebe visited San Francisco for a week in February to work on a project to estimate the Hepatitis C Virus (HCV) burden in San Francisco. The San Francisco Department of Public Health, University of California San Francisco, and community partners recently announced a major initiative to eliminate HCV in the city, known as *End Hep C SF.* Activities within this initiative include rapid scale-up of HCV testing and navigation, education and prevention campaigns, and expansion of treatment access through clinical and non-traditional settings. To measure the potential effect of these interventions, it is critical to have a valid estimate of citywide HCV prevalence, including in ‘key populations’ with programmatic significance, allowing for improved targeting and tailoring of interventions to maximize impact. If a high prevalence community like San Francisco can significantly reduce the burden of HCV, *End Hep C SF* could provide a model for successful interventions elsewhere. Eduard is one of the principal analysts on the team tasked with producing these baseline estimates.

CROI 2017, Seattle

Alex Welte and Eduard Grebe attended the annual Conference on Retroviruses and Opportunistic Infections, held this year in Seattle. The work they presented was on the topic of using laboratory assays to perform 'staging' of HIV infections, in the sense of attaching a statistically meaningful label of 'recent vs non-recent infection', or some kind of 'time since infection' estimate, in addition to a conventional 'diagnostic' result which simply classifies a patient as infected or not. Development of assays for these purposes has attracted considerable attention in the last 20 years or so. The overall 'diagnosis and staging' algorithms proposed have always involved using a conventional regulatory-approved assay for the HIV presence/absence determination, followed by the application of a customised staging assay. Together with collaborators in the CEPHIA consortium (http://www.incidence-estimation.org/page/cephia-overview), SACEMA presented the first analysis of a proposed staging algorithm which uses only routinely collected diagnostic markers, in contexts where modern diagnostic platforms with high innate 'dynamic range' are being applied. Welte and Grebe also attended a two day WHO technical working group on these kinds of staging algorithms, at which they presented new ideas on the transferability of staging algorithms between contexts of application where performance characteristics may differ.

INTERNATIONAL EXCHANGE PROGRAMMES:

Clinic on Dynamical Approaches to Infectious Disease Data (DAIDD)

The fifth annual Clinic on Dynamical Approaches to Infectious Disease Data (DAIDD), hosted by the University of Georgia's Department of Epidemiology and Biostatistics, was held in Jacksonville and Yulee, Florida, from 4 to 10 December 2016. Presented in collaboration with the International Clinics on Infectious Disease Dynamics and Data (ICI3D) Program, this clinic brought together graduate students and young researchers from North America and Africa to learn about the conceptual foundations of dynamical modelling of infectious diseases and formulate their own research questions in line with these concepts. There were 22 student participants, 8 of whom were from Africa. There were 8 faculty members, including 4 of our North American collaborators, and the following SACEMA people: Juliet Pulliam, Cari van Schalkwyk, Eva Liliane Ujeneza, and Brian Williams, with Gavin Hitchcock as Program Evaluator.

Eva says: "My experience as a Faculty member at DAIDD was really great. What I enjoyed the most was the mentoring sessions. Having discussions with the participants about their projects and seeing them unfolding was quite an experience."

Cari says: "I really enjoyed the small group sessions and I think most of the participants benefited from these, getting (in some cases) three different suggestions for their model diagrams… Overall I think DAIDD was superb – the content, the venue, the mix of participants, the mix of faculty, and the mixing of participants and faculty. I also realised how important it is that we all spent the entire week together – meals and bike rides are just as important as formal sessions."

Participants and faculty at DAIDD, Florida

EVENTS:

Short course on Individual-based modelling in epidemiology

From 27th to 31st March, 22 participants attended the first edition of the short course "Individual-based modelling in epidemiology: A practical introduction". The course took place at the Stellenbosch Institute for Advanced Studies, next door to SACEMA, and was taught by Prof Wim Delva and Dr Lander Willem (University of Antwerp, Belgium). Participants (of whom two thirds were SACEMA students and staff), were introduced to the basic principles of developing, exploring, and fitting individual-based models, with class-room examples inspired by research questions related to the transmission dynamics of HIV, influenza, and African animal trypanosomiasis. At the end of the course, participants were challenged to extend the classroom models, using NetLogo and R for simulation and model exploration. Based on the overwhelmingly positive feedback, we are hopeful that this will prove to be the first of many editions.

Participants, faculty, and SACEMA staff at the IMB course in Stellenbosch

Discussion group on "How to be a Scientist"

This weekly discussion, held on Monday afternoons, provides a forum for SACEMA's 'junior' researchers and some senior staff to explore together the many different aspects of being a scientist -- from doing our best possible scientific work, to grappling with the broader meaning of our contributions, to engaging with the larger scientific community and the public, to understanding local and global issues related to scientific funding and the structure of higher education. Topics included so far in 2017 are: Developing and updating an academic CV; Paper abstracts: purpose and construction; Modelling for community engagement: measles in schools (in response to an outbreak at a school in Stellenbosch); Choosing an appropriate journal; Recognizing and preventing discrimination in professional interactions; Language of instruction for mathematics in multilingual settings; and "One good diagram communicates better than a 1000 words": Visualization in mathematics and science education and research.

SACEMA Seminars

The following seminars were held between January and April:

- 18/01/2017: Steve Bicko Cygu: Immune Biomarker Reference Range Estimation for Healthy Paediatric Patients in South Africa.

- 20/01/2017: Kathleen Green: Whole body modelling of glucose metabolism in malaria patients.

- 25/01/2017: Fanuel Otieno: Intimate Partner Violence and Age Disparity in Sub-Saharan Africa.

- 27/01/2017: Christianah Olojede: Partner turnover rate and the lifetime number of sexual partners in Cape Town.

- 10/02/2017: Elissa Schwartz: Virus dynamics, immune control, and escape: HIV, EIAV, & Influenza.

- 17/02/2017: Eddy van Doorslaer: The population health impact of the distribution of free antiretroviral medication in South Africa.

- 24/02/2017: Jacky Snoep: Strengths and limitations of mechanistic approaches in mathematical modelling studies.

- 03/03/2017: Sheetal Silal: Supporting Malaria Elimination in the Asia-Pacific through Mathematical Modelling.

- 10/03/2017: Gaston Mazandu: Overcoming communicable and non-communicable diseases in Africa: a lost battle?

- 17/03/2017: Florian Marx: Population-level impact of tuberculosis control interventions targeted to former TB patients in high incidence settings.

- 24/03/2017: Wilfred Ndifon: Stochastic dynamics in biology.

- 06/04/2017: Lander Willem: Catching the risk of infectious disease transmission with an individual-based model.

- 21/04/2017: Eduard Grebe: Estimating population-level HIV incidence by combining synthetic cohort and recency biomarker approaches: a demonstration using survey data from KwaZulu-Natal, South Africa.

UPCOMING EVENTS:

Clinic on Meaningful Modelling of Epidemiological Data (MMED)

The eighth annual Clinic on Meaningful Modelling of Epidemiological Data (MMED) will take place at AIMS in Muizenberg from 29th May to 9th June 2017. This 2-week modelling clinic will bring together graduate students, postdoctoral scholars, and other researchers from North America and Africa, with the goal of engaging the participants in epidemiological modelling projects that use real data to grapple with practical questions in a meaningful way. The Clinic will consist of a series of lectures, discussions, and tutorials that will guide participants through the process of developing data-based, dynamical models of disease spread and using models to answer public health questions.