4.2 USING COMPLEX SYSTEMS APPROACHES IN EPIDEMIOLOGIC RESEARCH

Chair: Prof. George Kaplan, USA

04-2.1 FORESIGHT TACKLING OBESITIES: FUTURE CHOICES

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Foresight is a permanent part of the UK Government Office for science led by the Government Chief Scientist. Its purpose is to take a long term look at the prospects for particular issues thought to have impact on society. Obesity was chosen at a time when its growth in prevalence was inexorably rising and attempts to deal with it had failed; targets set by the Dept of Health had routinely been exceeded.

This presentation will review the work of Foresight Obesity project in particular the epidemiological modelling component. This consisted of two parts; Modelling the future trajectory of obesity prevalence, indeed the distribution of BMI by age, sex, ethnicity, class and geographic region from the annual surveys of the Health Survey for England. These predictions could be subject to a range of policy options which affected BMI or business as usual. Given these predictions up to 2050, we built a micro simulation of the UK population with same demographics and the BMI growth predicted. These simulated populations were subjected to the risks of disease associated with BMI and the morbidity, mortality, quality of life and life expectancy registered and the likely NHS costs accrued estimated. http://www.foresight.gov.uk/Obesity/Obesity_final/Index.html.

We will describe the methods we used and the results. The role of this kind of modelling in public health policy development will be discussed.

04-2.2 HEALTHPATHS DYNAMICS: USING FUNCTIONAL HEALTH TRAJECTORIES TO QUANTIFY IMPACTS ON HEALTH-ADJUSTED LIFE EXPECTANCY (HALE) IN CANADA

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There is significant dispersion in health status in populations, as well as a strong correlation between health status and socio-economc status. However, there remains considerable uncertainty as to the quantitiative importance of various causal factors in accounting for these health inequalities. Since health status is intrinsically a reflection of co-evolving dynamic processes, it is essential to employ an analytical framework that brings together robust estimates of individuals' health status as functions of health determinants dynamics in order to assess realistically the sources of health inequalities.

This analysis is based the Health Utilities Index (HUI), where the index is computed as a non-linear function of eight distinct categorical attributes—vision, hearing, speech, mobility, dexterity, cognition, emotion, and pain. The complex dynamics of HUI in a representative sample have been observed with Statistics Canada' National Popultation Health Survey every 2 years since 1994.

The analysis begins with estimates of multivariate functional health trajectories, conditional on co-evolving risk factors. It then uses longitudinal microsimulation, drawing on the estimated *system* of equations for the dynamic relationships among the eight HUI components and major health determinants. The microsimulation process is used to synthesise a realistic base case representative longitudinal population sample, and then a series of carefully constructed counter-factual populations. Comparisons of the distributions of health-adjusted life lengths and summary HALE measures between counter-factuals and the base case are then used to estimate the quantitative importance of the major factors in accounting for HALE in Canada.

04-2.3 DYNAMICS OF SMOKING IN ADOLESCENCE AND INFLUENCE OF SOCIAL NETWORKS

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Most smokers have begun the habit before the age of 18 and understanding the dynamics of smoking in adolescence and the influence of social networks may help us design better interventions.[1] In 2001, Queens University Belfast began a longitudinal study of adolescents (the BYDS study) over annual five waves, on individual attributes, behavioural traits and school-friendship networks.

We have systematically reviewed the prospective studies on peer network effects on adolescent smoking behaviour and disparate results, quality and methodological perspectives are evident. A common feature is an emphasis on topology and metrics[2] but with little account taken for nodal characteristics and broader school or contextual factors.

To illustrate their importance, we use data from 1000 adolescents in eight BYDS schools first to describe how peer network topologies vary between boys and girls and across schools.

A relatively new method of analysis is employed based on stochastic actor-orientated models (implemented in SIENA[3]). We will present data from multiple waves to illustrate how this can accommodate both network topology and individual characteristics to trace the effects of peers on the evolution of smoking behaviour within in a continuous time stochastic process and place our findings (on gender differences and school level factors) in the context of our systematic review.

04-2.4 COMPLEXITY, EPIDEMIOLOGY AND THE UNDERSTANDING OF "WHAT IF"

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Einstein is reputed to have said that "everything should be as simple as possible, but not simpler." These words ring ever more true to epidemiologists as we struggle to gain knowledge about complex disease processes that involve dynamic interactions between biological, behavioural, social, spatial, socioeconomic, and global determinants. Understanding the etiologic and policy implications of such a rich stew of factors challenges the "independent effects" model of understanding population health. Fortunately, there are recent developments in which bridges are being built between computer science approaches designed to model and simulate complex systems and epidemiologic researchers. We will describe the development of an agent-based in silico complex systems model that is focused on integrating dynamic, non-linear, and multilayered economic, behavioural, social, biologival, and neighbourhood determinants of health and discuss how it can be used to inform our answers to questions such as—"if poor children went to good schools, how much would it eliminate socioeconomic inequalities in hearts disease when they become adults?"