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Enhancing policy maker decisions: a framework to assess determinants and space-time risk of infant, child and adult mortality in rural South Africa and elsewhere

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Lack of data and reusable frameworks for policy makers

Reliable mortality data are essential for planning health interventions, yet such data are often not available or reliable in developing countries, especially in sub-Saharan Africa (1). This lack of reliable data makes it difficult for policy makers to make informed decisions and to optimise resource allocation in poor settings where few resources are available. Health and socio-demographic surveillance sites (HDSSs), such as Agincourt (located in rural north-east South Africa), are often the only way to assess and prospectively understand health trends at a population level (2), and thus have the potential to address this gap. Lessons learnt in these types of populations have the potential to be replicated elsewhere and also allow the opportunity to develop methodological frameworks in which to give health outcomes and contributing risk factors.

Developing a framework in which to assess health outcomes and associated determinants

This article summarises the main findings from my PhD (3). Data were used from the Agincourt study area for a 16 year period (1992-2008). The main purpose of my PhD was to apply Bayesian geostatistics to better understand the dynamics of age-specific mortality both in space and time, to identify age-specific mortality risk factors, in the presence of spatial and temporal correlation, which have a high "impact" at a population level, to relate inequalities in risk factor distributions to observed spatial mortality risk patterns, and thus, provide a platform to help improve policy planning and resource allocation in this and other poor rural settings.

What we found and lessons learnt

The profound impact of the HIV epidemic on mortality in this rural population is evident as well as the subsequent decrease in mortality following the roll-out of antiretroviral therapy.
Figure 1 depicts adult communicable disease mortality (largely due to HIV/TB) between 1993 and 2010 and highlights this temporal pattern. The hazard of mortality (Figure 2) is high in the first few years of life then rapidly decreases and reaches its lowest hazard round the age of 8 years. The hazard of mortality starts rising once more round puberty and steadily increases thereafter.

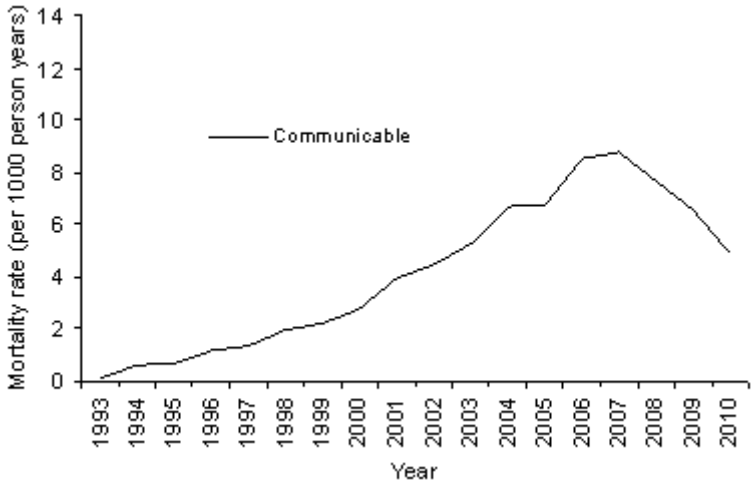

Figure 1: Communicable disease mortality rate (per 1000 person years) among adults (15-49 years), 1993-2010

While we expect to see a linear increase in the log hazard of all-cause mortality with increasing age through adulthood (Figure 2), a non-linear upward "bulge" is observed, indicating an increased hazard of mortality among younger adults due to the HIV epidemic. The elevated log hazard of mortality in the first few years of life in this population is again due to the direct and indirect (e.g. maternal death – see below) effects of HIV.

Distinct clustering of mortality both in space and space-time was observed (particularly in the upper central and south east regions of the study area) and we demonstrate that mortality hotspots as well as variation can be identified even in relatively small geographic areas (Figure 3). The most important risk factors for infant and child mortality were maternal mortality and low socio-economic status. Among adults a complex interaction of factors such as ethnicity, male gender, circular migration (often for labour and associated high risk behaviour) and household dynamics (partner or other household deaths e.g. household head, female headed households, poverty and/or unemployment) appeared to be the most important attributable drivers of mortality risk.

Significant differences in the risk factor profiles of the identified mortality 'hotspots' included ethnicity (South African versus former Mozambican refugees); greater maternal, partner, and household mortality; household head mortality and demographic profile (younger females headed households); labour migration; lower education; and low socio-economic status i.e. poverty. A complex interaction of highly attributable multilevel factors (and their relation to HIV risk) had a definite impact on the space-time distribution of mortality in this rural population (3). The risk factor profiles of identified mortality hotspots also varied, suggesting that a blanket population wide strategy may not be as effective as area-(or community-) specific tailored interventions

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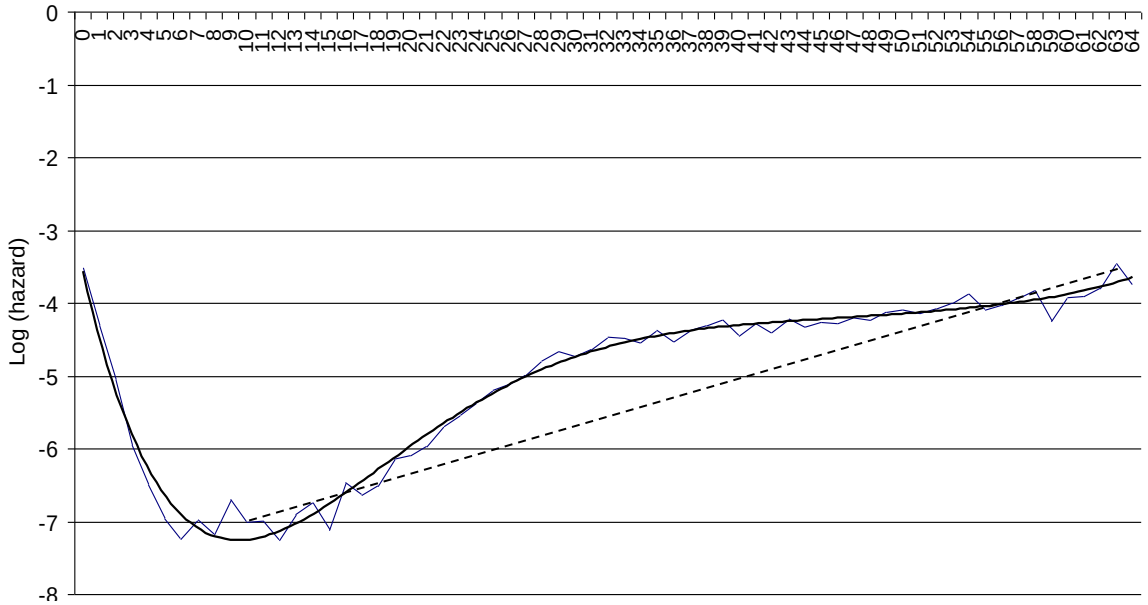

Figure 2: Observed log hazard of mortality by age, 1993-2008 (dashed linear line represents the expected pattern through young and middle aged adulthood)

This study has demonstrated the considerable potential of advanced Bayesian spatial-temporal methods for analysing longitudinal outcomes and associated determinants. This integrated framework and recommendations should prove valuable to decision makers and has definite application in other settings within the country and the region. Interventions that target the mother-infant pair (i.e. prevent vertical transmission of HIV and ensure survival amongst mothers [especially those who are HIV positive] during infancy and childhood) are urgently needed. There is also a need to increase access to a variety of services for more vulnerable "high mortality" households, identified as a prominent risk factor for subsequent age-specific mortality.

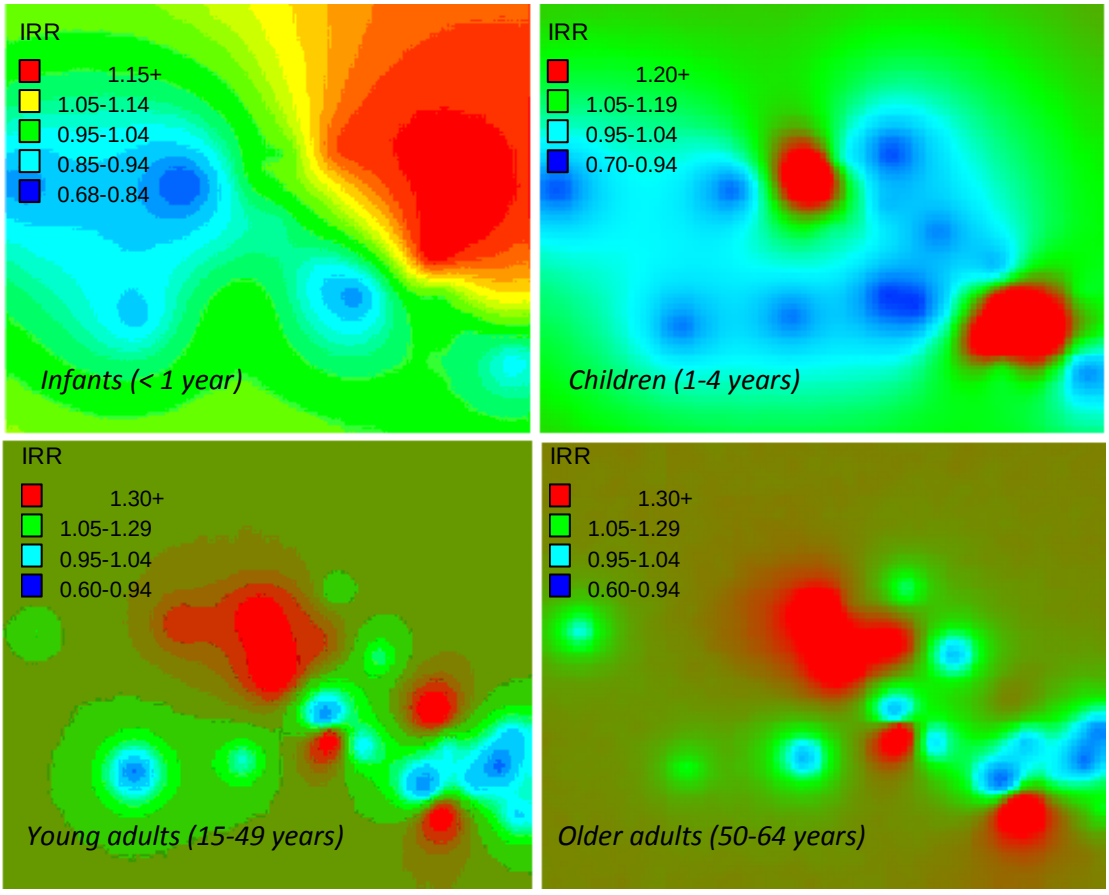

Figure 3: All-cause mortality risk by age group within the Agincourt rural sub-district, 1992-2008

The strong spatial clustering of diarrhoeal and malnutrition mortality among children in the south east part of the study area represents a breakdown or absence of basic services, such as provision of water and sanitation, that needs to addressed. Adult education campaigns (with regards to unsafe sex) and improved testing of highly mobile or migrant individuals is essential, as circular migrants were at a higher risk of mortality and appeared to be part of the driving mechanism behind the excess mortality risk observed in one particular village in the upper central part of the site. The emergence of non-communicable disease mortality is also of concern, suggesting the need for increased screening for and control of non-communicable disease risk factors and disease (e.g. integrated chronic disease management).

Note: This summary is largely taken from a published article: Sartorius B. Modelling determinants, impact, and space-time risk of age-specific mortality in rural South Africa: integrating methods to enhance policy relevance. Glob Health Action. 201324;6:19239.

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3. Sartorius B. Modelling determinants, impact, and space-time risk of age-specific mortality in rural South Africa: integrating methods to enhance policy relevance. Glob Health Action. 2013;6:19239.