How mathematics has shaped my life and career

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Status of mathematics in Southern Africa before 1960

- I was born in Northern Rhodesia now called Zambia

- Northern Rhodesia was part of the federation of Rhodesia and Nyasaland
- Rhodesia consisted of Northern Rhodesia (Zambia), Southern Rhodesia (Zimbabwe) and Nyasaland (Malawi)
- This territory was under British rule and was administered from Salisbury (Harare).

School system

- Schools were segregated according to race: Native schools (for blacks), Colored schools (mixed race), Indian schools and white schools.
- The native schools in Rhodesia and Nyasaland were affected by the decision to barn Africans from studying mathematics in South Africa in the 1950'.
- Since the territory relied on South African teacher training colleges, our teachers had no formal training in mathematics.
- In 1960 the common textbook in mathematics was withdrawn from native schools and replaced by a textbook for natives entitled “Native Arithmetic”.

Early days

- In the early days my challenge was to show that I can learn and enjoy mathematics.

- We knew as youngsters that we were being prepared for simple clerical jobs in the copper mines.
- Studying mathematics became a symbol of defiance to the colonial government.
- After completing my first degree, It was obvious that I could use mathematics to address problems in my community e.g. water, diseases, energy etc.

The period 1960-1980

- The states in Southern Africa gained political independence between 1960-1980, except South Africa.
- During the period 1960-1980 there was rapid expansion of educational institutions.
- When I completed my PhD in 1981 there were only 4 black PhD holders in Southern Africa (my self and three others).
- Prof Dzinotyiweyi, Prof Phiri and I met in Gaborone, Botswana in 1981 and formed an organization the Southern Africa Mathematical Sciences Association (SAMSA).

SAMSA and partners: Brief description

- The SAMSA-NUFU activities and achievements will be discussed by Prof Bernt Oksendal.
- The SAMSA-AMMSI activities and achievements for Southern Africa will be discussed by Prof Wandera Ogana.
- The SAMSA-MASAMU activities and achievements will be discussed by Prof Overtoun Genda.
- SAMSA-DIMACS activities (Prof Fred Roberts)
- SAMSA activities will be discussed by Dr Levis Eneya.
- SAMSA-CDE activities (Prof Herb Clemens)
- I will concentrate on how mathematics has influenced my life.

Type of program

- As part of SAMSA activities, we agreed to initiate training and research programs that were targeted to addressing problems of our region.

- We also wanted to initiate research that was relevant but also permitted the use of new mathematical theories.

Problems in sub-Sahara Africa

- The major problems in Southern Africa can be classified as (i) Endemic diseases (ii) lack of clean water and sanitation (iii) Lack of energy (iv) Lack of skilled human resource.
- I have devoted my career to studying endemic diseases and training at MSC and PhD levels for the universities.
- I will concentrate on the problems of endemic diseases but illustrate how we can manage this problem by taking care of (ii) and (iii) above.

Endemic diseases

- We are studying the following endemic diseases (i) HIV/AIDS, (ii) Malaria and (iii) HIV-Kaposi's sarcoma
- I have used these three diseases to boost research and training in the region.
- I have also used these three diseases to provide outreach services to health planners.
- As a result of our studies, I have served on many government committees.
- I will outline briefly some of our achievements.

HIV/AIDS research

- Before the year 2004, the criteria for accessing anti-retroviral drugs was a CD4 count of 200 copies per micro liter of blood.
- Most governments in the region were using this threshold for economic reasons (no biological justification).
- However, from the number of deaths among drug recipients and the number of new HIV infections, it was obvious that the threshold was not beneficial.
- We published a paper “M. Kgosimore and E. M. Lungu (2004). The effect of vaccination and treatment on the spread of HIV/AIDS. Journal of Biological Systems. Vol. 12, No 4, pages 1-19.

HIV/AIDS research

- We concluded that for individuals to benefit from treatment, a minimum threshold of 350 copies per micro liter of blood was necessary.
- After debates for many years, the threshold has ben increased to 350 for most countries in Southern Africa.
- During the period 1985-2007, anti-retroviral drugs were not given to children under the age of 5 for many reasons.
- We formulated a model “M. Kgosimore and E. M. Lungu (2006). The effects of vertical transmission on the spread of HIV/AIDS in the presence of treatment. MBE. Vol. 3, number 2, pages 297-312.

HIV/AIDS research

- Our results showed that even if 60% of treated children reached adulthood, they would not change the reproduction number significantly.
- Our work contributed to the campaign for treatment of children. Today all children in Southern Africa born HIV positive receive HIV treatment.
- Our work " Esther Chigidi and Edward M. Lungu (2009). HIV model incorporating differential progression for treatment-naïve and treatment-experienced infectives. MBE. Vol. 6, pages 427-450 revealed the following:

HIV/AIDS research

- Failure to treat treatment-experienced patients could lead to development of drug resistant strains.

- However, at the current rate of development of these strains the population of individuals carrying these strains is unlikely to exceed 5% in the next 20 years.
- We have formulated and analyzed a model for treatment of AIDS-related Kaposi's. Barbara Szamolay and Edward M. Lungu(2014). Journal of Biological systems.
- The model incorporates the pharmacodynamics of HAART alone or combination therapy involving HAART and KS therapy.

HIV/AIDS research

- Our results indicate that administration of combination therapy to individuals co-infected with HIV-1 and HHV-8 can greatly amplify the therapeutic response of low-dose KS therapies.
- For combination therapy, adherence levels above 85% can significantly reduce the risk of KS and HIV-1 for periods under 1 year.
- For longer treatment periods, however, at least 90% adherence level is recommended.
- Based on our results, we recommend at least HAART treatment for all infected with HIV to reduce the risk of KS.

Improving HIV/AIDS treatment

- Southern Africa has abundant surface as well as ground water yet most homes lack clean water.
- In homes where parents are living with HIV/AIDS, the children have the responsibility to collect water and firewood.
- These chores deviate their attention from studies.
- Recently, we have been modeling ground water flow and how it can be made available in peoples homes using solar driven pumps.

Integrated HIV/AIDS-treatment

- Investing in solar devices to generate power to drive water pumps would benefit Africa in two ways
- Clean water from boreholes would be pumped in many rural homes.
- Solar energy can be used for lighting and cooking in many rural homes
- Availability of clean water and solar energy in rural homes would free the children from domestic chores so that they can concentrate on education.
- THANK YOU