Cardiovascular health research, training, and capacity building for the eradication of rheumatic fever and rheumatic heart disease in our lifetime: the inaugural Bongani Mayosi Memorial Lecture

George A Mensah

Introduction
The Bongani Mayosi Memorial Lecture was established by the European Society of Cardiology and the World Heart Federation in 2019. It was created as a tribute to Professor Mayosi’s tireless efforts to advance research, training, and capacity development to combat cardiovascular diseases in low-income and middle-income countries (LMICs). Professor Mayosi was a visionary clinician-scientist and former dean of the Faculty of Health Sciences at the University of Cape Town (figure). He was a fellow of the European Society of Cardiology and an active member of the World Heart Federation. Among his scientific interests, rheumatic fever (RF), rheumatic heart disease (RHD), and other cardiovascular diseases of poverty represented a specific passion. His accomplishments in these areas have been described in The Lancet and in tributes published after his tragic death on July 27, 2018.

This essay focuses on the clinical and public health challenges and the opportunities for eradicating RF and RHD. It begins with a brief synopsis of the huge burden of RF and RHD, especially in endemic regions of the world. It then highlights the lack of adequate local clinical and public health infrastructure and workforce capacity to tackle effective clinical care delivery in LMICs. It addresses research advances that provide hope that eradication is feasible and cites success stories from Cuba and the French Caribbean islands as well as programmes and roadmaps created by national and international societies and research funding agencies to address RF and RHD.

The essay concludes with the implications of the landmark 71st World Health Assembly resolution and call to action to end RF and RHD. This resolution and call to action to member states provides the impetus and represents the political will necessary for a sustained eradication of RF and RHD. Strategic collaborations with ministries of health and scientific and professional organisations to accelerate research, training, and capacity development are also needed. The central theme of this article is that, while many research questions remain, we know enough today to prevent, treat, and eradicate RF and RHD in our lifetime.

The burden of RF and RHD
The global burden of RF and RHD is substantial. There are an estimated 30–40 million current cases of RHD in the world—a prevalence of 2.5–3.2 cases for every 1000 people. Including children with latent RHD, the global burden is estimated to be as high as 100 million prevalent cases. The regions with the highest disease burden are predominantly in LMICs, mostly in Oceania, south Asia, and central sub-Saharan Africa or in low-resourced, underserved communities in high-income countries. Knowledge of these regions of endemcity can inform targeted strategies for disease elimination. These endemic regions are also regions in which scientific workforce capacity for implementation research to develop and test locally acceptable, affordable, and sustainable strategies to eliminate RF and RHD is in need of strengthening.

Over the past quarter century, significant progress has been made in reducing the burden of RF and RHD. Since 1990, the global age-standardised mortality due to RHD has declined by nearly 50%. In the decade of 2007–17, the age-standardised rate (per 100000) for disability-adjusted life years (DALYs) has also declined nearly 24% in males and 20% in females. Similarly, the age-standardised rates for mortality and years of life lost (YLL) in both males and females declined in the last decade by 21–3% and 25–9%, respectively. In fact, the largest decline in mortality rates among cardiovascular diseases in that same decade was recorded for RHD, rates of which declined by 21–3% from 4–7 to 3–7 deaths per 100000. The opportunity to...
accelerate these declining rates, especially in endemic regions, provides the best hope of eradicating RF and RHD; however, it will require the appropriate degree of clinical and public health infrastructure, capacity, and the ability at the national and regional levels to support the eradication of RF and RHD.

**Infrastructure and capacity to eradicate RF and RHD**

There is a general lack of adequate domestic clinical and public health infrastructure and workforce capacity to tackle effective clinical care delivery and related public health practice in many LMICs. For example, WHO has estimated that all of sub-Saharan Africa accounts for a 4% share of the global health workforce, although it shoulders nearly a quarter of the global disease burden. This huge workforce deficit has remained unchanged in sub-Saharan Africa for a decade. Similar workforce shortages have been observed in or projected for other LMICs in southeast Asia by 2030. In fact, the UN has cautioned that, if current trends persist, there will be a gap of nearly 18 million health-care workers, mostly in LMICs, by 2030.

These shortages of physicians, nurses, and allied health-care personnel in endemic areas have a direct impact on the ability to prevent and control RF and RHD. Strategies for accelerating training and workforce capacity development are needed. Also needed are strategies to address the inadequate access to effective medications that often compounds workforce shortages in LMICs. In the case of RF and RHD, penicillin is the mainstay of primary and secondary prevention; thus, implementation strategies that increase drug availability, acceptability, and affordability, and ensure sustainable and reliable supply chains are crucial. When primary and secondary prevention fail, access to cardiovascular specialty care becomes necessary, especially in pregnant women who can have significant valvular heart disease.

Professor Mayosi was an ardent advocate for training programmes for both clinical care and research capacity development as well as a strong proponent of effective policies and tailored programmes to attract, recruit, and retain health-care personnel in underserved areas. He convened the first All Africa Workshop on Rheumatic Fever and Rheumatic Heart Disease that led to the adoption of the Drakensberg Declaration and subsequent communiqués that called for strategies to address important gaps in the local capacity for biomedical and behavioural science and implementation research crucial for the eradication of RF and RHD. An important part of strategies proposed to address clinical and research capacity development was the creation of centres of excellence in endemic regions and linking them with appropriate regional and global networks to support locally relevant research, knowledge translation, and progress towards the elimination of RF and RHD.

**Advances in biomedical science research**

Although many compelling scientific questions and critical challenges persist, we nevertheless have a firm understanding of the pathogenesis and of the basic, clinical, and population science aspects of acute RF and RHD. Repeated exposures to untreated pharyngeal infection with group A *Streptococcus*, in susceptible individuals, and in the presence of additional social and environmental determinants, represent the likely upstream risk factors for acute RF. These social and environmental determinants are important and include poverty, housing overcrowding, and social deprivation; thus, strategies that address social determinants are crucial in the eradication of acute RF and RHD.

In 2016, Professor Mayosi and colleagues summarised the potential pathogenesis pathways from antigen presentation and processing through various immunological and inflammatory responses that contribute to RHD. Muhamed and colleagues recently provided a review of a half-century (from 1961 to 2011) of research progress in Africa that spanned registry observations to basic science research and addressed several of these pathways. Improved understanding of these pathways and the mechanisms of action of virulence factors as well as recent innovations in vaccine development against group A *Streptococcus* provides more hope for the future eradication of RF and RHD.

**Strategic partnerships needed**

Contemporary success stories from Cuba and the Caribbean islands of Martinique and Guadeloupe also provide hope that eradication of RF and RHD is feasible in our lifetime. The intervention approaches in these success stories used a combination of public awareness efforts; training of the health-care workforce; primary and secondary prevention strategies; registry-based care; health systems strengthening; and importantly, coordination with local clinical and public health efforts. Thus, strategic collaborations with country ministries of health in endemic regions and scientific and professional organisations can help accelerate research, training, and capacity development.

As shown in the World Heart Federation’s roadmap document, the road to successful eradication of RF and RHD must embrace multiple component interventions at all prevention levels—primordial, primary, and secondary prevention. These prevention levels require coordination and strategic partnerships of stakeholders from multiple sectors and disciplines, and are best informed by research evidence and evidence-based tools. As a result, the continued engagement and support of health organisations, professional societies, non-profit foundations, and research-funding organisations can contribute substantially to progress in eradicating RF and RHD.

**A landmark call to action**

The 71st World Health Assembly resolution and call to action to end RF and RHD represents a landmark
opportunity to accelerate the prevention, control, and eradication of RF and RHD.\textsuperscript{3,23} This resolution and call to action articulates specific actions for Member States and the World Health Assembly secretariat. The actions provide the impetus and represent the much-needed political will necessary for a sustained effort towards eradication of RF and RHD. Important among the actions are acceleration of multisectoral efforts in poverty reduction; improved access to primary health care, as well as to diagnostic technology; improved capacity to detect and treat group A streptococcal pharyngitis, RF, and RHD; and ensuring a consistent supply of quality-assured benzathine benzylpenicillin for secondary prophylaxis. Other actions include improved efforts in estimation of disease burden and trends; provision of resources and other support for national programmes; and increased international collaboration and resource mobilisation in support of the elimination of RF and RHD.

Conclusion

Professor Mayosi was passionate about the prevention and treatment of RF and RHD. He had hoped to see the eradication of these diseases in his lifetime. His tragic and untimely death leaves the completion of this mission to us. The good news is that we already know enough about the aetiological agent, the social and environmental determinants, and the pathogenesis pathways in RF and RHD to enable us to make a huge dent in the disease burden in endemic regions of the world. Taken together with recent advances towards vaccine development, we have a real opportunity to eradicate RF and RHD in our lifetime.

However, this is a challenge that requires scientific innovation and discovery as well as efforts to support sustained clinical and public health implementation of strategies proven to be effective in the prevention and treatment of RF and RHD. The landmark World Health Assembly resolution and call to action provides that political will and the impetus for worldwide action to end RF and RHD. We already know enough to be successful in this endeavour; but knowing is not enough, we must also act. And the time to act is now.

Declaration of interests

I declare no competing interests.

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