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ISSUES IN MEDICINE

# Engaging surgeons among clinician-scientists

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Since completion of the Human Genome Project at the turn of the century, there have been significant advances in genomic technologies together with genomics research. At the same time, the gap between biomedical discovery and clinical application has narrowed through translational medicine, so establishing the era of personalised medicine. In bridging these two disciplines, the clinician-scientist has become an integral part of modern practice. Surgeons and surgical diseases have been less represented than physicians and medical conditions among clinician-scientists and research. Here, we explore the possible reasons for this and propose strategies for moving forward. Discovery-driven personalised medicine is both the present and the future of clinical patient care worldwide, and South Africa is uniquely placed to build capacity for biomedical discovery in Africa. Diverse engagement across clinical disciplines, including surgery, is necessary in order to integrate modern medicine into a developing-world contextualised perspective.

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## Surgery as a scientific discipline

Just over two decades ago, *Lancet* editor-in-chief Richard Horton invoked the spectre of comic opera in evaluating published surgical research.[1] While this might be seen as failure to recognise challenges inherent to surgical research, there was truth in the assertion that few surgeons pursue high-level science. As Horton demonstrated, retrospective case series and single-institution experiences dominate the surgical literature, with few randomised trials. While not widely adopted, the IDEAL framework was proposed to establish a guide for testing surgical innovation and conducting randomised trials.[2,3] This work, however, largely falls within the remit of clinical research, i.e. is conducted by full-time clinicians who perform research as part of their quest to improve their practice.

## What is a clinician-scientist?

Recently, following the unprecedented advancements in genomics in biomedical sciences and the advent of personalised care, clinicians have had to engage more actively with basic science and come to terms with its increasing influence on patient management decisions.[4,5] This move towards individualised treatment through discovery has re-established the importance of the clinician-scientist – a medical practitioner who has studied scientific methodology and is engaged in both clinical practice and biomedical research. These are practitioners fluent in two disciplines, clinical medicine and science, who bridge the gap between the clinic and discovery through translational research.[6,7] The surgeon-scientist is a category of clinician-scientist that merits consideration owing to the particular challenges that come with surgery. As the number of clinician-scientists increases, forming a necessary bridge to medical progress in rapidly evolving fields, we need to ensure that a career in surgery is a viable option for them, and address barriers that may impede this.

## Surgeons and scientific discovery

Surgeons have been at the forefront of scientific progress since the late 19th century, with nine Nobel laureates having been surgeons.[8,9] Although surgery as a field has grown exponentially over the years, both in complexity and number of practitioners, reflected by an increase of over 125% of academic surgical faculty,[10] a steady decline in National Institutes of Health funding to surgical departments was already noted over a decade ago.[11,12] One of the challenges, of course, is that beyond understanding the diseases they treat, a surgeon's success relies on acquiring complex technical skills that can only be achieved through sequestering thousands of hours in the operating room or the surgical laboratory. This unique time demand, coupled with evolving outcome standards and rapidly advancing techniques, has made true mastery a moving target. Considering the burden on surgeons' time, is the paucity of surgeons and funding in translational science an indicator of the limited viability of surgery as a career choice for scientists, or does it reflect an unbalanced support system with poor institutional understanding of the role of the clinician-scientist as an entity?

## An uneven playing field

There are no published data in South Africa (SA) about National Research Foundation (NRF) and other funders' awards to scientists who are also clinicians, let alone surgeons, but we can compare the relative impact of surgical research in comparison with non-surgical. As a high middle-income country, academic centres in SA have the resources to bring a scientific perspective to bear on diseases of the poor. While appreciating the uneven availability and distribution of resources in the country, our leading universities have the capacity to conduct research at the highest level. This capacity for global influence was recently demonstrated in the 2020 Global Universities Ranking, which placed SA institutions among the world leaders in

infectious disease research, with the University of Cape Town ranked 10th in the world, and the University of the Witwatersrand 21st, out of nearly 1 500 universities worldwide spanning 86 countries.[13]

Conspicuously, the same ranking failed to register any SA institutions in the areas of oncology or surgery, suggesting that our impact is imperceptible internationally. This underlines the enormous discrepancy in impact between communicable and non-communicable disease (NCD) research, which may reflect longstanding differences in funding and resource allocation. In fact, among NCDs, cancer now competes with cardiovascular disease as the leading cause of death globally, and close to 70% of cancer-related deaths occur in low- and middle-income countries (LMICs) that receive only 5% of cancer-targeted funding. Unsurprisingly, global cancer outcomes are diverging, with high-income countries showing a steady decrease in cancer-related deaths, while LMICs are increasing.[14,15] Developing cancer care capacity must be one of the sustainable development goals moving forward, and since cancer is a core surgical condition across specialties, a dearth of surgical engagement in translational research will hinder progress.

## Contextualising innovation and excellence

There have been SA surgeons who were productive scientists during their tenure, such as Christiaan Barnard, and although there are outstanding clinical researchers who have been productive in surgical disciplines,[16] two recent achievements prompt one to wonder why this has taken so long.

Anthony Figaji, head of paediatric neurosurgery at Red Cross War Memorial Children's Hospital and the University of Cape Town, holds the DSI/NRF SA research chair for clinical neuroscience research – the only surgeon, and one of very few clinicians, to hold a research chair in SA. He has been recognised internationally for his work in neurotrauma and central nervous system tuberculosis and in 2020 became the first surgeon to be inducted as a member of the Academy of Science of South Africa, an acknowledgement of his contribution to science in this country.[17-19]

Elmi Muller, head of general surgery at Groote Schuur Hospital and the University of Cape Town, has been a leading figure in the field of renal and liver transplantation for the past decade, attested to by a profile in *The Lancet* in 2012.[20] Her work paved the way for renal replacement therapy for HIV-positive patients, forcing a change in US legislation and earning her UCT's Alan Pifer award in 2019 in recognition of outstanding research in the service of disadvantaged people.[20] She has recently received an A1 rating from the NRF, the first SA surgeon to achieve this distinction, and has recently been appointed Dean of the Faculty of Medicine and Health Sciences at Stellenbosch University.

It is noteworthy, however, that both these researchers have focused a large part of their work on infectious diseases, and this cannot be the only way for SA surgeons to have scientific impact. A move towards improved NCD research funding is overdue.

## Identifying and overcoming barriers

These examples demonstrate that while there may be barriers and difficulties to surgeons being clinician-scientists, there is in fact an important and viable place for them. Among these barriers is the discrepancy between job expectation and implementation, and poor appreciation institutionally for the role of the clinician-scientist. The clinical sphere, including one's peers, expects absolute time commitment to patient care, while partial engagement in science risks a skills deficit that undermines one's ability to engage with other scientists. Institutional barriers, on the other hand, rest largely on a lack of appreciation for the value and role of a clinician-scientist. Indeed, a recent analysis of policy papers on clinician-scientists across different countries (USA, UK, Canada and Germany), along with an interview-based survey, highlighted a number of obstacles hindering the success of clinician-scientists. These included a lack of mutual understanding between the scientists and their clinical colleagues, poor start-up and long-term funding, and limited time allocation to research.[6]

As South Africa enters the genomic era,[21,22] new initiatives will enable multinational, collaborative capacity building into genomic sciences in Africa, such as the H3Africa consortium, which has already helped produce high-quality, locally generated research.[23,24] This is an opportune time to broaden beyond infectious diseases to the emerging problems in LMICs such as cancer, and include surgeons in supporting translational research. In an effort to realise the potential and nurture the next generation of clinician-scientists, leaders in academic medicine and funding institutions must confront the changing environment to identify and implement strategies to support scientists in the service of society. Key areas to be considered include:

### Research integrated into medical education

- Integration of research training in medical student education to foster an interest in science among undergraduates.
- The UCT clinical scholars programme initiated by the late Prof. Bongani Mayosi is an excellent model that could be expanded.
- Provision of structured research methodology teaching to specialist registrars during their MMed programme, as ignorance of the research process may discourage trainees from pursuing an academic career.

### Protection of faculty/consultant research time

- Clinical service pressures currently overwhelm clinicians' time, leaving research to be conducted during personal time. This disincentivises surgeons and other clinicians from research.
- Hospital- and institutionally supported structured clinical and research time models that incentivise academic productivity will create a supportive environment for scientists.

### Research and laboratory space

- Space, resource and technical equipment lack of availability is a major impediment to scientific productivity.
- Consideration of shared laboratory space, biobank repositories and specialised skills such as bioinformatics would reduce barriers to scientific productivity.

### Increased funding opportunities

- Broadening of funding opportunities beyond infectious diseases is necessary.
- Consideration of other sources of funding, such as philanthropic gifts.
- National and international interdisciplinary and institutional collaboration could enhance grant acquisition.

It is indisputable that the progress of a society mirrors its advancement in science. The current SARS-CoV-2 viral pandemic and the unprecedented pace at which effective vaccines were developed and made available has been testament to the ingenuity and importance of medical science. Vaccine availability imbalance and the emergence of variants and accompanying vaccine efficacy uncertainties have also highlighted the significance of developing local biomedical discovery and translational capacity to tackle uniquely African permutations

of otherwise global diseases.[25-27] Expanding the pool and capacity of future clinician-scientists to incorporate bright surgically inclined minds will allow us to be better prepared for the crises and opportunities that lie ahead.

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1. Horton R. Surgical research or comic opera: Questions, but few answers. Lancet 1996;347(9007):984-985. https://doi.org/10.1016/s0140-6736(96)90137-3
2. McCulloch P, Altman DG, Campbell WB, et al. No surgical innovation without evaluation: The IDEAL recommendations. Lancet 2009;374(9695):1105-1112. https://doi.org/10.1016/s0140-6736(09)61116-8
3. Bilbro NA, Hirst A, Paez A, et al. The IDEAL Reporting Guidelines. Ann Surg 2021;273(1):82-85. https://doi.org/10.1097/sla.0000000000004180
4. Irmisch A, Ximena B, Chevrier S, et al. The Tumor Profiler Study: Integrated, multi-omic, functional tumor profiling for clinical decision support. Cancer Cell 2021;39(3):288-293. https://doi.org/10.1101/2020.02.13.20017921
5. Alejandro Sweet-Cordero E, Biegel JA. The genomic landscape of pediatric cancers: Implications for diagnosis and treatment. Science 2019;363(6432):1170-1175. https://doi.org/10.1126/science.aaw3535
6. Hendriks B, Simons A, Reinhart M. What are clinician scientists expected to do? The undefined space for professionalizable work in translational biomedicine. Minerva 2019;57(2):219-237. https://doi.org/10.1007/s11024-019-09367-4
7. Rosenblum ND, Kluijtmans M, Ten Cate O. Professional identity formation and the clinician-scientist: A paradigm for a clinical career combining two distinct disciplines. Acad Med 2016;91(12):1612-1617. https://doi.org/10.1097/acm.0000000000001252
8. Goldstein AM, Blair AB, Keswani SG, et al. A roadmap for aspiring surgeon-scientists in today's healthcare environment. Ann Surg 2019;269(1):66-72. https://doi.org/10.1097/sla.0000000000002840
9. Toledo-Pereyra L. Nobel laureate surgeons. J Investig Surg 2006;19(4):211-218. https://doi.org/10.1080/08941930600840592
10. Weigel RJ, Upchurch GR, Eberlein TJ, Lucas CE. Presidential forum discussion: Development of surgical scientists. Ann Surg 2015;262(4):555-562. https://doi.org/10.1097/sla.0000000000001400
11. Rangel SJ, Moss RL. Recent trends in the funding and utilization of NIH career development awards by surgical faculty. Surgery 2004;136(2):232-239. https://doi.org/10.1016/j.surg.2004.04.025
12. Mann M, Tendulkar A, Birger N, Howard C, Ratcliffe MB. National Institutes of Health funding for surgical research. Ann Surg 2008;247(2):217-221. https://doi.org/10.1097/sla.0b013e3181568e26
13. US News. 2021 best universities in the world. 2020. https://www.usnews.com/education/best-global-universities/rankings (accessed 9 January 2021).
14. Bertram MY, Sweeny K, Lauer JA, et al. Investing in non-communicable diseases: An estimation of the return on investment for prevention and treatment services. Lancet 2018;391(10134):2071-2078. https://doi.org/10.1016/s0140-6736(18)30665-2
15. Atun R, Bhakta N, Denburg A, et al. Sustainable care for children with cancer: A Lancet Oncology Commission. Lancet Oncol 2020;21(4):e185-e224. https://doi.org/10.1016/s1470-2045(20)30022-x
16. Biccard BM, Madiba TE, Kluyts HL, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: A 7-day prospective observational cohort study. Lancet 2018;391(10130):1589-1598. https://doi.org/10.1016/s0140-6736(18)30001-1
17. Donovan J, Rohlwink UK, Tucker EW, et al. Checklists to guide the supportive and critical care of tuberculous meningitis. Wellcome Open Res 2019;4:1-19. https://doi.org/10.12688/wellcomeopenres.15512.2
18. Donovan J, Figaji A, Imran D, Phu NH, Rohlwink U, Thwaites GE. The neurocritical care of tuberculous meningitis. Lancet Neurol 2019;18(8):771-783. https://doi.org/10.1016/s1474-4422(19)30154-1
19. Figaji A. Commentary: Guidelines for the Management of Pediatric Severe Traumatic Brain Injury, Third Edition: Update of the Brain Trauma Foundation Guidelines, Executive Summary. Neurosurgery 2019;85(2):E386-E387. https://doi.org/10.1093/neuros/nyz208
20. Davies J. Elmi Muller: Bending rules, changing guidelines, making history. Lancet 2012;379(9828):1781. https://doi.org/10.1016/s0140-6736(12)60749-1
21. Rohlwink UK, Figaji A, Wilkinson KA, et al. Tuberculous meningitis in children is characterized by compartmentalized immune responses and neural excitotoxicity. Nat Commun 2019;10(1):1-8. https://doi.org/10.1038/s41467-019-11783-9
22. Tegally H, Wilkinson E, Lessells RJ, et al. Sixteen novel lineages of SARS-CoV-2 in South Africa. Nat Med 2021;27:440-446. https://doi.org/10.1038/s41591-021-01255-3
23. Choudhury A, Aron S, Botigué LR, et al. High-depth African genomes inform human migration and health. Nature 2020;586(7831):741-748. https://doi.org/10.1038/s41586-020-2859-7
24. Gulsuner S, Stein DJ, Susser ES, et al. Genetics of schizophrenia in the South African Xhosa. Science 2020;367(6477):569-573. https://doi.org/10.1126/science.aay8833
25. Tegally H, Wilkinson E, Giovanetti M, et al. Emergence of a SARS-CoV-2 variant of concern with mutations in spike glycoprotein. Nature 2021;592(7854):438-443. https://doi.org/10.1038/s41586-021-03402-9
26. Abdool Karim S, de Oliveira T. New SARS-CoV-2 variants – clinical, public health, and vaccine implications. N Engl J Med 2021;384:1866-1868. https://doi.org/10.1056/nejmc2100362
27. Abdool Karim SS. Vaccines and SARS-CoV-2 variants: The urgent need for a correlate of protection. Lancet 2021;397(10281):1263-1264. https://doi.org/10.1016/s0140-6736(21)00468-2

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