

Training the next generation of Sudanese immunologists: a case for mentorship

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INTRODUCTION

Science in Africa faces numerous obstacles, including lack of funding, limited training opportunities and political hurdles.¹ In particular, immunology training in Sudan is particularly challenging. Despite globalization and technological advances, and the very nature of science being an “international enterprise,” Sudanese immunologists are still largely disadvantaged. Lack of core funding, critical infrastructure and training opportunities render cutting-edge immunology in Sudan nearly impossible. In addition, the disconnect between Sudanese immunologists and their international peers limits opportunities for collaboration and training. In this article, I highlight the challenges I faced as an aspiring immunologist to obtain funding to train in cutting-edge immunology, and the essential role my mentors have played in this journey. I also share my perspective of what needs to be done, both back home and by the international immunology community, to enable the next generation of Sudanese immunologists to realize their dreams.

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THE CHALLENGES OF STUDYING IMMUNOLOGY IN SUDAN

My initial training was in medical laboratory science (the equivalent of biomedical science in the UK). During my studies in Sudan University of Science and Technology in Khartoum, Sudan, I was fortunate to attend a course on basic immunology. The instructor was my first mentor and friend Dr Abdelbagi M Nagi, who sadly passed away in 2017. Dr Nagi inspired me to pursue immunology. His training in the United States and Canada in cellular immunology armed him with a deep understanding of the subject, unmatched by his colleagues. It is important to mention that Dr Nagi not only ignited my interest in immunology, but also took me under his wing. He always gave me advice regarding my career. I learned so much from him during my master’s project, which he supervised. Moreover, when I was promoted to lecturer, he put his trust in me to follow his footsteps and teach immunology. Despite the tremendous support I received from Dr Nagi, research training in cellular and molecular immunology was largely missing.

There are many reasons why I considered pursuing my passion, cutting-edge immunology, outside Sudan. First of all, immunology-focused programs were not popular in Sudanese universities. The few

available ones were not research intensive, with the faculty lacking the training necessary for this sophisticated field of study. The political instability and low wages had led to a unique form of “brain drain,” whereby faculty who trained abroad would not come back, as they found it difficult to establish a research program upon their return. The addition of Sudan in 1993 to the US list of countries sponsoring terrorism (State Sponsors of Terrorism)² meant that the country would live in isolation, making the prospect of training in the United States (slightly less so in Europe) even more difficult, as international higher education institutions would avoid collaborating with Sudanese universities and research institutes.

In addition to the lack of research-oriented immunology programs and experienced faculties, several other challenges are worth mentioning. Funding for science in Sudan is scarce, but more so for immunology. The disconnect between the majority of Sudanese immunologists and their international counterparts rendered it difficult to obtain international funding. Furthermore, critical infrastructure needed to conduct essential immunological research, for example, flow cytometers, cell sorters, next-generation sequencing machines, and facilities to house and experiment on mice were difficult to come by, to name a few. In addition, US sanctions made the acquisition of essential machines and reagents (e.g.

antibodies for flow cytometry) nearly impossible. Some institutions resorted to obtaining these devices and consumables through an agent, which incurred further charges and overburdened an already frail research budget. Consequently, Sudanese immunologists were unable to produce quality work that would attract funding, international collaboration and talent. All of this was further complicated by a lack of library services necessary to obtain primary literature. The existence of many essential and key articles behind paywall, and the inability of universities to afford subscriptions to major journals, meant that many Sudanese scientists would have no access to papers essential to conduct their research. As a result, Sudan ranked 19th in Africa in terms of immunology output between 1996 and 2013, with 635 articles and 8414 citations. In comparison, the UK, which ranked first in Europe in the same time frame, produced 79 201 articles that were cited 2 590 073 times.³

GETTING FUNDING FOR A PHD IN IMMUNOLOGY

Inspired by Dr Nagi's teaching and advice, I considered doing a PhD in immunology. It was immediately clear to me, given what I discussed above, that doing this in Sudan would not be desirable. I always wanted to do cutting-edge immunology research. Thus, I started applying to immunology programs in North America, being influenced by Dr Nagi's legacy. Up to that point, my profile did not include significant research experience in immunology, something that made me less competitive among applicants. The painful reality was that even getting an internship for most Sudanese students would be a really difficult affair, and that is for a variety of

reasons. First, university funding was really limited. Second, most Sudanese professors did not have the "right" network, which made applying for internship and/or PhD positions more complicated. Thus, Sudanese students, including myself, had to rely on themselves in contacting professors, with no reputation (either the university's or the supervisor's) to back their plea for attention.

To solve those two problems, namely, making myself more competitive to get the funding, and finding a laboratory in which I can do my PhD, I did two things. First, I reckoned that my chances of getting funded would be greater if I competed with graduates with similar profiles. Thus, I turned my attention to scholarships given exclusively to Sudanese researchers. Among those, the Doctoral Program in Germany, offered by the German Academic Exchange Service (Deutscher Akademischer Austauschdienst [DAAD]),⁴ was an attractive and prestigious option. Second, to solve the problem of finding a laboratory, I started collecting information on potential laboratories in Germany that do research matching my areas of interest. I started emailing the professors one after the other. I was interested in the potential link between certain viral infections and the incidence of autoimmune diseases, something that I always mentioned in my emails (interestingly, a recent report in *Science* studied this link⁵). However, almost all of my emails went unanswered! Only one person responded positively.

Professor Jochen Huehn, of the Helmholtz Centre for Infection Research (HZI), asked me for an interview. After a first meeting with him, he agreed to supervise me and help with the application to DAAD. Professor Huehn would

become my PhD mentor, and one of the most important people in my academic life. I will be forever grateful to the fact that he responded to my email, given that I had not graduated from a reputable university, nor had a great curriculum vitae. Intriguingly, I would argue that my experience is a common one, especially among graduates from low-income countries. In my view, persistence, coupled with advice from the right mentors, would eventually pay off.

LOOKING AHEAD: BENEFITTING FROM MENTORING WHILE NAVIGATING ACADEMIA

Succeeding in academia can be a challenging undertaking. Limited funding and uncertain job prospects make career planning for young scientists, and immunologists alike, ever more daunting. This is particularly true for aspiring scientists from backgrounds other than White.^{6,7} Furthermore, scientists need to learn about many "unwritten" rules, for example, publication and authorship, office politics, with whom should they collaborate and how to build the right network, among other things that do not have clear guidelines. Nevertheless, there is no single route to success. That is why we keep hearing about incredible success stories of great scientists who have made it, their own unique way, in immunology. Given all of this, the role of mentoring in the career development of young immunologists cannot be overemphasized.

In my case, my mentors have been vital to my journey (and will continue to be). Clearly, they have been immensely helpful in pointing the way into the world of immunology. My work in Professor Huehn's laboratory paved the way

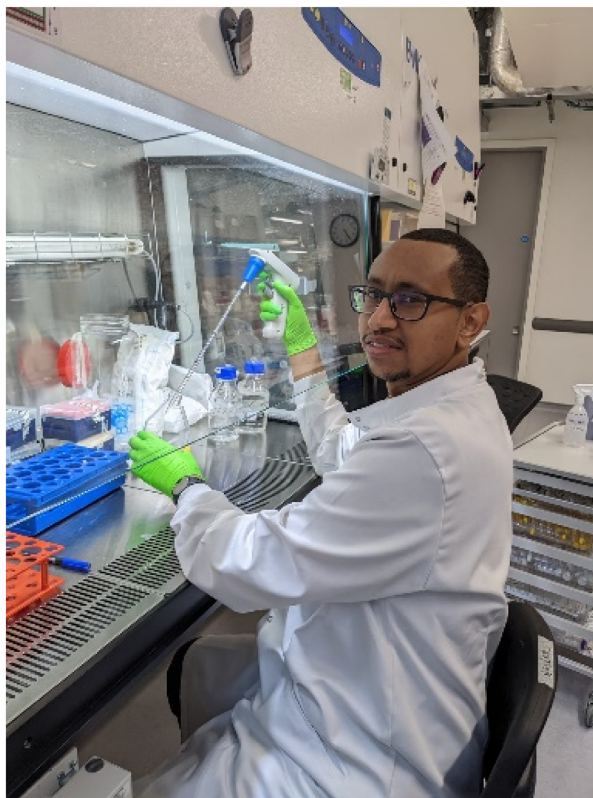


Figure 1. Working at University College London (UCL). Mentoring paved the way for me to join Professor Lucy Walker’s laboratory at UCL’s Institute of Immunity and Transplantation to do cutting-edge research.

for me to continue my journey by joining Professor Lucy Walker’s laboratory at University College London’s (UCL) Institute of Immunity and Transplantation (Figure 1). I have learned so much from working under Professor Walker’s guidance, and will continue to benefit from her expertise and support throughout the rest of my scientific journey. In addition, I have enjoyed and will continue to enjoy the support and advice of many other mentors, and will be forever grateful to them. Finally, I would like to highlight the fantastic mentorship scheme by the British Society for Immunology (BSI).⁸ I have had the opportunity to take part in it, and still benefit from the tremendous support from my mentor, Professor Gary Entrican.

THE WAY FORWARD

Although I have discussed the challenges I personally faced during my journey, my story will definitely resonate with many of my colleagues from other African countries. Thus, the solutions can benefit not only immunologists in Sudan, but also across Africa.¹ Much can be done to help the next generation of Sudanese immunologists to get advanced training, which would eventually aid in establishing immunology programs in Sudan that deliver research of international quality. Importantly, to achieve this, we need to have a sufficient number of Sudanese immunologists with strong training in Sudanese universities.¹ Admittedly, much has to be done back home to set in motion the

desired change. In addition to increasing the funding allocated to immunological research, universities need to rethink their hiring strategies, putting staff research output as the primary criterion for recruitment and promotion. More effort can be put toward striking agreements with immunology programs in universities in UK for example, which would lead to more collaboration and exposure for Sudanese immunologists.

Internationally, funding bodies need to rethink their strategy for recruitment of PhD students from low-income countries. For instance, they may assign a quota or entire PhD programs that recruit students exclusively from low-income countries. The criteria for recruitment should take into account the objective

obstacles those researchers face (some are outlined in this article) when selecting PhD students. Graduate schools may also run “virtual” immunology master’s programs that feature world-class researchers, specifically aimed at Sudanese students (or students from sub-Saharan Africa). Those measures will not only benefit Sudanese immunology researchers and students, but also increase the diversity of the international immunology landscape, allowing more talented and hardworking students to enter the immunology workforce. My final piece of advice goes to my fellow early career immunologists in Sudan. Persistence is key, and reach out to as many mentors as you can and make sure to implement their advice.

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CONFLICT OF INTEREST

I have no conflicts of interest to declare.

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