Challenges of Teaching and Researching Physiology in Sub-Saharan Africa

Sub-Saharan Africa (SSA) consists of 47 countries with a population of ~910 million (http://worldbank.org/region/SSA). There are presently ~168 Medical Schools in SSA, with 26 in Nigeria and 8 in the Republic of South Africa (3). SSA is plagued by multifarious factors that present an uphill task to achieving acceptable milestones to developmental objectives. The region contains the largest number of countries that have the least GDP among all other nations in the world; for example, although the GDP (in USD) for period 2008–2013 (data.worldbank.org/indicator/NY.GDP.PCAP.CD) in the U.S., UK, and Australia are 51,749, 30,093, and 67,556 respectively, the majority of SSA countries have GDPs of less than $2,000.00, except South Africa with $7,508. The estimated GDP of Nigeria is $1,555.00. Coupled with this low income level is a high disease burden, which competes for available resources. In addition, the per capita spending on higher education has been estimated to be less than $4,000.00 in SSA (2). Despite the low GDP, most of the countries are plagued by corruption and inept governments as well as political instability, civil strife, and wars that deplete the available, meager resources. The result of this is limited funding for the provision of adequate resources, both human and fiscal, for the proper training at university/higher education level in SSA. In addition, of the few numbers that we are able to train, a large percentage is lost via brain drain to advanced countries in the West. The impact of these observations on teaching and research challenges in physiology in SSA cannot be overemphasised.

Teaching Challenges

The teaching of physiology in SSA has traditionally been domiciled in medical schools, with a majority of teachers using the traditional face-to-face method largely due to limited resources. Our teaching methodology largely utilizes the white board and overhead/multimedia projectors. Many schools are beginning to incorporate some ICT components into their teaching, e.g., with use of videos, YouTube, and electronic blackboard.

We in SSA have contributed to the training of several doctors as well as recording some modest achievements in training of PhDs that have helped to reinforce the system. A majority of faculty obtained their PhD locally. Despite the constraints, many institutions are increasing students’ intake (3). Many schools surveyed (personal questionnaire) have students enrollment ranging from 20 to >600, whereas the number of lecturers range between 2 and 18, to cope with a large workload. In the survey, postgraduate students enrolled for training in MS/PhD programs range from nil to ~30, whereas PG graduates produced cumulatively in the last 5 years range from nil to 20 per school, the larger numbers being from South Africa and the older universities in Nigeria.

The major constraint posing challenges to teaching and research is funding. Most universities depend virtually on government subvention to run their programs. The issue is not helped by the pegging of tuition fees by government coupled with poor staff salaries (3). It is estimated that funding for tertiary education can be as low as $1,000.00 per student in ~10% of SSA countries (7), whereas the majority have per student funding in the range of $1,800.00 to $4,000.00 (2). This sharply contrasts with funding in the U.S. and many European and Asian countries, which run into tens of thousands of dollars. It is only recently that some universities in SSA have embarked on the use of Income Generating Units (IGU) or charge high tuition fees to raise additional funds, which can account for up to 56% in Uganda (7), to meet up with costs.

Other issues related to teaching challenges include but are not limited to the following.

1) Limited number of PhD holders as lecturers. This is mainly due to low production rates as a result of a low number of supervisors/advisors and poor resources. This is a real problem since it considerably reduces the ability for sizeable in-country training that is required to meet manpower needs as well as providing medical training of those who can man our hospitals, especially in rural areas.

2) Low lecturer-to-student ratio and large classes are quite common, resulting in non-ideal lecture rooms and facilities as well as poor supervision during practical classes. An example of a large practical class with few teachers and limited equipment is shown in the illustration, with the use of a multimedia projector to reach out to a large number of students for the teaching of practical physiology. Recently, there have been efforts to acquire digital, teaching/practical platforms such as ADI PowerLab and WPI DataQ instruments.

3) Outdated and inadequate textbooks due to unaffordable costs, e.g., cost of an imported textbook is about the monthly living allowance of an average student in Nigeria. There is now the alternative of locally authored textbooks, which are affordable but are not necessarily current in terms of content.

4) Limited ICT/internet facilities for lecturers to engage students in out-of-class teaching. This is because access is poor and expensive. Many universities cannot afford the cost of internet bandwidth, and students and staff often have to recourse to internet cafes at high cost. Many departments do not have more than five computers for all the staff and over 500 students. There are no PC clusters and hardly any hot spots to access the internet.

5) Outdated curriculum is rampant in many SSA universities due to a lack of exposure of lecturers to foreign science and hence the inability to update their course contents. However, some universities are now reviewing their curriculum and embracing such approaches as problem-based learning, e.g., Ibadan (Nigeria) and Sudan. However, South Africa is an exception to most of the challenges that we have enumerated.

6) Poor and erratic public power supplies are prevalent in a majority of countries, which make running classes difficult, espe-
cially for long-duration projects. Many institutions have had to procure power-generating sets for back up when public supply fails, which is quite often. Even then, this is limited and often leads to truncation of teaching and practical classes.

Challenges to Research Capability

With the possible exception of South Africa, the research output from the region is very low in terms of publication in indexed journals. It has been estimated that SSA contributes <0.9% to global published work, with South Africa contributing over 50% of that amount (7). In a report covering the decade 1995–2004, the top three publishing countries, in terms of output of published works indexed in PubMed, from medical schools in SSA are South Africa (41.5%), Nigeria (16.1%), and Kenya (6.8%) (2). An analysis of university rankings bears this out as the highest-ranked university from SSA is University of Cape Town at 113. Only five African universities are in the world’s top 1,000 (6). This was not the case in the 1970s when some African universities were featured among the topmost institutions in the world.

The obvious reason for the low research output is poor funding and thus less resources for acquiring appropriate equipment for research. There are hardly any grants for research except in South Africa and one or two other countries, e.g., the Tertiary Education Trust Fund (TETF) in Nigeria, which is obtained as a contribution from the business community and now is being used to fund research grants and postgraduate training. The poor funding in SSA is reflected in the quality of articles that lack mechanistic approaches. The current trend of translational research, nanotechnology among others, is grossly lacking compared with publications from the developed countries and some developing ones like India.

However, efforts are being made to play “catch up.” For example, our laboratory has been studying the effects of a high-salt diet on vascular mechanisms by using rat aortic rings, and our results were later confirmed using the pressurized mesenteric artery preparation (5) during the author’s tenure as a British Heart Foundation Fellow at Leeds University. However, on return to Nigeria, such a facility was not available, but we are still publishing using the ring preparation (4). Our subsequent studies, however, have been on investigating the role of the renal epithelial sodium channel (ENaC) in normotensive and hypertensive Nigerians (S. O. Elias, PhD thesis, Lagos, 2012) while collaborating with foreign laboratories for DNA sequencing and identification of genetic mutations. We have had to depend on foreign laboratories for these facilities. We hope that this foray will open new ground and attract funding and graduate students to genetic and molecular aspects of physiology as well as allow us to establish some laboratory space and requisite equipment for such research.

Other challenges relating to research include the following.

1) Heavy teaching load, as mentioned earlier, with too many students and too few teachers and hence little or no time available for research work.

2) Outdated equipment and little availability of reagents and consumables for research projects due to very low budget, which is very prominent in most universities in SSA, with the possible exception of South Africa. Many of us still teach and work with drum Kymographs, water-filled spirometers, and analog/pen recorders (in the affluent departments). Equipment acquisition is compounded by low currency devaluation as well as political instability and corruption.

3) Low PhD graduate production, which is compounded by in-breeding due to inability to send our students for exposure to foreign laboratories as a result of funding constraints. Low or absent funding for research is a major problem. Many departments do not have research grants except for a few that trickle in from foreign sources. In many departments, the total annual institutional research support is less than $10,000.00 per annum!

4) Lack of or limited access to journals, which is worsened by high subscription costs as well as low access to free e-journals (except mostly back issues from Highwire Press-Stanford and Hinari). Availability of free full text of current issues in PubMed is low.

5) Brain drain from SSA is a major problem since a large percentage of our trained faculty are lost from the profession, with up to 30% leaving the continent for better pay and better access to research facilities, whereas others go to the ministry or the private sector (3).

Appeal for Support

This brings up the point of how we in SSA (except perhaps South Africa) can leverage the superb research facilities in the developed countries. It will also involve the exposure of our staff to research at cellular and subcellular levels, including cell signaling as well as translational research in line with current trends.

Thus an appeal is being made to the IUPS and other societies in the developed world such as the American Physiological Society (APS), the Physiological Society (Physoc) of UK, Federation of European Physiological Societies (FEPS), German, Dutch, Japanese societies, etc. to come to the aid of SSA. As the way forward, here are some suggestions.

1) Provision of more sabbaticals for nationals of SSA to laboratories in the developed countries where they can acquire requisite skills that are in demand and can be adapted for use locally.

2) Provision of laboratory space for research training/mentoring and skills acquisition by our younger colleagues to increase their research capabilities. Initiation of technology transfer workshops by experts from the IUPS or its affiliates from the developed world. In 1980, the IUPS organized such a workshop in Lagos, supervised by Profs. Otto Hutter, Lawrence Smaje, and John Patrick. This attracted lecturers from the West African sub-region. In addition, staff from institutions in SSA can go to developed countries for a duration of 6–12 mo for hands-on experience on more frequent arrangements. A few of these exist, e.g., a Physoc Uk program that is limited, but more will be required and welcomed. A back-up scheme involving electronic mentoring can also be initiated between a mentoring institution abroad and a mentee in SSA. This will require funding to set up an ICT unit in the department for this purpose. This “soft” support may be more useful since it does not suffer from the bureaucratic wrangles that befall supply of hardware to our countries. Rigid bureaucracy and graft are persistent impediments.

3) A mechanism for equipment transfer through donation of “surplus to requirement” but useful equipment to universities...
in SSA. This is a crucial area that needs intervention due to the prohibitive costs of local acquisition of these items. For example, establishing a “warehouse” system in the IUPS and its affiliates for donation of equipment and transfer of such to interested laboratories in SSA. This part will involve liason with credible organizations, and the African Association of Physiological Sciences (AAPS) can take the lead. In addition, national physiological societies can also be involved, to start with, since they are closer to the source. For example, the Physiological Society of Nigeria is almost 40 years old and is fairly well structured. The AAPS can be involved to see whether some form of decentralization can be effected.

4) Funding/grants to be made available to identified research-active laboratories doing some good work, so as to scale up their researches. This can be tagged on to the AAPS, which can then initiate South-South research collaboration so as to increase the internal pool of active African researchers.

The above observations and other suggestions are to emphasize assistance to SSA physiologists to boost teaching and research capabilities and thereby improve the present dismal situation. This should also serve to arrest the brain drain and make competent and willing researchers remain in their country and contribute meaningfully to global scientific enterprise.

In conclusion, the totality of this write-up and observations are to make us in SSA to be more visible on the world map of scientific enterprise in the subject area of physiology (FIGURE 1).

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References