**The Africa Center for Biostatistical Excellence: A proposal for enhancing biostatistics capacity for Sub-Saharan Africa**

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**ABSTRACT**

Sub Saharan African (SSA) has a shortage of well-trained biomedical research methodologists, in particular, biostatisticians. In July 2014, a group of biostatisticians and researchers from the region attended a brainstorming workshop to address ways to close the gap in this critical skill. The workshop recognized that recommendations from previous workshops on building biostatistics capacity in SSA had not been implemented. The discussions culminated with a proposal to setup an Africa Center for Biostatistical Excellence, a collaborative effort across academic and researcher institutions within the region, as a vehicle for promoting biostatistics capacity building through academic masters programs as well as workshops targeting researchers.

**1. INTRODUCTION**

In sub-Saharan African (SSA) Countries, the burden of communicable diseases such as HIV, Tuberculosis (TB) and malaria continues to rise despite the increasing efforts made to fight these diseases through prevention and treatment. Some regions of Africa are prone to outbreaks of infectious diseases, such as the recent epidemic from the Ebola virus. These outbreaks have potential devastating effects on the economic development, health system and health of the affected countries. In addition, according to the 2010 WHO Global Status Report on Non-communicable diseases, the burden of non-communicable diseases (NCDs) such as cancer, diabetes, hypertension, and heart disease in the region has increased dramatically[1]. The creation of a sustainable, multidisciplinary health research enterprise to inform and contribute to strategies addressing *these* problems in SSA countries is of paramount importance for improving health, promoting development and advancing science in the region.

Although not yet uniformly distributed across Africa, in recent years there has been a welcome expansion of health research activities in several countries in the region. In the last decade, SSA has witnessed an increase in funding towards fighting HIV/AIDS, TB, malaria and other tropical diseases[2]. There has been a corresponding increase in the amount of both primary and secondary prevention and treatment research in these disease areas[3]. This growth has created a demand for well-trained methodologists who can contribute to the design, conduct, analysis and reporting of research studies and provide mentoring and training of the next generation of researchers. Local experts such as epidemiologists, social scientists and (to a lesser extent) health economists are now available in many African countries. International agencies have been at the forefront of supporting the building of local research capacity through scholarships, fellowships and infrastructure funding [refs]. However, despite these novel attempts, the imbalance between disease burden and research capacity is still lagging.

This paper describes a conceptual framework and guiding principles for building biostatistics capacity in SSA, a necessary methodological skill for successful development and enhancement of health in the region through research.

***1.1. Why build capacity in biostatistics?***

Two percent of published research articles come from the SSA region and the rejection of submitted papers is largely on account of poor study design and statistical methods[4][5][6]. The biostatisticians’ unique ability to estimate sample size, define sampling procedures, quantify uncertainty and generate sound inferences from data make them integral members of health research teams. A universal shortage of biostatisticians has been documented in many countries including the United States[7] and Canada[8]. Experts predict that the demand for well-trained biostatisticians is going to continue to expand, especially in the Pacific-rim countries and China [9][10]. In particular, there remains a critical shortage of biostatistics expertise in SSA resulting in an overreliance on input from biostatisticians sourced from economically developed countries for writing competitive grants, executing biostatistical procedures, conducting advanced data analysis, publishing in high profile journals, and teaching biostatistics at under- and postgraduate level[11]. The few biostatisticians based at universities or research institutions in SSA are generally overburdened and unable to keep up with the demand for their expertise. Furthermore, important emerging fields, such as bioinformatics and genomic research require application of new statistical methods, experience that is often lacking in Africa[12]. In the area of practicing Evidence-based Health Care, biostatistics is a key enabling competency to review, appraise, synthesize, and interpret evidence from research studies to guide policy formulation and practice decisions[13, 14]. The role of biostatistics in advancing a successful biomedical research agenda continues to expand and evolve. SSA needs to scale-up local training, mentorship and support of biostatisticians in order to meet the ever-increasing demands for this skill.

As of March 2015, very few academic institutions in SSA offer graduate level degrees specializing in biostatistics (Table 1). Biostatistics modules are included in Masters of Public Health (MPH) and Master of Science (MSc) Epidemiology programs. These provide basic training in elementary biostatistics, data management and analysis but do not prepare students for significant leadership roles in research study design and complex statistical analyses. Other institutions offer Masters and Doctoral level degrees in biostatistics as research degrees, an approach that may result in graduates lacking sound theoretical grounding in biostatistics. What is urgently required is an innovative and sustained response to biostatistics strengthening at a high level in SSA. A cadre of professional and academic biostatisticians is needed to play a leadership role in developing the discipline of biostatistics, contribute to multidisciplinary, collaborative research in the health sciences and train the future generation of biostatisticians. Good statistics departments do exist at SSA universities, however, they focus almost exclusively on training students for business, accounting and commercial careers, rather than for work in the biomedical field. Statistics departments offering some biostatistics modules generally do not link up with Health Sciences Faculties, which means that students do not develop an understanding of the clinical context, or worse, never have the opportunity to fully appreciate the value of statistics in health and biomedical research. When they do link up with Health Sciences Faculties, biostatisticians are overwhelmed with providing consulting services to clinicians and other health workers leaving no time for building biostatistics capacity at their institutions. Moreover, there are significant retention problems as skilled biostatisticians are often drawn to the private sector for better salaries.

The current lack of investment in biostatistics in SSA can be attributed to a general lack of awareness of the fundamental role of biostatistics in the conduct of research. Some researchers consider biostatistics an ancillary service. However, the biggest challenge in training more biostatisticians in SSA is the lack of expertise and resources.

In 2009, a National Institutes of Health led workshop on building biostatistics capacity in SSA was held in Washington, DC[11]. A follow-up workshop involving more participants from SSA was held in 2011 in Gaborone, Botswana. Recommendations from these two workshops consistently highlighted the need for local capacity building initiatives in biostatistics as well as strengthening collaborations between institutions from the north and SSA research institutions. In July 2013, Stellenbosch University organized a workshop in Cape Town, engaging about 30 biostatisticians and researchers from across SSA (Figure 1, workshop participants are listed in Appendix A). The purpose of the workshop was to develop an action plan for implementing recommendations from previous workshops as well as build regional collaborations aimed at strengthening biostatistics in SSA (ref- PAMJ). At the conclusion of the 3-day workshop, participants supported the creation of an Africa Center for Biostatistical Excellence (ACBE) as a vehicle for implementing previous workshop recommendations. This article describes a conceptual framework of how a hub like ACBE would be an incubator for fostering biostatistical capacity building in SSA through nurturing existing programs, creating South-South and South-North linkages to facilitate cross-fertilizations, exchange of ideas, mentorship, and sharing of resources.

**2. THE AFRICA CENTER FOR BIOSTATISTICAL EXCELLENCE**

A Center of Excellence (CoE) is an organizational unit (on-local or virtual) that embodies a set of capabilities and specialized professional knowledge recognized as an important source of value creation, with the intention that the capabilities be leveraged by and or disseminated to others (ref). We are proposing an Africa Center for Biostatistical Excellence (ACBE), a virtual organizational unit that brings together expert biostatisticians from academic and research institutions across SSA. The main objective of the ACBE is to provide organizational capacity and infrastructure to enhance biostatistics capacity building in the region. Secondary objectives include fostering collaboration on methodological research in biostatistical issues, facilitating continuing education for members, and promote cross-fertilization and exchange of ideas. Additionally, the ACBE will provide scientific guidance to investigators on research study design, statistical methodology, and data management, data analysis, and data interpretation.

***2.1. Biostatistics capacity building through formal masters level academic programs***

In order to meet the current pressing needs for biostatistical support in biomedical and public health research, SSA academic institutions need to produce biostatistics graduates at master’s level. The key challenges experienced by academic institutions in establishing biostatistics-training programs include lack of teaching staff and expertise in critical areas, lack of financial support for students, and access to software. The ACBE can address shortages of teaching staff by promoting collaborative teaching across institutions. Because biostatisticians tend to specialize in one or two specific areas, institutions can share this expertise. Institutions that are within the same geographic area (e.g. the city of Cape Town has 4 academic institutions – University of Cape Town, Stellenbosch University, University of the Western Cape, Cape Peninsula University of Technology - and various research institutions) could potentially run joint training programs where personnel from these institutions jointly teach. As Internet connection in SSA continues to improve, online teaching can be used to overcome the distance barrier, allowing staff from other countries to teach a module.

The workshop identified key competencies a masters level biostatistician need to be effective contributors to SSA-based research (Table 2). The ACBE will contribute to development of a standardized curriculum for biostatistical training that balances the need to train students in areas relevant to the region’s problems and the important aspects of statistical theory and methodology. The Center will be a resource center, supporting regional institutions in developing academic programs in biostatistics and in international benchmarking. The ACBE will develop and maintain a repository of online courses, accessible to SSA institutions.

Mentorship of students in a working environment is critically important for their learning process. Thabane et al advocates establishment of structured mentoring programs to help trainees develop survival skills[8]. The ACBE will establish relationships with research projects, governments and private industry to provide practical training opportunities, integrating learners into all aspects of biomedical research. ACBE would also organize mentoring workshops to train potential mentors to develop mentoring skills [8].

***2.2. Capacity building through short courses***

There is a need to bring awareness of the fundamental role of biostatistics in biomedical research. While experienced investigators value collaboration with biostatisticians, most researchers regard biostatistics as an ancillary service (ref - Welty) for data crunching. These researchers need to become familiar with biostatistics. Investigators who are aware of the assumptions and pitfalls of the statistical methods used to generate scientific evidence in their field will be more informed consumers of the literature and will have additional motivation to conduct better research – from study design to data analysis and interpretation of finding (ref-Welty). The ACBE will organize and run biostatistics short courses targeted at biomedical and public health researchers across the region.

***2.3. Supporting research proposal development and analysis of data***

The ACBE will act as a resource center for biomedical researchers within the region. The center will assist with grant writing proposals especially with study design, data management and statistical analysis plans. The current practice of sending data from research conducted in SSA abroad is unacceptable and unsustainable. First, such practice inhibits the growth of researchers because they are not active participants of data analysis. Once a research sends a request for data analysis, they have to wait for the statistician. However, if statistical analysis is conducted locally, there are opportunities of active interaction between the researcher and statistician, generating teaching moments for both collaborators. Secondly, outsourcing of analyses abroad delays timely publication of research results. Often, biostatisticians from abroad have other bigger projects that demand their time, relegating SSA requests to the bottom of the list. The ACBE will provide timely services by linking researchers to biostatisticians in their countries.

***2.4. Collaborating on biostatistical methodological research***

SSA’s problems are unique hence present unique methodological challenges requiring local solutions. Most biostatisticians in SSA institutions work in isolation, spending most of their time on statistical consulting to research projects and teaching elementary biostatistics to undergraduate students. These activities leave no time for the biostatisticians to engage in methodological research, stunting their careers and growth. The ACBE would provide a platform for collaborating on methodological problems encountered in research. The Center of Excellence would provide the opportunity to engage in collaborative research by sharing tasks with colleagues, promoting north-south and south-south collaborations.

***2.5. Organizational structure***

An Executive Board consisting of a Program Director based at the home institution and co-directors from partner institutions shall govern the ACBE. Their mandate will be to set priorities and provide broad oversight of ACBE. An International Advisory Board consisting of an interdisciplinary team of renowned experts from academic institutions, education, industry and government, providing direction and guidance, will support the Executive Board. A Coordinating Center (CC), managed by the Program Director, will be established at the home institution, but will draw membership from selected institutions on a rotational basis. The CC provides administrative and operational services, and coordinates activities. Figure 2 shows the proposed organizational framework of the ACBE.

The functioning of the ACBE will be based on principles of collaboration, transparency, integrity respect and embrace diversity of skills and backgrounds. It is anticipated that ACBE activities will be funded through collaborative grants. A monitoring and evaluation system will be established to assess achievements of the collaboration. Participation in this collaboration will be voluntary.

**3. CONCLUSION**

In this paper we define a framework to enhance biostatistics capacity building in SSA. The success of this initiative is dependent on strong collaboration among several institutions. Research institutions and projects will play a significant role in providing the experiential learning required to produce a graduate ready to hit the ground running.

There are several collaborative initiatives between institutions such as the Medical Education Partnership Initiative (MEPI) that have established networks that the ACBE can piggyback on. There are efforts to strengthen South-to-South partnerships that will benefit the ACBE. There are opportunities to increase cross institution training through e-learning and online platforms. However, the biggest challenge to the success of the ACBE initiative will be the availability of funding. Funding agencies need to prioritize building of biostatistics capacity in SSA. Now is the time to invest in the next generation of biostatisticians that will fill the ever-increasing need of this critical skill in SSA.

**ACKNOWLEDGEMENTS**

We would like to acknowledge funding from the US National Institutes of Health / Fogarty International Center (NIH/FIC) Grant Award 1D71TW009758-01 and US PEPFAR Grant Award T84HA21652-01-00 for Medical Education Partnership Initiative (MEPI).

**REFERENCES**

1. WHO | Publications on NCDs.

2. PEPFAR: Working Toward an AIDS-Free Generation. http://www.pepfar.gov/. Accessed 26 Mar 2015

3. Nachega JB, Uthman OA, Ho Y-S, et al. (2012) Current status and future prospects of epidemiology and public health training and research in the WHO African region. Int J Epidemiol 41:1829–46. doi: 10.1093/ije/dys189

4. Paraje G, Sadana R, Karam G (2005) Increasing International Gaps in Health-Related Publications. Sci 308 :959–960. doi: 10.1126/science.1108705

5. Povoski SP, Young DC (2007) Good science requires sound biostatistical principles. Am J Surg 194:136–7; author reply 137–9. doi: 10.1016/j.amjsurg.2006.06.039

6. Volmink J, Dare L (2005) Addressing inequalities in research capacity in Africa. BMJ 331:705–6. doi: 10.1136/bmj.331.7519.705

7. DeMets DL, Stormo G, Boehnke M, et al. (2006) Training of the next generation of biostatisticians: a call to action in the U.S. Stat Med 25:3415–29. doi: 10.1002/sim.2668

8. Thabane L, Wells G, Cook R, et al. (2011) Canadian-led capacity-building in biostatistics and methodology in cardiovascular and diabetes trials: the CANNeCTIN Biostatistics and Methodological Innovation Working Group. Trials 12:48. doi: 10.1186/1745-6215-12-48

9. Zelen M (2006) Biostatisticians, biostatistical science and the future. Stat Med 25:3409–14. doi: 10.1002/sim.2658

10. Fegan G, Moulsdale M, Todd J (2011) The potential of internet-based technologies for sharing data of public health importance. Bull World Health Organ 89:82. doi: 10.2471/BLT.11.085910

11. Gezmu M, DeGruttola V, Dixon D, et al. (2011) Strengthening biostatistics resources in sub-Saharan Africa: research collaborations through U.S. partnerships. Stat Med 30:695–708. doi: 10.1002/sim.4144

12. Mandala WL, Cowan FM, Lalloo DG, et al. (2014) Southern Africa consortium for research excellence (SACORE): successes and challenges. Lancet Glob Heal 2:e691–2. doi: 10.1016/S2214-109X(14)70321-3

13. Dawes M, Summerskill W, Glasziou P, et al. (2005) Sicily statement on evidence-based practice. BMC Med Educ 5:1. doi: 10.1186/1472-6920-5-1

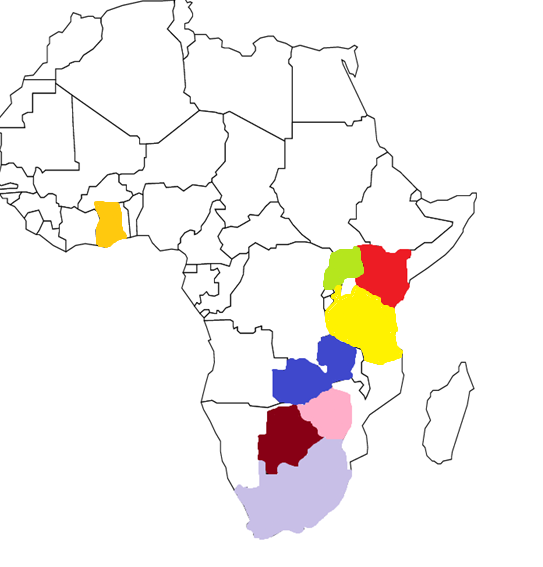
14. Frenk J, Chen L, Bhutta ZA, et al. (2010) Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. Lancet 376:1923–58. doi: 10.1016/S0140-6736(10)61854-5

**Table 1. Sub-Saharan Africa Institutions with a Masters in Biostatistics program (March, 2015)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| INSTITUTION | ACADEMIC DIVISION | NAME OF PROGRAM | YEAR PROGRAM STARTED | FULL  / PART TIME | DURATION | TOTAL COMPLETED | CURRENT NO. OF STUDENTS | ADMISSION REQUIREMENTS | ANNUAL INTAKE |
| UNIVERSITY OF ZIMBABWE, ZIMBABWE | College of Health Sciences, Department of Community Medicine | MSc in Biostatistics | 2007 | FULL | 2 YEARS |  |  | Good first degree (upper second or better) in Statistics, Medicine, Health, Social or Biological sciences with substantial statistics & Advanced level mathematics | 7 |
| JIMMA UNIVERSITY, ETHOPIA | College of Natural Sciences | Masters in Biostatistics | 2009 | FULL | 2 YEARS | 41 | 11 second yr. & 10 first yr. | BSc-direct entry or Other fields (Health, Biology, Math and Agriculture)- Bridging course for one / two semester | 10 |
| UNIVERSITY OF NAIROBI, KENYA | Institute of Tropical & Infectious Diseases | MSc in Medical Statistics | 2008 | FULL | 2 YEARS | 24 |  | Holders of upper second class in any degree + strong mathematics background OR lower second class + 2 years experience OR pass + 5 years experience |  |
| University of Malawi, MALAWI | Chancellor College, Faculty of Science | MSc in Biostatistics | 2010 | FULL | 2 YEARS | 13 |  | Bachelors degree majored in Statistics + enough background in Mathematics; Bridging course for students without statistics background |  |
| Kilimanjaro Christian Medical University College, TANZANIA | [Directorate Postgraduate Studies](http://www.kcmuco.ac.tz/index.php/acandres/directorate-of-postgraduate-studies) | MSc in Epidemiology & Applied Biostatistics | 2012 | FULL  /PART | 2 YEARS / 3 YEARS | 14 | 8 second yr. & 7 first yr. | Undergraduate in medicine, statistics or biological sciences; mathematics at advanced level; at least one year working experience after undergraduate | 8 |
| University of the Witwatersrand, SOUTH AFRICA | School of Public Health, Division of Epidemiology and Biostatistics | MSc Epidemiology in the field of Epidemiology and Biostatistics | 2000 | FULL/PART | 2 YEARS/ 3 YEARS | 139 | 19 first years | Undergraduate in Medicine, four year honours degree in health sciences or statistics. Experience working in a research environment will be an add on. |  |

Table 2. Key competencies for a Masters level biostatistician

|  |  |
| --- | --- |
| Competence Area | Skill set |
| Biostatistics | * Biostatistical reasoning * Statistical theory and concepts * Practical Analytical skills |
| Epidemiology, research methods and ethics | * Formulating clear research questions * Study design * Proposal and grant writing * Systematic reviews * Research ethics |
| Computing and data management | * Data management * Quality control * Advanced statistical programming |
| Support skills | * Collaboration * Communication – oral and written * Consulting skills * Life-long learning * Leadership skills * Project management, time management, people management * Entrepreneurial skills * Mentorship skills * Innovative thinking |



Tanzania (1)

Botswana (1)

South Africa (13)

Zimbabwe (1)

Uganda (1)

Kenya (3)

Zambia (1)

Ghana (1)

Figure 1. Countries represented at the initial Africa Center for Biostatistical Excellence (ACBE) planning meeting

Figure 2. The Africa Center for Biostatistical Excellence (ACBE) organizational chart

Appendix A: Participants to the 2014 Workshop on Building Biostatistics Capacity in Sub Saharan Africa.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Surname | Name | Institution, Country |
| 1 | Achia | Thomas | University of Witwatersrand (WITS), South Africa |
| 2 | Blay | Samuel | Kwame Nkrumah University of Science and Technology (KNUST), Ghana |
| 3 | Bukirwa | Victoria | African Centre for Global Health and Social Transformation (ACHEST), Uganda |
| 4 | Chikte | Usuf | Stellenbosch University, South Africa |
| 5 | Conradie | Willie | Stellenbosch University, South Africa |
| 6 | Delva | Wim | South African Centre for Epidemiological Modelling and Analysis (SACEMA), South Africa |
| 7 | Esterhuizen | Tonya | Stellenbosch University, South Africa |
| 8 | Fegan | Greg | Kenya Medical Research Institute & University of Oxford |
| 9 | Fish | Therese | Stellenbosch University, South Africa |
| 10 | Grobler | Anneke | Center for the AIDS Programme of Research in South Africa (CAPRISA), University of KwaZulu Natal, South Africa |
| 11 | Machekano | Rhoderick | Stellenbosch University, South Africa |
| 12 | Mccaul | Michael | Stellenbosch University, South Africa |
| 13 | Michelo | Charles | University of Zambia, Zambia |
| 14 | Muller | Chris | Stellenbosch University, South Africa |
| 15 | Musenge | Eustasius | University of Witwatersrand (WITS), South Africa |
| 16 | Musonda | Patrick | University of Zambia, Zambia |
| 17 | Muzigaba | Moize | University of KwaZulu Natal Medical Education Partnership Iniative (MEPI), South Africa |
| 18 | Nieuwoudt | Martin | South African Centre for Epidemiological Modelling and Analysis (SACEMA) , South Africa |
| 19 | Njiri | Francis | University of Nairobi, Kenya |
| 20 | Ola Ama | Njoku | University of Botswana, Botswana |
| 21 | Osanjo | George | University of Nairobi, Kenya |
| 22 | Rusakaniko | Simba | University of Zimbabwe, Zimbabwe |
| 23 | Sartorius | Benn | University of KwaZulu Natal Medical Education Partnership Iniative (MEPI),South Africa |
| 24 | Thabane | Lehana | McMaster University, Canada |
| 25 | Todd | Jim | London School of Hygiene and Tropical Medicine, UK and Kilimanjaro Christian Medical College Tanzania |
| 26 | Van Schalkwyk | Cari | South African Centre for Epidemiological Modelling and Analysis (SACEMA), South Africa |
| 27 | Welte | Alex | South African Centre for Epidemiological Modelling and Analysis (SACEMA), South Africa |
| 28 | Young | Taryn | Stellenbosch University, South Africa |
| 29 | Zunza | Moleen | Stellenbosch University, South Africa |