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

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Abstract

Sub-Saharan Africa (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 identify ways in which to reduce the deficit 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 specialized academic masters programs as well as regular workshops targeting researchers.

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Keywords

Biostatistics; Sub Saharan Africa; Capacity-building; Research; Collaboration; Center of Excellence

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 2014 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 continues to increase unabated [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 [4, 5]. However, despite these 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 [6][7][8]. 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 [9] and Canada [10]. Experts predict that the demand for well-trained biostatisticians is going to continue to expand, especially in the

Pacific-rim countries and China [11][12]. 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 [13]. 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 [14]. 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 [15, 16]. 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 other areas of biostatistics besides their research area. 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.

1.2. Recommendations to build an Africa Center for Biostatistical Excellence

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 [13]. 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 2014, 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 [17]. 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 (potentially 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 disseminated to others. 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 masters level biostatisticians need to be effective contributors to SSA-based research (Table 2). The ACBE will contribute to the development of a standardized curriculum for biostatistical training that balances the need to train students in areas relevant to the region's needs 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 effective skills [10]. 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 [10].

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 for data crunching [18]. These researchers need to become more 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 findings [18]. 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 researcher submits a data analysis request, she has to wait for the statistician to perform that analysis off-site. 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 little time for the biostatisticians to engage in methodological research, limiting their intellectual development. 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, managed by the Program Director, will be established at the home institution, but will draw membership from selected institutions on a rotational basis. The coordinating center 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 work independently or with minimum supervision.

There are several collaborative initiatives between institutions such as the Medical Education Partnership Initiative (MEPI) that have established networks that the ACBE can utilize. 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. We hope that funding can be established to invest in the next generation of biostatisticians that will fill the ever-increasing need of this critical skill in SSA.

Acknowledgments

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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	School of Nursing and Public Health, 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
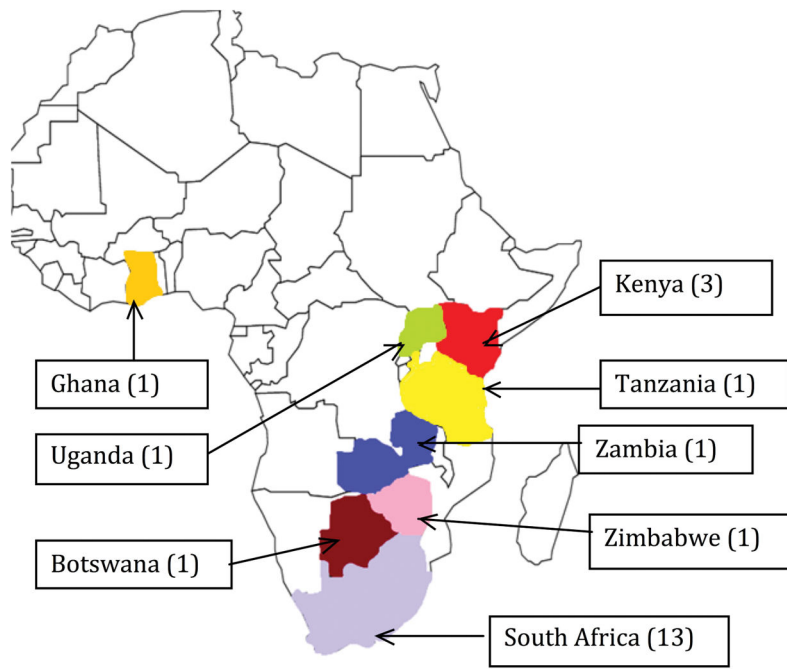
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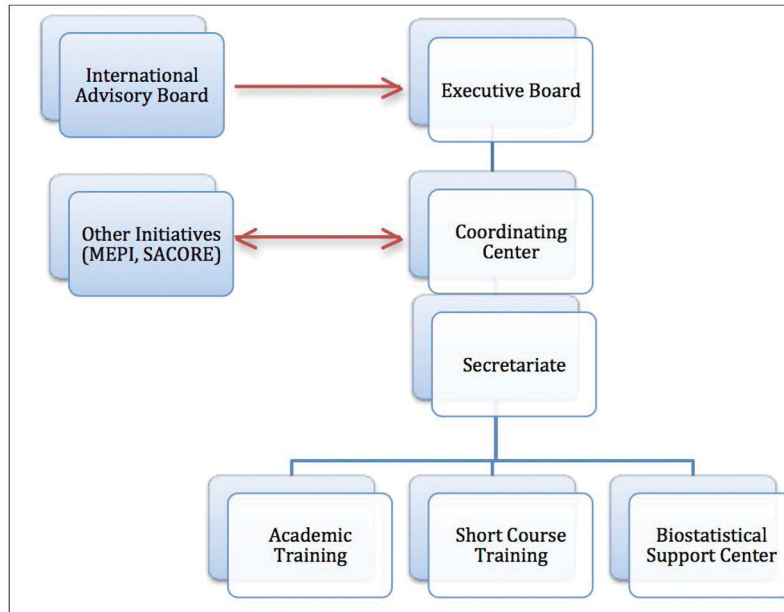
Figure 2.

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 REQUI...
UNIVERSITY OF ZIMBABWE, ZIMBABWE	College of Health Sciences, Department of Community Medicine	MSc in Biostatistics	2007	FULL	2 YEARS			Good fir... in Statis... Biologi... statistics
JIMMA UNIVERSITY, ETHIOPIA	College of Natural Sciences	Masters in Biostatistics	2009	FULL	2 YEARS	41	11 second yr. & 10 first yr.	BSc-dir... Biology ... course f...
UNIVERSITY OF NAIROBI, KENYA	Institute of Tropical & Infectious Diseases	MSc in Medical Statistics	2008	FULL	2 YEARS	24		Holders ... + strong ... second c... + 5 year...
University of Malawi, MALAWI	Chancellor College, Faculty of Science	MSc in Biostatistics	2010	FULL	2 YEARS	13		Bachelo... enough ... Bridging... statistics
University of Zambia, Zambia	Department of Public Health	MSc in Epidemiology and Applied Biostatistics	2010	Full	2 YEARS	30		Undergr... biologic... some go... evidenc... related r...
Kilimanjaro Christian Medical University College, TANZANIA	Directorate Postgraduate Studies	MSc in Epidemiology & Applied Biostatistics	2012	FULL/PART	2 YEARS/3 YEARS	14	8 second yr. & 7 first yr.	Undergr... biologic... advance... experien...
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	Undergr... honours ... statistics ... environm...

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