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Population Health Science: A Core Element of Health Science Education in Sub-Saharan Africa

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Abstract

Sub-Saharan Africa suffers an inordinate burden of disease and does not have the numbers of suitably trained health care workers to address this challenge. New concepts in health sciences education are needed to offer alternatives to current training approaches.

A perspective of integrated training in population health for undergraduate medical and nursing education is advanced, rather than continuing to take separate approaches for clinical

and public health education. Population health science educates students in the social and environmental origins of disease, thus complementing disease-specific training and providing opportunities for learners to take the perspective of the community as a critical part of their education.

Many of the recent initiatives in health science education in sub-Saharan Africa are reviewed, and two case studies of innovative change in

undergraduate medical education are presented that begin to incorporate such population health thinking. The focus is on East Africa, one of the most rapidly growing economies in sub-Saharan Africa where opportunities for change in health science education are opening. The authors conclude that a focus on population health is a timely and effective way for enhancing training of health care professionals to reduce the burden of disease in sub-Saharan Africa.

The needs of the peoples of sub-Saharan Africa (SSA) for more and better health care are broad and well documented.¹ Solutions to fulfilling these needs have had limited success, and innovative approaches must be explored to address the growing burden of disease. We propose population health science education in the training of health professionals as part of the solution to this challenge. We focus on SSA and East Africa in particular, where there is the promise of significant growth in health science education.² We argue that incorporation of a population health perspective into emerging curricular development and training will build a stronger and more capable health workforce.

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Global Context and Definitions

What is population health and population health science?

Population health is a growing field of inquiry and training in health science that examines the behavioral and social determinants of disease, in addition to their biological mechanisms. It has become a critical perspective in health science education at a time when such education is in need of radical reform. As the Lancet Commission on Health Professionals for a New Century describes in its 2010 report, the current state of health professionals training worldwide is based on “fragmented, outdated, and static curricula that produce ill-equipped graduates. The problems are systemic: mismatch of competencies to patient and population needs; poor teamwork; ... narrow technical focus without broader contextual understanding; episodic encounters rather than continuous care; ... and weak leadership to improve health-system performance.”³

Kindig and Stoddart⁴ defined population health in 2003 as “the health outcomes of a group of individuals, including the distribution of such outcomes within the group.”⁴ In the decade following, the definition has evolved to include the examination of complex questions

about the determinants of health in a population. The inclusion of population health in the medical curriculum has been advanced in many developed countries including the United States, Canada, and Australia.^{5,6} Although its roots can be traced back to the Flexner Report in 1910,⁶ the term has only recently become widely used,⁷ and efforts to incorporate systems thinking and population health perspectives into training in the United States, for example, still continue.⁸

Population health science is an interdisciplinary approach to addressing questions of population health and draws on expertise from basic, clinical, behavioral, and social sciences.^{9,10} The approach integrates traditional public health, including epidemiology, and the professional health sciences with social sciences and other disciplines. Population health science interacts with other societal sectors, advancing the concept of “health in all policies,”¹¹ which is the inclusion of health considerations in decisions made in all societal sectors. Population health science takes a life course approach^{12,13} and focuses on translation and dissemination of new knowledge into useful applications.¹⁴

Concept and theoretical framework

The multilevel nature of the influences on population health is illustrated by the

framework introduced by the U.S. National Institutes of Health–supported Centers for Population Health and Health Disparities (Figure 1).¹⁵ While the usual focus of health science training goes no further than the proximal factors of biologic pathways and individual risk factors, population health draws on the social and physical environment and the fundamental “causes of the causes” to fully integrate an understanding of how both intermediate and distal factors affect health and disease.

The Importance of Population Health Training in Africa

The integration of a population health perspective in health science education should be part of the solution to the profound health challenges faced by SSA countries.¹⁶ It has been estimated that Africa sustains 24% of the global burden of disease, though it is served by only 3% of the world’s health workforce, with on average only 18 physicians per 100,000 population.^{1,17} Add to this the depth and

breadth of the disease burden in SSA and the complications of population growth, economic deprivation, weak health systems and infrastructure, and sociopolitical unrest, and the challenges become enormous. Traditional education that separates public health from clinical health care potentially compromises the opportunity for developing the breadth of leadership required to address complex systems issues across the spectrum of prevention and health care that collectively impact the health of the population.¹⁸ A critical mass of competent local health professionals trained to understand the complexities of disease burden and address clinical challenges as well as their determinants is necessary, although not sufficient, to improve health outcomes.^{19–22}

East African health systems continue to be overwhelmed by the burden of the “big three” diseases of HIV/AIDS, malaria, and tuberculosis. HIV/AIDS remained the greatest contributor to

adult mortality in Kenya, Tanzania, and Uganda from 2000 to 2012, with up to 18.2% of deaths attributable to HIV.^{23–25} Malaria remains a chief cause of adult mortality, but more notably of child mortality, accounting for up to 13% of child deaths in Uganda, the third leading cause of child death.²⁵ Tuberculosis, while contained in many regions within East Africa, continues to challenge health systems in high-transmission areas where treatment is complicated by drug resistance. Health workers are strained further by the increasing burden of noncommunicable diseases, including ischemic heart disease, stroke, cancer, and type 2 diabetes associated with the rise of industrialization.^{23–27} The complexity of this challenge demands the creation of the capacity for management, research, and new professional skills that take a population health perspective.

Part of this capacity may be provided in the context of the East African Community, which since 2000 has

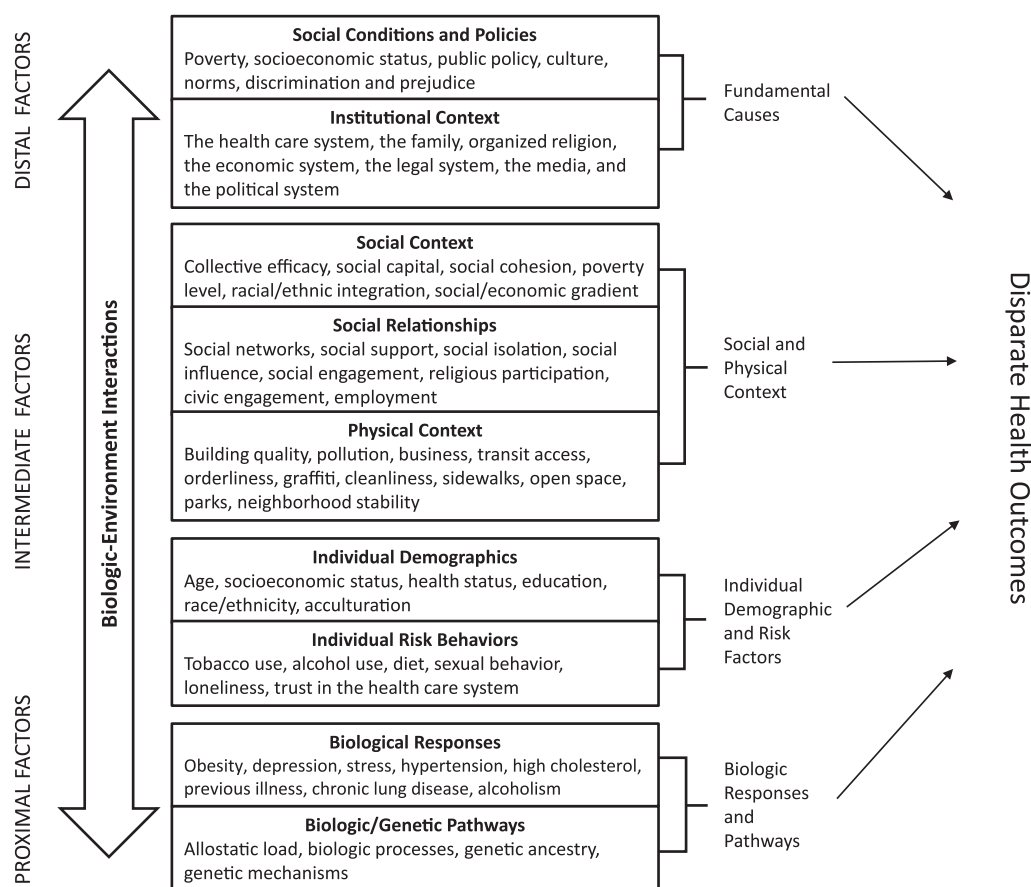


Figure 1 Multilevel, population health science model of disease causation illustrating examples of proximal to distal factors that result in health outcomes and inequities in these outcomes. Reproduced with permission from Warnecke RB, Oh A, Breen N, et al. Approaching health disparities from a population perspective: The National Institutes of Health Centers for Population Health and Health Disparities. *Am J Pub Health.* 2008;98:1608–1615.¹⁵ The Sheridan Press.

been the regional intergovernmental organization encompassing Burundi, Kenya, Rwanda, Tanzania, and Uganda, a region with a 2014 population of approximately 145.5 million.²⁸ The Inter-University Council for East Africa is the mechanism through which the transformation of health professional education could be implemented as the number of medical and nursing schools increase and there is commitment to more effective integration across the region.

East Africa has long recognized the importance of addressing people's health. Immediately after gaining independence in 1961, Tanzania began training "barefoot" doctors to reach as many of its population as possible.²⁹ Kenya, Tanzania, and Uganda continue to train and promote community health workers³⁰; Tanzania's health workforce in particular depends on midlevel health workers to manage preventive and clinical care programs from district hospitals.³¹ Many ongoing efforts exist to address the disease burden through improved quality and quantity of training for the health care and public health workforce.^{19,32–39} The majority of these efforts as described in the literature are multi-institutional consortia, many with partners from developed countries.^{1,18,21,32,40–43} These consortia leverage collective strengths across institutions and share best practices for training. Many institutions have developed graduate degree programs in public health, either within existing medical schools or by developing schools of public health within existing universities.^{33,34,44–48} Prioritization of the development of curriculum and training in locally relevant health problems,^{32,35,49–51} investment in infrastructure,^{18,52} and a focus on research competencies is common across many of these training and research programs.^{18,41–43}

Despite an abundance of public health training efforts at the postgraduate level, and a small number targeting innovative undergraduate medical education, we see few efforts that combine these two approaches to train a new type of health science professional that can understand and act on both the "upstream" or distal causes of disease and the traditional proximate causes. We highlight two cases in East Africa (Boxes 1 and 2) where initiatives have begun to train health professionals at the undergraduate level to address locally relevant health

problems with an understanding of their underlying social and cultural determinants.

The Opportunity for Building Population Health Into the Health Sciences Curricula in East Africa

Given this backdrop, we advance the thesis that in order to increase the quality, scope of expertise, and retention of health care workers in East Africa, training for doctors, nurses, and other health professionals should incorporate the perspectives and skills of population health science. By enabling clinicians to be more broadly equipped to address health needs of varied communities across the region, such an approach has potential to increase the geographic distribution of health workers and to improve the quality of the local workforce. Also, health professionals with skills in population health enhance effective problem solving in health systems. This is consistent with a United Nations 2030 Sustainable Development Goal, to "ensure healthy lives and promote well-being at all ages," which focuses heavily on prevention and systems approaches that are key pillars of population health.⁵³ Health science education must be made relevant to the challenges faced by the local context to expect advances in health at a population level. A leading Kenyan public health activist claims that in Africa, "if better health does not happen in communities, it doesn't happen; if it happens in communities, it happens in the nation."⁵⁴

The traditional approach is to provide public health training during graduate education, primarily the master's level, largely to physicians or nurses who have already completed their clinical training. Although less common, initiatives such as the Medical Education Partnership Initiative or the new curricula at the Muhimbili University of Health and Allied Sciences illustrate that training in population health science can effectively begin much earlier. In East Africa, students enter medical or nursing education directly after completing secondary school at an average age of 18 years. They are required to show proficiency in the English language, mathematics, physics, chemistry, and biology, but are not exposed more broadly to the social sciences. As the population health science approach envisages, painting a broad canvas for health professional education (from molecules to society) is proposed as a common foundation of broad-based general education at the start of health professional education. This would accomplish two objectives. First, it would allow students to see the relationships between different forms of knowledge and the advantage of a transdisciplinary approach to problem solving, which is a key part of population health sciences. Secondly, this foundation would enable the acquisition of habits of critical thinking, problem solving, communication, and collaboration rather than rote learning, and would also promote a sense of social responsibility.

Box 1

The Medical Education Partnership Initiative University of Nairobi Partnership for Innovative Medical Education Program, Illustrating a Population-Health-Science-Based Approach to Undergraduate Health Professional Education in East Africa

The Medical Education Partnership Initiative (MEPI), launched in 2010, is a five-year, \$130 million initiative to scale up medical education and human resources for health in sub-Saharan Africa.^{1,52,53} The MEPI Partnership for Innovative Medical Education—Kenya (PRIME-K), between the University of Nairobi College of Health Sciences, the School of Medicine & Department of Global Health at University of Washington, and the School of Medicine at the University of Maryland in the United States, is one MEPI grant that addresses the increasing demand for clinical training, locally relevant research, and retention of faculty. Through PRIME-K, initiated in 2011, the University of Nairobi implemented decentralized clinical training at 14 sites across Kenya. This model fosters locally relevant research through research training in rural hospitals, exposes health sciences students to the determinants and burden of disease in rural settings, and reduces the emphasis on clinical training in the main tertiary hospital, allowing students more experience with patient care and better hands-on skills training. This program also supports research training and adjunct faculty positions at the University of Nairobi to local physicians to provide the training and support necessary to carry out locally relevant research. As of 2014, 306 students have rotated through the decentralized training sites, 182 adjunct faculty have been trained, and locally relevant research proposals have been developed. Interviews with students and local health workers have suggested that the program has improved mentoring, quality of patient care, and interest in research,⁵² though long-term impact on health outcomes is yet to be determined.

Box 2

The Muhimbili University of Health and Allied Sciences Competency-Based Curriculum, Illustrating a Population-Health-Science-Based Approach to Undergraduate Health Professional Education in East Africa

Between 2008 and 2011, with support from the Bill & Melinda Gates Foundation, Muhimbili University of Health and Allied Sciences (MUHAS) in Dar es Salaam, Tanzania and the University of California, San Francisco in the United States partnered to train health professionals to work more effectively within local health systems to address Tanzania's priority health areas.^{54,55} MUHAS developed competency-based curricula for its undergraduate and postgraduate programs to replace the traditional didactic curricula to better train graduates to address the country's health care problems. Faculty assessed existing course content for gaps and redundancies, reviewed available competency frameworks mainly from Australia, the United Kingdom, and the United States, and developed eight competency domains, each with up to nine core competencies. Five of the domains were similar to those adopted by the Accreditation Council for Graduate Medical Education and those proposed by the Institute for International Medical Education, and were common across all professional schools (medicine, nursing, public health, dentistry, and pharmacy). One of these competencies focuses on communication with communities and another on systems of care delivery, both important elements of population health science. The adoption of common competencies across disciplines promotes team building and a multidisciplinary approach to health care that is important in addressing Tanzania's population health burden.

Undergraduate medical and nursing education will need to incorporate concepts of population health and social determinants in the full range of courses. When learning about tuberculosis, for example, students must understand not just the knowledge of the tuberculosis bacillus and its clinical manifestations and treatment, but also the context in which the disease is transmitted and the social and environmental factors that affect susceptibility. Population health and social determinants need to be fully integrated into biomedical education, not taught as a separate subject.

Specialized courses will, however, also be necessary and they must cover both knowledge of population health and the skills to deal with the challenges to be faced.⁵⁵ As part of the report *Working for Health Equity: The Role of Health Professionals*,⁵⁶ recommendations for workforce education and training include courses that cover the social and economic conditions that affect health (e.g., housing, education), how social determinants affect health (i.e., biologic mechanisms), why certain populations are more vulnerable, variations in health outcomes by geographic areas, and how they are explained by an understanding of population health science.

From the population health perspective, the specific community and cultural context in which the health professional works will determine how many of these competencies are developed, but they include:

- Practice-based skills including taking a good social history, and how to

connect patients to services available in the community;

- Good communication skills to provide information appropriate to the level of a patient's understanding and cultural context; and
- Collaborative skills to work both within and outside the health sector by learning how to collaborate, share information, and build strong and effective health care teams and public health systems.

Currently, doctors, nurses, or other paramedical practitioners can take a path that leads directly to a master's or doctoral degree in public health topics.³⁶ But what we see as a novel opportunity is the integration of core population health science disciplines, especially including primary care.⁵⁷ This would give students the capacity to understand the social determinants of disease and the perspective needed to function more effectively in the clinical setting as well as the skills to understand and influence broader public health issues. For example, educators in Australia have introduced a student toolkit with eight essential questions that integrate the population health perspective into the medical curriculum. For all major diseases, students are required to know its distribution, cause, prevention, management, evidence base, personal impact, societal impact, and the societal response.⁵

Finally, graduate training at the master's and doctoral level is needed for those

who wish to have advanced training in population health to expand the pool of expertise in population health and research capacity in SSA. In 2004, less than 1% of the global scientific literature was authored by African investigators.¹⁸ Although this percentage is increasing, challenges to African-led research persist, including the lack of training in research methods, the absence of mentoring, and researchers' competing responsibilities to clinical practice.⁵⁸ However, the opportunities for African-based discovery research, health systems research, and population health studies are vast and unrealized. Because so many health challenges in Africa are context dependent, evidence generated by African investigators in African institutions would be most relevant to solving local problems. It follows that training health professionals should incorporate field training and research experiences. Students should become familiar with the determinants of health and disease both in rural and urban settings away from their medical schools.

Conclusion

How East African institutions incorporate population health science into their curricula will depend on the individual institutions and their faculty and leadership. Furthermore, what we are proposing is complex and will require a significant investment in planning and execution. This should start with making a convincing case to health and educational leaders that the population health approach is the most preferable way to move forward.

A population health approach can provide practitioners with a better understanding of the origins of disease and disability in the communities they serve, bring together the clinical and public health sciences, better prepare practitioners for leadership roles in their communities, and lay the groundwork for advanced studies and specialization in population health science.

Individuals who wish to pursue careers in population health science beyond clinical practice will need additional postgraduate training that allows them to publish original, context-specific research on critical population health problems in their communities. A strong research background also builds educators and role models for the next generation. The goal

would be to have a well-trained cadre of population health scientists in East Africa who can then be integrated across the region through meetings, conferences, and newer communication technologies to solve problems critical to the region. These individuals would draw on the training and perspectives of frontline physicians, nurses, and paramedical personnel also trained in the essentials of population health.

Population health training seeks to place emphasis on interventions in the home, the village, and the larger community, not just providing treatment to those who present at clinics or hospitals. In the words of one African leader, “health is made at home and only repaired in health facilities when it breaks down.”⁵⁹

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References

- Collins FS, Glass RI, Whitescarver J, Wakefield M, Goosby EP. Public health. Developing health workforce capacity in Africa. *Science*. 2010;330:1324–1325.
- Mullan F, Frehywot S, Omaswa F, et al. Medical schools in sub-Saharan Africa. *Lancet*. 2011;377:1113–1121.
- Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *Lancet*. 2010;376:1923–1958.
- Kindig D, Stoddart G. What is population health? *Am J Public Health*. 2003;93:380–383.
- Trevena LJ, Sainsbury P, Henderson-Smart C, Clarke R, Rubin G, Cumming R. Population health integration within a medical curriculum: An eight-part toolkit. *Am J Prev Med*. 2005;29:234–239.
- Maeshiro R, Johnson I, Koo D, et al. Medical education for a healthier population: Reflections on the Flexner Report from a public health perspective. *Acad Med*. 2010;85:211–219.
- Tricco AC, Runnels V, Sampson M, Bouchard L. Shifts in the use of population health, health promotion, and public health: A bibliometric analysis. *Can J Public Health*. 2008;99:466–471.
- Lucey CR. Medical education: Part of the problem and part of the solution. *JAMA Intern Med*. 2013;173:1639–1643.
- Mabry PL, Olster DH, Morgan GD, Abrams DB. Interdisciplinarity and systems science to improve population health: A view from the NIH Office of Behavioral and Social Sciences Research. *Am J Prev Med*. 2008;35 (2 suppl):S211–S224.
- Diez Roux AV. Integrating social and biologic factors in health research: A systems view. *Ann Epidemiol*. 2007;17:569–574.
- Gawanas B. Politics, economics, and society. In: Omaswa F, Crisp N, eds. *African Health Leaders: Making Change and Claiming the Future*. Oxford, UK: Oxford University Press; 2014:145–168.
- Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: Conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol*. 2002;31:285–293.
- Hertzman C. The biological embedding of early experience and its effects on health in adulthood. *Ann N Y Acad Sci*. 1999;896:85–95.
- Green LW, Ottoson JM, Garcia C, Hiatt RA. Diffusion theory and knowledge dissemination, utilization, and integration in public health. *Annu Rev Public Health*. 2009;30:151–174.
- Warnecke RB, Oh A, Breen N, et al. Approaching health disparities from a population perspective: The National Institutes of Health Centers for Population Health and Health Disparities. *Am J Public Health*. 2008;98:1608–1615.
- Ijsselmuiden CB, Nchinda TC, Duale S, Tumwesigye NM, Serwadda D. Mapping Africa’s advanced public health education capacity: The AfriHealth project. *Bull World Health Organ*. 2007;85:914–922.
- World Health Organization. Working together for health: The world health report. 2006. <http://www.who.int/whr/2006/en/>. Accessed May 20, 2016.
- Ezeh AC, Izugbara CO, Kabiru CW, et al. Building capacity for public and population health research in Africa: The consortium for advanced research training in Africa (CARTA) model. *Glob Health Action*. November 2010;3:doi:10.3402/gha.v3i0.5693.
- Omaswa FG. The contribution of the Medical Education Partnership Initiative to Africa’s renewal. *Acad Med*. 2014;89(8 suppl):S16–S18.
- Omer MI. Can medical education rise to the challenge of the African crisis? *Ann Trop Paediatr*. 2005;25:227–241.
- Hofman K, Blomstedt Y, Addei S, et al. Addressing research capacity for health equity and the social determinants of health in three African countries: The INTREC programme. *Glob Health Action*. 2013;6:19668.
- Celletti F, Reynolds TA, Wright A, Stoertz A, Dayrit M. Educating a new generation of doctors to improve the health of populations in low- and middle-income countries. *PLoS Med*. 2011;8:e1001108.
- World Health Organization. Global Health Observatory Data, Kenya WHO Statistical Profile. Geneva, Switzerland: World Health Organization; 2015.
- World Health Organization. Global Health Observatory Data, Uganda WHO Statistical Profile. Geneva, Switzerland: World Health Organization; 2015.
- World Health Organization. Global Health Observatory Data, Tanzania WHO Statistical Profile. Geneva, Switzerland: World Health Organization; 2015.
- World Health Organization. Global Health Observatory Data, Rwanda WHO Statistical Profile. Geneva, Switzerland: World Health Organization; 2015.
- World Health Organization. Global Health Observatory Data, Burundi WHO Statistical Profile. Geneva, Switzerland: World Health Organization; 2015.
- East African Community Secretariat. East African Community facts and figures. 2015. http://statistics.eac.int/index.php?option=com_docman&task=doc_download&gid=146&Itemid=153. Accessed May 20, 2016.
- Iliffe J. *Modern East African Doctors: A History of the Profession*. Cambridge, UK: Cambridge University Press; 1998.
- Global Health Workforce Alliance. Global experiences of community health workers for delivery of health related millennium development goals: A systematic review, country case studies, and recommendations for integration into national health systems. 2010. <http://www.who.int/workforcealliance/knowledge/resources/chwreport/en/>. Accessed May 20, 2016.
- Kwesigabo G, Mwangi MA, Kakoko DC, et al. Tanzania’s health system and workforce crisis. *J Public Health Policy*. 2012;33(suppl 1):S35–S44.
- Oni G, Fatusi A, Tsui A, et al. Strengthening public health education in population and reproductive health through an innovative academic partnership in Africa: The Gates partners experience. *Glob Public Health*. 2011;6:193–209.
- Tweheyo R, Nalwadda C, Ayeababizwe N, Mukanga D, Rutebemberwa E, Bazeyo W. Two decades of post-graduate training in applied public health: The experience and

- challenges of the Uganda Public Health School Without Walls. *Pan Afr Med J*. 2011;10(suppl 1):11.
- 34 Pariyo G, Serwadda D, Sewankambo NK, Groves S, Bollinger RC, Peters DH. A grander challenge: The case of how Makerere University College of Health Sciences (MakCHS) contributes to health outcomes in Africa. *BMC Int Health Hum Rights*. 2011;11(suppl 1):S2.
 - 35 Kaaya EE, Macfarlane SB, Mkony CA, et al. Educating enough competent health professionals: Advancing educational innovation at Muhimbili University of Health and Allied Sciences, Tanzania. *PLoS Med*. 2012;9:e1001284.
 - 36 Nachege JB, Uthman OA, Ho YS, et al. Current status and future prospects of epidemiology and public health training and research in the WHO African region. *Int J Epidemiol*. 2012;41:1829–1846.
 - 37 Beaglehole R, Dal Poz MR. Public health workforce: Challenges and policy issues. *Hum Resour Health*. 2003;1:4.
 - 38 Greysen SR, Dovlo D, Olapade-Olaopa EO, Jacobs M, Sewankambo N, Mullan F. Medical education in sub-Saharan Africa: A literature review. *Med Educ*. 2011;45:973–986.
 - 39 Whitworth JA, Kokwaro G, Kinyanjui S, et al. Strengthening capacity for health research in Africa. *Lancet*. 2008;372:1590–1593.
 - 40 Guwatudde D, Bwanga F, Dudley L, et al. Training for health services and systems research in Sub-Saharan Africa—a case study at four East and Southern African universities. *Hum Resour Health*. 2013;11:68.
 - 41 Kabiru CW, Izugbara CO, Wambugu SW, Ezech AC. Capacity development for health research in Africa: Experiences managing the African Doctoral Dissertation Research Fellowship Program. *Health Res Policy Syst*. 2010;8:21.
 - 42 Mirzoev T, Lê G, Green A, et al. Assessment of capacity for health policy and systems research and analysis in seven African universities: Results from the CHEPSAA project. *Health Policy Plan*. 2014;29:831–841.
 - 43 Nangami MN, Rugema L, Tebeje B, Mukose A. Institutional capacity for health systems research in East and Central Africa schools of public health: Enhancing capacity to design and implement teaching programs. *Health Res Policy Syst*. 2014;12:22.
 - 44 Sanders D, Guwatudde D, Alexander L. Accessible public-health education: A potential growth area? *Bull World Health Organ*. 2008;86:A–B.
 - 45 Muula AS. Training public health professionals in Africa: Loma Linda University approach. *Croat Med J*. 2006;47:512–514.
 - 46 Mokwena K, Mokgatle-Nthabu M, Madiba S, Lewis H, Ntuli-Ngcobo B. Training of public health workforce at the National School of Public Health: Meeting Africa's needs. *Bull World Health Organ*. 2007;85:949–954.
 - 47 Kellerman R, Klipstein-Grobusch K, Weiner R, Wayling S, Fonn S. Investing in African research training institutions creates sustainable capacity for Africa: The case of the University of the Witwatersrand School of Public Health masters programme in epidemiology and biostatistics. *Health Res Policy Syst*. 2012;10:11.
 - 48 Alexander L, Igumbor EU, Sanders D. Building capacity without disrupting health services: Public health education for Africa through distance learning. *Hum Resour Health*. 2009;7:28.
 - 49 Masalu JR, Aboud M, Moshi MJ, et al. An institutional research agenda: Focusing university expertise in Tanzania on national health priorities. *J Public Health Policy*. 2012;33(suppl 1):S186–S201.
 - 50 Amde WK, Sanders D, Lehmann U. Building capacity to develop an African teaching platform on health workforce development: A collaborative initiative of universities from four sub-Saharan countries. *Hum Resour Health*. 2014;12:31.
 - 51 Williams JR, Schatz EJ, Clark BD, et al. Improving public health training and research capacity in Africa: A replicable model for linking training to health and socio-demographic surveillance data. *Glob Health Action*. August 31, 2010;3;doi:10.3402/gha.v3i0.5287.
 - 52 Noormahomed EV, Mocumbi AO, Preziosi M, et al. Strengthening research capacity through the medical education partnership initiative: The Mozambique experience. *Hum Resour Health*. 2013;11:62.
 - 53 United Nations Conference on Sustainable Development. UN General Assembly's Open Working Group proposes sustainable development goals. 2014. <https://sustainabledevelopment.un.org/content/documents/4538pressowg13.pdf>. Accessed May 20, 2016.
 - 54 Were MK. Community health, community workers and community. In: Omaswa F, Crisp N, eds. *African Health Leaders: Making Change and Claiming the Future*. Oxford, UK: Oxford University Press; 2014:109–124.
 - 55 Marmot M, Allen J. Health priorities and the social determinants of health. *East Mediterr Health J*. 2015;21:671–672.
 - 56 Allen M, Allen J, Hogarth S, Marmot M. *Working for Health Equity: The Role of Health Professionals*. London, UK: UCL Institute of Health Equity, University College London; 2013.
 - 57 Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q*. 2005;83:457–502.
 - 58 Hofman KJ, Kanyengo CW, Rapp BA, Kotzin S. Mapping the health research landscape in Sub-Saharan Africa: A study of trends in biomedical publications. *J Med Libr Assoc*. 2009;97:41–44.
 - 59 Omaswa F, Crisp F, eds. *African Health Leaders: Making Change and Claiming the Future*. Oxford, UK: Oxford University Press; 2014.