Medical schools in sub-Saharan Africa

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Small numbers of graduates from few medical schools, and emigration of graduates to other countries, contribute to low physician presence in sub-Saharan Africa. The Sub-Saharan African Medical School Study examined the challenges, innovations, and emerging trends in medical education in the region. We identified 168 medical schools; of the 146 surveyed, 105 (72%) responded. Findings from the study showed that countries are prioritising medical education scale-up as part of health-system strengthening, and we identified many innovations in premedical preparation, team-based education, and creative use of scarce research support. The study also drew attention to ubiquitous faculty shortages in basic and clinical sciences, weak physical infrastructure, and little use of external accreditation. Patterns recorded include the growth of private medical schools, community-based education, and international partnerships, and the benefit of research for faculty development. Ten recommendations provide guidance for efforts to strengthen medical education in sub-Saharan Africa.

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Introduction

Health in Africa is important as an issue of human equity and as a precursor to poverty reduction and human development. Africa has 24% of the world's burden of disease, but only 3% of the world's health workforce.[1] The Joint Learning Initiative[2] and the 2006 World Health Report[1] called attention to the particularly severe shortages of human resources for health in Africa. Early responses to the recognition of these shortages included calls for increased production of community health workers[3] and non-physician clinicians,[4] and task shifting to make effective use of available cadres.[5] Attention has now focused on education and retention of medical doctors in Africa, not because doctors will solve the vast unmet health needs of the continent, but in the belief that no health system can function well without an adequate number of doctors to participate in clinical and public health work, management, education, and policy making.[6] Sub-Saharan Africa has an estimated 145 000 physicians[7] (5% of the 2 877 000 practising physicians in Europe) to serve a population of 821 million (more than the population in Europe).[8] Overall, sub-Saharan Africa has a physician-to-population ratio of 18 per 100 000, compared with countries such as India (60 per 100 000), Brazil (170 per 100 000), and France (370 per 100 000).[8] Africa's poorest countries have even greater physician shortages.

The very low physician-to-population ratios in countries in sub-Saharan Africa result from several factors, including a modest output of students by a small number of medical schools, and emigration of many graduates to other countries or continents. (The term medical school refers to medical schools and colleges of medicine.) Any effort intended to improve health-system functioning in these countries should consider options to increase both the productivity of medical schools and the retention of their graduates within their countries.

National and international interest with respect to strategic investment in medical education in sub-Saharan Africa has been growing, but little is known about the status of medical schools or trends within medical education across the continent. For example, when we initially reviewed all available medical school databases (WHO, Institute for International Medical Education, Foundation for Advancement of International Medical Education and Research, and World Federation for Medical Education) in 2008, we identified 103 schools; however, our survey work identified 168 schools operating in sub-Saharan Africa. This absence of pan-African data and perspective is a major challenge for African governments and donor organisations seeking to address shortages in physician workforce.

The Sub-Saharan African Medical School Study addressed this knowledge gap by developing an information base for the status of, trends in, and prospects for African medical education for educators, policy makers, and international organisations. Figure 1 outlines the structure, participants, and sequence of activities that comprised this study.

Findings

General results

Of 168 medical schools, 146 were identified before the close of the study survey period in December, 2009. 105 (72%) schools responded. (All identified schools are shown in webappendix pp 7–10.) Countries with large populations ($p<0·0001$) and land masses ($p<0·0001$) had more medical schools than did smaller countries by multiple linear regression, but the recorded no significant correlation between a country's gross domestic product (GDP) per head, region of Africa, or national language and its number of medical schools. Survey respondents and site visited institutions represented all regions of sub-Saharan Africa and all major language groups. The data collected in the study site visits and the survey are summarised in 13 categories.

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See Online for webappendix

(1) Scaling up of medical education

Many countries are scaling up medical education as part of health-sector strengthening. Several national governments are investing greatly in human resources for health, producing health-sector strategic plans that include increases in health-care workforce. Medical education is essential to the development of the health-care workforce and is an integral part of human resource plans. Seven medical schools that responded were founded before 1960, and another 29 during the independence decades (1960–79). Little growth occurred during the 1980s, but 58 responding schools have opened since 1990 (figure 2).

Many medical schools are expanding enrolment of students. 59 of 78 (76%) schools that responded reported increases in the number of students in their first-year classes compared with 5 years ago. 56 of 105 (53%) reported plans to increase in the next 5 years, with 57 of 96 (59%) mandated to increase enrolment, generally from ministries of health or education. The present total enrolment of first-year students in 96 responding schools

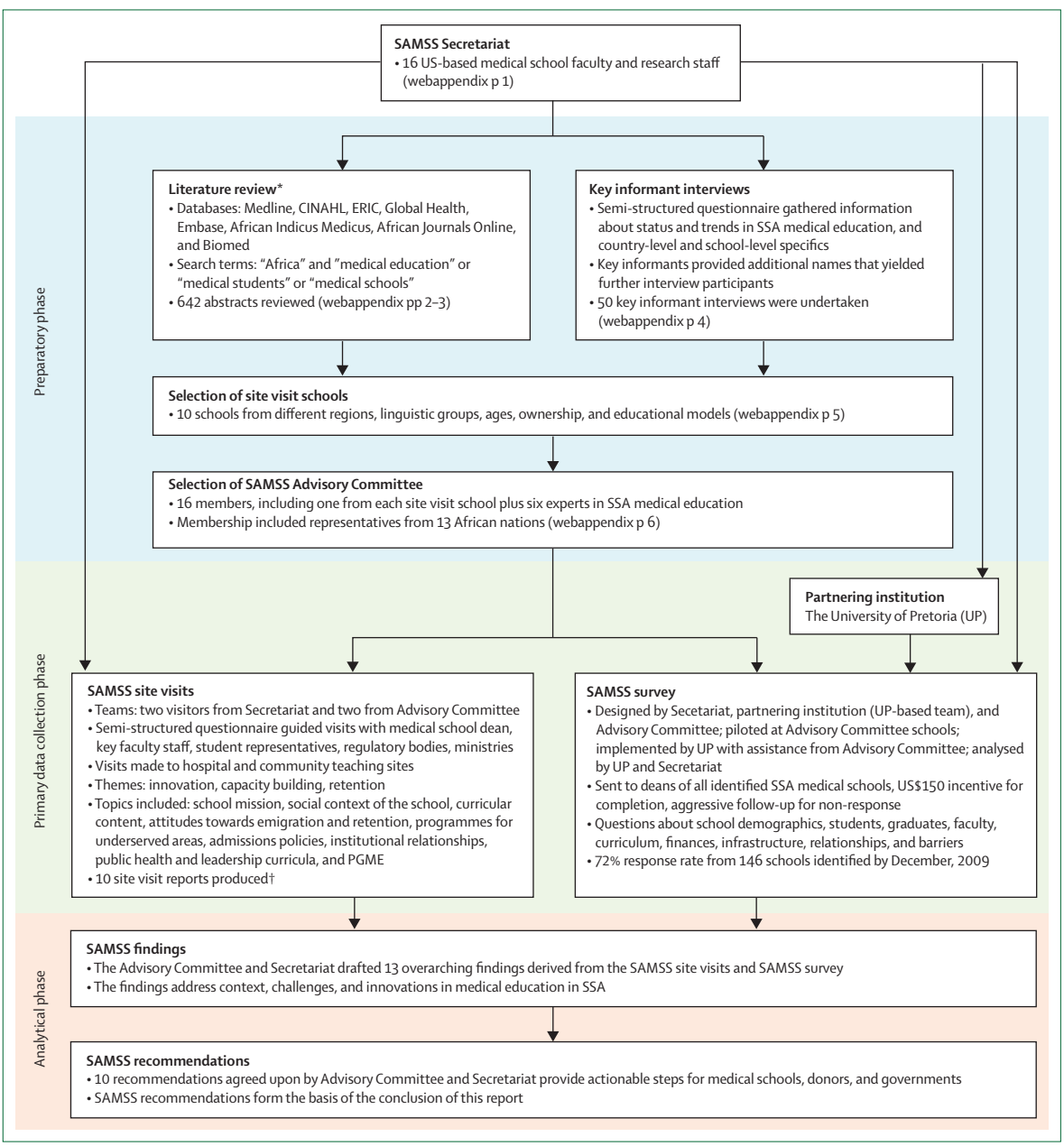

Figure 1: **Structure and methods of the Sub-Saharan Africa Medical School Study**
SAMSS=Sub-Saharan African Medical School Study. CINAHL=Cumulative Index to Nursing and Allied Health Literature. ERIC=Education Resources Information Center. SSA=sub-Saharan Africa. PGME=postgraduate medical education. *References available from authors on request. †Site visit reports available from the Sub-Saharan African Medical School Study website.

For more on the **Sub-Saharan African Medical School Study** see http://SAMSS.org

is 18 349. The number of graduates in responding schools was 7861 in 2008 (figure 3). These graduates represent the output of the 105 responding medical schools. Many of the non-responding schools are private or new, and their characteristics imply fewer average graduates for the 63 non-responding schools than for the responding schools. These data suggest an estimated 10 000–11 000 graduates per year from medical schools in sub-Saharan Africa. Differences between enrolment and graduation figures are mainly attributable to the opening or expansion of schools. A few universities admit large numbers of students before numbers are reduced in the second year. 59 of 84 (70%) responding schools reported that at least 80% of first-year students graduate.

The Ethiopian Government is investing greatly in a workforce scale-up plan based on a so-called flood and retain strategy, which involves a rapid, massive increase in the number of trained health workers and attendant retention measures. The Ministry of Education mandated that all medical schools expand their class sizes. Thus, Jimma University's (Ethiopia) first-year enrolment for 2009 increased from 200 to 250, and is expected to reach 350 for 2011. The government supports this strategy by investing in physical infrastructure, including construction of a new teaching hospital at the university. The Hubert Kairuki Memorial University in Tanzania exemplifies private sector scale-up, expanding from an initial intake of 25 first-year medical students in 1998, to 70 per year in 2010. The Tanzanian Government has assisted by providing student loans and grants to private school students, enabling more students to afford tuition fees.

For all medical schools in sub-Saharan Africa, including private schools, fees vary widely. Nine respondent schools (9%) offer free tuition, 47 (47%) charge US$1000 or less per year, and nine (9%) charge more than $5000. Private schools derive most of their income from tuition; public schools receive most of their operating budgets from the government (figure 4).

Respondents were asked to identify the three greatest needs for scaling up the quality and quantity of their graduates in an open-ended question. Webappendix p 11 shows a summary of responses. Faculty-related issues were most commonly identified as key to improving the quality of graduates (35 of 94 respondents rated this issue as most important). Infrastructure issues were most frequently regarded as essential to improve the quantity of graduates (37 of 94 respondents rated this issue as most important). Curricular issues were viewed as affecting quality, whereas improvements in clinical sites were regarded as helping with quantity. Budgetary issues were referred to in response to both questions.

(2) Effect of the country's health system

When civil society is in disarray and governance is compromised, medical education and retention of physicians will be affected. Graduates in many countries decline to work in rural areas because of lack of clinical support. Graduates from Ibadan University , for example, forgo employment in Nigeria's large and crucial network of secondary hospitals because of poor pay and working conditions, and shortages of supplies, support personnel, and equipment.

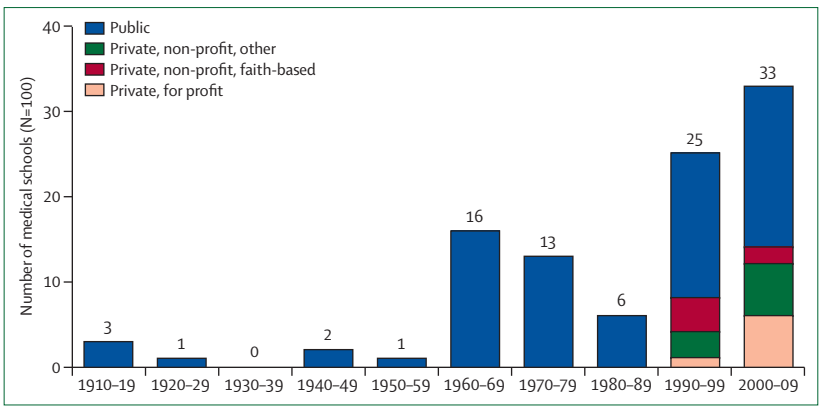

Figure 2: **Founding dates of medical schools in sub-Saharan Africa**
Five schools did not respond.

Assessment of retention strategies has been challenging because of the poor ability by most health systems to track medical school graduates. 47 of 58 (81%) survey respondents whose schools have graduated doctors reported no established tracking systems. Figure 5 shows the location of medical school graduates 5 years after graduation as estimated by the 62 schools responding to this survey question. The percentage of graduates estimated to be in rural general practice 5 years after graduation was positively correlated with the existence of a compulsory service programme ($p=0·039$), a moderate number of postgraduate medical education programmes ($p=0·016$), and French as a language of instruction ($p=0·016$); these data were analysed with ANCOVA. We recorded no significant correlation with GDP, the existence of a targeted recruitment programme for rural students, percentage of national population in rural areas, or use of community-based education. Many schools and nations are working to address emigration. National service is required from graduates in Mozambique, South Africa, Ethiopia, and Nigeria to obtain some clinical service from all graduates, although enforcement of these requirements is variable.

(3) Shortages within medical school faculties

Shortages within medical school faculties are endemic, problematic, and made worse by emigration of health-care workers. Almost every school visited in this study had some degree of faculty shortage in both basic and clinical sciences. The number of teaching staff (salaried full-time or part-time, and volunteer) at 51 of 98 responding schools is fewer than 100; about half have between 52 (25th percentile) and 147 (75th percentile) teaching staff. Small salaries, limited career options, heavy teaching loads, growing enrolment, and absence of equipment and support staff are the main barriers to retaining faculty staff.

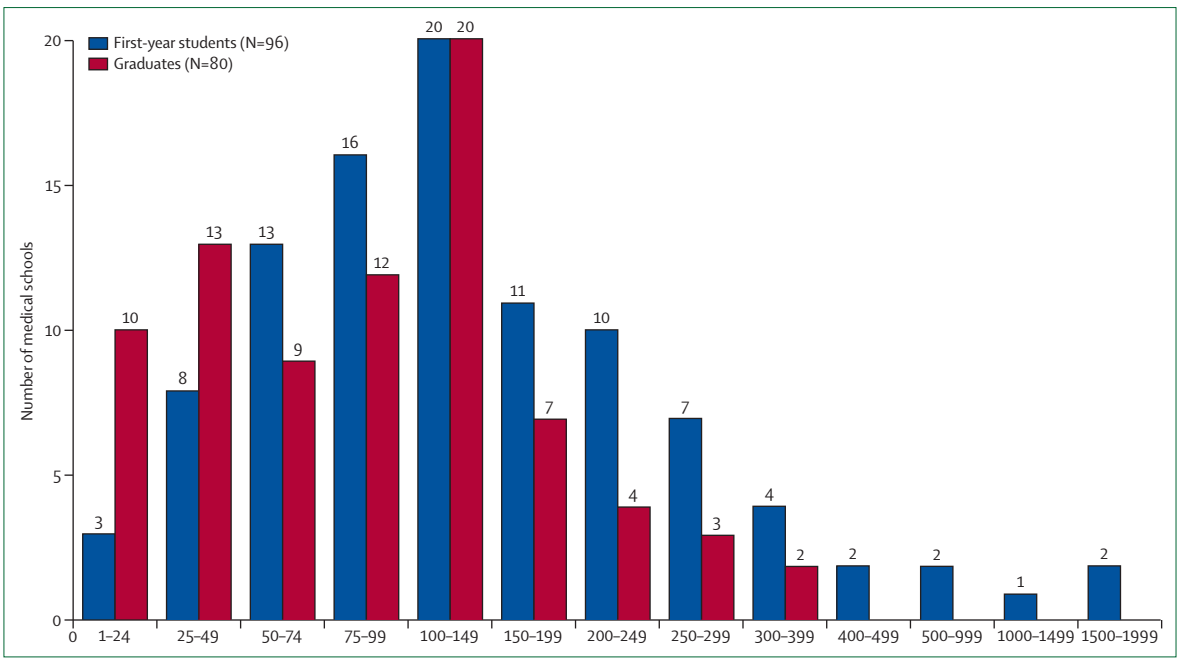

Figure 3: **Number of first-year students and graduates in medical schools in sub-Saharan Africa (2008)**
*N varies because some medical schools have not yet graduated doctors.

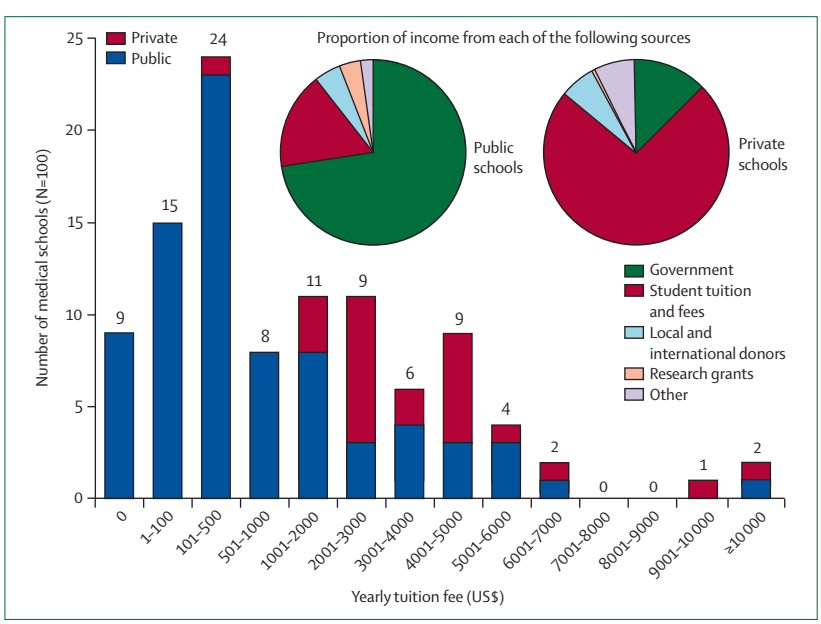

Figure 4: **Tuition costs and sources of income in medical schools in sub-Saharan Africa**

Shortages put extra pressure on faculty staff and promote emigration or relocation to private organisations and opportunities within non-governmental organisations. Faculty staff who are well trained and accredited are prime candidates to be recruited outside the country, resulting in the loss of both clinicians and teachers.

Academic salaries severely restrict recruitment and retention of faculty staff. In many universities, clinical staff are paid on the same scale as are other university professors, which is lower than that of public sector doctors set by ministries of health. Research opportunities are often scarce, and teaching responsibilities are great. At Gezira University, Sudan, the absence of basic scientists means clinicians frequently have to teach basic science to medical students. Many schools rely on expatriate faculty staff. The founding faculty members of the Walter Sisulu University in South Africa were from Uganda, Cuba, and Nigeria.

Some schools have initiated creative strategies to retain faculty staff, such as the Hubert Kairuki Memorial University in Tanzania, where incentives such as housing and communications allowances, free telephone air time, and seminar participation are provided. The Catholic University in Mozambique has made a targeted effort to train and promote the medical faculty. Nowadays more than half their faculty staff are Mozambicans, although the university remains dependent on expatriates as well. At Walter Sisulu University, the shortage of clinical faculty staff is relieved largely by partnerships with clinicians at local hospitals who are employed by the provincial Department of Health but obliged by their contracts to participate in teaching.

Loss of faculty staff at surveyed schools was substantial, with a median 10% of staff from 5 years ago no longer with the schools, and half of schools losing between 6% (25th percentile) and 18% (75th percentile) of teaching staff in 5 years. The greatest reason given for faculty loss was emigration (webappendix p 12). The percentage of vacant faculty positions was lowest in countries with a high GDP per head ($p=0·0084$), and highest in public medical schools ($p=0·0099$), by multiple linear regression. Most respondents (80 of 100) believed that doctor retention in their

country is a difficulty; however, only 51 listed any university-level steps taken to address the problem, most commonly salary increases or bonuses (20 respondents), strengthening programmes for postgraduate education (13), and community-based education (9).

(4) Weaknesses in medical education infrastructure

Deficiencies in medical education infrastructure are ubiquitous and restricting. At Jimma University, power, water, and telecommunications are unreliable, jeopardising training and innovation. At Ibadan University, informants expressed concern about daily power outages. Departments have to purchase generators for clinical and teaching functions. At Catholic University, challenges include an insufficient number of computers, restrictions in internet connectivity, and the absence of student hostels. Inadequate student housing near clinical sites is also a difficulty at Walter Sisulu University and Mali University.

The experience of the College of Medicine in Malawi is a good example of the role of partnerships to improve infrastructure. Assisted by funds from Sweden, Norway, and the Global Fund to Fight AIDS, Tuberculosis and Malaria, the school has constructed and improved lecture halls, libraries, hostels, computer facilities, offices, and recreational areas. These improvements accommodate larger class sizes and a growing faculty.

The study survey considered both the quality and quantity of specific physical and communications resources. Multiple linear regression explored relations between six summary resource scores (scores for buildings, libraries, laboratories, clinical sites, internet, and advanced information communication technology [ICT]) and various national and institutional factors (webappendix pp 13–14). High GDP was associated with high scores for five of the six resources, older schools had high scores for four, and public schools rated their resources as worse in three indicators. Schools charging higher tuition fees reported more advanced ICT resources than did those charging lower fees.

(5) Coordination between ministries of education and health

Insufficient coordination between ministries of education and health can be a barrier to medical schools' ability to increase the capacity of the health workforce. Coordination between these two ministries was a problem in almost all countries visited. The ministry of education generally provides funds for medical schools, whereas the ministry of health is the main employer of school graduates. In many countries, coordinated planning for budgets, priorities, and outcomes between ministries of health and education is poor, which contributes to inappropriate curricula and the graduation of doctors who cannot find employment in the country. In Mali and Sudan, the yearly number of medical graduates substantially exceeds the in-country capacity to hire new physicians, despite the need for health services.

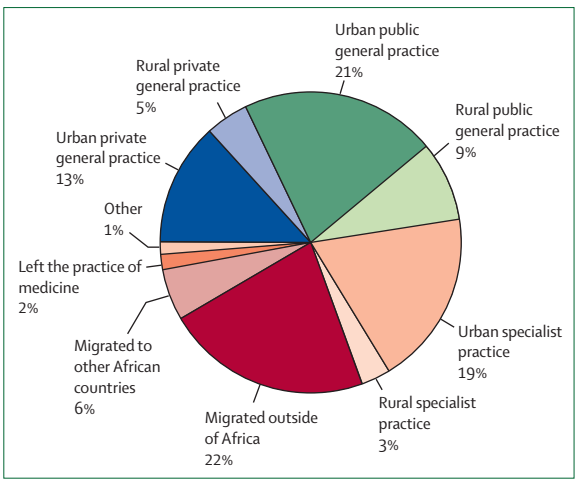

Figure 5: **Estimated location of graduates from medical schools in sub-Saharan Africa 5 years after graduation**
Data are mean reported percentage of graduates (N=62).

Overall, ministries of education seem to be more active in setting of medical school priorities than are ministries of health. 69 of 100 survey respondents reported that ministries of education either contribute substantially or are the main drivers of priorities, compared with 49 of 101 reporting that ministries of health are the substantial or main contributors. One survey respondent mentioned that an important innovation had been the transfer of supervision of the school from the ministry of education to the ministry of health.

(6) Accreditation and quality measurement

Accreditation and quality measurement are important developments to standardise medical education and physician capabilities. Various levels of accreditation and certification were noted in the countries visited. In Ethiopia, there is no official continuous accrediting body for medical schools. Accreditation is granted only when an institution is initially founded. However, many schools report progress in accreditation of institutions and assessment of graduates. In Mozambique, the newly formed Medical Council plans to develop accreditation standards for medical schools and external examinations for medical students. The Tanzanian Commission for Universities visits teaching institutions once before accreditation and then every 4 years. The Malawi Medical Council uses guidelines from the Southern African Development Community for accreditation and quality assurance.

(7) Educational planning focused on national health needs

Education planning focused on national health needs is improving the ability of medical graduates to meet such needs. Schools are increasingly emphasising community oriented, relevant, or nationally focused medical

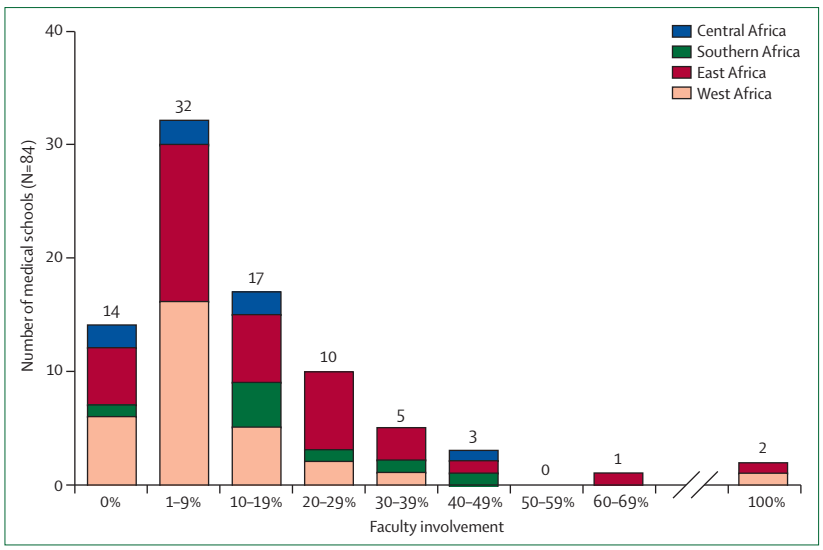

Figure 6: **Faculty involvement in grant supported research in medical schools in sub-Saharan Africa, by region**

education. Many of the schools are developing curricula around national priority health problems, and are using rural and community-based experiences to improve their programmes. Although some initiatives are undertaken by the schools alone, many are set in the context of government priorities and national service programmes.

In Malawi, the curriculum is designed to immerse students in local health issues. The curriculum focuses on the most common diseases and health disorders in Malawi and the surrounding region. At Gezira University, community-based courses make up 25% of studies, and many courses are undertaken at field sites including district hospitals, community health centres, clinics, and patients' homes. The Catholic University is incorporating management training for students, in recognition that some graduates will be serving in administrative positions as regional health officers or hospital chief medical officers after graduation.

(8) Importance of research

Beyond the creation of new knowledge, research is important for development of medical school faculties, retention of staff, and infrastructure strengthening. Many schools reported that research promoted staff recruitment and retention and attracted external partners. Older schools with stronger research portfolios continue to develop research programmes with use of established sources of funding, providing some capability to train young faculty members. However, although well established schools experience success in garnering research support, newer and smaller schools face a challenge. These schools often have younger faculty staff who do not have the training and mentorship to bid successfully for research grants. Additionally, staff shortages at many schools increase the teaching load, restricting time available to pursue research.

The University of Mali has purposefully built its research capacity over 30 years. Initial faculty members were sent abroad for graduate training, and returning graduates were guaranteed support. Present research faculty staff teach at the medical school, benefiting both staff and students. The University of Malawi collects 10% indirect costs from all research grants to create a financial base to support research. Their Research Support Centre assists the faculty in grant writing, research design, and grant administration, which further develops research capacity at the university increase salaries for research faculty staff.

Despite these examples, at most medical schools in sub-Saharan Africa less than 10% of faculty members are involved in sponsored research (figure 6). We compared the percentage of faculty members involved in grant-supported research with a series of potential predictive variables by multivariable linear regression. Although many universities provide several types of research support (webappendix p 15), only two types (provision of strengthened institutional research instruments such as research or ethics committees [p=0·0002] and provision of funded research time [p=0·049]) were significantly correlated with an increased percentage of faculty members involved in grant-supported research. The presence of research training programmes (internal or external) was not a significant factor. We recorded linguistic variation, with schools using English as a language of instruction having faculties more likely to participate in research (p=0·027) and Arabic speaking faculties being less likely to do so (p=0·047).

(9) Curricular innovations

Impressive curricular innovations are occurring in many schools. Survey respondents reported several non-traditional teaching methods used in medical schools in sub-Saharan Africa, including community-based education, problem-based learning, and multidisciplinary team-based learning (webappendix p 16). These three educational methods tended to be implemented together. Institutions using a higher degree of any of these instructional methods during the preclinical years were more likely to use the other methods during this period (p<0·0001 for each correlation), and institutions using more team-based learning during clinical years were likely to use more problem-based (p=0·0003) and community-based (p<0·0001) learning during this period.

Structured community exposure and community-based education provide students with experiences working with underserved populations and improve graduates' preparation to deal with national health problems. At Jimma University, community-based education is central to the educational mission, starting with a community-based training programme. Medical students begin work at community sites after successfully mastering tasks including data collection, community diagnosis, analysis, and preparation of a plan for an intervention for local problems. At the College of Health

Sciences at Makerere University, Uganda, a new curriculum includes regular exposure to patients in rural communities throughout medical school. At Gezira University, the curriculum includes community orientation, providing an organising principal for medical students, faculty staff, and graduates. A sense of social accountability is present in all aspects of education, and the school's community oriented mission is prominently displayed at the entrance to the medical school building. Faculty members in oncology, nephrology, and paediatrics commented to the site visit team about the continual effect of community oriented principles in their work.

(10) Significance of postgraduate medical education

Postgraduate medical education is an important aspect of a national health-system development strategy. Of 96 survey respondents who reported about their postgraduate programmes, 58 reported that clinical postgraduate programmes were offered, and 47 reported the number of graduates per year from these programmes. These 47 programmes included 1909 places for clinical postgraduate programmes, representing available places for less than 25% of the 7861 total graduates reported to the study. The most commonly offered postgraduate programmes were in internal medicine (14% of reported postgraduate medical education places), obstetrics and gynaecology (13%), paediatrics (13%), surgical subspecialties (11%), and general surgery (11%).

Makerere and Ibadan Universities have well developed systems of postgraduate medical education. Other schools offer fewer programmes for postgraduates, often paediatrics, surgery, and obstetrics/gynaecology, whereas a few have no postgraduate programmes. By increasing such programmes, schools have been able to retain more graduates and to hire some of the newly trained graduates as faculty members. Some schools implement so-called sandwich postgraduate programmes in which residents pursue the programme at home but spend time during training at a regional or international programme. This principle is intended to provide exposure to clinical work abroad while mitigating the tendency of doctors to remain abroad when all their training is done elsewhere.

(11) Quality of secondary schools

Variability in quality of secondary schools creates challenges in medical school admissions. Sound secondary education systems are prerequisites to success in medical school, but the quality of secondary education is not strong in many countries. As a result, many schools have developed preparatory or recruiting programmes for disadvantaged students. The Catholic University, Hubert Kairuki Memorial University, and the College of Medicine in Malawi have implemented preparatory years to assist students in meeting the demands of formal medical education. The Walter Sisulu University has established quotas by race to reflect the demographics of South Africa, and assesses applicants with a scoring system that includes motivation and commitment to service. Additionally, the first-term curriculum provides language instruction, computer training, basic science remediation, and a focus on study skills. A peer mentoring programme helps students to adjust to campus life.

(12) Private medical schools

Despite challenges, private medical schools represent an area of innovation and growth in medical education in sub-Saharan Africa. The first private medical schools opened in the 1990s, and private schools now constitute 21% (22 of 105) of all responding schools (figure 2). A search of databases suggests that a third (21 of 63) of non-responding schools are privately owned, which would mean that 26% (43 of 168) of currently operating medical schools are private schools. Supporters argue that the privatisation of medical education is in keeping with global trends in education, whereas others counter that this movement is largely commercial and inevitably inequitable.

Two of the ten schools visited were private institutions. The Hubert Kairuki Memorial University is a not-for-profit institution founded in 1997, which has earned a reputation for graduating high-calibre physicians. This university partners with public district hospitals to provide students with additional clinical teaching sites. The Catholic University is a faith-based, not-for-profit school founded in 1995. The university is a model of successful collaboration with the Government of Mozambique, the Catholic Church, and several international organisations.

(13) International partnerships

International partnerships are an important asset for many medical schools. Almost all medical schools in sub-Saharan Africa, including all schools visited, are engaged in collaborations locally and internationally, mainly with institutions in Europe, North America, and Africa (webappendix p 17). The University of Mali cooperates with the French Government, which has assisted them with programmes in community health practice and public health training. Mali has also developed research collaborations with European, North American, and other African universities. Makerere University has a long history of collaboration with foreign academic and non-profit organisations. These linkages have contributed to the school's research capabilities and training programmes. The University of Malawi exemplifies a so-called south–south collaboration, with its involvement in joint training programmes through the Southern Africa Human Capacity Development Coalition.

Discussion

We have noted a remarkable growth in medical education in the region over the past two decades, which began well before the attention by the international community to the massive shortage of health workers in the region. The decision of many countries to invest in building new

medical schools and expanding present ones, young people's intense interest in the study of medicine, and the emergence of private medical education all provide evidence of this movement. The obstacles to scale-up, however, remain substantial. Without larger and more stable health workforces, there is little chance of stemming the AIDS epidemic or realising the Millennium Development Goals in Africa. Many international organisations (including the US President's Emergency Plan for AIDS Relief, WHO, World Bank, the Global Fund, bilateral aid agencies, and philanthropies) have reached this conclusion.[9] The present global attention being paid to scale-up of health workforce makes this a favourable time for medical education in sub-Saharan Africa.

The universal insufficient numbers of faculty staff and the general disrepair of campus infrastructure are among the most prominent findings documented by this study. These findings are not surprising to anyone familiar with medical education in the region. Basic science and clinical faculty members are in short supply everywhere, severely restricting quality educational scale-up. Substantial deficiencies are often present in laboratories, libraries, classrooms, lecture halls, and hostels. The deficit in information technology and bandwidth is especially problematic, denying students the possibility of bypassing older learning methods to benefit from the rapidly advancing developments in internet-based learning. The study documented the consistency and magnitude of these problems, establishing a baseline from which to pursue scale-up.

The convergence of global attention and clear specification of impediments facing the expansion of medical education create a moment of opportunity. National authorities and international partners working together with medical colleges have the possibility of creating new, collaborative investment strategies, developing long-term commitments for conjoint funding with use of mechanisms such as endowment funds for faculty enhancement, dedicated funds for new laboratories and computer needs, or umbrella funding to support north–south or south–south partnerships between universities.

An unforeseen aspect of this study was the opportunity it afforded African medical education leaders to meet and work together. Twice previously (in the 1960s and the 1990s) an African Medical Schools Association was initiated but not sustained.[10] Most medical education policy in Africa has centred on programmes and issues within countries, with little opportunity to discuss common problems and solutions between countries. The opportunity afforded by this study for educational leaders to visit elsewhere in Africa to compare programmes and policies proved very instructive and energising. A revitalised African Medical Schools Association would be in a position to have an important role in the expansion of medical education in sub-Saharan Africa, including data collection for existing programmes, documentation of best practices, promotion of accreditation and certification initiatives, and updates on present and developing medical schools.

This study also noted an important change in the role of postgraduate medical education in sub-Saharan Africa. Positions in postgraduate medical education programmes are not plentiful in most African countries. Many African medical graduates seeking advanced training travel to Europe and North America, and many do not return. To train more graduates in basic specialties and to stop the emigration of young graduates, many countries are now opening and expanding postgraduate medical education programmes. This trend will be essential to build sustainable, quality physician cadres in all countries and to improve the ranks of medical school faculties.

The study was not modelled on any previous work but succeeded in creation of a data gathering strategy that is unique and potentially applicable to studies of other geographical areas in which information about health professional education is not well developed. The key characteristics of the study structure were: (1) literature review and key informant interviews to establish baseline knowledge; (2) appointment of an advisory board of educators and policy leaders from the area of study to provide perspective, advice, findings analysis, and conclusion framing; (3) data gathering with qualitative (structured site visits) and quantitative (survey) instruments, both involving primary participation by the advisory board; and (4) inclusive (advisory board and secretariat) engagement in analysis, writing, editing, and publishing.

Limitations

This study had several limitations. The published work about medical education in Africa was mainly in English. Articles written in French were fewer, and in Portuguese and Arabic rare. Although attempts were made to identify more non-English articles with the assistance of study Advisory Committee members, few were found. The preponderance of Anglophone Advisory Committee members and staff also restricted the study's use of non-English sources of information. Of the ten site visited schools, two (in Mali and Côte d'Ivoire) were French speaking (one less than population parity would warrant), six were Anglophone, one was Lusophone, and one was Arabic speaking. The under-representation of Francophone countries occurred despite several attempts to establish contacts with schools in the Democratic Republic of the Congo, Senegal, and Cameroon. Similarly, the survey responses showed some regional under-representation, with lower response rates in countries such as the Democratic Republic of the Congo, Angola, and Sudan. 22 schools were not surveyed because they were founded or identified after the study was completed.

Survey limitations included the subjective nature of several questions, unanswered questions in surveys of some individual schools, and inconsistently answered questions from schools within the same countries. Questions such as the proportion of income from various

***Panel:* Recommendations to promote and improve medical education and population health in sub-Saharan Africa**

1. Launch campaigns to develop capacity of medical school faculties, including recruitment, training, and retention
2. Increase investment in medical education infrastructure
3. Build structures to promote interministerial collaboration for medical education
4. Fund research and research training at medical schools
5. Promote community oriented education based on principles of primary health care
6. Establish national and regional postgraduate medical education programmes to promote training, excellence, and retention
7. Establish national or regional bodies that are responsible for accreditation and quality assurance of medical education
8. Increase donor investment in medical education aligned with national health needs
9. Recognise and review the growing role of private institutions in medical education
10. Revitalise the African Medical Schools Association

sources, reasons for staff loss, and graduates' emigration and practice choices were usually estimates by respondents rather than data-based answers. Neither the survey nor site visits assessed graduate competencies because of the absence of established regional standards of educational quality.

Unanswered questions within returned surveys proved problematic. Some questions were understandably omitted by specific schools, such as questions about graduates from schools that had yet to graduate students. When questions were left unanswered without explanation, attempts were made to contact respondents to complete questionnaires. The number of responses to each relevant question is reported for each finding. In some cases, inconsistent answers pertaining to national requirements were found in schools in the same countries. For example, eight countries with multiple schools responding gave inconsistent answers about whether a compulsory service requirement exists in their country.

Conclusions and recommendations

This study analysed the workings of African medical schools during 2 years of investigations. Advisory Committee members felt that the perspectives they had developed in this work warranted collective recommendations about actions that should be taken to promote and improve medical education and, in turn, population health in sub-Saharan Africa. A set of recommendations was drafted, circulated to all participants in the study, discussed, modified, and ratified at a study meeting in Dar es Salaam, Tanzania, on April 16, 2010. The panel shows these recommendations.

We hope that the work of the Sub-Saharan African Medical School Study and its recommendations will catalyse further innovation and investment in medical education in sub-Saharan Africa. This action, in turn, should help to produce a more robust workforce with the aim of improved health in Africa.

Contributors

All authors contributed to the research for this article. FM, SF, FO, SRG, EB, and CC contributed to the design of the article; FM, SF, CC, SRG, TW, and HR to the writing of the article; and EB, CC, FM, SF, and TW to the data analysis.

Conflicts of interest

FO, PR, and NKS received grant funding from the Bill & Melinda Gates Foundation. HA, SC, EB, CC, JC, SBC, SF, SRG, TH-M, EH, LJ, FM, HR, and TW received salary indirectly from grant funding from the Bill & Melinda Gates Foundation. AH, EB, MJ-MID, DEEA, JF, JI, MJ, GLM, EOO-O, FO, and NKS received honoraria indirectly from the Bill & Melinda Gates Foundation. EH and A-JN received a consulting fee indirectly from the Bill & Melinda Gates Foundation. AH, HA, SBC, EB, CC, JC, SC, MJ-MID, DEEA, JF, SF, SRG, EH, JI, MJ, MM, GLM, FM, A-JN, HR, EOO-O, FO, PR, and NKS received support for travel to the African Medical Education Symposium for study purposes. EB, CC, JC, MJ-MID, TH-M, JI, MJ, LJ, MM, GLM, FM, A-JN, EOO-O, FO, PR, and NKS received support for travel to the initial study meeting in Kampala, Uganda, for study purposes. CC, JC, JI, MM, GlM, FM, AN, HR, EOO-O, FO, PR, and NKS received support for travel to site visit meetings for study purposes. AH, EB, MJ, A-JN, and NKS received fees for participation in review activities such as data monitoring boards, statistical analysis, endpoint committees, etc. AH, EB, and A-JN received payment for writing or reviewing the report. AH and EB were provided administrative support. The following authors state that they have received other grants or have grants pending from the Bill & Melinda Gates Foundation: CC will travel to a meeting in Kampala, Uganda, in November, 2010; NKS is part of a subcontract for a twinning grant for Makerere University to Johns Hopkins University; and MJ-MID and NKS received funds to organise site visits by the study team to their institutions. All other authors declare that they have no conflicts of interest.

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