Training the Next Generation of African Pathologists

Ann Marie Nelson, MD[a,b,*], Martin Hale, MB ChB, FCPath (Anat) SA[c], Mohenou Isidore Jean-Marie Diomande, MD, FWACP[d], Quentin Eichbaum, MD, PhD, MPH, NNHC, JD[e], Yawale Iliyasu, MD[f], Raphael M. Kalengayi, MD, MMedSC, SpPath, PhD[g], Belson Rugwizangoga, MD, MMed(Path)[h], Shahin Sayed, MMed(Path)[i]

KEYWORDS

• Global health • Pathology • Training • Accreditation • Quality

KEY POINTS

- Access to and availability of health care depend on adequate, well-trained health care providers.
- The current state of pathology workforce and training faces challenges to recruitment and retention of staff, development of standards and credentialing, and reliable funding.
- The cost of training is paid by the trainee in several countries and, coupled with poor salaries, creates a significant barrier to recruitment and retention of good trainees.
- Government salaries are often inadequate, forcing trained physicians and technical staff to seek employment in the private sector or to emigrate to countries with better opportunities.

Continued

Disclosure Statement: The authors have nothing to disclose.

[a] Department of Pathology, Duke University School of Medicine, Durham, NC 27710, USA; [b] InPaLa Consulting, 1330 Floral Street NorthWest, Washington, DC 20012, USA; [c] Department of Anatomical Pathology, National Health Laboratory Service, University of the Witwatersrand, 7 York Road, Parktown, Johannesburg, 2193, South Africa; [d] UFR Sciences Médicales, Université Félix Houphouët-Boigny, 01 BP V166, Abidjan 01, Côte d'Ivoire; [e] Department of Pathology, Microbiology and Immunology, Vanderbilt University Medical Center, The Vanderbilt Clinic, 4511C, Nashville, TN 37232, USA; [f] Department of Pathology, College of Medical Sciences, Ahmadu Bello University, Samaru, Zaria, Kaduna State 810001, Nigeria; [g] Department of Pathology, University of Kinshasa, Kinshasa 11, Democratic Republic of Congo; [h] University of Rwanda School of Medicine and Pharmacy, Avenue d'Armee, PO Box 3286, Kigali, Rwanda; [i] Department of Pathology, Aga Khan University Hospital, 3rd Parklands Avenue, P.O.Box 30270, Post code 00100, Nairobi, Kenya

* Corresponding author. InPaLa Consulting, 1330 Floral Street NorthWest, Washington, DC 20012.
E-mail address: amnpath62@gmail.com

Clin Lab Med ■ (2017) ■–■
https://doi.org/10.1016/j.cll.2017.10.004 **labmed.theclinics.com**

Continued

- These case studies demonstrate features required for successful training: a reliable funding source, adequate numbers of qualified teachers, access to training material and procedures, and opportunities for meaningful work and advanced training.
- Creation of regional colleges of pathology holds the promise of more uniform training standards, the ability to share workforce between countries, and the ability to advocate for better funding and for national health plans that include pathology and laboratory diagnoses.

INTRODUCTION

Quality patient care should be the goal of health care systems at all levels and in all settings. Pathology and laboratory medicine have been the missing links in global health programs that have been developed and implemented over the past few decades. For example, disease and cause of death data based on clinical impression or verbal autopsies reflect the basic demographics of the population or the disease category, but may not recognize the actual condition, whether an infection or a noncommunicable disease.[1,2] The double burden of communicable and noncommunicable diseases makes histologic diagnosis and more complex clinical laboratory capability a priority. With the introduction of precise therapy, the need for a precise diagnosis is critical.

Although no clear guidance has been issued from international health organizations indicating the number of pathologists (anatomic and clinical) required per capita for adequate health care, the number in low- and middle-income countries (LMIC) is clearly insufficient. Because the current workforce is so overburdened, the quality of a pathologist's professional performance is likely to suffer. Exacerbating the staffing shortage is a concomitant scarcity of trained laboratory technologists, histotechnologists, and cytotechnologists.[3] Beyond insufficient personnel, pathologists in many developing countries have little or no access to current, relevant medical literature or to continuing education programs. In addition, infrastructural support is either lacking or poorly maintained, further contributing to poor professional performance.

In this article, the authors focus on African training activity (primarily anatomic pathology) with several case studies; address challenges; and discuss current efforts to create regional standards.

HISTORICAL PERSPECTIVES

Postgraduate training in pathology was formally established in South Africa by the South African Institute for Medical Research (SAIMR) in the late 1940s with a 3-year postgraduate fellowship in Clinical Pathology, later extended to 4 years. Many graduates of this program went on to become heads of departments of pathology at other universities in South Africa. Because of limited postgraduate training positions, several of these graduates pursued specialty training overseas in countries such as the United Kingdom; the Diploma in Clinical Pathology from the Hammersmith Hospital was a revered qualification.[4] Many of the illustrious names in the history of pathology in South Africa and Rhodesia (now Zimbabwe) obtained this qualification, going on to establish postgraduate training programs of their own, the fruits of which continue to this day.

With the passage of time, countries in Southern Africa established their own postgraduate qualifications and examining bodies. South Africa was the first of these,

with the Colleges of Medicine of South Africa in 1954, the College of Pathologists being part of this structure. In addition, universities created the Master of Medicine (MMed) degree, with both the College fellowship and university degrees offering these in the individual disciplines of pathology. The MMed concept has extended to other universities in Botswana, Zimbabwe, Zambia, and East Africa.

The University College Ibadan, Nigeria commenced clinical teaching in October of 1957, the same year the Faculty of Medicine was formed and the University Teaching Hospital was opened. Professor G.M. Edington was named chairman of the Department of Pathology in 1960 and started training Nigerian pathologists, while Uganda started pathology training at Makerere University in 1960s.

The Catholic University of Lovanium in the Belgian Congo was founded in 1954, followed in 1956 by a Faculty of Medicine and a Hospital (Cliniques Universitaires de Léopolville) with the Department of Anatomical Pathology starting in 1959. After independence in 1960, the country became the Democratic Republic of Congo (DRC), and Leopoldville was renamed Kinshasa. In 1965, the University became known as the Lovanium University of Kinshasa (UNIKIN) and the Teaching Hospital, Cliniques Universitaires de Kinshasa.

In 1972, Lovanium University was nationalized and renamed the UNIKIN. Between 1968 and 1976, a Congolese medical doctor was sent to Belgium for pathology training and obtained his PhD. Professor R.M. Kalengayi returned to UNIKIN to establish a diagnostic service as well as undergraduate and postgraduate training in pathology.

APECSA (Association of Pathologists of East, Central, and Southern Africa) was established in November 1990 in order to improve communication with organizations interested in pathology education and to coordinate activities within the region. The Society was formed based on the recommendations of a survey on medical training conducted in 1985 by Professor M.S.R. Hutt. Professor Hutt and Professor Sebastian Lucas (UK) specifically looked at diagnostic and training capacity in pathology at medical schools within East Africa, including the number of histopathologists, clinical pathologists, and trained technical staff.[5,6] In order to update this information and reassess pathology capacity on the continent, some of the original APECSA members together with InPaLa, an international group of pathologists associated with the International Academy of Pathology, developed an on-line survey (see later discussion).

As described above, the medical education programs in Africa were established within public universities and hospitals. The same is true today. The challenge of poverty and emerging economic classes creates the need for a vast public health system, which includes pathology and laboratory services for those who cannot afford private health care. Most of the population in most countries in this region seeks care in public institutions. South Africa and Kenya have expanding numbers of private hospitals and medical specialists to accommodate the health care needs of those who can afford care. Many other countries have private laboratories, often in the capital or other major cities, that charge fee-for-service to both private and public practitioners because many university and public hospitals do not have access to equipment and reagents to perform diagnostic tests. Patients with adequate financial resources often travel to other countries for specialized diagnosis and care.

PATHOLOGY TRAINING IN SUB-SAHARAN AFRICA

Data on training are taken from the survey of pathology capacity in sub-Saharan Africa that was conducted between 2011 and 2014. The information requested included numbers of pathologists and technicians, training positions, workload and workflow,

infrastructure, and availability of cancer care.[3,7] The data were organized by region (East, West, Southern, and Francophone Africa; **Box 1**). Missing information was gathered through the end of 2015 via extensive additional e-mails and one-on-one discussions with working pathologists and clinicians in Africa. Medical school data were obtained from the sub-Saharan Africa Medical Schools Study (SAMSS.org). Complete survey data with interactive details on pathology capacity in Africa can be found at the African Strategies for Advancing Pathology (ASAP)[8] Web site (pathogyinafrica.org).

Although there are currently pathology training programs in 25 countries (**Fig 1**), the rate of training is not sufficient for the needs of the regions. From conversations, it can be estimated that less than 1% of medical graduates opt for training in pathology, but there are no reliable data. Factors that hamper recruitment of trainees and retention of profession staff include poor salaries compared with other specialties, such as surgery and medicine; inadequate provision of laboratory facilities and supplies; and limited opportunities for continuing education. All these lead to lack of job satisfaction. The need to seek additional salary through the private sector further depletes the public workforce.[9]

Data Summary by Region

Southern Africa: 7 countries

South Africa accounts for nearly one-third of all pathologists in Africa with 285 anatomic pathologists and 75 trainees (Case Study 1). Zimbabwe has 5 pathologists and 2 trainees. Botswana employs 6 pathologists from other countries and currently has 5 national trainees; Namibia also uses a foreign work force of 5 pathologists. There are 3 pathologists in Madagascar, but none in Swaziland or Lesotho.

Francophone sub-Saharan Africa: 18 Countries

At the time of the survey, there were 83 pathologists in 15 countries. Since that time, Guinea and Benin have each added 2 pathologists on site. The DRC (Case Study 2) and Côte d'Ivoire (Case Study 3) have the most, but still fall significantly below 1 per million population. (Rwanda is the only country in the region that has improved the number of pathologists per million people, but now affiliates with Anglophone East Africa [Case Study 6]).

Eleven countries have a total of 53 pathologists in training in the region. In most programs, the cost is paid by the trainee. Chad sends residents to other African countries for training; Burundi had to cancel their program because of a lack of funds.

Lusophone Africa: 4 countries

Guinea Bissau and Cape Verde are included in the Francophone countries but have no public-sector pathologists. Angola has 12 pathologists and 4 trainees. Mozambique currently has 8 pathologists and 4 trainees.

Anglophone sub-Saharan West Africa: 5 countries

Nigeria has 150 pathologists and 20 training programs for Anatomic Pathology with greater than 200 trainees in 5-year programs that are paid for by the government (Case Study 4). Ghana has 30 pathologists (3 of whom are Nigerian) and 2 training programs with 5 trainees. Liberia, Sierra Leone, and Gambia had no pathologists at the time of the survey.

Anglophone East Africa: 9 countries

Seven countries have a total of 178 pathologists. Kenya has the most with 60 (25% in private practice). The University of Nairobi has greater than 20 trainees, including a few international participants from other countries in the region. Tuition is required, but the

Box 1
Countries of sub-Saharan Africa by region, as discussed in the survey

Francophone Africa

Benin
Burkina Faso
Burundi
Cape Verde
Cameroon
Chad
Côte d'Ivoire
Central African Republic
Democratic Republic of Congo
Gabon
Guinea
Guinea-Bissau
Mali
Mauritania
Niger
Senegal
Republic of Congo
Rwanda[a]
Togo

West Africa: Anglophone

Ghana
Nigeria
Gambia
Liberia
Sierra Leone

East Africa

Ethiopia
Kenya
Malawi
South Sudan
Tanzania
Uganda
Zambia

Southern Africa

Angola
Botswana
Lesotho
Madagascar
Mozambique
Namibia
South Africa
Swaziland
Zimbabwe

[a] Now associates with East Africa.

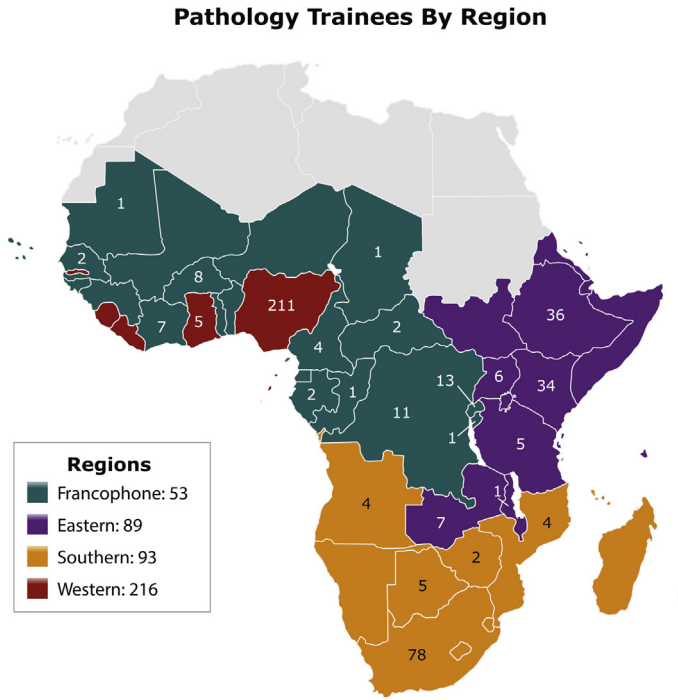

Fig. 1. Map of sub-Saharan Africa showing number of residents in countries of each region (data are from 2015 and differ from some information in the case studies). (*Data from* December 2015 based on African Strategies for Advancing Pathology Survey.)

Kenyan government pays for those employed by the Ministry of Health. Aga Khan now has a training program with 4 residents per year whose tuition is paid by the institution (Case Study 5).

Uganda lists 24 pathologists, but not all work in surgical pathology and some are working in other countries. They have 6 slots for training, but students must pay their own tuition, and trainees from other countries fill several of the positions. Tanzania has 22 pathologists with 5 trainees; Malawi, 9 pathologists and 1 trainee, and Zambia, 6 pathologists with 7 trainees. Ethiopia had only 1 pathologist in 1990, and now has 55 with 36 trainees. South Sudan did have 2 pathologists, but the health system functions poorly because of the civil war. The authors have no data on Djibouti or Somalia.

STRATEGIES AND RECOMMENDATIONS MOVING FORWARD

What approaches should be considered in expanding the pathology workforce? What are the essential factors required for success?

Case Studies

Five of the case reports detail training programs in each of the regions and were chosen to demonstrate successes and challenges in the training programs (Appendix 1). The first 4 are in large government medical schools and hospitals. South African medical education systems are the oldest and have well-developed standards of training and accreditation. DRC and Côte d'Ivoire were the first in Francophone Africa. Amado Bello in Nigeria was created in order to expand medical care and training to northern

Nigeria. Unlike the first 4, Aga Khan is a private health and hospital system that developed postgraduate training to fill clinical needs and is adding a medical school. Each of these programs serves as a source of trained pathologists for the rest of the country as well as the region.

The final case study for Rwanda is included to describe what is required to start, de novo, a pathology training program and to demonstrate challenges to building and sustaining a quality education that is an integral part of a functional health system.

Challenges for Medical Training in Low-Resource Settings of Africa

Regional harmonization of curricula and certification

Medical education in low-resource settings faces unique challenges but also presents specific opportunities. The landmark *Lancet* report of 2010 on "Health Professionals for a New Century" by Frenk and colleagues[10] emphasized the importance of linking health education curricula to local health needs and contexts.

The approach to pathology education is arduous given the continent's severe shortages of qualified pathology professionals and education facilities, the establishment of Economic Community of West African States (ECOWAS), College of Pathology of East, Central, and Southern Africa (COPECSA), and the South African pathology standards, as well as the efforts toward stepwise accreditation for pathology laboratories are highly laudable moves in the right direction, and the efforts of these bodies should be strongly supported. Development of local standards of assessment and accreditation is important for sustainability of pathology education on the continent and ultimately serves the interests of faculty recruitment and retention. The brain drain of pathology professionals, not only to HICs but also to the private sector within African countries, detracts from the much-needed educational efforts for training and capacity building of pathologists on the continent. This issue clearly requires urgent attention.

Finally, because pathology as a discipline asks fundamental questions pertaining to the scientific basis of disease, the issue arises of how much support should be given to research. Students drawn to pathology are curious about pathogenesis and may wish to undertake research. If resources were not limited, the answer to this question would be a simple "yes." However, in settings of limited resources providing such opportunities presents a nettlesome dilemma because it may both enhance faculty retention in academic pathology departments and also siphon away financial resources needed for education and training of increased numbers of diagnostic anatomic and clinical pathologists. Any research partnerships should include agreements to avoid this problem.

National and regional collaboration on requirements is necessary to assure a more uniform content and quality of education and to assess competence of trainees. South Africa developed training and accreditation standards more than 50 years ago. The ECOWAS recently developed and came to a consensus on a harmonized curriculum. The COPECSA has formulated a curriculum that will soon be approved (Appendix 2)

Quality assurance and the role of technical staff

Pathology and laboratory medicine are disciplines that require reliable and reproducible results. Specimen handling from procurement to fixation, processing, and staining/testing must meet standards to assure accurate interpretation, making it essential to have qualified, trained personnel in the laboratories. It is critical that full cognizance is given to meeting accepted accreditation standards, be it in the teaching and training environment or in the clinical practice setting.

Further data

Additional data are needed to formulate guidelines on establishing or modifying pathology training programs, to determine what is required for sustainability, and to monitor and evaluate impact. The American Society for Clinical Pathology (ASCP) is working on an updated survey by country and by individual institutions that will provide greater detail on current staffing and training as well as national strategies, funding, partners, and other factors related to training outcomes. It is important that the data are kept as current as possible in order to reflect improvement and identify areas of need.

SUMMARY

The ever-increasing demands of medical care, brought about by population growth, complexity and depth of medical investigation, the looming era of personalized medicine, and therapy require fully functional, integrated pathology that is not an add-on to health care but stands at the center of the health care delivery process.[11,12]

Although this may be seen as an impossible task, with the right approach, departments of pathology can be rebuilt, but requires strong, focused leadership from within the specialty accompanied by financial and institutional support for a sustained period of time. As these departments grow, develop critical mass, and become self-sustaining, they can be used to extend and support other training platforms, either by using a "hub-and-spoke" concept or by setting up "twinning program", whichever is most suitable. Unfortunately, all too often, support begins to wane as administrators seek to control budgets; soft targets such as teaching platforms, particularly successful ones, are the first to feel the squeeze, and it is only a matter of time before the impetus is lost. External partnerships provide valuable transfer of knowledge and technology, subspecialty training, and mentoring, but these are short- to mid-term solutions.[2]

Pathology is accustomed to some degree of relegation the world over, but this is exacerbated in LMIC. If this hard-won pathology education is to be used to the fullest, it is essential that there is political buy-in accompanied by local ownership and support so that health care can be delivered to those who desperately need it. The evidence presented in this article suggests that the tide may be turning, and the ripples of change need to be supported by the international community to turn this into a tsunami.

ACKNOWLEDGMENTS

Drs Ephata Kaaya, Zahir Moloo, and Robert Lukande and Ms Diane Sterchi provided information on training. Mr Jack Chirieleison created the graphics.

REFERENCES

1. Fligner CL, Murray J, Roberts DJ. Synergism of verbal autopsy and diagnostic pathology autopsy for improved accuracy of mortality data. Popul Health Metr 2011;9:25.
2. Carlson JW, Lyon E, Walton D, et al. Partners in pathology: a collaborative model to bring pathology to resource poor settings. Am J Surg Pathol 2010;34:118–23.
3. Nelson AM, Milner DA, Rebbeck TR, et al. Africa: pathology in the sub-Sahara. In: Boyle P, Ngoma T, Sullivan R, et al, editors. The state of oncology in Africa 2015. Lyon (France): iPRI Scientific Publication; 2016.
4. Mills A. A pathologist remembers. Memories of childhood and later life. Bloomington (IN): AuthorHouse UK Ltd; 2013. 1663 Liberty Drive.

5. Hutt MS, Spencer H. Histopathology services for developing countries. Br Med J 1982;285:1327.
6. Lucas SB. Report on pathology in sub-Saharan Africa. Inaugural Meeting of Association of Pathologists of East, Central and Southern Africa (APECSA). Dar es Salaam 1990 (includes data from study by Prof MRS Hutt).
7. Nelson AM, Milner DA, Rebbeck TR, et al. Oncologic care and pathology resources in Africa: survey and recommendations. J Clin Oncol 2016;34:20–6.
8. African Strategies for Advancing Pathology Group Members. Quality pathology and laboratory diagnostic services are key to improving global health outcomes. Am J Clin Pathol 2015;143:325–8.
9. Kaschula ROC. The practice of pathology in Africa. Arch Pathol Lab Med 2013; 137:752–5.
10. 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(9756):1923–58.
11. Robboy SJ, Weintraub S, Horvath AE, et al. Pathologist workforce in the United States: I. Development of a predictive model to examine factors influencing supply. Arch Pathol Lab Med 2013;137:1723–32.
12. Bainbridge S, Cake R, Meredith M, et al. Testing times to come: an evaluation of pathology capacity across the UK. Report of Cancer Research UK. 2016. Available at: https://www.cancerresearchuk.org/sites/.../testing_times_to_come_nov_16_cruk.pdf. Accessed June 7, 2017.
13. Available at: http://www.health.uct.ac.za/fhs/about/history. Accessed June 4, 2017.
14. Marais Malan. In quest of health: the South African institute for medical research 1912-1973. Johannesburg (South Africa): Lowry Publishers; 1988.
15. Available at: http://isystems.hpcsa.co.za/iregister/RegisterSearch.aspx. Accessed June 7, 2017.
16. Available at: http://cs2016.statssa.gov.za/. Accessed June 7, 2017.
17. Available at: http://www.gov.za/ABOUT-SA/HEALTH#sefako. Accessed June 7, 2017.

APPENDIX 1: CASE STUDIES OF CURRENT TRAINING MODELS

Case Study 1: South Africa by Martin Hale

In order to gain specialist registration with the Health Professions Council of South Africa (HPCSA), a 4-year training period in one of the pathology disciplines at an accredited institution is required, terminating with a single exit examination in the discipline concerned convened by the College of Pathologists. Often the training period is extended, particularly in Anatomical Pathology consequent to its extensive knowledge base, with most trainees writing the specialist examination after 5 years.

Medical education in Southern Africa had its beginnings with the establishment of medical schools in the region, the first at the University of Cape Town, the faculty being established in 1912.[13] This was followed soon after by the establishment of the SAIMR, also in 1912. The SAIMR was from its early days closely associated with, and indeed played an instrumental role in, establishing a medical school within the University College, later to become the University of the Witwatersrand.[14] This close association continues to the present day, paving the way for the creation of the concept of joint posts between the SAIMR and the University of the Witwatersrand, with the School of Pathology being formalized between the 2 institutions in 1970. This allowed full integration of the teaching, research, and service responsibilities. Although this arrangement at times creates elements of disagreement and friction

between the parties concerned, there is no doubt that it is on the whole beneficial to all and is a model that should be considered for implementation in other LMICs, bringing with it economies and efficiencies not seen with divided models.

The training of anatomic pathologists in South Africa is a joint responsibility of the universities and the National Health Laboratory Service, the universities comprising Sefako Makgatho University of Health Sciences, University of Pretoria, University of the Witwatersrand, University of KwaZulu-Natal, University of the Free State, Walter Sisulu University, Stellenbosch University, and the University of Cape Town. Training includes the full spectrum of anatomic pathology inclusive of immunohistochemistry, electron microscopy, and molecular pathology. Currently, there are 114 registrar posts recognized by the HPCSA, with only 75 occupied, a situation that requires immediate attention. Indeed, the number of funded registrar posts needs to be significantly increased over and above these to meet existing and future health care needs.

In common with the rest of the world, there is an acute shortage of anatomic pathologists practicing in South Africa, with the number registered being 285, although review shows that this includes retired professionals and those practicing outside the country, between them, probably accounting for approximately 50 to 100 of these.[15]

The current population of South Africa is 55.6 million, of which 8.8 million have private health insurance.[16,17] Compounding the limited number of anatomic pathologists is the knowledge that the majority by far are in the private sector serving approximately 8.8 million lives, with approximately 50 anatomic pathologists in the public sector providing care to 80% of the population (44.5 million). This results in ratios of pathologists to the population cared for in the public sector that are very similar to countries in East Africa.[9]

Case Study 2: Democratic Republic of the Congo by Rafael Kalengayi

Since 1976, 27 pathologists have been trained with 8 attaining a PhD in the DRC or abroad; 5 of the 8 are practicing and teaching pathology in the DRC. Of the remaining 22, 13 are practicing in-country and 6 are scattered across the world (United States, Europe, Japan, and sub-Saharan Africa).

Currently, there are 12 laboratories in the DRC, with 8 of these in Kinshasa and one each in Kimpese, Lubumbashi, Bukavu, and Goma staffed by 8, 2, 3, 2, and 1 pathologists, respectively. Postgraduate training takes place in 2 sites, Kinshasa and Lubumbashi, the former currently having 20 residents (the number has increased since 2014).

Case Study 3: Cote d'Ivoire by Isidore Diomande

The Faculty of Medicine of Abidjan, created in 1966, is part of the University Felix Houphouet-Boigny of Cocody-Abidjan. It has 3 teaching hospitals, 2 of which have Anatomic and Clinical Pathology (Cocody and Treichville). Cocody has a workload of 4000 specimens per year (2/3 Anatomical Pathology [AP], 1/3 Clinical Pathology [CP]), while Treichville receives 5000 to 6000 specimens (2/3 AP, 1/3 CP). Cocody Hospital has 4 pathologists and 5 histotechnicians; Treichville Hospital has 5 pathologists and 2 histotechnicians. Automated immunohistochemistry has been available since 2013, consequent to a partnership between Roche Laboratory and the Ivorian Government to support the diagnosis and treatment of breast cancer, the predominant cancer in women. Mammography, including core breast biopsies, Her2, ER, and PR testing, are routinely used; Roche subsidizes the cost of chemotherapy.

Teaching in anatomic pathology started in 1970 with Professor Robert Loubière from France, seconded by 2 Ivorian assistants (Prof E. Marcel and the late Prof D. Akribi) and 2 French assistants. Since 1980, the training staff is exclusively composed of Ivorians. The specialty training program started in 1991 with trainees from Cote

d'Ivoire, Burkina Faso, Mali, Congo Brazzaville, Central Africa Republic, Mauritania, Senegal, Togo, and Chad. To date, 22 pathologists have been trained. Foreign pathologists have returned to their countries, and Ivorians are practicing in Abidjan and Bouake.

The training program encompasses 4 years and includes a limited rotation and a research component for the preparation of a dissertation. Ivorian trainees are charged an annual tuition fee of 1150 USD while their international counterparts pay 1700 USD per annum.

Case Study 4: Nigeria by Yawale Ilyasu

Ahmadu Bello University (A.B.U.), located in Zaria and the first university in North Western Nigeria, was founded in 1962. It has 2 campuses, the Samaru main campus, which includes the Faculty of Medicine among others, and the Congo campus, which hosts the faculties of Administration and Law. The Faculty of Medicine has a large medical program with its own teaching hospital, the A.B.U. Teaching Hospital (ABUTH, Zaria), one of the largest hospitals in Nigeria and Africa.

The Department of Pathology (Morbid Anatomy/Anatomic Pathology) was established in 1972 and is the pioneer department of the other 3 clinical pathology departments in A.B.U./ABUTH, Zaria. The department has a dual role of training and clinical laboratory diagnostic services carried out by 13 pathologists, 9 resident pathologists, laboratory technicians, and the secretarial staff. The other 3 clinical pathology departments have 23 fellows, including 11 hematologists, 7 medical microbiologists, and 5 chemical pathologists and several laboratory technicians and secretarial staff.

The department's academic programs, in addition to residency training in Pathology, which began in 1979, include training of medical students of A.B.U. and other undergraduate students of Pharmacy and Nursing Sciences and postgraduate master and doctorate degrees in Pathology (Clinical Laboratory Management).

Annually, the department processes and reports on 3500 histopathologic specimens, 2000 cytopathologic slides, performs variable numbers of postmortem examinations, and hosts clinicopathologic meetings with the surgeons. Residents in pathology rotate to each pathology department for a period of 3 months. In addition, those in anatomic pathology undertake an additional 6 months doing autopsy pathology in centers such as Ibadan, Oyo State, and Lagos, in the southern part of the country, where there is better exposure.

In the last 5 years, the Department of Anatomic Pathology has produced 14 fellows of both the National Postgraduate Medical College of Nigeria and the West African College of Physicians: 4 were retained, 2 are post–fellowship residents, 4 are in other teaching hospitals, 3 are in various federal medical centers, and 1 is in a specialist hospital. The clinical pathology departments produced 22 fellows in the same period: 10 in hematology and blood transfusion, 7 in medical microbiology, and 5 in chemical pathology.

Case Study 5: Aga Khan, Kenya by Shahin Sayed

The Aga Khan University (AKU) is an international university, which was chartered in Pakistan in 1983. In East Africa, AKU comprises the School of Nursing, the Medical College, the University Hospital, and an Institute of Educational Development. The University (East Africa) has been offering Masters Programs in Internal Medicine, Surgery, Diagnostic Radiology, Pediatrics, Anesthesia, Anatomical Pathology, and Clinical Pathology since 2006. All programs are approved by the Commission for Higher Education and the Medical Practitioners and Dentists Board of Kenya. The undergraduate program in Medicine and Surgery will begin in 2020.

There is an acute shortage of medical specialists and subspecialists within the East African region and especially in pathology. The AP and the CP programs at AKU were established in response to national and regional priorities, there being only one other training program in Pathology (AP/CP combined) offered by the University of Nairobi.

The programs in AP and CP are each 4 years in duration. Currently, there are 8 residents in each program (2 per year); however, there is an allowance for supernumerary positions (one in CP and one in AP). A total of 7 full-time faculty in AP and 8 full-time subspecialty faculty in CP oversee the program. In addition, a part-time faculty is in charge of the forensic pathology teaching. The eligibility criteria for residency include an undergraduate degree in Medicine recognized by the Kenya Medical and Dentist's Board of Kenya and the passing of a vigorous residency interview process at AKU.

Since the inception in 2006, there have been 15 AP and 13 CP graduates from the program, all of whom have been absorbed within Kenya and Tanzania. Three of the former residents have undergone further subspecialty training (Pediatric Pathology at the University of Cape Town, Molecular Pathology at Glasgow University, and Renal Pathology at the University of Toronto). In addition, 2 of the alumni (currently faculty in the Department of Pathology and Laboratory Medicine at AKU, Nairobi) have recently enrolled in a PhD program at the University of Stellenbosch in Cape Town, South Africa.

Residents in AP are exposed to more than 20,000 surgical cases annually and 15,000 gynecologic and nongynecologic cytology cases. There is a well-established automated immunohistochemistry platform offering a broad panel of antibodies. The Clinical Pathology section of the laboratory provides a repertoire of 800 tests and runs 3.2 million analyses per year, providing ample opportunities for hands-on experience. Transfusion medicine uses gel technology and a platelet apheresis program. Molecular pathology investigations are available for infectious diseases together with BCR-ABL for chronic myelogenous leukemia.

A research component and the completion of a MMed thesis form part of the eligibility criteria for the final-year examinations. At the end of 4 years and successfully meeting the eligibility criteria, residents sit University qualifying examinations for the MMed in Anatomic Pathology and MMed in Clinical Pathology, respectively.

Case Study 6: Establishing a Pathology Residency in Rwanda by Belson Rugwizangogo

The Republic of Rwanda's Vision 2050 and the Sustainable Developments Goals highlight the importance of high-quality health care services, qualified and skilled staff across the health system, and access including histologic diagnosis by an anatomic pathologist, universally considered the gold standard, to guide further therapeutic options in many diseases, but especially cancer.

To support this, the Government of Rwanda approved the MMed in Anatomic Pathology at the University of Rwanda College of Medicine and Health Sciences (UR/CMHS) School of Medicine, starting in the academic year 2013/2014. Before this, the 3 pathologists chosen to set up and coordinate the training were sent for residency in Tanzania, Kenya, and China.

The MMed Anatomic Pathology residency is a 4-year program enthusiastically welcomed by the partners in the health system and oversubscribed for the posts available. The residents receive stipends and tuition fees from the Ministry of Health of Rwanda. **Table A1** shows the number of the residents enrolled in this program since its launch in October 2013.

Table A1
Enrollment of residents in the Master of Medicine anatomic pathology program

	Number of Residents		
Academic Year	Men	Women	Totals
2013–2014	5	1	6
2014–2015	2	1	3
2015–2016	3[a]	1	4[a]
2016–2017	2	2	4
Total	10[a]	5	17[a]

[a] Two enrolled residents have suspended the studies for personal concerns; therefore, the current number of residents is 15.

A training program is well designed with an objective assessment of knowledge and skills, and consequently, some trainees may be required to repeat a year (**Table A2**), with the first group graduating in 2017.

Table A2
Residents in the Master of Medicine anatomic pathology program, academic year 2016-2017

	Number of Residents		
Class	Men	Women	Totals
I	2	2	4
II	1	1	2
III	3	1	4
IV	4	1	5
Total	10	5	15

Initially, the University of Rwanda relied on visiting lecturers working for other institutions in Rwanda and faculty from partner institutions abroad to deliver the curriculum. Participating partner institutions include US Institutions (USI) through the Partners in Health (PIH), ASCP, and the Human Resources for Health[2] to provide superspecialists to teach different courses in the different modules, whereas other contents are covered by local UR/CMHS staff, visiting staff, and staff of the hospitals in which the pathology residents rotate.

The current (2017) contribution of the USI faculty is estimated to be 96 credits of the 240 credits in the program (40.0%). Year 3 residents are required to undertake rotations (observership) in Molecular Pathology/Diagnostics Laboratories abroad, because this is not available in the East-African Region. These rotations are performed in the USI.

The future of Pathology Services in Rwanda depends on the sustainable development of the Pathology Residency in the country producing highly skilled and knowledgeable graduates that are retained in the system.

Career development plans for existing and prospective teaching staff are being developed in partnership with PIH and ASCP, for Anatomic Pathologists, Clinical Pathologists, Laboratory Scientists, and the residents, focusing on mentorship, research, teaching, and clinical service with the aim to build a Pathology residency program that will serve as a center of excellence in the East and Central African Region. The graduates will be deployed to different hospitals and teaching institutions in Rwanda by a joint committee of the Ministry of Health and the University of Rwanda. The objective

of this career development plan is to have, within the next 7 years, well-trained staff that owns the Pathology Residency Program in Rwanda in all aspects of its mission. The expectation is to have by 2024: 24 medical staff with professional fellowships in various Pathology subspecializations (including 4 postdoctoral fellowships), 9 PhDs, and 41 laboratory scientists. This process has already started with one pathologist already pursuing a Fellowship in Nephropathology in Boston, Massachusetts.

APPENDIX 2

ECOWAS (Francophone, Anglophone, and Lusophone Countries of West Africa)

In 2003, the ECOWAS authorized free circulation and installation of medical specialists throughout the region, which created a heightened need to ensure a uniform level of skills across health care sectors. The harmonization process began under the supervision of the West African Health Organization (WAHO), with the creation of an Experts Committee (EC), composed of the directors of all medical specialized training programs. In addition, a Steering Committee (SC) was created that consisted of the deans of the medical schools, the representatives of the anglophone colleges (West African College of Surgeons, West African College of Physicians, National Postgraduate Medical College of Nigeria, and Ghana College of Physicians and Surgeons), the universities and other higher education institutions in the region, and a representative of the African and Malagasy Council for Higher Education. Workshops were organized to facilitate the harmonization of programs in both francophone and anglophone countries, and the recommendations made by the EC were subsequently validated by the SC. Consensus has been achieved on denomination of the qualification, duration of study, faculty required, academic governance, admission criteria, curricula, teaching methods, and infrastructure.

Although there are certainly disadvantages to the process, the harmonization of training programs is the most effective method of regional integration. Harmonizing training programs has facilitated recognition of diplomas throughout the ECOWAS region and has led to the free circulation and exchange of medical professionals, trainees, and trainers in the ECOWAS region.

Obstacles had to be overcome. These obstacles included language (French, English, and Portuguese are spoken in the ECOWAS region); faculties were requested to teach the different languages in their programs. WAHO supervised this process and continues sponsoring the exchange of language specialists for 1 to 3 months in the region. Second, for some, harmonizing training programs proved to be financially prohibitive ($300,000). The process is also lengthy, and to date, only Burkina Faso has created a Diploma of Specialized Study in ACP. Accreditation of programs and institutions is overseen by the Regional Council for Education and Training of Health Professionals created by the Council of Ministers of Health.

College of Pathologists of East, Central, and Southern Africa

Established in 2010 at the APECSA meeting in Kampala, Uganda, the COPECSA was formed to develop leadership and promote regional excellence in the practice of pathology and to be responsible for maintaining standards through training, examinations, and professional development. Currently, COPECSA has a representation of 120 pathologists across Africa, specifically, Burundi, Eritrea, Ethiopia, Kenya, Malawi, Mauritius, Nigeria, Republic of South Africa, Rwanda, Republic of Tanzania, The Seychelles, Uganda, Zambia, and Zimbabwe.

One of the strategic goals of the College is to harmonize pathology training in member countries. A comprehensive curriculum in Anatomical Pathology, General

Pathology, and Clinical Pathology has been developed to serve as a regional guide. Through its various partnerships, COPECSA has been engaged in several training projects. The College partnered with the Royal College of Pathologists (UK), The British Division of the International Academy of Pathology, Aga Khan University Hospital Nairobi, Stellenbosch University, and the East Central and Southern Africa (ECSA) Health Community on the *Lab Skills Africa* program. This program was designed to improve the quality of pathology and laboratory medicine across 20 laboratories in Kenya, Uganda, Tanzania, Zambia, and Zimbabwe using integrated skills training, knowledge transfer, leadership development, and mentoring; it served a combined population of 110 million people with 1.7 million tests (HIV, rapid malaria, peripheral blood film, hemoglobin/hematocrit estimation, urinalysis, and tuberculosis) and provided training and mentoring to 100 pathologists, biomedical scientists, laboratory technologists, and technicians.

In 2016, COPECSA, in partnership with the University of Colorado Cancer Center and ASAP, was the recipient of a National Cancer Institute PAR 15-155 initiative, which evaluated the best approaches to training anatomic pathologists and senior residents in ECSA. This program engaged 17 pathology departments and trained 52 pathologists and senior residents in institutions from Zimbabwe, Kenya, Uganda, Tanzania, Zambia, Rwanda, Burundi, Malawi, Madagascar, Mozambique, and Botswana.

In partnership with the International Academy of Cytology, a total of 27 practicing pathologists from the region trained in image-guided fine-needle aspiration biopsy during a tutorial in Nairobi.