VOLUME 34 · NUMBER 1 · JANUARY 1, 2016

JOURNAL OF CLINICAL ONCOLOGY

REVIEW ARTICLE

Oncologic Care and Pathology Resources in Africa: Survey and Recommendations

Ann M. Nelson, Danny A. Milner, Timothy R. Rebbeck, and Yawale Iliyasu

Ann M. Nelson, Joint Pathology Center, Silver Spring, MD; Danny A. Milner, Harvard Medical School and Harvard School of Public Health, Boston, MA; Timothy R. Rebbeck, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA; and Yawale Iliyasu, Ahmadu Bello University, Zaria, Nigeria.

Published online ahead of print at www.jco.org on November 17, 2015.

Written on behalf of the African Strategies for Advancing Pathology (ASAP) Consortium.

Authors' disclosures of potential conflicts of interest are found in the article online at www.jco.org. Author contributions are found at the end of this article.

Corresponding author: Timothy R. Rebbeck, PhD, Dana-Farber Cancer Institute, 1101 Dana Building, 450 Brookline Ave, Boston, MA 02115; e-mail: timothy_rebbeck@dfci.harvard.edu.

0732-183X/16/3401w-20w/$20.00

DOI: 10.1200/JCO.2015.61.9767

ABSTRACT

The connection of a clinician who identifies a patient with signs and symptoms of malignancy to an oncologist who has the tools to treat a patient's cancer requires a diagnostic pathology laboratory to receive, process, and diagnose the tumor. Without an accurate classification, nothing is known of diagnosis, prognosis, or treatment by the clinical team, and most important, the patient is left scared, confused, and without hope. The vast majority of deaths from malignancies occur in sub-Saharan Africa primarily as a result of lack of public awareness of cancer and how it is diagnosed and treated in the setting of a severe lack of resources (physical and personnel) to actually diagnose tumors. To correct this massive health disparity, a plan of action is required across the continent of Africa to bring diagnostic medicine into the modern era and connect patients with the care they desperately need. We performed a survey of resources in Africa for tissue diagnosis of cancer and asked quantitative questions about tools, personnel, and utilization. We identified a strong correlation between pathology staffing and capacity to provide pathology services. On the basis of this survey and through a congress of concerned pathologists, we propose strategies that will catapult the continent into an era of high-quality pathology services with resultant improvement in cancer outcomes.

J Clin Oncol 34:20-26. © 2015 by American Society of Clinical Oncology

INTRODUCTION

Pathology has been a bottleneck in the provision of appropriate clinical care in resource-constrained settings. Nowhere has this problem been more acute than in sub-Saharan Africa (SSA). As a result, clinical care has suffered at all levels. Adesina et al[1] summarized the consequences of limited pathology in low-resource settings. In primary care, inadequate pathology leads to mis- or underdiagnosis that leads to inadequate referral. At referral centers, inadequate diagnosis and follow-up can result. Thus, inadequate pathology results in treatment delays, poorer clinical outcomes, and suboptimal use of limited resources. The lack of pathology also leads to inadequate reporting of disease rates, which leads to inadequate knowledge of cancer incidence, prevalence, and mortality that limits the ability to plan for medical care needs. Thus, the settings in which medical resources most need to be carefully used are those in which the least data are available for appropriate resource planning.

The limited state of pathology in SSA is a consequence of many factors, including periods of political instability in some locations and limited economic resources to develop and maintain high-quality facilities. These factors affect many areas of health care. However, pathology also suffers from perceptions and biases that further limit its development. Many individuals, from laypersons to physicians, in SSA perceive of the discipline of pathology by its forensic pathology activities, including autopsy. Unlike some areas of clinical practice, pathology is not a commonly known or widely understood discipline in the general population. Change in the perception of pathology and education about its value are major needs in low-resource countries. This education is needed in health care settings, among clinicians, and in ministries of health and other government agencies. The goal of this education would be to improve training, recruitment, and retention of pathologists and to increase capacity for pathology services.

Low-resource countries, particularly those in SSA, must develop self-sustaining systems to support pathology capacity that capitalize on using the right resources in the right places.[2-6] Moreover, specific cancers in Africa may require basic or clinical research to find therapies and solutions to delivering those therapies optimally on the continent.[7-23] In this report, we have performed a survey of current resources and summarize the state of pathology capacity for oncologic care. We have also attempted to provide a summary of the steps that need to be taken to create these self-sustaining systems.

METHODS

An online survey of pathology capacity in SSA was conducted between 2011 and 2013. Surveys were available in English, French, and Portuguese. The link was sent on several occasions to more than 200 pathologists, including those in Africa and those collaborating in Africa. These individuals were identified by membership lists from the International Academy of Pathology and African Organization for Research and Training in Cancer or were individuals known to the members of African Strategies for Advancing Pathology (ASAP). In total, we received 67 responses from 48 unique institutions in 26 of 44 SSA countries. Data were also obtained by telephone and e-mail from 10 additional countries that did not respond to the survey. Thirteen of the ASAP participants assisted in identifying specific individuals in those countries and assisted in the validation of the information reported here. ASAP members provided information about the eight countries with no pathology services.

The information requested included numbers of pathologists and technicians, training positions, workload and workflow, and infrastructure and availability of cancer care (oncologists, chemotherapy, and radiation therapy). The complete survey (in four languages) can be found at the Pathology Situation Analysis Web site (http://goo.gl/ZFr6k). The data were organized by region (East, West, South, and Francophone Africa). Duplicate responses from the same institution were combined and verified. The data are displayed on interactive

Table 1. Results of African Pathology Centers Survey by Country: Providers and Services

			Providers (No.)				Services				
Country	Population (No.)	No. of Persons per Pathologist	Pathologists	Histopathology Technicians	Cytopathology Technicians	Oncologists	IHC	Molecular	Chemotherapy	Radiation Therapy	% of Cancers With Pathologic Diagnosis
Angola	24,906,000	2,075,500	12	23	7	24			Y	Y	
Benin	10,567,000	NA	0	4	0	4	Y	N	Y	Y	< 10
Botswana	2,156,000	359,333	6	3	8	6	N		Y	Y	10-50
Burkina Faso	18,184,000	2,273,000	8	4	0	3	N	N	Y	Y	
Burundi	9,684,000	3,228,000	3	3*	0	0	N	N	N	N	
Cameroon	21,636,000	3,606,000	6	2	3		N	N	Y	Y	10-50
Central African Republic	5,462,000	1,365,500	4	3	0	0	N	N	Y	N	
Chad	13,439,000	6,719,500	2	2	0	0	N	N	N	N	
Cote d'Ivoire	24,926,000	1,661,733	15	8	1	4	Y	N	Y	N	10-50
Democratic Republic of Congo	74,081,000	4,938,733	15	21	4	4	Y	N	Y	Y	10-50
Ethiopia	89,060,000	1,619,273	55	19	†	6	Y		Y	Y	
Gabon	2,337,000	779,000	3	8	0	4	Y	N	Y	Y	
Ghana	27,379,000	912,633	30	6+	4	7	Y	N	Y	Y	> 50
Kenya	43,558,000	725,967	60	10+	4	10+	Y		Y	Y	> 50
Madagascar	22,747,000	NA									
Malawi	16,056,000	1,784,000	9	1	1	1	Y		Y	N	< 10
Mali	17,512,000	3,502,400	5	3	0	2	N	N	Y	N	> 50
Mauritania	3,716,000	1,238,667	3	4	1	1	N	N	Y	Y	> 50
Mauritius	1,262,000	84,133	15	4	3	11	Y	Y	Y	Y	> 50
Mozambique	25,392,000	3,174,000	8	17‡	6	4	Y		Y	N	10-50
Namibia	2,217,000	554,250	4	5	3	4	N		Y	Y	10-50
Niger	18,529,000	9,264,500	2	2					Y	N	
Nigeria	182,336,000	1,072,565	170	1,400‡	‡	20	Y		Y	Y	10-50
Republic of Congo	4,638,000	1,546,000	3								
Rwanda	11,180,000	2,236,000	5	10+	2	0	Y		Y	N	< 10
Senegal	13,950,000	1,992,857	7			12§	Y		Y	Y	10-50
Sierra Leone	6,432,000	6,432,000	1	0	0	0	N	N	N	N	10-50
South Africa	54,425,000	224,897	242	69	94	40+‖	Y	Y	Y	Y	> 50
South Sudan	12,165,000	6,082,500	2	0	0	0	N		N	N	< 10
Tanzania	48,126,000	2,187,545	22	20	20	12¶	Y		Y	Y	< 10
Togo	6,967,000	2,322,333	3	2	0	0	N	N	Y	N	10-50
Uganda	35,225,000	1,467,708	24	13	5	6	Y	N	Y	Y	10-50
Zambia	15,254,000	2,542,333	6	4+	2	5	N		Y	Y	
Zimbabwe	13,426,000	2,685,200	5	1	0	4	N	N	Y	Y	10-50

NOTE. Empty cells indicate no response or no data available. There are no public sector pathologists in Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, and Swaziland.
Abbreviations: IHC, immunohistochemistry; N, no; NA, not available; Y, yes.
*Technicians have bench training only.
†Pathologists do cytology screening.
‡Technologists do histology and cytology.
§Medical and surgical oncologists.
‖General surgeons also practice some oncology.
¶Oncology fellowships.

maps and charts using FusionMaps and FusionCharts (InfoSoft, Kolkata, India) linked to a MySQL database (Oracle, Washington, DC). This article focuses on provision of cancer care and does not cover all data collected in the survey.

A congress was held in Siena, Italy, from May 31 to June 4, 2014, which included representatives from Australia, Burundi, Cote d'Ivoire, Italy, Kenya, Mozambique, Nigeria, South Africa, Tanzania, Uganda, the United Kingdom, and the United States. The participants were selected because of their long experience in working in African pathology, leadership roles in current African pathology organizations and institutions, and reputation for participation in groups previously concerned with pathology infrastructure in Africa. The group met under the direction of a professional meeting facilitator with the goal of brainstorming strategies for effecting change in African pathology globally. As part of this work, specific recommendations concerning advancing oncologic care were put forward as action items. A summary of those recommendations are provided to support the data discovered by the survey, and a call to action has been generated.[24]

RESULTS

Functional Pathology Laboratories in Africa

There is wide variability in the availability of pathology providers, availability of services, and caseload. It is apparent that there are huge gaps in adequate service coverage concerning both personnel and utilization. Tables 1 and 2 list the results of the survey that was conducted between August 2011 and July 2014. These results are also summarized as graphs in Figure 1 and can be found online (www.pathologyinafrica.org/data). Table 1 and Figure 1 report the numbers of providers and services available in each country surveyed. As expected, the number of pathology providers in each country is small, with pathologists per population ranging from 9,264,500 persons per pathologist in Niger to 84,133 persons per pathologist in Mauritius. This is in stark contrast to the estimated population per pathologist in the United Kingdom or United States, which is in the range of 15,000 to 20,000 persons per pathologist.[1] Clinical services that should be routinely available in all countries were not available in many; immunohistochemistry was available in 16 countries (53% of 30 countries reporting data), and molecular diagnostics were available in two countries (11% of 18 countries reporting data). South Africa is the only country with routine access to immunohistochemistry and molecular testing for the public sector. Table 2 and Figure 2 report the caseloads for small biopsies, large surgeries, fine-needle aspiration (FNA), and gynecologic services including Pap smears. Diagnostic procedures (small biopsies and FNA biopsies) are combined; these tests are used to rule out or diagnose malignancy and to plan therapy such as surgery, chemotherapy, or radiation. We identified statistically significant correlations between the number of providers (Table 1) and caseload

Table 2. Results of African Pathology Centers Survey by Country: Caseload per Year

		Small Biopsies		Large Surgery		FNA		Gynecologic Services/Pap Smear		Diagnostic Procedures (small biopsy + FNA)	
Country	Total No.	No.	TAT (days)	No.	TAT (days)	No.	TAT (days)	No.	TAT (days)	No.	TAT (days)
Benin	2,200-5,000	1,000-2,000	7	100-500	1-3	100-500	1-3	1,000-2,000	3-5	1,001-5,000	7
Botswana	10,000-15,000	500-1,000	3-7	5,000	7-30	500-1,000	1-7	5,000-6,000	3-28	501-1,000	7
Burkina Faso	1,500-3,000	500-1,000	14	500-1,000	7	< 100	14	500-1,000	1-3	501-1,000	14
Burundi	~100	< 100	1-3	< 100	1-3	< 100	1-3	< 100	1-3	< 100	7
Cameroon	1,500-3,500	500-1,000	7-14	500-1,000	1-3	100-500	1-3	500-1,000	1-3	501-1,000	7-14
Central African Republic	1,200-4,000	100-500	> 30	< 100	> 30	100-500	7	1,000-2,000	28	501-1,000	> 30
Cote d'Ivoire	4,000-7,500	2,500-5,000	3-7	100-500	7	500-1,000	1-3	500-1,000	3-5	1,001-5,000	7
Democratic Republic of Congo	3,500-8,500	1,500-4,000	3-5	1,000-2,000	3-7	500-1,000	1-3	300-1,500	3-5	1,001-5,000	7
Gabon	1,500-3,500	1,000		500				800		1,000	
Ghana	> 16,000	5,000-7,000	7-14	6,000-8,000	14-28	2,000-3,000	3-14	3,000-4,000	7	5,001-10,000	7-14
Kenya	> 20,000	> 10,000	7-14	> 10,000	3-14	6,000-8,000	1-6	> 10,000	1-7	> 10,000	7-14
Malawi	1,200-3,000	1,000-2,000	28	100-500	14	100-500	14	< 100	14	1,001-5,000	14
Mali	4,000-7,000	2,000-3,000	14	1,000-2,000	28	500-1,000	7	500-1,000	7	1,001-5,000	7-14
Mauritania	1,500-3,500	1,000-2,000	7	100-500	7	< 100	1-3	500-1,000	7	1,001-5,000	7
Mozambique	> 15,000	4,000-5,000	7	3,000-4,000	14	3,000-4,000	1-3	> 5,000	7	5,001-10,000	< 7
Namibia	< 400	< 100	1-3	< 100	1-3	< 100	1-3	< 100	1-3	< 100	< 7
Nigeria	> 20,000	> 10,000	21-28	> 10,000	7-28	6,000-1,000	1-7	3,500-8,000	21-28	> 10,000	14
Rwanda	2,000-4,000	1,000-2,000	14	500-1,000	14	< 100	1-3	500-1,000	1-3	1,001-5,000	7-14
Senegal	3,000-9,000	1,000-2,000	14-28	1,000-2,000	28	500-2,000	5-28	500-1,000	3-28	1,001-5,000	14-28
Sierra Leone	100-3,000	500-1,000	7	100-500	14	100-500	1-3	500-1,000	7	501-1,000	7
South Africa	> 40,000	> 10,000	1-5	> 10,000	3-7	> 10,000	7	> 10,000	14	> 10,000	7-14
South Sudan	400-2,000	100-500	14	100-500	14	100-500	1-3	100-500	1-3	100-500	14
Tanzania	> 15,000	5,000-6,000	21-28	5,000-6,000	7-28	5,000-6,000	3-5	2,000-4,000	3-28	5,001-10,000	7-14
Togo	2,100-4,500	1,000-2,000	14	1,000-2,000	28	< 100	7	100-500	7	1,001-5,000	7-14
Uganda	6,500-9,000	3,000-4,000	21-28	3,000-4,000	7-28	500-1,000	1-7	< 100	1-3	1,001-5,000	7-14
Zambia	6,000-10,000	3,000-5,000	7-14	2,000-3,000	14-28	< 100	7	1,000-2,000	7	1,001-5,000	14
Zimbabwe	6,000-8,000	5,000-6,000	7	1,000-2,000	14	< 100	1-3	< 100	1-3	5,001-10,000	7

NOTE. Empty cells indicate no response or no data available. No information is available from Angola, Chad, Ethiopia, Madagascar, Mauritius, Niger, or the Republic of the Congo.
Abbreviations: FNA, fine-needle aspiration; TAT, turnaround time.

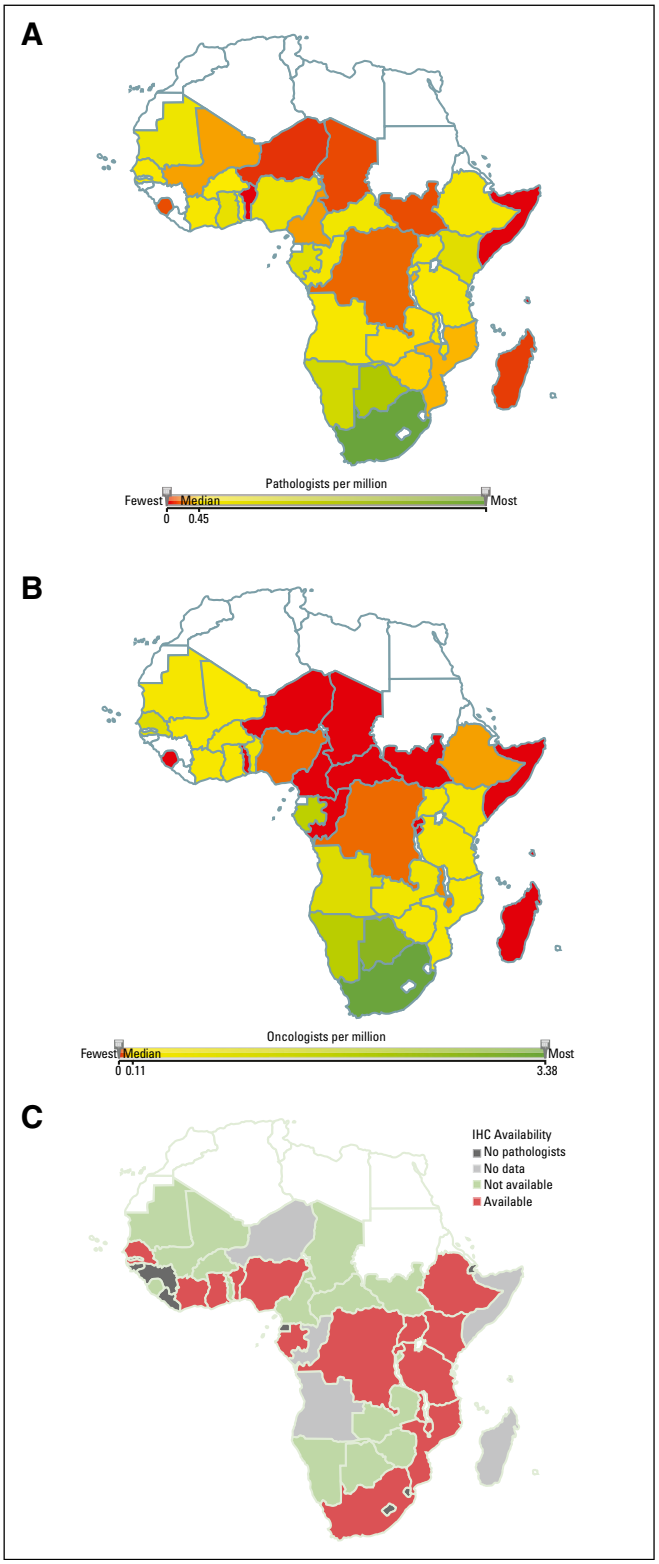

Fig 1. Graphical summary of pathology providers and services. (A) Number of pathologists per million population. (B) Number of oncologists per million population. (C) Immunohistochemistry (IHC) availability. Interactive maps can be found at www.pathologyinafrica.org/data.

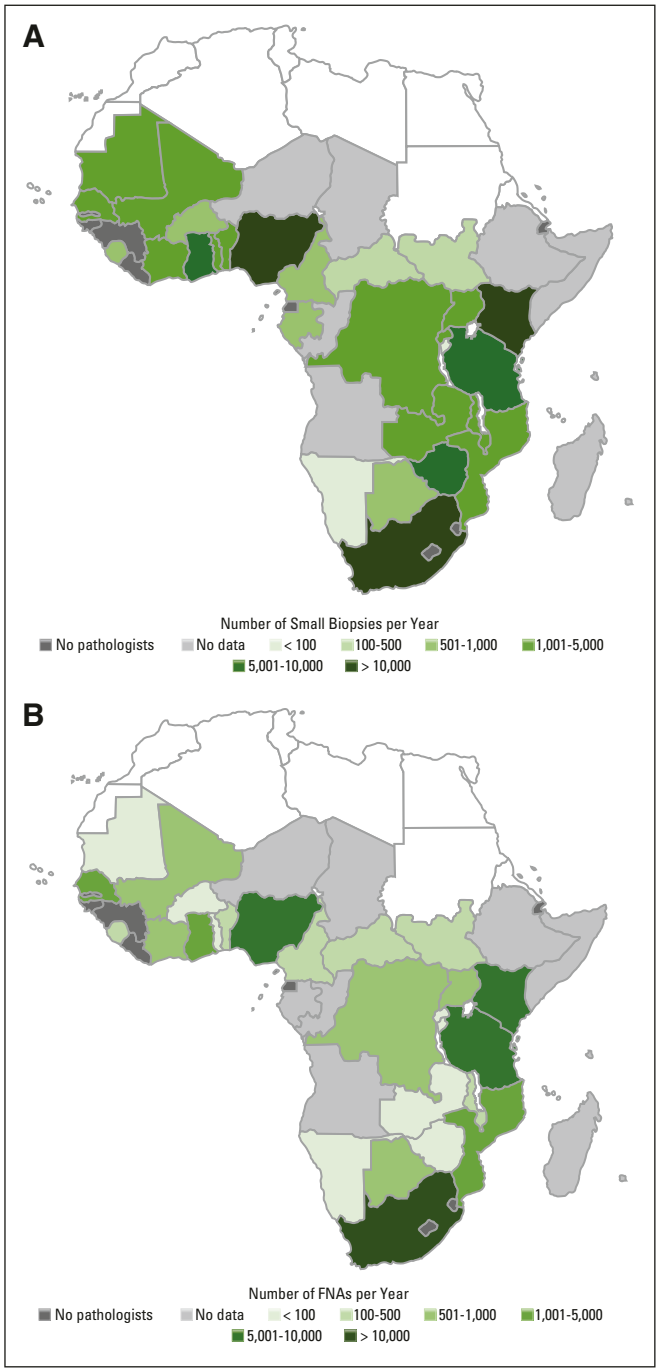

Fig 2. Graphical summary of pathology caseload. (A) Number of small biopsies per year. (B) Number of fine-needle aspiration (FNA) biopsies per year. Interactive maps can be found at www.pathologyinafrica.org/data.

(Table 2), with $P < .01$ for most correlations between biopsy, surgical, FNA, and gynecologic caseload and number of pathologists, histotechnologists, or cytotechnologists (results not shown). In contrast, the turnaround time was generally inversely correlated with staffing, but the associations were not statistically significant (results not shown).

Similarly (although our data were limited to responses from pathology and not necessarily clinicians), chemotherapy (28 of 32 counties reporting, 88%) and radiation therapy (20 of 32 countries,

63%) were also unavailable in many countries (Fig 3). Thus, provision of relevant clinical services seems to be sparse or nonexistent in Africa.

DISCUSSION

Global Strategies to Change Oncologic Care in Africa

The ASAP Group[24] was formed in 2014 at a meeting in Siena, Italy, to address the challenge of generating sustainable pathology capacity in SSA. The ASAP Group created a 5-year strategic plan to achieve the following overarching goal: "Develop a robust framework for efforts to increase and improve pathology services within sub-Saharan Africa." The two main strategic aims are advocating for pathology and making pathology work. ASAP identified four areas required to achieve these aims. Each of these target areas directly affects oncologic care and will lead to improved outcomes in patients with cancer.

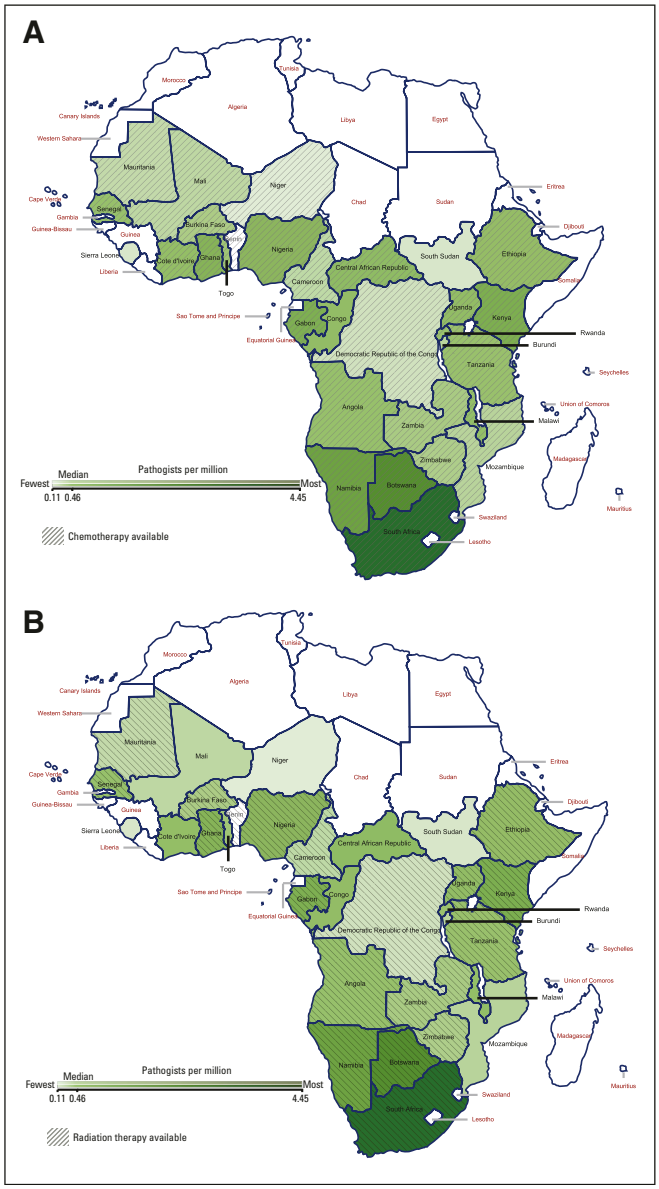

Fig 3. Pathologists per million with availability of (A) chemotherapy or (B) radiation therapy. Interactive maps can be found at www.pathologyinafrica.org/data.

Advocacy. For pathology services in SSA to improve such that superior oncologic care is possible, it is essential to advocate from the patient population, through the health care system, and within the ministries of health for the essential need of pathology and generate the necessary resources to support it.

Infrastructure development. Currently, throughout SSA, there are regions where neither functioning pathology services nor supporting networks for development exist. In other regions, functioning labs have individual aging pathologists with no contingency plan for the future. Still others suffer from broken, non–service-covered equipment or frequent stockouts of needed reagents. Dedication at the governmental level in parallel with external focused support on a case-by-case basis will bridge these gaps and create sustainable, value-based, integrated pathology systems.

Impact data. As was shown in the survey data, many gaps exist in the flow of oncologic care from the pathology perspective. In some of the best cases currently in Africa, one pathologist exists for every 500,000 persons compared with one pathologist per 15,000 to 20,000 persons in the United States and United Kingdom.[1] Without improved pathology services, developing countries in SSA will not be able to respond adequately to the emergence of noncommunicable diseases. To control this, surveillance systems and databases, including tumor registries, need to be set up. Only with real data from individual labs and regions can population-level prevention programs and much needed specific scientific research be accomplished.

Education and training. The lack of qualified pathology staff has severely impacted specimen procurement, turnaround time, diagnostic accuracy, and quality control. Implementation of formal training and education programs is of the utmost importance to improve capacity in this region, create value-based pathology services, and impart sustainability to the discipline.

Local Strategies to Change Oncologic Care in Africa

There are both global strategies to improving pathology capacity for oncologic care across Africa as well as local strategies for improving the care at an individual site. The most important aspect of this latter approach is internal and external assessment of the health care system and level of pathology functionality. To support pathology processes, inputs (clinicians, surgeons, payers) and end users (oncologists, radiation therapy, chemotherapy) must be available to actually effect change in patient outcomes. Complex strategies may be necessary to meet a given region's needs, as diagramed in Figure 4. In this scenario, capitalizing on technology, focused training, and top-down management can rapidly improve services and affect patient outcomes. This model of oncologic care includes the following components: education of the general population about cancer, prevention, treatment options, diagnosis, and health care infrastructure; community health centers that have direct access to all primary care patients where trained screeners can look for signs of early to late malignancy and determine the next steps for patient care from sampling to palliative referral (also a level at which cytologic samples could be taken [FNA] and sent via telepathology or directly to a referral laboratory or mass screenings, such as breast exams, prostate exams, human papillomavirus testing, and HIV testing, could be performed and centrally reported); large district or regional health centers that include personnel trained to perform biopsies and with resources to preserve samples

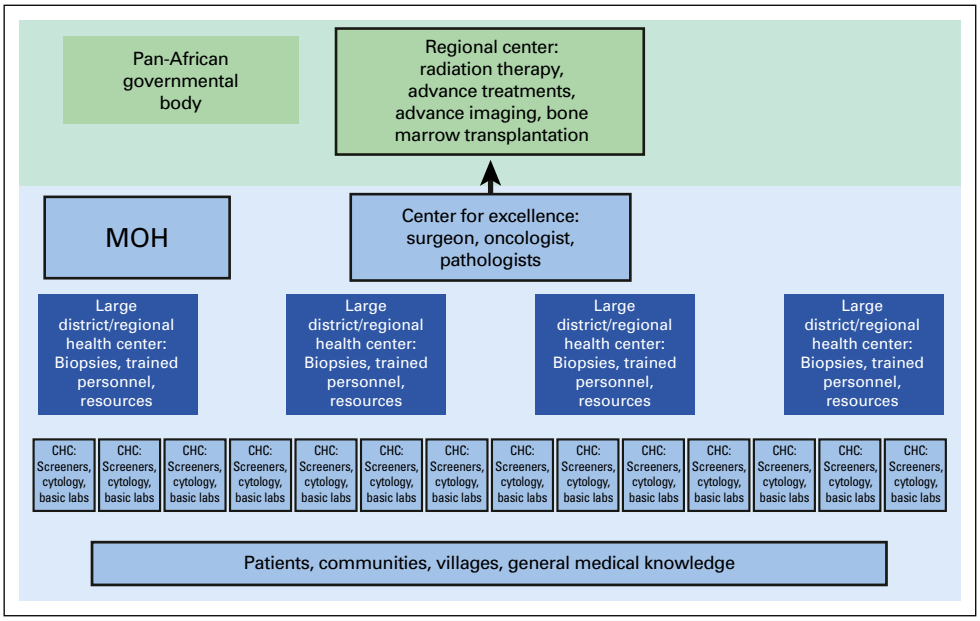

Fig 4. An example model of oncologic care organization within a country (or region) that can maximize the diagnostic resources needed at all levels while minimizing the personnel requirements to achieve universal coverage. CHC, community health center; MOH, ministry of health.

properly and get them, via an established network, to a pathology laboratory (at this level, chemotherapy nurses could also be stationed to provide care after diagnosis); and centers for excellence that can be established for patients who need complex surgical intervention, pathologic evaluation, and oncologic consultation to determine treatment plan. Specialized or limited services such as radiation therapy/Gamma Knife, advance imaging, and complex treatments like bone marrow transplantation may be more efficiently set up in regions of the continent to cover multiple countries depending on need. As with any system, as personnel become more expert and resources build, services can be moved further out to the lower levels.

A critical determinant of the success of pathology in Africa is the alignment of pathologists with pathology facilities. If either of these is inadequate, services will suffer. The key to addressing deficiencies in either of these domains begins with assessment of the local situation in terms of staffing, equipment, reagent flow, training, and other key components of a functional system. A systematic, formal assessment of the needs, strengths, and deficiencies of the situation will identify the steps required to improve the level of pathology services. Similarly, an alignment between pathology and other clinical cancer services is required. Just as inadequate pathology for diagnosis is a bottleneck in providing optimal treatment, optimal pathology services may not be impactful if the ability to treat cancers is inadequate.

CONCLUSION

As in most of the developing world, SSA lacks essential resources to implement safe and effective diagnostic care. Increases in the rates of noncommunicable diseases, especially cancer, in this region are leading to the growing demand for quality pathology services and diagnostic laboratory medicine. Implementation of a sustainable, high-quality system is a necessary action that needs to be taken to address the growing burden on established health care resources. Achievement of the previously outlined strategies will help increase pathology and diagnostic laboratory services. Establishing this framework will help initiate implementing a cost-effective, high-quality, sustainable system that ensures an improved and more sustainable level of care.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Disclosures provided by the authors are available with this article at www.jco.org.

AUTHOR CONTRIBUTIONS

Conception and design: All authors
Administrative support: Ann M. Nelson, Danny A. Milner, Timothy R. Rebbeck
Provision of study materials or patients: All authors
Collection and assembly of data: All authors
Data analysis and interpretation: All authors
Manuscript writing: All authors
Final approval of manuscript: All authors

REFERENCES

1. Adesina A, Chumba D, Nelson AM, et al: Improvement of pathology in sub-Saharan Africa. Lancet Oncol 14:e152-e157, 2013
2. Malami SA, Iliyasu Y: Fine needle aspiration cytology in Nigeria. Acta Cytol 52:400-403, 2008
3. Razack R, Michelow P, Leiman G, et al: An interinstitutional review of the value of FNAB in pediatric oncology in resource-limited countries. Diagn Cytopathol 40:770-776, 2012
4. Carey P, Fudzulani R, Scholfield D, et al: Remote and rapid pathological diagnosis in a resource challenged unit. J Clin Pathol 67:540-543, 2014
5. Cox JA, Lukande RL, Kalungi S, et al: Practice of percutaneous needle autopsy: A descriptive study reporting experiences from Uganda. BMC Clin Pathol 14:44, 2014
6. Cox JA, Lukande RL, Kalungi S, et al: Needle autopsy to establish the cause of death in HIV-infected hospitalized adults in Uganda: A

comparison to complete autopsy. J Acquir Immune Defic Syndr 67:169-176, 2014

7. Naresh KN, Ibrahim HA, Lazzi S, et al: Diagnosis of Burkitt lymphoma using an algorithmic approach: Applicable in both resource-poor and resource-rich countries. Br J Haematol 154:770-776, 2011

8. Rogena EA, De Falco G, Schurfeld K, et al: A review of the trends of lymphomas in the equatorial belt of Africa. Hematol Oncol 29:111-115, 2011

9. Ly M, Antoine M, Dembélé AK, et al: High incidence of triple-negative tumors in sub-Saharan Africa: A prospective study of breast cancer characteristics and risk factors in Malian women seen in a Bamako university hospital. Oncology 83:257-263, 2012

10. Moreira C, Nachef MN, Ziamati S, et al: Treatment of nephroblastoma in Africa: Results of the first French African pediatric oncology group (GFAOP) study. Pediatr Blood Cancer 58:37-42, 2012

11. Traoré B, Keita M, Diane S, et al: Clinicopathological study of breast diseases presenting to the surgical oncology unit of Donka University Hospital in Conakry, Guinea. West Afr J Med 31: 227-231, 2012

12. Israëls T, Kambugu J, Kouya F, et al: Clinical trials to improve childhood cancer care and survival in sub-Saharan Africa. Nat Rev Clin Oncol 10: 599-604, 2013

13. Katumba J, Obore S, Kaye DK: Health-related quality of life among patients with ovarian cancer at Mulago Hospital, Uganda. Int J Gynaecol Obstet 122: 115-117, 2013

14. Kingham TP, Alatise OI, Vanderpuye V, et al: Treatment of cancer in sub-Saharan Africa. Lancet Oncol 14:e158-e167, 2013

15. Mtonga P, Masamba L, Milner D, et al: Biopsy case mix and diagnostic yield at a Malawian central hospital. Malawi Med J 25:62-64, 2013

16. San Roman M, Aguilo F, Clapes M, et al: Burkitt's lymphoma treatment in a rural hospital in Sierra Leone. Trans R Soc Trop Med Hyg 107:653-659, 2013

17. Yao JJ, Couitchere L, Atimere Y, et al: Childhood cancer in Cote d'Ivoire, 1995-2004: Challenges and hopes. S Afr Med J 103:113-115, 2013

18. Carbone A, Vaccher E, Gloghini A, et al: Diagnosis and management of lymphomas and other cancers in HIV-infected patients. Nat Rev Clin Oncol 11:223-238, 2014

19. Davidson A, Wainwright RD, Stones DK, et al: Malignancies in South African children with HIV. J Pediatr Hematol Oncol 36:111-117, 2014

20. Elkhodary TR, Ebrahim MA, Hatata EE, et al: Prognostic value of lymph node ratio in node-positive breast cancer in Egyptian patients. J Egypt Natl Canc Inst 26:31-35, 2014

21. Gopal S, Fedoriw Y, Montgomery ND, et al: Multicentric Castleman's disease in Malawi. Lancet 384:1158, 2014

22. Scherber S, Soliman AS, Awuah B, et al: Characterizing breast cancer treatment pathways in Kumasi, Ghana from onset of symptoms to final outcome: Outlook towards cancer control. Breast Dis 34:139-149, 2014

23. Stagno V, Mugamba J, Ssenyonga P, et al: Presentation, pathology, and treatment outcome of brain tumors in 172 consecutive children at CURE Children's Hospital of Uganda: The predominance of the visible diagnosis and the uncertainties of epidemiology in sub-Saharan Africa. Childs Nerv Syst 30: 137-146, 2014

24. African Strategies for Advancing Pathology Group Members: Quality pathology and laboratory diagnostic services are key to improving global health outcomes: Improving global health outcomes is not possible without accurate disease diagnosis. Am J Clin Pathol 143:325-328, 2015

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Oncologic Care and Pathology Resources in Africa: Survey and Recommendations

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or jco.ascopubs.org/site/ifc.

Ann M. Nelson
No relationship to disclose

Danny A. Milner
Consulting or Advisory Role: Biosciences Solutions Group
Patents, Royalties, Other Intellectual Property: UpToDate

Timothy R. Rebbeck
No relationship to disclose

Yawale Iliyasu
No relationship to disclose

Acknowledgment

The African Strategies for Advancing Pathology (ASAP) team wishes to acknowledge the outstanding support of this initiative by Alexia Eslan. The ASAP Group consists of the following members: Akin Abayomi, MBBS (Lond), MRCP (UK), MPhil (Pret), FRCP (Edin), FCPath (SA), FRCPath (UK); Mohenou Isidore Jean Marie Diomande, MD, FWACP; Kenneth Anthony Fleming, DPhil, MA (Oxon), MB ChB, FRCPath, FRCP; Ann Marie Nelson, MD, FCAP, FASCP; Shahin Sayed, MBChB, MMED (Pathology); Michael Wilson, MD, FCAP, FASCP; Dan Berney, MB, BChir, MA, FRCPath; Carla Carrilho, MD, MSc, PhD; Rita D'Angelo, MS, CQE, SSBB; Sambe Duale, MD, MPH; Rosemary Emodi, LLB LLM Barrister-at-Law; Andrew Field, MBBS (Hons), FRCPA, FIAC DipCytopath (RCPA); John Flanigan, MD; Martin John Hale, MB ChB, LRCP (Edin), LRCS (Edin), LRCP&S (Glas), FCPath; Alec James Howat, MBBS, FRCPath; Yawale Iliyasu, MBBS (ABU), FMCPath (Nig), FIC, MIAC, IFCAP, FCPath (ECSA); Lorenzo Leoncini, MD; Sebastian Lucas, MA, BM BCh, FRCPath, FRCP, consultant histopathologist at Guy's & St Thomas' National Health Service Foundation Trust (London, United Kingdom); Robert Lukande, MD, MMED (Pathology); Danny Arnold Milner Jr, MD, MSc, FCAP; Louis Ngendahayo, MD, MMEd; Francis Omaswa, MD, FRCSurg; Timothy R. Rebbeck, PhD; Julia Royall, BA, MA; Edda Assel Mtambo Vuhahula, DDS (Dar), PhD in Pathology (Hiroshima); Jack Welch, MD, PhD; and Richard Zarbo, MD, DMD.