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## The evolution of comprehensive cancer care in Western Kenya

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### ABSTRACT

In the next 20 years, it is expected that 70% of incident cancers will be diagnosed in the developing world. There exist very few models of cancer care delivery in resource constrained settings. We present a model of cancer care delivery that developed as a result of a multi-institutional collaboration between high-income country academic medical centers and a Kenyan medical school and governmental referral hospital. Based on the infrastructure provided by a successful HIV care program, AMPATH-Oncology presently offers a range of clinical services across the continuum of care, including cervical cancer and breast cancer screening, palliative care, and oncology clinics in pediatric, adult, and gynecology oncology. This program grew from 346 patient visits amongst a few dozen patients in 2004 to over 30,000 visits by 2012 between screening programs and treatment programs. This paper describes the development of the program over a 7-year period.

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### 1. Cancer in the developing world

In 2008, the American Cancer Society estimated that 56% of incident cases and 64% of deaths due to cancer occurred in low- and middle-income countries (LMCs) [1]. Combined, HIV/AIDS, tuberculosis, and malaria account for fewer deaths in the developing world than does cancer [2]. Because of industrialization, the encroachment of developed world habits (smoking, poor diet), and demographic shifts (population aging), within two decades 70% of all incident cancers globally will occur in LMCs [3–5]. Cancer mortality in developing countries is as high as 80% (compared to 30% in High Income Countries), ensuring that cancer will continue to move up the rankings as a cause of death in these settings [6].

Thus, LMC healthcare systems, already underfunded and designed to handle only acute illness and injury, are woefully underequipped, ill-designed, and under-staffed for dealing effectively with the rise in chronic diseases [7]. Models to optimize the delivery of cancer care in under-resourced environments must be developed to address this impending global health care crisis.

The global health community has not been ignoring the health threat cancer poses in developing countries. A number of multi-lateral organizations have adopted resolutions or written white-papers on this topic [5,8–11]. Some groups have presented high-level guidance documents for governments, which have common themes: national cancer registry systems; prevention; screening; treatment; palliative care; and development of cancer research agendas and investment in training the workforce to address the demands of both research and clinical care. On the other hand, only a few groups have offered more pragmatic guidance in actual on-ground implementation of cancer care – the outstanding example being the Breast Health Global Initiative's (BHGI) 'resource-stratified matrix guidelines' [12]. These guidelines divide healthcare systems into 4 economic strata and then present resource-appropriate recommendations for screening, diagnosis,

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**Table 1**  
Summary of “Policy Brief on the Situational Analysis of Cancer in Kenya” [46].

National cancer plan	No
Cancer registry	Kenya Medical Research Institute (KeMRI) Moi Teaching and Referral Hospital
Radiation units in public sector	2 Cobalt-60 Units
National screening programs	None
Radiation oncologists	4–5 <sup>a</sup>
Oncologists	3–4 <sup>a</sup>

<sup>a</sup> Variability reflective of discrepancies in the original report.

and treatment of breast cancer. The BHGI recommendations, as well as those of CanTreat, also have common themes: affordable, feasible treatment regimens; the imperative to establish cancer treatment and the need to develop novel approaches to delivery; the need to start these programs now, to build infrastructure sufficient to meet the near-term needs for cancer care in LMCs [13]. However, as invaluable as these guideline and recommendations are, implementation has lagged, so there is limited documentation of successful models of resource-appropriate cancer care collaboration between high-income countries and low- and middle-income countries (HC–LMC collaborations) in the literature.

The program descriptors and documentation of programmatic evolution in pediatric oncology, mainly from the Monzas International School of Pediatric Hematology/Oncology (MISPHO) and the St. Jude International Outreach Program, (IOP), form the bulk of the published literature [14–19]. More recently, descriptors of the process and implementation of creating a breast-specific cancer care delivery system have been published [20]. These publications offer insight into the logistics of program development in resource-constrained settings, the use of outcomes data to improve care delivery, and the critical role of understanding the local constraints and feasibility of care delivery and the unique solutions that are created to solve these issues. In addition literature is developing in the field of cervical cancer screening in LMCs, primarily out of India, South Africa and Zambia [21,22]. However, this literature is limited in its scope, focusing on either age-specific populations, or on disease-specific populations – and thus there is a gap in the literature on the implementation of comprehensive cancer control programs in the developing world. To redress this gap, we offer a description of the evolution of a relatively comprehensive cancer care program in Western Kenya, in the hope that it can help others as they create similar programs in similar settings.

## 2. The setting: Western Kenya and AMPATH

There is minimal infrastructure for cancer care in Kenya. Table 1 summarizes a recent report by the Kenyan government on cancer care. Beyond these basic numbers, cancer care is largely inaccessible due to geography, limited resources, or cost. Patients in need of radiation in Western Kenya frequently have earliest available appointments 3 to 6 months in the future at facilities 4–6 h away in Nairobi, cancer drugs are frequently unavailable in governmental hospitals, and have limited availability on the open market, the costs of transport, chemotherapy, and radiation therapy often render these services unobtainable.

To contextualize cancer care in Kenya, Table 2 presents basic demographics and health related indicators for Kenya. Additionally, there is a national health insurance schema, the National Health Insurance Fund (NHIF), which covers a substantial portion of inpatient hospital fees in governmental hospitals. However, this is underutilized – in spite of enrollment fees ranging from US\$2 to US\$25 monthly only 2.7 million (less than 10% of the population) are enrolled [23,24]. Western Kenya, with a population of 20 million, is served by Kenya’s second national referral center, Moi Teaching and Referral Hospital (MTRH), which has 700 beds

**Table 2**  
Demographics and health-related indicators for Kenya.

Population	37 million [47]
GDP per capita	US\$ 760 [47]
Population living in rural areas	78% [47]
Infant mortality	55/1000 live births [47]
Life expectancy	54 years [47]
Total national budget dedicated to health	8.4% [48]
Government expenditure annually on health per capita	US\$ 8.30 [2]

(frequently shared between two patients), and in 2010 had more than 37,000 admissions, and 200,000 outpatient clinic visits.

AMPATH, the Academic Model Providing Access to Healthcare, was created in 2001 through collaboration between Moi University School of Medicine (MU), MTRH, and a consortium of North American academic medical centers to increase access to anti-retroviral drugs for HIV-positive patients in Western Kenya [25–27]. Serving a catchment of 2 million with over 100 clinics ranging from relatively full service facilities (i.e. governmental District Hospitals), with physical buildings, reliable electricity, and in-house laboratory services to basic facilities relying on tented clinics or makeshift buildings, AMPATH presently has over 160,000 patients enrolled in its HIV care program. Supporting this clinical care and research enterprise are: an NIH-certified grants management office; the AMPATH Reference Lab, a WHO certified TB reference lab, a Good Clinical and Laboratory Practices (GCLP) and ISO 9000 certified laboratory with capability for routine clinical labs; and, an open-source electronic medical record system, the AMPATH Medical Records System (AMRS) [28–31]. Growing from its original mission this organization has expanded its mission to encompass primary health care and chronic disease management. AMPATH-Oncology developed out of this infrastructure as a result of the demands of AMPATH clinicians for services for their cancer patients.

## 3. AMPATH-Oncology

AMPATH-Oncology developed from the platform of this HIV-care program to address the care of cancer patients, for whom there were limited treatment options available. AMPATH-Oncology has evolved in 4 separate periods, driven by available resources and clinical demands. The first services to develop were in pediatric oncology, which transitioned into care for AIDS-related malignancy, then to broad-based cancer treatment services, and most recently, a formally structured model for rationed care commensurate with the resource constraints and population burden of western Kenya. Table 3 presents the evolution of services within AMPATH-Oncology, the difficulties encountered while implementing changes, and the major investments in terms of programmatic funding during each of these 4 periods: pre-2005 (Period 1); 2005–2008 (Period 2); 2008–2010 (Period 3); and, 2010–present (Period 4). Table 4 presents the clinical care team, the capacity building efforts during each period, the evolution of clinical services, clinical volume, and total operational budget.

We believe AMPATH-Oncology represents a uniquely comprehensive approach to cancer care delivery in resource-constrained settings. The evolution of AMPATH-Oncology documents a planned, step-wise progression of services, as described by MISPHO and BHGI, balanced against the immediate clinical needs on-ground [19,32]. AMPATH-Oncology carries forward the guiding principles of USAID-AMPATH, principles which allowed this program to develop into one of the largest and most comprehensive HIV/AIDS treatment programs in sub-Saharan Africa. These principles include involvement of Kenyan colleagues in a true partnership, in terms of program ownership, the engagement of the key local representatives of the government of Kenya in shaping the program,

**Table 3**  
Evolution of oncology services and challenges for healthcare delivery over time.

Period	Impetus for change	Challenges encountered	Costs
1 (pre-2005)	Children with curable cancer without access to care	<ul style="list-style-type: none"> <li>• Ad hoc therapeutic approach due to limited prior exposure to cancer care amongst clinicians</li> <li>• Small clinical team facilitated uniformity in care protocols</li> </ul>	<ul style="list-style-type: none"> <li>• Chemotherapy</li> <li>• Clinician time</li> </ul>
2 (2005–08)	HIV-positive patients dying in spite of access to anti-retrovirals	<ul style="list-style-type: none"> <li>• Limited access to chemotherapeutics</li> <li>• 1st-line protocols for HIV-associated cancers, but ad hoc therapeutic approaches</li> <li>• Increased referral for non-HIV-associated cancers due to lack of access to any other cancer services</li> <li>• Increased access to chemotherapy as program began purchasing directly from suppliers in bulk</li> </ul>	<ul style="list-style-type: none"> <li>• Chemotherapy</li> <li>• Clinician time</li> <li>• Clinician training</li> <li>• Consumables associated with cancer treatment and screening services</li> <li>• Transportation to remote clinics</li> </ul>
3 (2008–10)	Cancer patients without access to cancer care presenting to HIV-malignancy clinics	<ul style="list-style-type: none"> <li>• Creation of the Department of Haematology and Oncology in MTRH</li> <li>• Continued increases in referral for patients with cancer</li> <li>• Expansion of services preceding protocol development led to increase in ad hoc therapeutic approaches</li> <li>• Increased clinical volume exposed lack of training amongst clinical staff</li> </ul>	<ul style="list-style-type: none"> <li>• Chemotherapy</li> <li>• Clinician training</li> <li>• Consumables associated with cancer treatment and screening services</li> <li>• Transportation to remote clinics</li> </ul>
4 (2010–present)	Clinical volume exceeding available resources	<ul style="list-style-type: none"> <li>• Continued increases in patient volume threatened to overwhelm available resources</li> <li>• Recognition that many patients present with disease for which chemotherapy will not benefit</li> <li>• Lack of palliative care services highlighted</li> <li>• Task shifting, with training and explicit care protocols, as a reasonable solution to lack of trained personnel</li> </ul>	<ul style="list-style-type: none"> <li>• Chemotherapy</li> <li>• Clinician training</li> <li>• Consumables associated with cancer treatment and screening services</li> <li>• Transportation to remote clinics</li> <li>• Development of pathology resources</li> <li>• Expansion of screening services</li> </ul>

a development agenda which long-term sustainability a major driver of decisions, and finally, an explicit fostering of research to improve our understanding of disease, program implementation, and improve care from the outset. This balance within AMPATH-Oncology results in a program with truly shared ownership, in which Kenyan clinicians have equal investment in the program as the non-Kenyan physicians. This shared ownership ensures not only long-term stability to this program, but also lends flexibility in addressing the immediate needs of the community in Kenya.

An excellent example of the flexibility inherent in this collaboration is the transition from period 3 to 4, driven by several facts apparent to clinicians on the ground: first, many patients presented in late stages of cancer, with death imminent; second, based on very limited supplies of chemotherapy and the cost to the patient, many patients did not have a meaningful therapeutic benefit; and third, the programmatic budget would soon be overwhelmed by providing free chemotherapy to the rapidly rising patient population. Therefore, it became apparent that the humanistic desire to help all patients presenting to AMPATH-Oncology would have to be tempered with approaches to care based on local presentations, expected response rates, active attempts at down-staging, and offering patients therapeutic alternatives to palliative chemotherapy. This led to expert-led reviews balancing literature-based expectations and local experience to rank order cancers seen within AMPATH-Oncology, similar to the process described by the WHO [33]. This rank-order was then used to divide commonly observed cancers into three categories: curable or high expected response and clinical benefit; expected moderate rate of response and clinical benefit from treatment; and then presentations and disease to which we expected minimal response rates or clinical benefits. For the last category of disease, it was determined that palliative care was the best treatment option. For the former two categories, locally-feasible treatment algorithms and chemotherapy protocols were implemented with targeted supportive care, in a process similar to those described by MISPHO [34].

Further, AMPATH-Oncology's approach has led to unplanned benefits – while not explicitly planned, the initial request by

Kenyan clinicians to develop a cancer treatment program led to increased enthusiasm for development of screening programs. Various authors have commented that screening efforts in LMCs without treatment opportunities suffer from low engagement because of the pervasive sense that screening simply informs the patient earlier of a hopeless situation, thus subsequent follow-up is poor [32]. In the context of a successful treatment programs breast and cervical cancer screening can translate into reductions in mortality.

A unique and distinguishing characteristic of AMPATH-Oncology is the multi-institutional partnerships representing academic institutions from the United States, Canada, and Europe collaborating with MTRH and AMPATH. AMPATH-Oncology's organic development process has the advantage of facilitating collaborative approach, in which clinicians and scientists from high-income countries (HCs) are challenged to find solutions for clinical needs defined by their LMC colleagues. These solutions evolve through a dynamic process matching the content expertise from HCs with process expertise of the LMCs. Content expertise refers to an understanding of the current evidence based standard of care, whereas process expertise refers to the understanding of the system constraints of LMCs and the potential local solutions to approximate the HC standards. Similar processes have been successfully used by the various pediatric oncology groups [15,18,34].

The potential weakness to this approach is the inherent reactive nature to programmatic development – programmatic change is driven by shifting clinical demands, therefore infrastructure to support the evolving clinical mission of AMPATH-Oncology lags behind program goals and implementation. This risk can be mitigated through early adoption of clinical documentation, which can be used in post hoc quality assessment and improvement efforts [18,35]. This can be accomplished either via a pre-existing comprehensive clinical records system, or more practically, a minimum set of key indicators (a minimum dataset) that can be used in a step-wise evaluation and then subsequent addition of new indicators can allow for progressive expansion of clinical data tracking and treatment guidelines.

**Table 4**  
Capacity building and financial burden for AMPATH-Oncology over time.

Period	Personnel	Capacity built	Services offered (additive to previous period)	Approximate patients by service/year	Budget (estimated per year, US\$)	
1 (pre-2005)	<ul style="list-style-type: none"> <li>• 1 Physician</li> <li>• 1 Nurse<sup>a</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Established clinical registry for pediatric cancers</li> <li>• Developed space within MTRH for in-patient pediatric oncology service</li> </ul>	<ul style="list-style-type: none"> <li>• In-patient pediatric oncology care</li> <li>• Out-patient pediatric oncology care</li> </ul>	<ul style="list-style-type: none"> <li>• Pediatric oncology</li> </ul>	<50	N/A <sup>b</sup>
2 (2005–08)	<ul style="list-style-type: none"> <li>• 3 Physicians</li> <li>• 2 Nurses<sup>a</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Development of basic treatment protocols for AIDS-associated cancers</li> <li>• Re-investment in Eldoret cancer registry</li> <li>• Development of cervical cancer screening and dysplasia treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Outpatient HIV malignancy service (MTRH and remote sites)</li> </ul>	<ul style="list-style-type: none"> <li>• Pediatric oncology</li> </ul>	<50	\$50,000
3 (2008–10)	<ul style="list-style-type: none"> <li>• 3 Physicians</li> <li>• 1 Medical officer</li> <li>• 4 Nurses<sup>a</sup></li> <li>• 1 Pharmacy technician</li> </ul>	<ul style="list-style-type: none"> <li>• Established outpatient cancer care in MTRH</li> <li>• Trained nurses and pharmacy staff in chemotherapy safety and administration</li> <li>• Creation of an oncology pharmacy</li> <li>• Establishing a multi-disciplinary tumor board</li> <li>• Developed resource-feasible treatment algorithms for pediatric oncology</li> </ul>	<ul style="list-style-type: none"> <li>• Adult outpatient chemotherapy service</li> <li>• In-patient adult oncology consult service</li> <li>• Cervical cancer screening</li> </ul>	<ul style="list-style-type: none"> <li>• HIV oncology</li> <li>• Pediatric oncology</li> </ul>	<200 50–100	\$250,000
4 (2010–present)	<ul style="list-style-type: none"> <li>• 3 Physicians</li> <li>• 2 Medical officers</li> <li>• 4 Clinical officers</li> <li>• 6 Nurses<sup>a</sup></li> <li>• 1 Pharmacist</li> <li>• 3 Pharmacy technicians</li> <li>• 3 Data staff</li> <li>• 4 Research staff</li> </ul>	<ul style="list-style-type: none"> <li>• Developed resource-feasible treatment algorithms for all clinical services</li> <li>• Developed an immunohistochemistry section with pathology</li> <li>• Trained nurses in clinical breast exam and “screen and treat” cervical screening program</li> <li>• Trained gynecologists in radical hysterectomy</li> <li>• Expansion of the electronic medical record to include medical oncology</li> <li>• Established a gynecologic oncology fellowship with 2 fellows in training program, led by University of Toronto</li> </ul>	<ul style="list-style-type: none"> <li>• Gynecology oncology clinic</li> <li>• Scale up cervical cancer screening</li> <li>• Breast screening clinic</li> <li>• Palliative care clinic and inpatient service</li> <li>• Palliative care day care services</li> <li>• Immunohistochemistry for ER/PR and lymphoma</li> <li>• Multiple myeloma clinic</li> <li>• Sickle cell program</li> <li>• Hemophilia clinic</li> </ul>	<ul style="list-style-type: none"> <li>• Adult oncology</li> <li>• Cervical screening</li> <li>• In-patient consultation</li> <li>• Pediatric oncology</li> <li>• Medical oncology</li> <li>• Gynecology oncology</li> <li>• Cervical screening</li> <li>• Breast screening</li> <li>• In-patient consultation</li> </ul>	600 300 200 250 4000 230 9000 2800 1200	\$750,000

<sup>a</sup> Nursing is supplemented on high clinical volume days by quasi-volunteer nurses, who have received training in chemotherapy safety and administration.

<sup>b</sup> During this period, Non-Kenyan AMPATH-Oncology was not involved.



Another strength of the AMPATH-Oncology approach has been early incorporation of research into the clinical mission. There are minimal data to inform clinical decisions in cancer medicine in developing world settings. Given the challenging practice environment of Kenya, the utilization of protocols developed in HCs, and the minimal available outcomes data in LMC populations, shorter implementation–evaluation timelines could lead to more cost-efficient treatment with better outcomes [35–41]. An example of the relatively immediate turn-around of research into clinical practice was the creation of the cervical cancer screening program. Under the funding from a Fogarty International Center AITRP grant, a pilot project comparing visual inspection under acetic acid (VIA) to Papanicolaou smear for screening for cervical cancer was completed. This led to the establishment of a VIA-based screening service, and through donations, the equipment and training for the performance of colposcopy and LEEP for suspicious lesions were instituted [42]. At this time AMPATH-Oncology has active research agendas in epidemiology [43], care delivery [44,45], and drug safety, in addition to clinical trials evaluating therapeutic efficacy. AMPATH-Oncology works with the network of researchers amongst the collaborating North American institutions, as well as with outside cooperative groups such as the AIDS Malignancy Consortium and the AIDS Clinical Trials Group.

Finally, the critical component to stemming the tide from the enormous impending burden of cancer is developing an adequately trained workforce. The number of well-trained Kenyans in the various disciplines of cancer care – from pathology, medical, surgical, radiation oncology and nursing – remains woefully underpowered. Programs such as AMPATH-Oncology build a critical bridge to beginning to redress this deficiency, by linking the subject expertise of the developed world with the on-ground experience of Kenyan clinicians, ensuring that approaches to care are both practically applicable and sustainable.

#### 4. Conclusion

The health problems and existing healthcare in LMCs are heterogeneous, and therefore no one strategy will fit all low income countries. However, successful models for treatment and prevention of HIV/AIDS in Sub-Saharan Africa offer a viable foundation on which to build other aspects of essential healthcare infrastructure in LMCs. It is critical that multiple strategic approaches to improving cancer care outcomes are explored and validated to cover the needs of multiple low/middle income settings, including the expansion of the workforce [38]. At present, AMPATH-Oncology represents one of the few multi-institutional collaborations creating a near-comprehensive cancer care program for pediatric and adult cancers. This platform will allow for unique insight into cancer care delivery, cancer care cost effectiveness analyses, cancer epidemiology, and locally relevant translational research.

#### Conflict of interest

None declared.

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