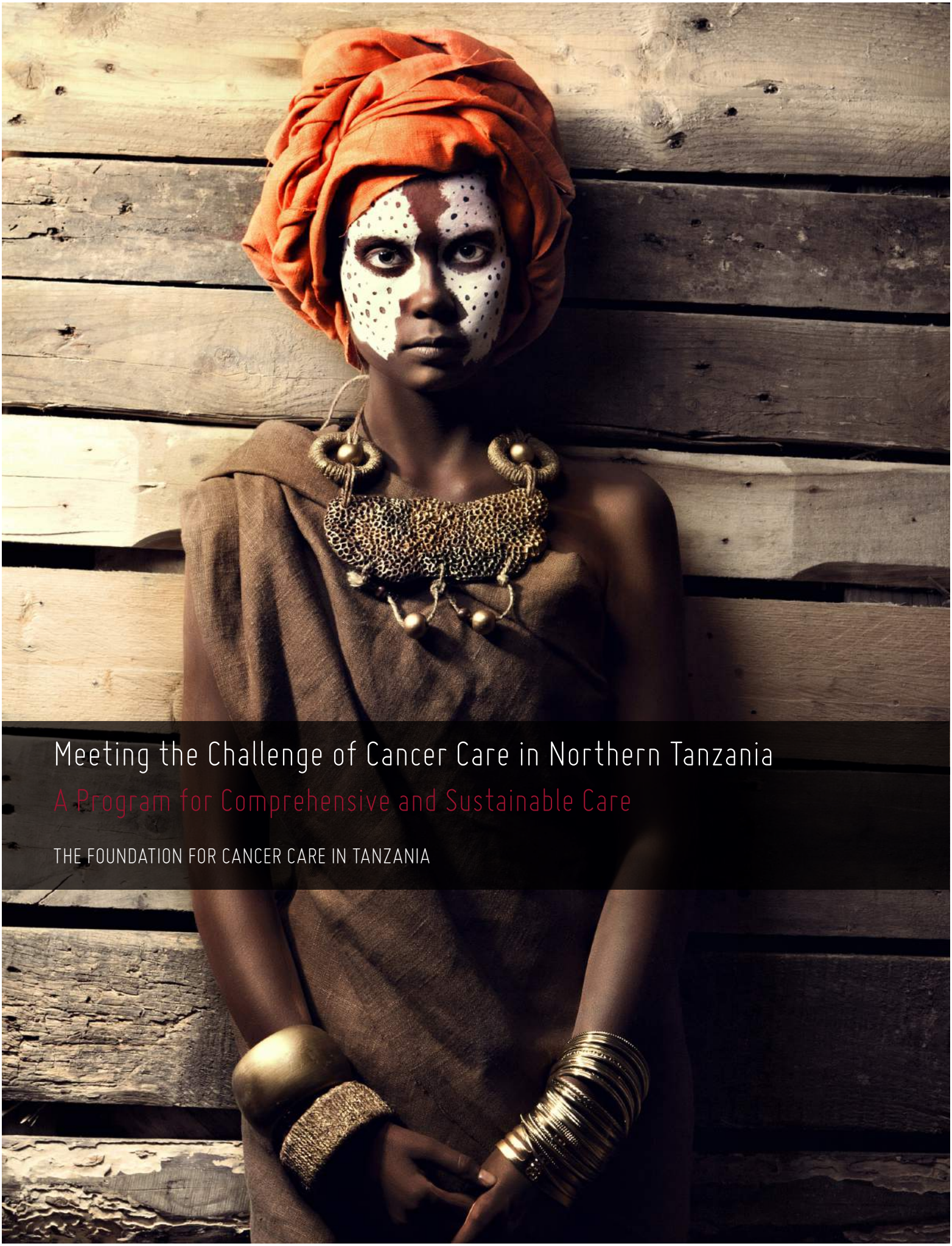


Meeting the Challenge of Cancer Care in Northern Tanzania

A Program for Comprehensive and Sustainable Care

THE FOUNDATION FOR CANCER CARE IN TANZANIA

content

About this Report

The Foundation for Cancer Care in Tanzania (FCCT) is a Minnesota-based 501(c)(3) nonprofit working to reduce cancer prevalence and mortality in the under-resourced northern region of Tanzania. FCCT commissioned this white paper to provide its partners with an evidence-based report designed to stimulate discussion and generate ideas that result in the development of effective solutions to fight cancer. FCCT intends the white paper to be a working document that will be revised and improved based on input and recommendations from international and Tanzanian cancer specialists, caregivers, and healthcare workers.

This version of the FCCT white paper is still a work in progress. Currently, we are inviting input from an international team of healthcare workers across many cancer disciplines on how best to use the data presented in this paper to build an effective cancer care program. Together, these collaborators will help us prepare to face the challenges involved in delivering the cancer care that is so desperately needed in northern Tanzania.

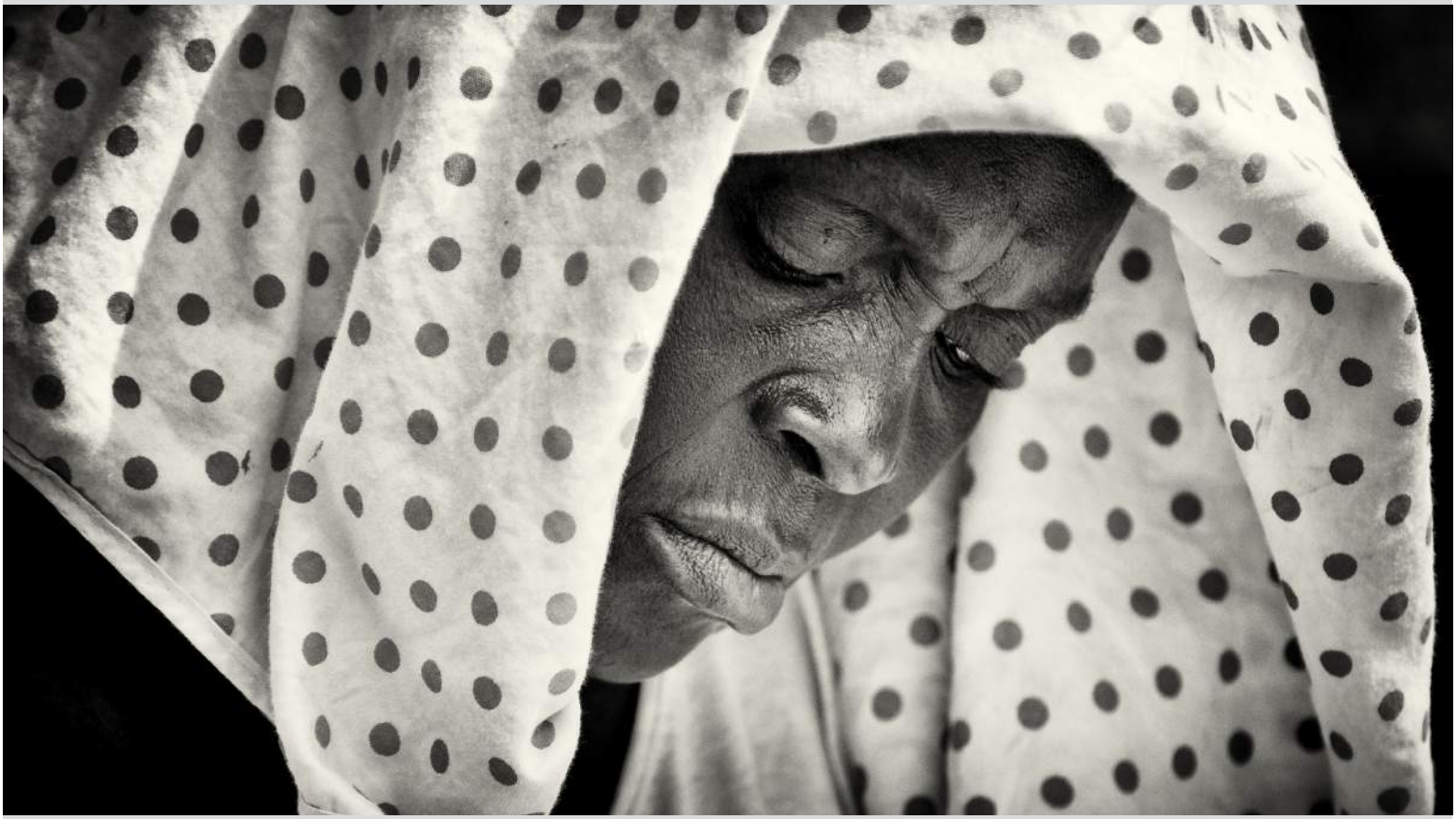
If you would like to join our team, please email us at FCCTanzania@gmail.com.

Page composition by Charity-Launch

"We're working in Tanzania because we believe that hope and dignity are not commodities reserved to the global elite – they are fundamental human rights, deserved by all."

TANZANIACANCERCARE.ORG

preface



PREFACE

Cancer is rapidly becoming an epidemic throughout the world. Currently, 8.2 million people die from cancer every year, according to the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO website 2014), which puts cancer among the leading causes of death worldwide. Owing in part to lack of preventive measures and limited access to healthcare, mortality rates are much higher among patients in low-income countries (LICs). The number of new cancer cases is expected to rise by about 70% over the next two decades, and LICs will shoulder a disproportionate percentage of the burden (Parkin et al. 2003).

As one of the poorest countries in the world, Tanzania is no exception. The country currently sees more than 35,000 (Ferlay et al. 2014) new cancer cases every year, according to the Ministry of Health and Social Welfare, and 80% of the country's cancer victims die each year. Although Tanzania has made strides toward implementing comprehensive cancer care with the establishment of the Ocean Road Cancer Institute (ORCI) and cancer care facilities at Bugando Medical Centre (BMC), these facilities face shortages in equipment and medicines, and currently only have the combined capacity to serve about 5,000 patients annually, according to Dr. Kristin Schroeder, who is an oncologist at BMC. As a result, large areas of Tanzania remain relatively untouched by formal cancer care programs, including the Northern Healthcare Zone, which is home to more than 15% of Tanzania's population according to the 2012 National Census Tanzania (National Bureau of Statistics (NBS) website.

It is the vision of the Foundation for Cancer Care in Tanzania (FCCT) to implement a comprehensive cancer care system in the Northern Healthcare Zone, starting with the construction of the Cancer Care Institute on the KCMC campus in September 2015. Our long-term aim—to provide education, prevention, treatment, and palliative care to all cancer patients in the Northern Healthcare Zone—will require careful planning, strategic utilization of current infrastructure, and coordination with many partners. In pursuit of a high-quality care system that is both implementable in the short-term and sustainable in the long-term, we have drafted this white paper on cancer care in LICs and the infrastructure needed to support effective care in Tanzania.

This is no easy task; building the Cancer Care Institute is just the beginning of a project that has no end. Such is the nature of the fight against cancer—a fight we may never win entirely. But with the help of individual and organizational partners in Tanzania and around the world, we can greatly improve patient outcomes and mortality rates in northern Tanzania. I invite you to join us in that undertaking.

The first step in transforming cancer outcomes in Tanzania is to further develop our understanding of effective cancer care strategies in low-resource settings. To that end, FCCT commissioned this white paper, which describes the current state of cancer and cancer treatment in East Africa, and particularly Tanzania. This evidence-based report is designed to inform and guide its readers—and FCCT— towards the development of productive, sustainable solutions for cancer care in the Northern Healthcare Zone.

This version of the FCCT white paper is still a work in progress. Currently, we are inviting input from an international team of healthcare workers across many cancer disciplines on how best to use the data presented in this paper to build an effective cancer care program. Together, these collaborators will help us prepare to face the challenges involved in delivering the cancer care that is so desperately needed in northern Tanzania.

executive summary

INTRODUCTION

The Foundation for Cancer Care in Tanzania (FCCT) is a Minnesota-based 501(c)(3) nonprofit working to reduce cancer prevalence and mortality in the under-resourced northern region of Tanzania. FCCT commissioned this white paper to provide its partners with an evidence-based report designed to stimulate discussion and generate ideas that result in the development of effective solutions to fight cancer. FCCT intends the white paper to be a working document that will be revised and improved based on input and recommendations from international and Tanzanian cancer specialists, caregivers, and healthcare workers.

GROWTH IN DEMAND

Cancer is already one of the leading causes of death worldwide, causing more than 8 million deaths a year; the World Health Organization (WHO) predicts that the global cancer burden will increase 60% between 2000 to 2016 (WHO website 2014), and 70% of the new cases will be in low-income countries (LIC) (Parkin et al. 2003). Yet cancer remains absent or low on the health agendas of many LICs (Lingwood et al. 2008).

In Tanzania, like in many LICs, the need for improved cancer care is already critical, and in the coming years demand for care will only continue to intensify. A highly diverse country located in the African Great Lakes region, Tanzania is one of the poorest countries in the world; in 2012, the World Bank calculated that 68% of its 47.7 million people lived on less than $1.25 a day (World Bank website 2014). Cancer rates are rising dramatically in Tanzania, as in much of the developing world, and the extreme poverty of its population presents many obstacles to cancer care. Many of the most prevalent cancers in Tanzania are relatively easy to treat with early detection and the right equipment. Yet currently only two cancer institutes in Tanzania are able to diagnose and treat patients, and they have combined capacity to handle less than 5,000 cases annually (Schroeder 2014), which represents less than 15% of Tanzania's new cancer cases (United Republic of Tanzania National Bureau of Statistics (NBS) website 2014).

Tanzania sees an estimated 35,000 new cancer cases every year (WHO website 2014). Given that the country's current cancer mortality rate is around 80% (WHO website 2014), a cancer diagnosis often predicts a long and painful death. If these patients lived in a high-income country (HIC), about one-third of these cancers could be prevented and another third could be treated effectively if diagnosed early; in Tanzania, as in many LICs, a large percentage of cancer patients do not even have access to palliative care (Lingwood et al. 2008).

LACK OF ACCESS TO CARE

The Tanzanian government began developing a nationwide cancer care system in 2008 with the establishment of the Ocean Road Cancer Institute (ORCI), which is located in Dar es Salaam, Tanzania's largest city. More recently, the government developed a cancer care facility at Bugando Medical Centre (BMC) in Mwanza, the country's second largest city, in collaboration with international non-governmental organizations (NGOs) and western universities. Although both of these programs provide much-needed cancer care, they face severe shortages in healthcare staff, equipment, and medicines. Patients who live far from these facilities are often unable to pay for transportation and accommodations during treatments, a reality that further limits access to care (Kingham et al. 2013).

Many cultural factors also prevent patients from obtaining timely cancer care in Tanzania and other East African countries (Kingham et al. 2013). Cancer patients living in rural areas generally have low awareness of the disease or its symptoms. They often feel stigmatized by disease, or are afraid of surgery and other treatment options (Brinton et al. 2014). Consequently, most patients arrive at hospitals with late-stage cancer when a cure is unlikely; many other patients who could potentially be cured fail to complete the full course of treatment (Lingwood et al. 2008). These situations contribute to the high cancer mortality rates in Tanzania.

Perhaps the most serious impediment to comprehensive cancer care in Tanzania is the serious shortage of qualified healthcare providers. In Tanzania, the primary consultation is usually with a non-physician health worker who lacks knowledge or background in the presenting symptoms of cancer. According to a 2009 World Bank report on Tanzanian healthcare, only 35 percent of the recommended government staffing position norms was filled with qualified health workers (Haazen 2012);

doctors trained as surgeons, radiologists, pathologists, and pharmacists capable of mixing drugs for chemotherapy were scarce to non-existent (Scheffler et al. 2008). In 2014, only six oncologists worked in Tanzania according to the WHO website (2014).

TANZANIA'S CANCER CONTROL STRATEGY

The Ministry of Health and Social Welfare recognizes the need to expand comprehensive cancer care services to under-resourced regions, including the Northern Healthcare Zone, and in 2013 it issued a National Cancer Control Strategy (NCCS) to implement effective preventive, diagnostic, and treatment measures over a ten-year period. The NCCS calls on development partners and other stakeholders to support the strategy and provide financial and programmatic assistance in executing it. The Foundation for Cancer Care in Tanzania is one such partner, dedicated specifically to improving cancer care in the Northern Healthcare Zone.

In accordance with NCCS, FCCT will work with its partners to establish a comprehensive cancer care network that will serve cancer patients in Tanzania's Northern Healthcare Zone. The northern zone spans four of the country's thirty regions and contains 15% of the population with an estimated 3,642 new cancer cases annually and an estimated five-year prevalence of 10,894 cases (Parkin et al. 2003). Currently, the northern zone bears many of the hallmarks of cancer care in other low-income countries, including lack of diagnostic and staging capabilities, low coverage of screening programs, and poor availability of adjuvant therapy and expensive treatment (Lingwood et al. 2008).

SUCCESSFUL CANCER CARE MODELS IN LOW-RESOURCE ENVIRONMENTS

Although establishing a comprehensive care model in northern Tanzania presents a daunting challenge, care models that have been successfully implemented in similar low-resource settings can be used as prototypes for cancer care in northern Tanzania. Kenya, Uganda, and other LICs (Strother et al. 2013) have recently launched successful cancer care programs that utilize a "hub-and-spoke" model. These programs often build on existing healthcare infrastructure originally designed to fight HIV/AIDS, and their care delivery systems can reach even remote rural areas.

Some of the most successful cancer care programs in LICs have focused on particular types of cancer, such as HIV/AIDS-related cancers like Kaposi sarcoma (Casper et al. 2011), or a specific demographic group, such as women or children (Strother et al. 2013). Specialization of this sort allows organizations to focus limited resources on activities that improve outcomes most effectively while simultaneously acquiring greater knowledge on how to strengthen and eventually extend care delivery systems to treat more types of cancer and other demographic groups.

EXISTING COMPONENTS OF COMPREHENSIVE CARE IN NORTHERN HEALTHCARE ZONE

In its plans to implement a comprehensive and sustainable cancer care program in northern Tanzania, FCCT is poised to partner immediately with two existing healthcare facilities: Kilimanjaro Christian Medical Centre (KCMC), a national referral hospital located in Moshi, and Arusha Lutheran Medical Centre (ALMC), a smaller hospital in nearby Arusha. KCMC and ALMC currently offer limited cancer care, but like the model

TANZANIA AND SURROUNDING AREA

The proposed Cancer Care Program will operate on the "hub-and-spoke" model of care, with the central hub located in Moshi, Tanzania (indicated above with a check-mark).

programs in Kenya and Uganda, both hospitals have existing programs and healthcare delivery infrastructure that could serve as a foundation for a cancer care platform. For instance, KCMC operates a small screening program for breast, cervical, and prostate cancer as part of an ongoing research program. KCMC employs several radiologists who are able to diagnose some cancers and its surgical staff regularly performs biopsies. The hospital offers a radiology residency program with two-year and four-year training tracks. KCMC also manages one of two cancer registries in Tanzania. Additionally, KCMC's Reproductive Health Centre, ophthalmology department, and Community Development Program all have infrastructure in place that could provide a platform for eventual delivery of cancer screening, diagnosis, and care. Many of KCMC's research programs, laboratory facilities, and staff development programs and exchanges are borne of its thirty-year collaboration with Duke University in North Carolina.

Similarly, ALMC and Selian Hospital have a strong HIV/AIDS program with an extensive community-based testing, screening, and home-based treatment and palliative care program. Potentially these programs could be expanded to include cancer education and screening. Like KCMC, ALMC has an established surgery department that regularly conducts biopsies and tumor removals, and also operates a surgical residency program and nursing school. ALMC has strong ties to the University of Minnesota Medical School and other international universities that offer professional staff exchanges and training programs, positioning it to play an important role in expanding cancer care throughout the region.

THE PROPOSED NORTHERN ZONE CANCER CARE PROGRAM

FCCT plans to implement a comprehensive cancer care program in northern Tanzania which will include all the components of cancer care: prevention; screening and early detection; diagnosis and treatment; and palliative care. The program will operate on the "hub-and-spoke" model of care that has

seen success in other LICs, with a centralized "hub" facility serving as the referral center point for "spoke" hospitals spread throughout the region. Successful implementation of such an extensive program will require careful planning, prioritization, strategic utilization of current infrastructure, and coordination with many partners.

FCCT's initial focus will be to establish cancer therapy and treatment at the "hub" facility, increasing access to cost-effective, high-quality cancer care and thereby reducing mortality rates in the region. Its immediate goal will therefore be the construction of a centralized cancer care center on the KCMC campus in Moshi: the Cancer Care Institute (CCI). Simultaneously, FCCT will work with KCMC to recruit trained oncology staff, pathologists, and other specialists required to deliver high-quality care, with the goal of staffing an operational facility in 2016.

In its first phase, the CCI will comprise a medical oncology clinic with a six-bay infusion clinic, two exam rooms, a laboratory, and an eight-bed hostel for patients and families. Assuming the Phase I CCI is fully-staffed and functional in its first full year of operation, it will have the capacity to provide cancer treatment to approximately 1,320 patients annually, or about 12% of potential patients in the northern zone. The first phase of construction will cost around US$375,000.

In following phases, FCCT will expand the CCI to grow treatment capacity, add radiation therapy capabilities, and increase hostel space. Eventually the facility will include a radiation oncology wing (featuring two linear accelerator vaults, a brachytherapy vault, and MRI and CT Scan Units), an expanded medical oncology wing (including ten infusion beds, six exam rooms, and twenty pediatric oncology beds), a reception and administration wing, and a fifty- or sixty-bed hostel. The estimated capital costs of the entire facility are estimated at around USD $2 million, and are broken down in Section V.

FCCT also plans to build "spoke" centers throughout the Northern Healthcare Zone, starting with installation of a satellite clinic at ALMC in Arusha as soon as funds allow. The ALMC clinic will also be constructed in two phases, with the finished facility featuring a medical oncology clinic, radiation oncology clinic, and a small hostel (detailed construction estimates in Section V). The Arusha clinic will cost around US$375,000, putting FCCT's initial capital estimates at around US$2.5 million over three years.

While these facilities are constructed, FCCT will work with KCMC, ALMC, and other regional partners to build basic systems for prevention and detection, which will be the most effective way to improve outcomes and reduce patient loads in the future. Throughout these implementations, FCCT and its partners will evaluate existing programs as potential vehicles to extend cancer education and screening programs and preventative and palliative care programs.

Over the next decade, FCCT and its partners will continue to expand cancer treatment capacity at KCMC, ALMC, Selian Hospital, and at dispensaries, health centers, and other hospitals throughout northern Tanzania, until programs for prevention, detection, treatment, and palliative care span the entirety of the Northern Healthcare Zone.

MAJOR GAPS BETWEEN THE CURRENT CANCER CARE NETWORK IN THE NORTHERN HEALTHCARE ZONE AND FCCT'S VISION FOR CANCER CARE

There is a large disparity between FCCT's vision and the present state of cancer care in northern Tanzania. Currently, the Northern Healthcare Zone lacks capacity in almost every area of comprehensive cancer care: prevention, early detection, diagnosis and treatment, and palliative care. Implementation of widespread, sustainable cancer care in northern Tanzania will require the following developments:

TANZANIA HEALTH CARE

From top: Doctor demonstrates the use of a linear accelerator at Ocean Road Cancer Center in Dar Es Salaam, Tanzania; Professor Fatme Makame instructs radiology students at KCMC in Moshi, Tanzania; patients wait to see a doctor at KCMC in Moshi, Tanzania.

1. Cancer Treatment Facilities, Equipment, and Medicines

Although some components of cancer care are in place, the Cancer Care Institute lacks the physical capacity to expand offerings without the addition of new facilities. Neither KCMC nor ALMC has the necessary equipment to perform chemotherapy or radiation therapy, and both lack medicines for complex treatment and the means of mixing them. Building treatment capacity must be FCCT's primary focus.

2. Trained Professional Staff

Tanzania faces a massive shortage of skilled healthcare workers. A high-quality cancer treatment program will require hiring, retaining, and potentially educating additional radiologists, pathologists, medical physicists, and pharmacists capable of mixing drugs for chemotherapy. Hiring and retaining staff with these skills will be one of FCCT's greatest challenges.

3. Early Detection and Diagnosis Programs

Cancer mortality rates are much higher in LICs than in HICs, especially among young patients. Such disparities can be traced in large part to late presentation of disease. Common adult cancers are highly treatable if detected early, yet 80% of cancer patients present at Stage III or IV (Lingwood et al. 2008), making effective treatment nearly impossible. Unless the Cancer Institute can establish early diagnosis programs, cancer mortality rates will remain high.

4. Cancer Prevention Programs

More than one-third of cancer cases in Tanzania are associated with underlying infections resulting from HIV, HPV, and hepatitis viruses (Parkin et al. 2003). Other cancers can be prevented by changes in lifestyle. Currently few cancer education and prevention programs exist in northern Tanzania,

although several HPV vaccine programs were piloted in 2014 and could be expanded across the northern zone. Other prevention initiatives could be linked to existing HIV/AIDS treatment delivery systems.

5. Integrative Systems

Effective cancer treatment in HICs utilizes cross-disciplinary teams of specialists, but departments at KCMC are currently organized independently. A successful "hub-and-spoke" model will require integrated computer systems that facilitate record sharing, electronic transfer of images, and link diagnostic and radiotherapy equipment. A fully functioning care network in northern Tanzania also will depend on a well-developed referral system to funnel patients from remote clinics to facilities offering comprehensive diagnostics and care. Equally critical will be integrative education of staff across these levels of care.

6. Continuity of Care

In Tanzania many patients who begin cancer treatment fail to complete it, despite the fact that with prompt and complete treatment, survival rates for pediatric cancers could be markedly improved (Israels et al. 2012). Many patients and families cannot afford transportation and housing costs required for extensive treatment, especially in pediatric cases. Studies show that strong social support programs and the provision of free accommodations during care improves the continuity of care (Israels et al. 2012), (Stulac 2012), (Hadley et al. 2012).

7. Expanded Palliative Care

According to doctors at ALMC and KCMC, more than 75% of cancer patients in Tanzania present in late stages when a cure is no longer possible. Access to palliative care under these conditions is a critical component of comprehensive cancer care.

IMMEDIATE PRIORITIES: SUMMARY OF PROGRAM DEVELOPMENT

FCCT's short-term goal is to build the Cancer Care Institute, a comprehensive cancer care facility on the KCMC campus that has capacity to diagnose, treat, and house cancer patients; Phase I construction will start in September 2015. Eventually, the fully operational facility will include a laboratory, oncology pharmacy, bunkers for radiation equipment, infusion unit and rooms, office space, training rooms, and housing for patients and their families. While the facility is being built, the capacity necessary to run the institute will be developed, including financial and operational management, organizational development systems, treatment protocols, and staff hiring and training, along with establishment and expansion of screening, education, and palliative care programs.

In these early stages, FCCT prioritizes the following objectives:

1. Build diagnosis and treatment capabilities for approximately 1,320 patients annually by 2016, with capacity increasing as facilities are expanded. The Northern Healthcare Zone lacks much of the basic infrastructure needed to treat patients on-site rather than referring them to other hospitals. FCCT will secure the equipment, personnel, and facilities needed to begin offering comprehensive chemotherapy, surgical therapy, and eventually radiation therapy at the Cancer Care Institute at KCMC, as well as at the first "spoke" facility at ALMC.

2. Establish a pediatric chemotherapy pilot program. FCCT will pilot a pediatric chemotherapy program at KCMC in collaboration with Duke University and Muhimbili and Bugando Hospitals, both of which have small pediatric oncology

programs. The partnership will establish treatment standards and protocols for a cancer care network that can be emulated by teams treating other types of cancer. This program will launch in early 2015 and expand with the eventual addition of pediatric beds at the CCI.

3. Develop organizational and management systems and processes. FCCT will build an organization and management structure that supports a cross-functional care process capable of treating patients efficiently and with the best outcomes. Based on a "hub-and-spoke" model, this network will funnel cases from "spoke" centers like ALMC and Selian Hospital to the "hub" at KCMC. The Cancer Care Institute will assemble the people, processes, and protocols necessary to build such a network.

FCCT and its Tanzania-based NGO affiliate, the Tanzania Foundation for Cancer Care, will together continue to raise funds and provide a finance and accounting system that ensures ethical and reliable fund management in the US and Tanzania.

4. Establish cancer diagnosis and treatment planning staff. FCCT will begin to develop the human resources sufficient to serve a patient population of approximately 1,320 patients annually in the Cancer Care Institute's early years of operation, and to handle an increasing patient load as facilities are expanded. The initial list of projected staff can be found in Section IV.

FINANCIAL IMPLICATIONS

Implementation of a comprehensive and sustainable cancer care program in northern Tanzania will require sizeable investments in infrastructure, equipment, and personnel. The initial costs of installing the Cancer Care Institute requires US$375,000 for a first-phase oncology clinic and an additional US$300,000 for an accompanying hostel (which FCCT considers a critical component of comprehensive and accessible care); the full implementation of the CCI will cost around US$2 million USD. The full ALMC facility is estimated at around US$375,000 in its first phase, putting capital costs at around US$2.5 million over around three years. These numbers only encompass construction costs; medicines and equipment will need to be procured and transported to Tanzania, and trained cancer specialists will be critical to implementing effective cross-disciplinary care. Once the Cancer Care Institute has been scaled up to include radiation services in addition to chemotherapy, it will require about US$1.8 million to run in year one, and about US$1.1 million to operate in years two and three.

Nevertheless, these are low investment requirements given the potential impact on people's lives. Some of the most common cancers in Tanzania—like cervical cancer—are highly curable if detected early, and patient outcomes will improve dramatically with effective screening and improved access to continuous care. The financial model in Section VI demonstrates the impact of a US$350,000 investment in cancer patients in northern Tanzania: over 1,000 life-years added and 42 lives saved. These outcomes are many times higher than a similarly sized donation would bring in a high-income country, indicating that with relatively small financial investment, FCCT and its partners will be able to effect dramatic change in morbidity rates, mortality rates, and quality of life for cancer patients in northern Tanzania.

introduction

FOUNDATION FOR CANCER CARE IN TANZANIA

FCCT was founded in September 2013 to help address the overwhelming need for cancer care Tanzania. Among its founding visionaries were doctors who have worked in northern Tanzania for decades, and who have seen firsthand the plight facing individuals with cancer in this region of the world. FCCT's twenty-four-member board is comprised of oncologists, radiologists, pharmaceutical doctors, and healthcare administrators living in the United States and Tanzania, including Mark Jacobson (director of Arusha Lutheran Medical Centre) and Helmut Diefenthal (radiologist at Kilimanjaro Christian Medical Centre).

FCCT's mission has already united individual and organizational supporters from within and beyond the field of medicine. Since 2013, it has forged partnerships with medical foundations and hospitals like Duke Global Health Institute, Radiating Hope, Varian, East Africa Medical Assistance Foundation, University of Minnesota, American College of Radiology, KCMC, ALMC, and the Ministry of Health and Social Welfare in Tanzania.

The organization is supported by more than sixty sponsoring members who are committed to donating yearly to cover administrative costs. These and other donors have helped FCCT raise several hundred thousand dollars towards installing a cancer care facility on the KCMC campus in September 2015.

PURPOSE OF THE PAPER

The purpose of this paper is to provide individual and organizational supporters with contextual information about cancer prevalence and cancer treatment in East Africa, especially in northern Tanzania. The paper explores the challenges inherent in delivering care in low-resource environments, examines successful cancer care implementations in Tanzania's peer countries, and assesses the strengths and weaknesses of northern Tanzania's current healthcare infrastructure. Based on all of this, the paper makes suggestions and projections for FCCT's plans to build a comprehensive cancer system in northern Tanzania.

The paper includes six sections, the contents of which are summarized below:

Section II. External Analysis: Describes the setting in which FCCT will implement its cancer care system, including: brief description of Tanzania; disease, cancer prevalence, and mortality in Tanzania and other East African countries; the methods and challenges in cancer care in low-income countries; potential models for cancer care in low-income countries

Section III. Internal Analysis: Describes current cancer care capability of hospitals and institutions in Tanzania, including two of the hospitals that will comprise the cancer care system in the Northern Healthcare Zone

Section IV. Discussion: Summarizes the major disparities between the current cancer care capacity in the Northern Healthcare Zone and the comprehensive cancer care system envisioned by FCCT and its partners; outlines FCCT's plan to address the gap

Section V. Budgets: Outlines a capital budget and operating costs of the Cancer Care Institute

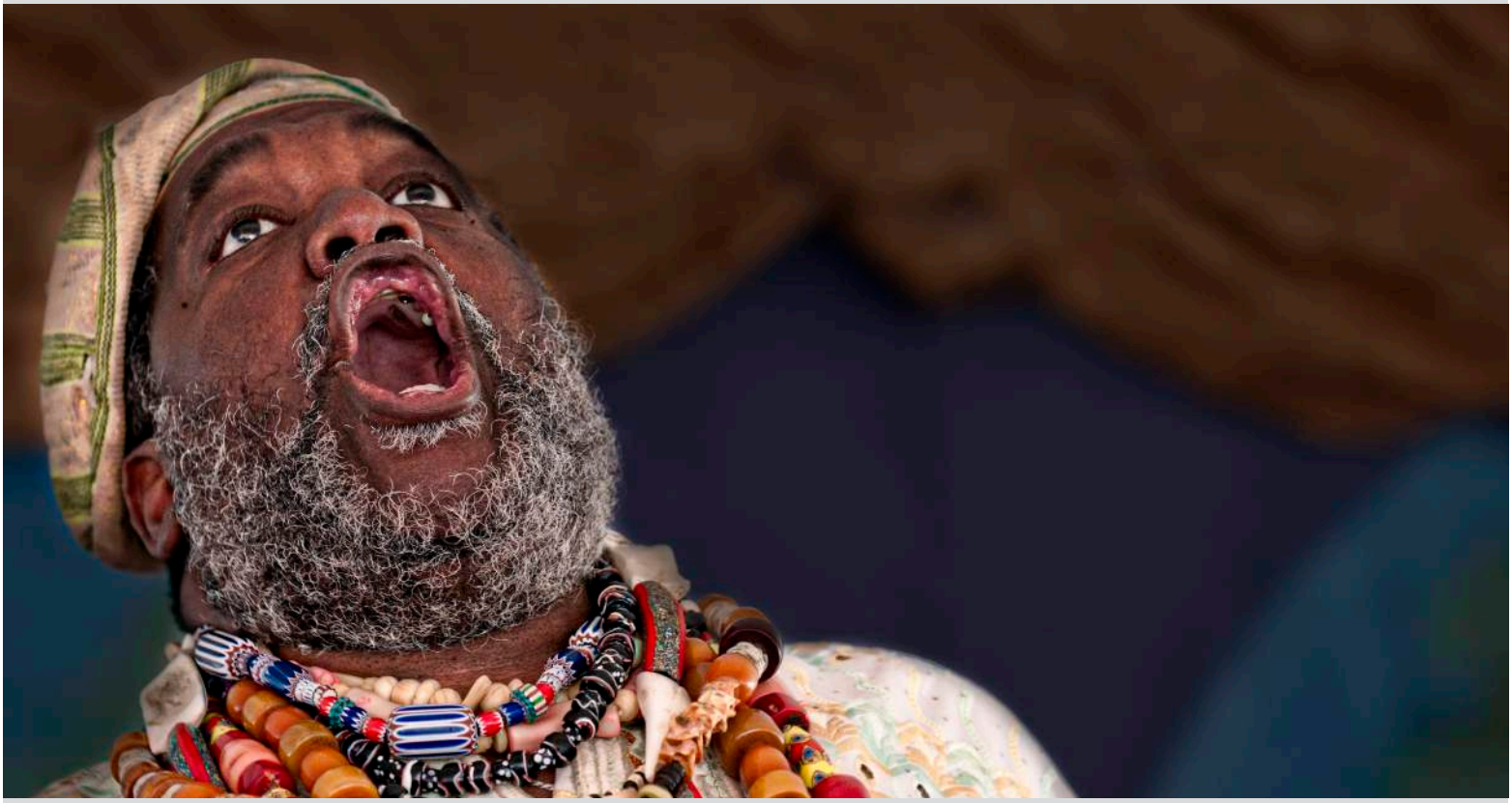
Section VI. Financial Model: Models the impact of potential donations on patient outcomes and population health

Section VII. Conclusion: Summarizes the cancer care landscape in northern Tanzania, recommended strategies for improving cancer care in the region and FCCT's short-term and long-term plans

external analysis

INTRODUCTION

This section summarizes the geography, the socioeconomic conditions, and the disease and mortality rates in Tanzania and offers a basic description of the Tanzanian healthcare system. It also provides an outline of prevalent cancers within the region and common challenges in treating such cancers in low-resource environments. It concludes by examining successful cancer care models in two of Tanzania's peer countries.



GEOGRAPHY

Tanzania is located in sub-Saharan East Africa (Figure 1) within the Africa Great Lakes region. The country's population was 47.7 million in 2012 (Table 1). Nationwide, about 80% of the population lives in rural areas, with only 20% residing in urban environments. The population is expected to grow at 2.9% annually, with the highest growth coming in rural areas; the World Bank estimates that this will put the population count at 100 million by 2035 (World Bank website 2014). In Tanzania, the average life expectancy at birth has increased dramatically from 49.1 to 61 years between 2000 and 2012 (World Bank website 2014). High population growth and rising life expectancy will increase pressure on Tanzania's already strained health infrastructure in the future.

The Tanzanian government divides healthcare into six geographic zones. FCCT aims to support comprehensive cancer care to people in the Northern Healthcare Zone, which comprises four regions (Figure 1) that include about 15% of Tanzania's population (or 6,804,733 people)(Table 1) United Republic of Tanzania National Bureau of Statistics website 2014).

FIGURE 1: TANZANIADISTRICT MAP

REGION	POPULATION	MALE POP.	FEMALE POP.	HOUSEHOLDS	PEOPLE/HOUSEHOLD
Arusha	1,694,310	821,282	878,811	378,811	4.5
Kilimanjaro	1,640,087	793,140	846,947	384,853	4.3
Tanga	2,045,205	992,347	1,052,858	438,258	4.7
Manyara	1,425,131	717,085	708,046	273,274	5.2
Total	**6,804,733**	**3,323,854**	**3,480,879**	**1,475,196**	**5**

TABLE 1: Population by region for sex, households, and household size (National Bureau of Statistics National Census 2012)

SOCIOECONOMIC CONDITIONS

The World Bank defines Tanzania as a low-income country and estimates that 68% of its people live on less than US$1.25 per day (World Bank website 2014). Below, Table 2 summarizes key indicators for Tanzania in comparison to the United States (2013 USD). In 2012/2013, the government of Tanzania allocated 7% of its Gross Domestic Product (GDP) to health expenditures. According to a 2012 World Bank report on health financing in Tanzania, public health expenditures averaged US$12.30 per person annually (Haazen 2012).

The United Nations Development Programme (UNDP) ranks Tanzania in the lowest quadrant of its human development statistics at 159 out of 187 countries on its Human Development Index (HDI), which is a summary measure of average achievement in key human development indicators like life expectancy, years of education, and living standards.

COUNTRY	TANZANIA	UNITED STATES
Population (millions)	47.7	298.6
Gross national income per capita (USD)	1,560	46,300
Life expectancy at birth	61	79
Infant mortality rate (per 1,000 live births)	36	6
Health expenditures (% of gross domestic product)	7.0	17.9
Out-of-pocket health expenditures (% of private expenditure on health care)	52.3	20.7

TABLE 2: Comparison of key economic and social indicators between Tanzania and the United States.

TANZANIAN HEALTHCARE SYSTEM

Healthcare services in Tanzania are organized in a pyramidal structure, with dispensaries and health centers at the base, followed by district hospitals, regional hospitals, and then the four national referral hospitals. Both government and private providers manage dispensaries and health centers. The four regions in the Northern Healthcare Zone contain 87 health centers, 866 dispensaries, and 45 hospitals, and about 90% of the population lives within reach of a primary health facility (The United Republic of Tanzania Ministry of Health and Social Welfare website 2014). KCMC functions as the referral hospital for the Northern Healthcare Zone.

REGION	POPULATION	DISPENSARIES	PER CAPITA	HOSPITALS	PER CAPITA
Arusha	1,694,310	220	7,701	10	4.5
Kilimanjaro	1,640,087	231	7,100	18	4.3
Tanga	2,045,205	275	7,437	9	4.7
Manyara	1,425,131	140	10,180	8	5.2
Total	**6,804,733**	**866**		**45**	

TABLE 3: Healthcare landscape in the Northern Healthcare Zone regions.

Dispensaries in the Northern Healthcare Zone are staffed by midwives and assistant medical officers (AMOs). Many of the dispensaries and clinics currently provide pre-and post-natal care, and diagnosis and treatment of common infectious diseases such as malaria, diarrhea, and acute respiratory diseases (Haazen 2012), (The United Republic of Tanzania Ministry of Health and Social Welfare website 2014). Dispensary staff rarely have the knowledge and background to identify or screen for common cancers, but could be trained to identify some lymphomas and breast cancers through routine administration of white blood cell count tests and breast exams; they could then refer patients to hospitals equipped to conduct further diagnosis and treatment. The government does have plans to begin administering the HPV vaccination to girls 9—14 through dispensaries and district hospitals to prevent cervical cancer. The pilot program, which will be done in collaboration with Merck, will be held in six districts in the Northern Healthcare Zone in 2014—2015.

Tanzania's healthcare system has significant shortages of qualified healthcare providers. According to a 2009 World Bank report, only 35 percent of the recommended government staffing position norms were filled with qualified health workers (Haazen 2012). Doctors trained as surgeons, radiologists, pathologists, or pharmacists capable of mixing drugs for chemotherapy are scarce to non-existent. In Tanzania, the primary consultation is usually with a non-physician health worker without knowledge or background in the presenting symptoms of cancer. For example, a child with symptoms of retinoblastoma may be seen initially by a community health worker, and the next visit may be to a non-physician eye care worker; the following visit may be to a non-physician eye care worker who may, in some cases, perform eye surgery themselves (Bowman et al. 2008). Much of Tanzania's healthcare—especially in rural areas—is provided by non-physicians or assistant medical officers, who may have many years of training and experience but not necessarily in cancer screening or diagnosis.

DISEASE, CANCER, AND MORTALITY IN LMICs

Chronic disease (cardiovascular disease, cancer, lung disease, and diabetes) causes around 60% of deaths worldwide, and 80% of these deaths occur in low- to middle- income countries (LMICs) (Strother et al. 2013). These diseases occur at younger ages in LMICs and cause a higher loss of life-years than in high-income countries (HIC). The American Cancer Society estimates that 56% of incidence and 64% of deaths due to cancer occur in LMICs. In pediatrics, the numbers are even more skewed, with 80% of the incidences and deaths due to cancer taking place in LMICs (Lingwood et al. 2008).

The International Agency for Research on Cancer (IARC) predicts that the number of new cancer cases and deaths will more than double1 between 2010 and 2030 because of population growth and aging as well as increased risk factors associated with economic development and urbanization, including smoking, obesity, lack of exercise, and reproductive behaviors. In the next two decades, cancer will cause 15% of all deaths and will account for 7% of all disability-adjusted life-years (DALYs) in LMICs.

In Tanzania, the five most prevalent for adults include cervical, prostate, breast, Kaposi sarcoma, and esophageal cancers (Ferlay et al. 2014). In children, the main cancers include Burkitt lymphoma, Kaposi sarcoma, Wilms' tumor and retinoblastoma.22 Nationwide, more than than one-third of all cancers in Tanzania are associated with underlying infections resulting from HIV, HPV, and hepatitis viruses (Ferlay et al. 2014). The IARC estimated cancer prevalence in Tanzania at 33,884 total cases/year, with 15,876 (43.9%) presenting in men and 19,008 (56%) in women in 2012 (Ferlay et al. 2014).

Estimated cancer rates in Tanzania probably understate the number of cases because many people, particularly those in rural areas, never seek treatment, and there are only two cancer registries currently tracking cases, both of which became operational only in the last several years.

MOST PREVALENT CHILDREN'S CANCERS

More than 85% of pediatric cancer cases and 95% of deaths occur in developing countries (Knaul et al. 2010). The difference in survival rates between rich and poor countries is greater for childhood cancers than for any other cancer; in LMIC countries, 90% of children with cancer die of the disease, compared to only 12% in HICs (Strother et al. 2013), (American Cancer Society 2010). The main barriers to successful care include lack of early diagnosis and the low continuity of treatment. Many families cannot afford transportation and housing costs for extended care (Lingwood et al. 2008). The majority of these children could be cured if they received prompt, effective, and complete treatment.

Successful cancer care programs should include social support that covers the costs of transportation, housing, and treatment. Potential treatment options include low-cost generic drugs that are available at US$50 per child provided in conjunction with social support that enables parents to complete treatment and provide ongoing care including nutritional support. Radiotherapy is recommended when available.

This section describes some of the most prevalent children's cancers in LMICs like Tanzania and the special challenges of treating each disease within the context of East Africa. Where possible, each description is accompanied by recommendations for prevention and/or treatment in a low-resource environment:

a. Burkitt Lymphoma

Burkitt lymphoma (BL) is the most common childhood cancer in Africa, and accounts for 30—50% of all childhood cancer in equatorial Africa, with an estimated annual incidence of 3 to 6 cases per 100,000. This rate is 50 times higher than the rate of BL in the US. The two clinical variants of BL found primarily in Africa are "endemic" and "immunodeficient." The endemic variant is associated with the HPV virus and usually presents with jaw masses in younger children, and often spreads to the nervous system. The immunodeficient variant is associated with HIV (Stefan & Lutchman 2014).

In a recent study of BL patients in South Africa, the overall survival rate was reported to be 64.7% compared to over 80% in HIC countries. The lower survival rate resulted largely from the late and advanced presentation of the cancers: over 80% of patients in the study presented with Stage III or IV. The delay in seeking treatment was longest in the most disadvantaged ethnic groups of South Africa, exemplifying the effects of a lack of education and access to healthcare (Stefan & Lutchman 2014).

Recommendation: Given that low survival rates are largely linked to late presentation, emphasis should be placed on early screening and detection measures as well as on providing access to continual care.

b. Wilms' Tumor

Wilms' tumor, also called nephroblastoma, is the most common type of kidney cancer in children worldwide. Wilms' tumor also has a high survival rate (85% to 90%) in well-resourced countries but much lower survival rates in LICs; in a 2013 study in Malawi, a low-resource country that borders Tanzania, the projected survival rate averaged 46%. In 31% of children that came for treatment, the cancer had spread

outside the kidneys. The main reasons for treatment failure included: 1) incomplete treatment (7%); 2) chemotherapy treatment-related deaths (15%); and 3) disease-related deaths (28%) with 11% of patients presenting inoperable tumors or metastases after preoperative chemotherapy and 17% experiencing relapse of disease (Israels et al. 2012).

c. Retinoblastoma

Retinoblastoma (RB) is a rare cancer that affects the eyes of very young children. As in most children's cancers, the annual incidence of RB in Africa exceeds that in HICs; for example, the annual incidence for children under 5 in Malawi is 20 cases per million compared to 3.8 cases per million in the US. According to a 2008 study conducted at the Ocean Road Cancer Institute (ORCI) in Dar es Salaam, most RB cases in Tanzania are not treated and there are significant treatment delays when children do receive treatment. ORCI estimated that it treated only 18% of the projected RB cases in Tanzania, leaving more than 80% of cases untreated. The patients who presented with RB at ORCI experienced an average delay of 10 months from when parents first noticed symptoms to the time of treatment. Long lag times increase the risk of the cancer spreading. By comparison, patients in London had an 8-week lag time between symptom presentation and treatment. At ORCI, the lag time was influenced by the primary health care professionals: community health workers were slower than general practitioners, and pediatricians were slower than ophthalmologists.

The profile of RB in Tanzania is skewed toward severe invasive disease. All 37 patients who participated in the ORCI study on RB were classified as ocular, orbital, or metastatic. Only children with ocular and orbital disease received chemotherapy. Remission was the main outcome measure and was defined as absence of disease at the end of treatment. Disease was ocular (eye socket) in 32%, orbital (eyeball) in 57%, and metastatic in 11%. Of those with ocular disease, 67% completed chemotherapy and all of these children achieved remission. In contrast, 48% with orbital disease completed chemotherapy and only 50% achieved remission (Bowman et al. 2008).

Recommendations: According to the study, improvements in mortality and morbidity will require a greater emphasis on early detection.

MOST PREVALENT ADULT CANCERS

Some of the most common adult cancers in LMICs like Tanzania are treatable if detected early enough, and several are potentially preventable. This section describes some of the most prevalent adult cancers in LMICs like Tanzania and the special challenges of treating each disease in the context of East Africa. Where possible, each description is accompanied by recommendations for prevention and/or treatment in a low-resource environment:

a. Cervical Cancer

East Africa has the highest incidence of cervical cancer in the world (WHO website 2014). In Tanzania, 54.4 women per 100,000 were diagnosed with cervical cancer and 34.2 women per 100,000 died of cervical cancer in 2012 (Ferlay et al. 2014). In Sub-Saharan Africa, including Tanzania, cervical cancer is the major cancer-related cause of death in women of all ages. A high rate of HPV infection and limited screening programs for cervical cancer are the main contributors to high cervical cancer incidence (Ngoma, et al. 2010). However, cervical cancer is highly curable if treated at an early stage. Morbidity and mortality can be reduced effectively through vaccination of girls against HPV before they become sexually active, and by screening and eradicating pre-invasive cancer through surgery or cryotherapy.

Cervical cancer screening through visual inspection with acetic acid (VIA), HPV-DNA test, and Pap smear testing are available on a limited basis in Tanzania; however, most women lack access or are unaware of these services. Through an ongoing study of the cervical cancer screening outcomes at KCMC, a small number of women have had access to screening. Women who detected cancer at Stage I were more likely to seek treatment than women diagnosed at later stages; the study showed that 14% of women who were screened began treatment at Stage I cancer compared to 7.8% of women who had not been screened (Lyimo & Beran 2010). According to the medical staff, over 80% of women who presented with cervical cancer at Selian Hospital or ALMC presented at Stage III or IV.

Recommendation: Cervical cancer is highly curable when detected early, and morbidity rates can be reduced through implementation of comprehensive HPV vaccination programs.

b. Kaposi Sarcoma

Kaposi sarcoma (KS) is the most common sarcoma and second most prevalent cancer in Tanzania, affecting all age groups and strongly associated with AIDS. The mean age at KS diagnosis was 40 years, with men presenting at a later average age (43) than females (35 years). Patients waited between 30 and 120 days after diagnosis before start of treatment. Most cases were found on the skin (87.3%), followed by oral cavity (12.2%). The median and average lengths of survival after diagnosis of KS were 8 months and 16 months respectively (Halfani, et al. 2014).

Recommendation: The main treatment for KS is to control of HIV/AIDS infection with antiretroviral agents combined with systemic chemotherapy.

c. Breast Cancer

Breast cancer is the most common cancer in women in the world, and the third most prevalent cancer in Tanzania. GLOBOCAN predicts a rapid increase in new breast cancers around the world, especially in women under 65 (WHO website 2014). As with most cancers in East Africa, women often do not seek medical treatment until they are at an advanced stage. The reasons for delay include lack of knowledge about cancer diagnosis, fear of surgery, non-acceptance of hospital care and/or preference for alternative care through traditional healers, and other challenges to receiving treatment. In Nigeria, the mean delay was 11.2 months between the onset of symptoms and presentation, and 39% presented with fungating tumors. Fear of mastectomy remains a prominent barrier to timely treatment in many LMICs, particularly given that husbands often leave their wives following such surgery (Ntirenganya et al. 2014).. Earlier detection methods could potentially increase survival rates for about one-third of breast cancer patients in Tanzania.

Recommendation: The main opportunities for breast cancer prevention and early diagnosis are the inclusion of healthy lifestyle education in maternal and child healthcare programs and education of healthcare staff and patients on breast cancer symptoms, clinical breast exams, and breast self-examination. Early detection could be increased by integrating breast cancer screening into HIV/AIDS service delivery systems and/or cervical cancer screening programs. Diagnosis is done primarily through core needle biopsies. Recommended treatment includes some combination of surgery, radiotherapy, hormone therapy, chemotherapy, and palliation where available.

d. Prostate Cancer

The WHO (World Health Organization website 2014) estimates that the prevalence of prostate cancer in developing countries

is about 4%; prostate cancer incidence estimates are significantly higher in Tanzania at 10.1%. Prostate cancer in Africa presents in patients approximately a decade earlier than in western countries, and patients also present with advanced disease in over 70% of cases (Bowa 2010).

There are very few screening programs for prostate cancer in Tanzania. Although the PSA test is used widely to screen prostate cancer in HICs, it is expensive and not widely available in Tanzania or other LMICs. The diagnosis of prostate cancer is limited further both by the low availability of ultrasound guided biopsy techniques and inadequate pathology services.

Recommendation: Early detection could be achieved by incorporating PSA screening in HIV/AIDS treatment clinics. Treatment is possible with a combination of chemotherapy, radiotherapy, hormonal therapy, and surgery.

e. Esophageal Cancer

Its rapid development and high mortality rate make esophageal cancer one of the most serious malignancies; worldwide, esophageal cancer is the eighth most prevalent cancer and the sixth most deadly. It is the fourth-most prevalent cancer in Tanzania. The major risk factors include tobacco use, human papillomavirus (HPV), and consumption of maize meal that has been contaminated with fungal mycotoxins (fusarium verticillioides and nitrosamine). Esophageal cancer has a higher prevalence in poor communities characterized by severe malnutrition, low intake of fruits, vegetables, and vitamins, and high use of alcohol and cigarettes.

The peak age of incidence of esophageal cancer in Tanzania is in the mid-40s, which is more than a decade earlier than in HICs. In a study conducted at Bugando Hospital in western Tanzania, men are more likely to develop esophageal cancer than women, perhaps due to the higher consumption of tobacco and alcohol by men compared to women.

Most patients in the Bugando Hospital study presented with an increased difficulty in swallowing and weight loss. As with most cancers in developing countries, patients tend to present at advanced stage, meaning mortality is very high and often only palliative care is possible. Even with operable tumors, postoperative mortality is about 50%. Diagnosis usually occurs three to four months after the symptoms first appear (Vandenberg et al. 2009).

Recommendation: Esophageal cancer prevention strategies include education on healthier lifestyles through improved nutrition, the elimination of tobacco, and reduced alcohol use. Other strategies include increased testing of maize meal for fungal mycotoxinas and vaccination for HPV. Treatment options include radiation therapy and surgery for palliative care.

CANCER CARE IN LMICs

According to the IARC, many of the most prevalent cancers in Tanzania could be treated cost-effectively. Moreover, if patients are diagnosed early, their lives can often be extended and many can be cured. The low survival rate of cancer patients in Tanzania and other low-income countries results largely from the late presentation of the cancers. According to the cancer mortality studies cited in this report, over 75% of patients in LICs present with Stage III or IV cancers (Lingwood et al. 2008). Treatment at these late stages is often palliative; thus education, screening, and early diagnosis are important components of a comprehensive cancer program.

Internationally, the WHO and other international agencies and leading universities have issued calls to action for holistic cancer care programs that include the four components of cancer care: prevention, early detection, diagnosis and treatment, and palliative care. The 58th World Health Assembly

resolution on cancer prevention and control (WHA58.22), adopted in May 2005, calls on member states to intensify action against cancer by developing and reinforcing cancer control programs (Lingwood et al. 2008). As mentioned above, some East African countries, including Kenya and Uganda, have subsequently launched cancer care programs, which are still in the early phases. Although many of these programs have seen relative success on small scales, numerous obstacles have slowed progress (Lingwood et al. 2008):

1. Insufficient priority and funding among donor agencies and governments owing to competing priorities such as HIV/AIDS, malaria, tuberculosis, and other infectious diseases.

2. Lack of knowledge among healthcare workers about cancer symptoms, screening procedures, and simple early-stage diagnostic tests, particularly in rural clinics.

3. Limited availability of diagnostics, even at regional hospitals, which are limited by lack of relevant expertise and equipment. Only a handful of pathologists, radiologists, oncologists, or medical physicists work in each country.

4. Lack of cancer medicines that are effective, easy to administer, and available to be administered to outpatients.

5. Restriction of treatment availability to facilities in major cities, which are accessible only to patients with money, transportation, and family support. Further, patients frequently drop out of follow-up treatment or discontinue medications.

6. Frequent care requests at advanced stages of the disease, when palliative care becomes their only option.

7. Shame and stigma associated with HIV/AIDS-associated malignancies such as KS, BL, and non-Hodgkin lymphoma. Poverty, lack of education, cultural issues, and family dynamics also delay people, particularly women, from seeking care.

8. Limited information on cancer incidences and mortality due to lack of reliable countrywide cancer registries and limited death certificates.

Despite these challenges, successful models do exist; two of these are discussed
below.

CANCER CARE MODELS IN RURAL LOW RESOURCE ENVIRONMENTS

In HICs, most cancer patients are treated by multidisciplinary medical teams that meet regularly to discuss the patients under their care. These teams typically consist of the medical oncologist, a clinical oncologist or radiotherapist, a surgeon, a radiologist, a pathologist, and an organ-specific specialist such as a gynecologist or urologist; the general practitioner may also be involved.

Healthcare organizations in east African countries like Tanzania often lack highly trained specialists, and hospitals tend to be organized by organ (e.g., heart), technique (e.g. surgery), or specific department. Organizing multidisciplinary teams to operate across departments presents serious management challenges in under-resourced settings. The severe shortage of specialists requires training of generalists, nurses, and AMOs to conduct procedures usually performed by physicians in HICs.

To address this issue and the challenges listed above, a "hub-and-spoke" framework is often recommended as the best way to organize and deliver cancer care in low-resource environments and to more remote areas. This type of structure distributes integrated, holistic care across a referral network

of facilities that provides different levels of care, ranging from simple screening programs in remote clinics to highly complex care and treatment at a central location. The community-level satellite facilities provide basic screening and diagnostic care, accompanied by a well-developed referral system that funnels patients to a "spoke" facility offering more comprehensive diagnostics and care. At the center of the network is the "hub" hospital with specialized pharmacies, laboratories, equipment, and staff. The "hub" also sets standards and clinical pathways for cancer care, collects performance data, holds multidisciplinary cancer conferences, and provides academic training and research leadership (Vandenberg et al. 2009).

"Hub-and spoke" programs have seen relative success in Kenya and Uganda over the past decade, where public-private-partnership organizations have established cancer care systems within an existing infrastructure that was developed to combat HIV/AIDS. In Kenya, AMPATH-oncology evolved from a small pediatric cancer care clinic to a larger facility that could also treat HIV/AIDS-related cancers. Over the past decade, USAID has provided funding and capacity development to scale up Kenya's HIV/AIDS infrastructure through on-site training, exchange programs, and specialists from North America and Europe. The USAID-AMPATH organization includes: 1) a NIH-certified grants management office and procedures for transparent transfer and utilization of funds; 2) an educational institute capable of organizing training workshops; 3) a Good Clinical and Laboratory Practices (GCLP) and ISO 9000-certified clinical laboratory, plus basic laboratory facilities in remote clinic sites; and 4) an open-source electronic medical record system (EMRS) with an associated monitoring and evaluation system.

Currently, the central "hub" in Kenya serves 50 remote sites in government facilities that range from permanent buildings with reliable electricity to basic settings such as a tent in a field. The remote clinics have become a network for population-based cancer screening and prevention activities. This network has a referral process that funnels more complex cancer cases to higher-level care centers and facilitates adequate follow-up. The network was reorganized into three care-defined departments: screening and prevention, diagnosis and treatment, and palliative care(Strother et al. 2013).

In Uganda, healthcare experts have addressed the shortage of specialists and the complexity of cancer treatment by focusing almost exclusively on infection-related cancers. In sub-Saharan Africa, nearly 50% of cancer cases are caused by infection compared to only 30% of cancers worldwide. Seven out of ten of the most common cancers in Uganda are attributable to HIV/AIDS and other infections; twice the number of HIV-positive cancer patients in Uganda died within one year of diagnosis compared to HIV-negative patients. Cancer also tends to present around a decade earlier than in HICs.

The Uganda Cancer Institute (UCI) and the US-based Fred Hutchinson Cancer Research Center (FHCRC) formed the Uganda Partnership for Cancer and Infectious Disease (UPCID) to investigate new therapies and care delivery methods specific to infection-associated cancers. UPCID links three interrelated activities to accomplish its objective: 1) advanced research in infection-related cancers to develop and test more effective and safer treatment and prevention regimens; 2) improvement of clinical capabilities though revised clinical protocols and medical support for patients with infectious cancers; and 3) training of US and Ugandan clinicians and support staff to build the human capacity for cancer care in a resource-limited region.

UPCID recognized that the delivery of effective cancer care required multidisciplinary teams with specialty training, and therefore established extensive training activities for

Ugandan pharmacy, laboratory medicine, and pathology staff as well as physicians, nurses, and other healthcare staff. It also recognized the fact that few American healthcare providers and researchers appreciated the issues faced in low-resource regions, which created an obstacle to effective collaboration; hence, UPCID developed a series of bidirectional training activities relevant to low- and high-resource regions (Casper et al. 2011).

CANCER TREATMENT IN LOW-RESOURCE ENVIRONMENTS

Radiology and chemotherapy would be effective in treating many of the cancers prominent in LMICs. However, complex cancer treatment presents special challenges in low-resource environments. Some of these are outlined below.

Radiology Treatment: According to studies in several HICs, for every 1,000 new cancer patients, 523 (52%) would need radiotherapy as part of their treatment, and 23% of these patients would require additional radiation for other areas of tumor involvement during the course of their illness. The IAEA suggests that this figure is higher in LICs—at least 60%. This rate will remain higher in the next decades until cancer services and public education programs become operational and effective.

According to the International Atomic Energy Agency analysis, most radiation equipment in Africa is located in countries with the highest GDPs: South Africa, Egypt, and other North African countries. Most cancer centers in Africa deliver primarily palliative services and simple curative treatments that are based on two-dimensional imaging and treatment planning. Most are small facilities with one or two radiotherapy machines (Abdel-Wahab et al. 2006).

In 2008, GLOBOCAN estimated that Tanzania had 21,180 new cancer cases and needed 30 machines to cover patients requiring radiotherapy; at the time, the entire country had three machines at its disposal. Since 2008, the number of new cancer patients has grown by more than 37%, while western Tanzania has gained just three additional machines. This leaves a deficit of 36 machines. Even if cancer institutes acquire machines, maintenance and service issues remain serious obstacles.

There is substantial debate on which type of radiotherapy equipment to set up at cancer institutes in LICs. However, the WHO recommends cobalt machines as the most effective equipment, given that they are relatively easy to maintain and can provide sufficient treatment or palliative care for most patients. In addition, cobalt-60 machines have simple infrastructure requirements (less power consumption, beam stability, and ease of operations) and offer cost-effective and uninterrupted treatments to large number of patients even in settings where power fluctuations are common. While cobalt machines provide less precise treatment than linear accelerators and are generally recommended for palliative care in HICs, their ease of maintenance outweighs the benefits of machines like linear accelerators, which are more expensive, require more sophisticated maintenance and calibration, and run the risk of breaking down (Levin et al. 2001).

In addition to cobalt and linear accelerators, brachytherapy equipment is recommended equipment at LIC cancer institutes. Some of the most prevalent cancers in Tanzania include cervical and prostate cancers, which are often most effectively treated by brachytherapy (a therapy which applies radiation more directly to tumors) (Ravichandran 2009).

Chemotherapy: Chemotherapy is often used in combination with surgery and radiotherapy. Successful treatment requires a consistent availability of medicines, a sophisticated pharmacy equipped to mix the drugs, and the trained staff and materials to administer the drugs. Although the initial set-up

for chemotherapy costs far less than purchasing radiotherapy equipment, the high cost and the inconsistent availability of medicines and the scarcity of highly trained pharmacists and oncologists remain significant barriers to the effective use of chemotherapy in countries like Tanzania.

A 2010 study on chemotherapy at ORCI in Dar es Salaam found that the availability of anticancer medicines was not adequate to meet demand, coming in at about 50% of all surveyed medicines. When chemotherapy drugs are not available at ORCI, the patients' other option is to purchase them from private pharmacies. However, these drugs tend to be very expensive at such pharmacies. The mean cost for anticancer drugs reported by patients was 106,300 Tanzanian shillings (TSh) (US$64); the unit cost ranged anywhere from 2,500 TSh ($1.50) to 744,000 TSh (US$450), which is equivalent to anywhere from one to seven months of income for a given patient. Most patients are not covered by health insurance to purchase their medicines. As a result, more than 70% of patients did not get the prescribed anticancer medicines at the hospital (Yohanna et al. 2011).

internal analysis

INTRODUCTION

There are two existing cancer treatment institutes in Tanzania, which provide a combination of surgery, chemotherapy, and radiation therapy in Tanzania's two largest cities: Ocean Road Cancer Institute (ORCI) in Dar es Salaam and Bugando Medical Centre (BMC) in Mwanza. Both institutes serve high population areas, but they are located far from patients residing in the Northern Healthcare Zone.

In 2007, the Tanzanian government formed a steering committee to develop a national cancer control strategy. It is now working alongside ORCI and NGOs like the International Network for Cancer Treatment and Research (INCTR) and the International Atomic Energy Agency (IAEA) on a US$600,000, three-year strategy to promote sustainable cancer care throughout Tanzania. Part of this strategy includes expanding cancer care into other care zones via three other university cities, including Moshi, as well as procuring drugs, furthering research, and carrying out national awareness campaigns on common signs of various cancers.

As part of this strategy, the Tanzanian Ministry of Health and Social Welfare (MoHSW) supports the creation of a cancer care program in northern Tanzania, starting with the construction of the Cancer Care Institute at KCMC. While the government may not be able to contribute to capital development, it will potentially provide limited help with personnel, training, and some medications. Kilimanjaro Christian Medical Centre (KCMC), which is the Northern Healthcare Zone referral hospital, will serve as the new cancer institute "hub" location in the proposed "hub-and-spoke model"; it will work initially with ALMC and Selian Hospital in Arusha Region because these hospitals have many of the components in place that can be expanded or repurposed to serve cancer patients. Additional hospitals will be added to the network in the next several years to serve the entirety of the Northern Healthcare Zone.
The following sections describe the two existing cancer care facilities that currently operate in Tanzania, as well as the current capabilities of the main hospitals located in the Northern Healthcare Zone that are proposed locations for the Cancer Care Institute and its associated cancer care network.

OCEAN ROAD CANCER INSTITUTE (ORCI)

ORCI is one of two specialist cancer treatment centers in the country. According to the ORCI website, about 20,000 people are diagnosed with cancer each year in Tanzania and the institute sees about 4,000 to 5,000new patients annually. At its current capacity, it cannot provide treatment for the large number of patients who require chemotherapy or radiotherapy. It sometimes has to place two, or even three, patients in one bed for months at a time.
ORCI has two cobalt units and one brachytherapy unit, but the units break down frequently. When they are functional, each of the cobalt machines can treat 100 patients per day. About 75% of radiation therapy provided is palliative, according to ORCI physicians. Patient waiting time currently averages three months. The institute staff includes three medical physicists and could potentially share or rotate staff to KCMC. ORCI staff estimates that 30% of patients receiving chemotherapy can access drugs through the government and the remaining 70% must purchase drugs privately at very high costs. For example, cervical cancer patients who require chemotherapy and radiation pay 4 million TSh per case, or US$2,300 (Yohana et al. 2011).
The Tanzanian government funds the running costs of ORCI, including basic tests and salaries, routine supportive care drugs, radiotherapy, and some food. NGOs that work with the Ministry of Health and Social Welfare (MoHSW) run the specialist treatments and facilities. INCTR pays for all BL care as well as salaries for specialist doctors. Children in Crossfire, another NGO, provides free chemotherapy for pediatric patients and pays for staff overtime.
ORCI currently does not have the capacity to support new cancer facilities in other locations because of serious shortages in beds, medicines, and radiation therapy capacity.

BUGANDO MEDICAL CENTRE (BMC)

BMC is a consultant and teaching hospital for the Lake and Western Healthcare zones of Tanzania. Located in the city of Mwanza on Lake Victoria, it has 900 beds and over 900 employees. It is a referral center for tertiary specialist

TANZANIA MEDICAL CENTERS: (Clockwise from top left) The main entrance to Kilimanjaro Christian Medical Center (KCMC), Bugando Medical Center, Arusha Lutheran Medical Center, doctors at work in Bugando.

care for six regions and serves a catchment population of approximately 13 million people.

Over the past several years, BMC—in collaboration with the Istituto Scientifico Romagnolo per lo Studio e la Cura dei Tumori (IRST) and other partners—has been building a cancer care program in western Tanzania. BMC provides chemotherapy, although it faces similar shortages in access to low-cost medicines as ORCI. In early 2015, BMC expects to begin providing radiation therapy as well. BMC and its partners recently built a radiotherapy center and received two linear accelerator machines in November 2014, and expect to obtain a cobalt-60 machine early in 2015.

BMC also has a licensed laboratory, pathologists, surgeons, and two oncologists. Like KCMC, BMC operates a research project on community-based cervical and breast cancer screening with early treatment of cervical cancer. The National Institute for Medical Research (NIMR) laboratory located at BMC is capable of high-quality testing of up to 2,000 samples per week with short turn-around time to support NIMR's large epidemiological studies. BMC lists its laboratory testing capabilities as: parasitology tests, biochemistry tests, microbiology tests, serological tests, hematology tests, and histopathology tests. The NIMR Data Management and Analysis Department was established approximately fifteen years ago, and in recent years has grown exponentially to meet the high volume of trials taking place at BMC. The NIMR Data Management and Analysis Department consists of a well-staffed statistical team led by a full-time senior statistician and a faculty member at the London School of Hygiene and Tropical Medicine (LSHTM), who plays a major role in statistical analysis of data and in mentoring junior staff with the goal of building capacity in this area.

KILIMANJARO CHRISTIAN MEDICAL CENTRE

Kilimanjaro Christian Medical Center (KCMC), which is located in Kilimanjaro Region in the city of Moshi, is one of four national referral hospitals, serving over 11 million people from the four regions that comprise the Northern Healthcare Zone. The hospital is a large complex with over 450 beds and more than 1,000 staff members, with hundreds of outpatients and visitors coming to the center daily; the facility includes 10 examination rooms, a clinical pharmacy, nursing counseling and conference rooms, offices, videoconferencing facilities, a data management unit, and a NIH-certified research laboratory managed by Duke University. It also houses the Kilimanjaro Christian Medical University College (KCMUCo), a fully registered university with undergraduate and graduate programs in medicine, rehabilitation, public health, nursing, and other focuses allied with KCMC's services and research.

It is likely that the existing programs at KCMC can become components of an interdisciplinary cancer treatment center. The departments are currently organized independently, but the hospital has started a new cancer management process that aligns staff to work collaboratively through a Tumor Board model established at ORCI. Health centers and programs that will help build the foundation for the cancer institute are listed below.

Reproductive Health Centre: KCMC runs a reproductive health center that focuses on women's health, including prenatal and maternal health and gynecological issues (including screening for breast and cervical cancers). The screening program covers about 2,000 women annually.

Ophthalmology: The KCMC Eye Department provides medical services such as treatment, training, and research in collaboration with the Ministry of Health and Social Welfare (MoHSW), Tumaini University, and international universities. The department provides service to more than 20,000 patients annually at the hospital or in outreach clinics. The department conducts over 5,000 eye surgeries annually and over 350 laser treatments for diabetic retinotherapy.

Radiology Residency Program: KCMC offers a residency program in radiology that includes two- and four-year training programs for physicians (MD) and AMOs. Students pursuing an M-Med in Diagnostic Radiology (the four-year course) acquire residence training by course work and thesis, and graduates have gone on to practice radiology in various public and private institutions in Tanzania. The AMO graduates follow two years of residency coursework with five years of clinical practice in smaller regional or district hospitals. The residency program currently trains 20 AMOs, 5 MDs, and 8 M-Meds.

Community Development Program: KCMC runs a Community Development Program with outreach initiatives that could be leveraged for cancer care. For instance, its HIV/AIDS program could also provide educational support for KS and BL, and its eye clinic could support diagnosis and for retinoblastoma or other HPV/HIV/AIDS-related cancers.

Partnership with Duke University: The KCMC-Duke Collaboration has operated for nearly 30 years and includes externally funded research at $5 million per year. The program supports 50 Duke and KCMC joint personnel in Moshi, Tanzania, who conduct research in the areas of maternal and women's health, mental health, trauma and emergency medicine, bacterial infections, and HIV/AIDS testing, prevention, and care. There are four full-time Duke faculty, two infectious diseases fellows, three global health residents, and three Duke medical/postgrad students currently living in Moshi.

Kilimanjaro Cancer Registry (KCR): KCMC is home to a cancer registry for citizens of the Kilimanjaro region that was launched fifteen years ago; however, gaps in the registry exist

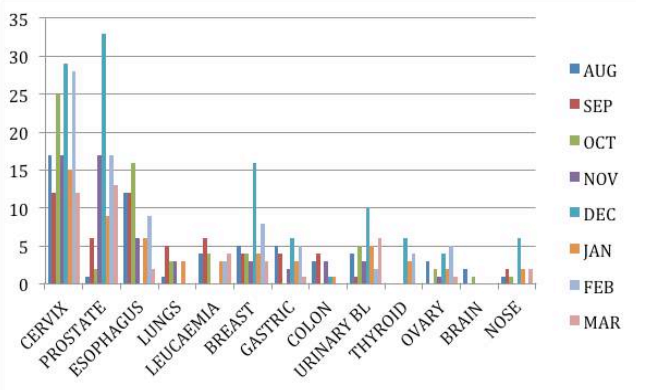


FIGURE 2: Cancer cases by site on KCR, August 2013 to March 2014

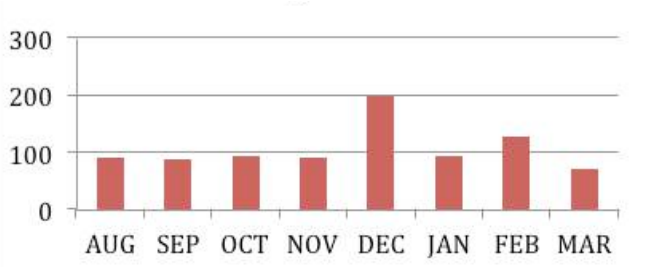


FIGURE 3: Total number of cancer cases reported on KCR, August 2013 to March 2014

because of gaps in funding. In 2013, KCR received funding from the Medical Education Partnership Initiative (MEPI) to buy equipment and pay its staff; KCMC now operates one of two regional cancer registries in Tanzania. The KCR registers information from people that originate from the Kilimanjaro region, which has a population of about 1.7 million. The main variables of cancer cases collected include diagnosis (clinical/pathology/hematology), treatment, treatment outcome (dead/alive/cured), or whether the patient was referred. Patient identifiers are also traced to the village level, and this information can be used to follow patients or to ascertain patient survival after treatment or diagnosis. While KCMC is not a specialized cancer hospital and treatment variables and outcomes are sometimes absent from the records, the KCR has nonetheless recorded over 8,000 cancer cases to date.

A medical doctor and public health specialist currently lead the KCR; two registered nurses oversee its record operations, which are verified by the director in charge of medical records. In the future, if more funding becomes available, the KCR plans to expand operations to include more district and regional hospitals within the Northern Healthcare Zone in order to make the registry more complete. Figure 2 below summarizes most frequently reported cancers in the registry from August 2013 to March 2014, and Figure 3 summarizes the number of cancer cases by month during the same time period.

KCMC CANCER CARE CAPABILITY

SCREENING AND PREVENTION

KCMC has a cervical cancer clinic held in the Reproductive Health Centre. In addition, it has outreach programs staffed by nurses and doctors who travel throughout the Kilimanjaro region to screen women for cervical cancer. Over the past four years the program has screened over 20,000 women. Less screening is done for other cancers, though some efforts do exist to screen for prostate cancer. The Community Medicine Department does screening and counseling for HIV/AIDS and some cancer education in small villages in the region.

CANCER DIAGNOSIS AND TREATMENT

Diagnostic Radiology: The role of the radiologist in cancer care is to localize, stage, and often perform image-guided biopsy in order to obtain the tissue for preliminary diagnosis. At KCMC, radiologists primarily work with general surgeons to identify tumors and perform biopsies. Tissue samples are sent to Dar es Salaam and Nairobi for diagnosis and staging.

Staffing and Training: The government of Tanzania currently employs one radiologist at KCMC who is capable of making cancer diagnoses and performing biopsies. KCMC directly employs another through the School of Radiology. KCMC also employs five X-ray technicians.

Equipment: KCMC provides basic radiology services, but its equipment lacks the digital capability required for communication within the hospital and in order to work efficiently as a "hub" organization. Images and information must be transferred manually between machines, departments, or other institutions. KCMC provides diagnosis and treatment with four X-ray machines, including two machines that provide plain films and two fluoroscopic X-rays. KCMC has five ultrasound machines shared across departments. KCMC owns a CT scanner that needs repair to be useable. Currently KCMC does not offer any radiation or chemotherapy; cases that need such treatment are referred to ORCI in Dar es Salaam.

Surgery: KCMC currently performs about 50% of cancer biopsies through surgery and provides surgical removal for some breast, cervix, ovarian, prostrate, esophagus, lung, colon, gastric, and thyroid cancers.

Anatomical Pathology: KCMC has been without full-time pathologists for the past two years and has relied on sending biopsies to ORCI or to Nairobi. KCMC is now setting up a new laboratory, and Duke University has just finished training two pathologists for Tanzania; two additional pathologists are in training.

Medical Oncology: There is no medical oncology staff, drugs, or equipment for chemotherapy, hormonal therapy, and targeted therapy. Patients are referred to ORCI.

Pharmacy: KCMC employs one PhD pharmacist capable of preparing chemotherapy drugs; it does not often procure chemotherapy drugs. KCMC does not own the equipment usually required for mixing the drugs. KCMC refers patients that require chemotherapy to ORCI.

Radiotherapy: Although about 50% of cancer patients need radiotherapy, KCMC has no staff or equipment to provide these services and refers patients to ORCI or outside the country. On-site treatment of patients who are currently referred elsewhere would require significant staff and equipment.

Palliative Care Capability: There is no formal care program at KCMC for cancer patients needing palliative care.

ARUSHA LUTHERAN MEDICAL CENTER

Arusha Lutheran Medical Center (ALMC) is a 125-bed hospital in Arusha, Tanzania, with over 25 doctors and specialists. It serves as a regional referral center for a population of up to 4 million. Combined with its sister hospital, Selian Lutheran Hospital (SLH), ALMC has over two hundred beds, seven operating theatres, and 550 staff. ALMC is a referral-level hospital with specialty consultant care; SLH is a community hospital. Together, both hospitals provide specialty care in medicine, pediatrics, OBG, general surgery, orthopedic surgery, and pediatric surgery. Health centers and programs at ALMC and SLH that will help build the foundation for the cancer institute include the following:

Educational Programs: ALMC offers a General Surgery Residency program, which is a five-year general surgery program accredited by PAACS under the auspices of Loma Linda University. ALMC launched a nursing school in 2014 and an Assistant Medical Officer School in 2012.

Community Health HIV/AIDS Treatment: ALMC and SLH have two community treatment centers that test, counsel, and treat HIV/AIDs patients with antiretroviral drugs. They also provide mobile HIV/AIDS testing and counseling in rural communities in Arusha and Manyara Regions. Although no cancer screening is offered currently within the program, it could provide infrastructure and facilities for education, training, and screening programs for HIV/AIDS-related cancers, including cervical cancer, BL, and KS.

Palliative Care: The Selian Hospice and Palliative Care Programme provide holistic care to over 4,500 chronically ill patients; 86% of these are HIV/AIDS patients. The core of the service is home-based care in Arusha and Manyara Regions that is provided by over 300 trained volunteers. The program includes weekly visits by volunteers who evaluate, care for, and refer patients to a central team for further evaluation and treatment. The hospice program is one of the four original programs to offer oral morphine for pain relief. The palliative care program has become a model for other hospitals throughout Tanzania.

ALMC CANCER CARE CAPABILITY

SCREENING AND PREVENTION

No formal cancer screening and prevention program currently exists at ALMC, but HIV/AIDS testing, counseling, and treatment infrastructure could be leveraged to add these services.

CANCER DIAGNOSIS AND TREATMENT

Diagnostic Radiology: At ALMC, radiologists work with general surgeons to identify tumors and perform biopsies. Tissue samples are sent to Nairobi for diagnosis and staging.

Surgery: ALMC has a strong surgical program with three general surgeons, two gynecological surgeons, and one each in orthopedics and pediatric surgery. As such, it offers wide and extensive surgical services.

ALMC performed 2,772 consecutive biopsies in its surgical services during the period of 2009-2014. Of these, 10% were reported as malignancies. All biopsies taken at the hospital during the period of 2009 to 2013 were processed by the same histopathology laboratory service in Nairobi, Kenya. Histopathology reports are returned by email to ALMC and double-recorded in the laboratory and in the surgical department.

Medical Oncology, Pharmacy, and Radiotherapy: ALMC currently provides very little treatment planning beyond surgery.

Cancer patients are referred to other hospitals for radiation and chemotherapy.

Palliative Care: Palliative care for cancer patients has not been set up, but a home-based care program is in place for HIV/AIDS.

discussion

OVERVIEW

In coming years, rising cancer rates will continue to strain Tanzania's already under-resourced healthcare system; the effectiveness and scope of cancer care across the country must be increased to meet the growing demand. Although cancer care has improved with the establishment of the Ocean Road Cancer Institute (ORCI) and cancer services at Bugando Medical Centre (BMC), treatment capacity only covers a small fraction of the population that needs it. Cancer patients in

outlying areas, including the Northern Healthcare Zone, still lack access to the basic components of comprehensive cancer care.

Northern Tanzania's current cancer-care capabilities only consist of rudimentary preventive and early detection programs, and none of the northern zone hospitals offer complex treatments such as chemotherapy or radiation therapy. Palliative care is rarely available, and the Tanzanian government maintains tight control of narcotics used for pain relief, making them difficult to obtain. Nonetheless, existing prevention and treatment infrastructure developed for diseases like HIV/AIDs offer a foundation on which to build a comprehensive cancer care program. Moreover, the prevalence of both preventable and highly curable cancers in Tanzania suggests that expanding cancer care will quickly yield dramatic and cost-effective outcomes.

The Ministry of Health and Social Welfare recognizes the need to expand cancer-care services to under-resourced areas like the Northern Healthcare Zone, and in 2013 it issued a National Cancer Control Strategy to implement effective preventive, diagnostic, and treatment measures over the next ten years. The Ministry has called on development partners and other stakeholders to support the strategy and to provide financial and programmatic assistance. FCCT is one such partner, dedicated solely to improving cancer care in the Northern Healthcare Zone.

FCCT has designed a comprehensive cancer care program to cover the more than 3,500 new patients diagnosed with cancer each year and the approximately 11,000 patients already living with cancer in the Northern Healthcare Zone. Its first initiative is to construct a centralized cancer care facility—the Cancer Care Institute (CCI)—that offers more robust treatment options (including chemotherapy) than are currently available in the area. The CCI will have capacity to treat about 1,320 patients in its first year of operation, and will eventually be scaled up to offer more treatment capacity and additional treatment options (like radiation). In the long term, the CCI will anchor a comprehensive "hub-and-spoke" model of care, supporting a network of programs at dispensaries, health centers, and other hospitals throughout the Northern Healthcare Zone, including ALMC in Arusha.

Education and prevention will be essential components of a truly comprehensive cancer care program in northern Tanzania, especially since many of the country's most common cancers are at least partially preventable. However, until it has the capability to implement such initiatives, the Cancer Care Institute will focus on patients who already suffer from the disease. Given the current dearth of treatment options and subsequently high mortality rates in northern Tanzania, cancer therapy and treatment capabilities must first be developed and strategically deployed. In similar cancer care programs in countries like Kenya and Rwanda, doctors deliver treatment almost exclusively to people with curable cancers. Some of these programs began as pediatric cancer initiatives, both because childhood cancers have high cure rates and because a cured child gains decades of life—but the studies cited here emphasize that most children do not complete treatment in countries like Tanzania, largely because of a series of small hurdles related to living on less than US$1.25 per day.

FCCT and its partners recognize the tremendous challenge ahead; full implementation of comprehensive cancer care throughout four regions of Tanzania will take time, and progress can only be achieved in a stepwise manner. Individually, each component will likely be both difficult and costly to implement. The initial scaled-down version of the CCI, for instance, will cost US$700,000 without factoring in equipment, medicines and staffing, and the full-scale facility at KCMC will come in at around US$2 million. This investment

only begins the process; further steps will be needed to extend care from the Cancer Institute at KCMC all the way to healthcare clinics in the patients' rural villages. However, every dollar invested in cancer care in northern Tanzania will yield immediate and dramatic results that far exceed the impacts of equal donations in high-income countries. Once the CCI is up and running, a donation of $10,000 will translate into treatment for 17 patients, resulting in an additional 30 life-years.

Consider the following scenario as an illustration of why installing comprehensive care in northern Tanzania is so imperative:

A mother living in a rural village notices that her child is ill. If she decides not to seek advanced care, her child will become one of the 90% of Tanzanian children diagnosed with cancer that die of a curable disease.

Initially, the mother may take her son to a traditional healer who soothes the mother's fears, but whose recommended remedy does not work. Next, she visits a clinic staffed by a midwife or a healthcare worker who knows the symptoms of malaria but has never seen cancer; a misdiagnosis leads to another ineffectual treatment.

If the mother has the resources, she may take her child to the nearest hospital where the child receives the correct diagnosis. But by this time, he might have become one of the 75% of Tanzanian patients who present with Stage III or IV cancer. The district hospital can only recommend one option: a fifteen-hour bus ride to Dar es Salaam, when the trip to Arusha or Moshi was the farthest distance the mother had ever traveled in her life.

Most women would stop at this point, but if this woman's church has collected enough money, and she is willing to travel to Dar es Salaam, she will navigate the crowded byways of a vast city and search out the cancer treatment center. Once there, she will likely discover three patients to each bed and find that the clinic lacks the medicines necessary to treat her son. She learns that the medications sold at private pharmacies cost many times more than her family's annual income. Even if the mother receives medicines from a charity or another donor, she may be unable to pay for food and lodging during the long course of treatment. Her family's crops may not be planted or harvested during her absence. Her losses are manifold.

The elements of comprehensive cancer care include prevention and education, screening and early diagnosis, treatment, and palliative care. If the mother and child had gained immediate access to comprehensive care, the scenario might have looked different:

1. If an education program helps either the mother or healthcare worker recognize the symptoms of cancer, the child is sent to a hospital for early diagnosis. If a community-based screening program exists, the cancer may be noticed even before the mother realizes her son is ill.

2. If the child's tumor is biopsied at a "spoke" hospital in the Northern Healthcare Zone cancer network and the results emailed to the "hub" location, an interdisciplinary medical team at the KCMC will devise an effective treatment plan and email back to the "spoke" hospital.

3. If the complexity of the case requires the mother to bring her child to the "hub", he will receive free treatment at KCMC, with access to food and shelter through the family hostel.

In this scenario, the chances for the child's recovery increase dramatically within a comprehensive cancer care system. However, his survival will still depend on the availability of proper medicines, properly maintained equipment, and

qualified staff being constantly available at the "hub" and each of the "spokes".

Doctors in Tanzanian hospitals who regularly provide the equivalent of the second scenario for HIV/AIDS, malaria, and other diseases know that things can and will go wrong each step of the way. But successful models of comprehensive cancer care have been achieved in other East African countries, and KCMC and ALMC have built the underlying infrastructure, existing programs, and strong relationships with American universities and other institutions to provide a solid foundation for an effective cancer care program.

GAP ANALYSIS

The Discussion section characterized the vast difference between FCCT's vision for a Cancer Care Institute that delivers comprehensive care and the existing state of cancer care in northern Tanzania. Currently, the Northern Healthcare Zone lacks capacity in almost every area of comprehensive cancer care: prevention, early detection, diagnosis and treatment, and palliative care. Implementation of widespread, sustainable cancer care in northern Tanzania will require a long-term commitment and the ongoing investments required to integrate all the necessary components of the system. The following section sets out the major gaps that need to be bridged to achieve FCCT's vision.

RESOURCES (FACILITIES, EQUIPMENT, AND MEDICINES)

Comprehensive cancer care requires sizeable investments in expanded facilities, new equipment, and cancer medicines. Although both KCMC and ALMC have some components of cancer care in place, they lack the physical capacity to expand offerings without the addition of new facilities. Neither hospital currently has the necessary equipment to perform chemotherapy or radiation therapy, and both lack medicines for complex treatment and the means of mixing them.

In the short term, facilities will need to be added on the KCMC and ALMC campuses to house equipment, medicines, and patients; equipment, such as cobalt-60 machines and linear accelerators, will need to be procured and transported to Tanzania. In the long term, "spoke" hospitals throughout the zone will need smaller expansions and will require at minimum the equipment necessary to implement basic screening and detection programs.

Once the initial investments in construction of facilities are made, strategies for full- utilization of these assets must be ready: sophisticated equipment needs be staffed by qualified workers and used continuously. Maintenance, service, and parts-replacement are as important as the machines themselves.

TRAINED PROFESSIONAL STAFF

Perhaps the most serious impediment to establishing a sustainable comprehensive cancer care program in Tanzania is the serious shortage of qualified healthcare providers. Doctors trained as surgeons, radiologists, pathologists, and pharmacists capable of preparing drugs for chemotherapy are scarce to non-existent. In Tanzania, the primary consultation is usually with a non-physician health worker without knowledge or background in the presenting symptoms for cancer. Capacity building and retention strategies are crucial to FCCT's plans for overcoming the shortage of staff.

A comprehensive cancer care program will depend on training such workers to administer routine screening tests in rural areas, as well as hiring and educating specialists like surgeons, radiologists, pathologists, and pharmacists capable of delivering more complex care at bigger facilities. Once trained, these professionals become hot commodities to staff hospitals

across Africa and many other organizations will likely offer higher pay and other amenities. Retention strategies must therefore include good salaries and benefits so as to protect prior investments.

EARLY DETECTION AND DIAGNOSIS PROGRAMS

Cancer mortality rates are much higher in LICs than in HICs, especially among young patients; close to 90% of pediatric cancer patients in LICs do not survive, whereas childhood cancer mortality in HICs is closer to 12%.23 Such inequalities can be traced in large part to late presentation of disease. Common adult cancers like cervical cancer are highly treatable if detected early, yet 80%3 of cervical cancer patients at ORCI presented at Stage III or IV, making effective treatment more difficult. Patients in rural settings in northern Tanzania currently have little to no access to screening programs, though KCMC does operate a cervical cancer screening outreach program and performs limited screening for some other cancers.

Measures for early detection will greatly reduce mortality rates in northern Tanzania, provided that care is available throughout the zone. Thus integrative referral processes from "spoke" to "hub" facilities will be critical to ensuring that patients receive appropriate care. Effective screening measures could be tied into HIV/AIDS-care infrastructure and/or existing cervical cancer screening programs operated by KCMC, ALMC, and other hospitals in the zone.

CANCER PREVENTION PROGRAMS

More than a third of cancer cases in Tanzania—BL, cervical cancer, KS, and esophogeal cancer—are associated with underlying infections resulting from HIV, HPV, and hepatitis viruses.6 This is not unique to Tanzania: In sub-Saharan Africa, nearly 50% of cancer cases are caused by infection compared to 30% worldwide. The Ugandan Cancer Institute, described above, has addressed this reality by focusing almost exclusively on infection-related cancers.

It is clear that comprehensive educative and preventive programs could greatly affect patient outcomes in northern Tanzania. Prevention initiatives could be effectively linked into HIV/AIDS treatment delivery and should include education on healthy lifestyles (e.g., eliminating smoking), immunizations where possible (as with the HPV vaccine), and information about self-detectable cancer symptoms to aid in early detection.

INTEGRATIVE SYSTEMS

Effective cancer treatment in HICs utilizes cross-disciplinary teams of specialists, but departments at KCMC are currently organized independently. However, KCMC recently began to align professional staff to work collaboratively based on a Tumor Board model established at ORCI, which will be essential in delivering more complex cancer care with the integration of the Cancer Care Institute.

A comprehensive cancer care program will not only utilize multidisciplinary teams at KCMC, but will also depend on integrative systems for referral and collaboration between dispensaries, health centers, and hospitals throughout the Northern Healthcare Zone. The existing healthcare infrastructure—a pyramidal structure with dispensaries at the bottom and referral institutes (like KCMC) at the top—is well-suited to support the "hub-and-spoke" framework that is so effective in organizing and delivering cancer care in low-resource environments. A fully functioning "hub-and-spoke" system in northern Tanzania will depend on computer linkages between diagnostic and treatment equipment and electronic connections between the various sites. The network will rely on a well-developed referral system to funnel patients from

remote clinics to facilities offering comprehensive diagnostics and care. Equally critical will be integrative education of staff across all levels of care.

CONTINUITY OF CARE

Currently, lack of continuous care is a major barrier to effective treatment of many cancers in northern Tanzania. In a study of patients with Wilms' tumor in Malawi, incomplete treatment contributed to a much lower projected survival rate (46%) than for patients in HICs (85-90%). Many patients cannot afford transportation and housing costs for extended care, especially in pediatric cases, and thus stop treatment prematurely. But with prompt and complete treatment, survival rates for pediatric cancers could be markedly improved.

Effective cancer care—especially for children—must be inexpensive or free and must include social supports like medicine subsidies, not to mention housing and transportation, all of which will increase the likelihood of complete treatment. The Cancer Care Institute at KCMC will need to include a hostel for families of in-patients, which must be constructed alongside the hospital facilities.

EXPANDED PALLIATIVE CARE

Currently, 75% of cancer patients in Tanzania present in late stages when a cure is no longer possible. Access to palliative care under these conditions is a critical component of comprehensive cancer care. The Northern Healthcare Zone currently has no formal program for palliative cancer care, although Selian Hospital in Arusha operates an extensive palliative care program for more than 4,500 chronically ill patients, 86% of whom have HIV/AIDS. A comprehensive cancer care program must include accessible palliative care and should build on the existing outreach infrastructure at Selian Hospital, whose palliative hospice program has become a model for similar programs throughout the country.

SUMMARY

Acquiring and developing the personnel, facilities, equipment, and systems necessary to improve cancer care in northern Tanzania will require sizeable investments and a long-term commitment. Nonetheless, the FCCT is prepared to take on the challenge with support from individual and organizational partners in Tanzania, in the US, and around the world.

The next sections outline FCCT's immediate and long-term priorities in light of the research and recommendations presented in this paper and in the gap analysis.

IMMEDIATE PRIORITIES AND SUMMARY OF PROGRAM DEVELOPMENT

FCCT's first priority is to establish the infrastructure necessary to improve cancer care in the Northern Healthcare Zone, starting with the construction of the centralized "hub" facility—the Cancer Care Institute (CCI)—and the simultaneous procurement of staff, equipment, and medicines. As demonstrated above, KCMC in Moshi is well equipped to house the CCI, given its prominence in the zone and the strength of its programs already in place. In October 2014, FCCT and KCMC executed a Memorandum of Understanding to jointly develop all the elements needed to impact cancer care in the Northern Healthcare Zone, and in November FCCT finalized a lease for a temporary operational base while it erects the new facilities. Construction will begin in September 2015.

Initially, the CCI will include two exam rooms, a laboratory, an oncology pharmacy, six infusion bays, office space, training rooms, and on-site housing for patients and their families. Construction will continue through several phases

THE CANCER CARE INSTITUTE: Artist's renderings of (from top left): the main enterance, the institute courtyard, the living corridor, and the patient hostel.

as existing programs are expanded and additional programs are developed. In its first complete year of operation—most likely, 2017—the CCI will treat an estimated 1,320 patients, or about 12% of potential patients within the Northern Healthcare Zone, assuming full staffing and functionality. In its full implementation, the Cancer Care Institute will feature a radiation oncology wing, an expanded medical oncology wing, a reception and administration wing, and an expanded hostel.

While the Phase I facility is being built, FCCT will establish capacity necessary to run the institute—including finance and operational management, organizational development systems, treatment protocols, staff hiring, and training, followed by expansion of the screening, education, and palliative care programs. The human resources required for the program will gradually expand as the care network grows.

FCCT also intends to install a satellite clinic at ALMC as immediately as possible, which will also be implemented in several phases. The finished facility will feature a medical oncology clinic, a radiation oncology clinic, and a small hostel.

Over the next decade, cancer treatment capacity will continue to expand at KCMC, ALMC, and at other hospitals in the network as FCCT implements the prevention and education, screening, diagnosis, treatment, and palliative care capabilities at smaller hospitals throughout the area, until the system encompasses the entire Northern Healthcare Zone.

CANCER CARE INSTITUTE: NEAR-TERM OBJECTIVES

In building the CCI at KCMC and the satellite clinic at ALMC, FCCT prioritizes the following short- and medium-term objectives:

1. BUILD DIAGNOSITC AND TREATMENT CAPABILITIES

The Northern Healthcare Zone lacks much of the basic infrastructure needed to treat patients on-site rather than referring them to other hospitals. FCCT will secure the equipment, personnel, and facilities needed to begin offering comprehensive chemotherapy and surgical therapy. In its first phase, the CCI will be comprised of a medical oncology clinic that has capacity to treat about 1,320 patients annually, if fully staffed and functional. Eventually, the CCI and the ALMC satellite clinic will both be scaled up to offer radiation therapy and more treatment capacity.

Chemotherapy: The greatest obstacles to providing chemotherapy include the lack of infusion facilities and equipment, inconsistent access to affordable medicines to treat the targeted cancers, and the lack of trained staff to plan and supervise treatment performed by trained nurses, technicians, and pharmacists.

FCCT initially plans to build capacity to deliver chemotherapy to approximately 1,320 patients annually in the Northern Healthcare Zone by 2016.

It will accomplish this by installing the following at the CCI during Phase I of construction: (i) chemotherapy facilities, including two exam rooms and six infusion bays; (ii) one infusion unit; (iii) an oncology pharmacy; (iv) specialized staff, including two medical oncologists, two medical assistants, one RN, two patient schedulers, two receptionist/administrators, and four-five chemotherapy staff.

In the near future, it will also install resources for the administration of chemotherapy at the ALMC satellite.

Family Housing: Construction of a hostel for family use during treatment is a critical means of ensuring accessibility and continuation of treatment.

FCCT plans to accommodate the families of patients receiving ongoing treatment. It will accomplish this by installing a sixteen bed hostel with common bathrooms, matron quarters, and community sitting and dining rooms.

It will also install family housing at ALMC in a later phase of construction.

Radiotherapy: The most critical gap in radiotherapy in the Northern Healthcare Zone is a facility to house radiation equipment, exam rooms and support service, and administration offices. Related challenges include lack of medical and support staff, equipment service and repair, and a process for storing and disposing of radioactive waste.

FCCT plans to offer comprehensive radiation treatment to patients in the Northern Healthcare Zone.

It will accomplish this by installing the following at the CCI in a later phase of construction: (i) radiation oncology facilities including exam rooms and appropriate adjoining space; (ii) radiation equipment including two linear accelerators, one brachytherapy machine, one MRI machine, one CT scanner; and (iii) specialized staff including two radiation oncologists, one planning physicist, and six radiation therapists/nurses.

Surgery: KCMC and ALMC both already have strong surgical oncology capacity, which will supplement and support the Cancer Care Institute and its "spoke" hospitals.

2. ESTABLISH A PEDIATRIC CHEMOTHERAPY PROGRAM

In early 2015, FCCT will begin to pilot a pediatric chemotherapy program at KCMC in collaboration with Duke University and Muhimbili and Bugando Hospitals. Both Muhimbili and Bugando Hospitals have small pediatric oncology programs and are primed to collaborate with FCCT, KCMC, and Duke to establish treatment standards and a pediatric oncology network team that documents protocols for a cancer-care network that can be emulated by teams treating other types of cancer.

The program will initially include two dedicated pediatric inpatient beds at KCMC and the treatment of approximately forty patients in the first year. Initially, approximately half of these patients will be treated for BL and half with another form of non-Hodgkin lymphoma. The program will also address pediatric retinoblastoma, which is both very common and very curable when discovered early. The pediatric chemotherapy program will be expanded as FCCT is able to build the outpatient facility described in this section, which will eventually offer twenty designated pediatric oncology beds.

3. DEVELOP ORGANIZATIONAL AND MANAGMENT SYSTEMS AND PROCESSES.

The Foundation for Cancer Care in Tanzania is associated with two organizational components in Tanzania: 1) the Cancer Care Institute, the facility at KCMC which will provide patient care and treatment; and 2) the Tanzania Foundation for Cancer Care, which is a Tanzanian-based NGO that will manage the distribution of funds within the Cancer Care Institute. These entities will collaborate with FCCT and KCMC to build capacity in the following ways:

(I) Shift independently operating departments to a cross-functional care process. Currently, KCMC's organ- or medical specialty-based departments operate largely independently of one another. FCCT and the Cancer Care Institute will partner with KCMC and ALMC to implement a cross-functional care process able to treat patients efficiently and with the best outcomes, working through the "hub-and-spoke" model of care with the CCI as the lead institution.
FCCT plans to build the people and processes that link cancer care components and disciplines to provide holistic care. To achieve this, the Cancer Care Institute will:

- Build a management organization as well as a cross-disciplinary team and/or tumor board that works together to plan and treat cancer, using existing medical and support staff to support oncology services
- Provide training on cross-functional team cancer care to staff working with the institute
- Develop standard cancer care protocols for the most prevalent cancers in Tanzania
- Train healthcare workers throughout the hospital network on established protocols
- Establish a computer-based network that links equipment and clinical information between KCMC with network locations and international hospitals that can provide additional expertise
- Develop referral processes that funnel more complex cases to the next level of care
- Facilitate adequate follow-up at the community level

(II) Provide reliable fund management. FCCT and its Tanzanian-based NGO partner organization, the Tanzania Foundation for Cancer Care, will together continue to raise funds and provide a finance and accounting system that ensures ethical and reliable fund management in both the US and Tanzania.

The Tanzania Foundation for Cancer Care was established as an NGO in 2014 in association with FCCT, a necessary step for a US-based nonprofit working abroad. Mark Jacobson, MD, the director of ALMC, is the chairman of the board. The NGO board

also includes prominent Tanzanian physicians, government and business leaders as well as the senior executives of FCCT, John Reiling, PhD, and Thomas Flynn, MD. The NGO will hire a Tanzanian executive to manage the organization in 2015.

4. ESTABLISH CANCER DIAGNOSIS AND TREATMENT PLANNING STAFF.

Initially, FCCT will begin to develop the human resources sufficient to serve a patient population of approximately 1,320 patients annually. The human resources plan is still in development, but the administration and general medical staff at the CCI is expected to include the following:

- registered nurses (RN) (2)
- licensed practical nurse (LPN) (1)
- medical assistants (2)
- department head (2)
- administrative assistant (2)
- lobby assistant (1)
- maintenance person (1)
- housecleaning agents (several)

The planned specialist staff is included in the description of radiation therapy and chemotherapy treatment sections above.

Staffing models for the satellite facility at ALMC are still in development.

budget

FACILITIES BUDGET

Construction of the Cancer Care Institute will be initiated in two phases, as will the implementation of the satellite clinic at ALMC. Detailed plans and costs of each phase of construction are outlined below. FCCT plans to begin construction on the Phase I CCI in September 2015, and launch both the expansion of the CCI and the installation of the ALMC clinic as soon as funds allow.

Jengo Imara Design Group, a registered architectural firm in Arusha, Tanzania, has been invited to develop preliminary construction cost estimates to support initiation of a funding campaign. Feasibility study drawings, with floor plans and perspectives, were drafted in 2014 and are included below.
Please note that construction estimates do not include costs of equipment, medicines, staffing, or day-to-day operations. Below, the operating budget estimates the costs of operating the full Cancer Care Institute at KCMC, once facilities and equipment are in place.

PHASE ONE: CCI MEDICAL ONCOLOGY WING

PRELIMINARY CONSTRUCTION COST ESTIMATES SUBMITTED BY JENGO IMARA DESIGN GROUP

A Medical Oncology Wing is envisioned in Phase I. Proposed Phase I Medical Oncology Wing elements include an entry area with registration and waiting; a clinical program with two exam rooms; an infusion program with six bays; plus ancillary areas as required. This wing shall be able to accommodate linear expansion of clinical and infusion programs in the future. A Radiation Oncology Wing, Patient Hostel, Children's Cancer Ward, and additional support services may be added later.

PHASE ONE: MEDICAL ONCOLOGY WING

Main Entry, with registration/records, waiting, and multi-purpose meeting room: (145 m2 x US$525/m2 assuming no A/C)	$ 76,125
Clinic, with intake, lab, doctor's office, two exam rooms, and support spaces: (180 m2 x US$575/m2 assuming no A/C)	103,500
Infusion, with six bays, pharmacy with hood room, and support spaces: (175 m2 x US$525/m2 assuming no A/C)	82,500
Verandas and Breezeways: (130 m2 x USD 275/m2)	18,000
Provision for temporary corridor to access site:	2,375
Provision for water and electrical supply connections:	7,500
Provision for external works, to be confirmed on site selection:	10,000
Builder's Work, Pre-Contract	**$300,000**
Provision for construction contingencies (8% of pre-contract builder's work)	24,000
Builder's Work, Post-Contract	**$324,000**
Provision for professional services (10% of post-contract builder's work)	32,400
Provision for loose furniture and medical equipment	15,000
Provision for reimbursable project expenses	3,600
Total Phase One Cost Estimate, ex-VAT	**$375,000**

THE CANCER CARE INSTITUTE: Artist's renderings of (clockwise from top left): the medical oncology wing, cancer institute main enterance, the institute courtyard, and the floor plan for the medical oncology wing.

PHASE ONE: CCI PATIENT HOSTEL

PRELIMINARY CONSTRUCTION COST ESTIMATES SUBMITTED BY JENGO IMARA DESIGN GROUP

Proposed Phase I Patient Hostel elements include eight bedrooms with two single beds in each, one for the patient and the other for an accompanying family member; separate common bathrooms for male and female guests; matron quarters; a common sitting room; a dining room for eighteen people with adjacent servery; corridors, and storage space. The hostel will accommodate linear expansion in the future.

PHASE ONE: PATIENT HOSTEL

Sitting and dining room wing: (125 m2 x US$475/m2 assuming no A/C)	$ 59,375
Bedroom wing: (270 m2 x US$525/m2 assuming no A/C)	141,750
Bathrooms: (65 m2 x US$625/m2 assuming no A/C)	40,625
Provision for water and electrical supply connections:	2,250
Provision for external works, to be confirmed on site selection:	6,000
Builder's Work, Pre-Contract	**$250,000**
Provision for construction contingencies (8% of pre-contract builder's work)	20,000
Builder's Work, Post-Contract	**$270,000**
Provision for professional services (10% of post-contract builder's work)	27,000
Provision for loose furniture and medical equipment	3,000
Total Phase One Cost Estimate, ex-VAT	**$300,000**

THE PATIENT HOSTEL: Artist's renderings of (clockwise from top left): the main entrance of the patient hostel, the cancer institute main enterance, the patient hostel, and the floor plan for the patient hostel.

PHASE TWO: RADIATION ONCOLOGY WING, AND RECEPTION AND ADMINISTRATION WING

PRELIMINARY CONSTRUCTION COST ESTIMATES SUBMITTED BY JENGO IMARA DESIGN GROUP

Envisioned program elements include a Radiation Oncology Wing with two linear accelerators plus brachytherapy, MRI and CT scan units; a Reception and Administration Wing; plus ancillary areas as required.

RADIATION ONCOLOGY WING

Two linear accelerator valuts with shared control room (335 m2 x US$800/m2 assuming proper shielding and A/C)	$ 268,000
Brachytherapy valut, MRI and CT scan units, and supporting equipment: (395 m2 x US$650/m2 assuming proper shielding and A/C)	316,000
Radiation Oncology office space and supporting facilities: (195 m2 x US$550/m2 assuming no A/C)	107,250
Radiation Oncology Wing	**$691,250**

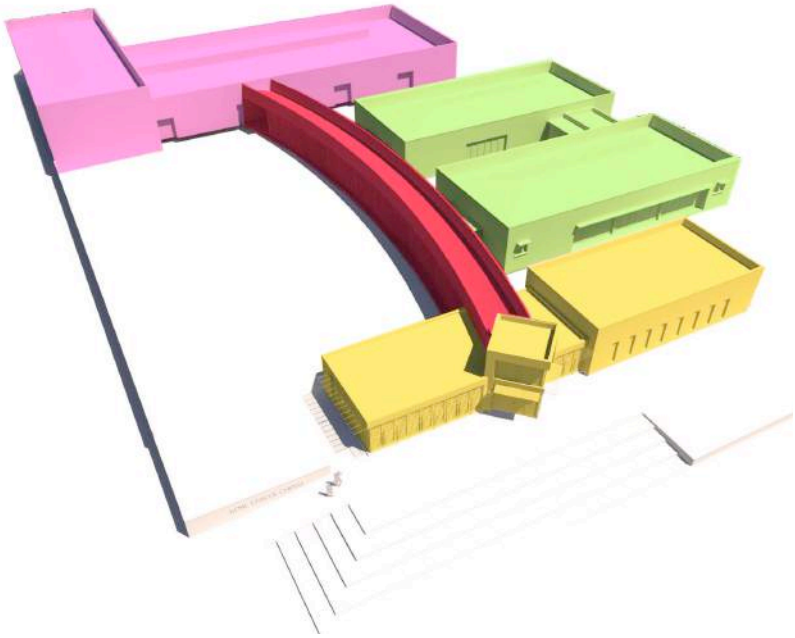
RECEPTION AND ADMINISTRATION WING

Reception and Waiting Area (160 m2 x USD 550/m2 assuming no A/C)	88,000
Administrative Offices and Staff Facilities (170 m2 x USD 550/m2 assuming no A/C)	93,500
Builder's Work, Post-Contract	**$181,500**

ANCILLARY SPACES AND PROVISIONAL SUMS

Outdoor Covered Walkway, 190 m2 x USD 300/m2	57,000
Provision for minor program additions during design	60,750
Provision for electrical connections, transformers and control panels	75,000
Provision for back-up electrical generators with shed	75,000
Provision for external works, to be confirmed on site selection	50,000
Total Phase One Cost Estimate, ex-VAT	**$317,750**
Total builder's work, pre-contract	**1,190,500**
Provision for construction contingencies (10% of pre-contract builder's work)	119,050
Builder's work, post-contract	**1,309,550**
Provision for professional services (8% of post-contract builder's work)	104,764
Provision for loose furniture and office equipment	100,000
Total estimated construction cost, ex-VAT	**$1,514,314**

THE CANCER INSTITUTE: Artist's renderings of (clockwise from top left): the main entrance of the cancer institute, the patient hostel, the living cooridor, and block diagram of the completed cancer institute.



SATELLITE CLINIC: ARUSHA LUTHERAN MEDICAL CENTER

PRELIMINARY CONSTRUCTION COST ESTIMATES SUBMITTED BY JENGO IMARA DESIGN GROUP

Note: This is a duplicate of the Phase I Cancer Care Institute Estimate. Phase I of the ALMC satellite clinic will likely be identical or similar to the KCMC facility. A Medical Oncology Wing is envisioned in Phase I. Proposed Phase I Medical Oncology Wing elements include an entry area with registration and waiting; a clinical program with two exam rooms; an infusion program with six bays; plus ancillary areas as required. This wing shall be able to accommodate linear expansion of clinical and infusion programs in the future. A Radiation Oncology Wing, Patient Hostel, Children's Cancer Ward, and additional support services may be added later.

PHASE ONE: MEDICAL ONCOLOGY WING

Main Entry, with registration/records, waiting, and multi-purpose meeting room: (145 m2 x US$525/m2 assuming no A/C)	$ 76,125
Clinic, with intake, lab, doctor's office, two exam rooms, and support spaces: (180 m2 x US$575/m2 assuming no A/C)	103,500
Infusion, with six bays, pharmacy with hood room, and support spaces: (175 m2 x US$525/m2 assuming no A/C)	82,500
Verandas and Breezeways: (130 m2 x USD 275/m2)	18,000
Provision for temporary corridor to access site:	2,375
Provision for water and electrical supply connections:	7,500
Provision for external works, to be confirmed on site selection:	10,000
Builder's Work, Pre-Contract	**$300,000**
Provision for construction contingencies (8% of pre-contract builder's work)	24,000
Builder's Work, Post-Contract	**$324,000**
Provision for professional services (10% of post-contract builder's work)	32,400
Provision for loose furniture and medical equipment	15,000
Provision for reimbursable project expenses	3,600
Total Phase One Cost Estimate, ex-VAT	**$375,000**

OPERATING BUDGET

The following is an overview of the projected operating expense budget for the Cancer Care Institute at KCMC in its first three years of full operations. Note that this budget represents the costs of the fully expanded CCI, which will offer both chemotherapy and radiation; costs will likely be significantly lower for the Phase I facility's first year of operations. An operating budget for the satellite clinic at ALMC has not yet been determined.

SUMMARY EXPENSE BUDGETS	YEAR ONE	YEAR TWO	YEAR THREE
Provider Labor – Cancer	$ 79,000	$ 107,000	$ 111,000
Other Labor – Cancer	250,000	331,000	366,000
Other Labor – Palliative	63,000	131,000	135,000
Drugs & Medical Supplies – Cancer	235,000	597,000	732,000
Drugs & Medical Supplies – Palliative	18,000	47,000	58,000
Site & Other Costs	185,000	224,000	234,000
Total Expenses	**$ 830,000**	**$ 1,437,000**	**$ 1,636,000**

TOTAL COST PER PATIENT	YEAR ONE	YEAR TWO	YEAR THREE
Cancer	$ 2,140	$ 1,439	$ 1,364
Palliative	$ 162	$ 178	$ 193

conclusion

CONCLUSION

With rising cancer mortality and morbidity rates threatening to intensify the burden on its already under-resourced healthcare system, Tanzania must increase the effectiveness and scope of cancer care across the country. Care has improved with the establishment of ORCI and cancer services at BMC, but the four regions that make up Tanzania's Northern Healthcare Zone still lack many of the basic components of comprehensive cancer care. The Foundation for Cancer Care in Tanzania is committed to improving cancer care in the Northern Healthcare Zone.

Northern Tanzania's current cancer care program is significantly underdeveloped; there are few preventive and detective measures in place, none of the zone's hospitals offer complex care like chemotherapy or radiation, and palliative care is offered almost exclusively by ALMC in Arusha Region. Nonetheless, existing prevention and treatment infrastructure around other diseases—like HIV/AIDS—offer powerful groundwork on which to build a comprehensive cancer care program. Moreover, the prevalence of both preventable and highly curable cancers in Tanzania indicates that expanding cancer care in the zone could quickly yield dramatic and cost-effective results.

To achieve such results, an effective model must incorporate the four pillars of comprehensive cancer care: prevention, early detection, diagnosis and treatment, and palliative care. Based on the current cancer landscape in Tanzania, existing healthcare capacity, recommendations from the Ministry of Health and Social Welfare and the WHO, and successful implementations of cancer care programs in countries like Kenya and Uganda, FCCT has designed a "hub-and-spoke" model to improve capacity around every component of care.

Implementation of a truly comprehensive and sustainable cancer care program in northern Tanzania will require sizeable investments in infrastructure, equipment, and personnel. The initial costs of installing the Cancer Care Institute will fall around US$675,000 for a first-phase oncology clinic and accompanying hostel without accounting for equipment, personnel, and operating costs. Medicines and equipment—like cobalt-60 machines—will need to be procured and transported to Tanzania. Trained specialists—of which the country has a marked shortage—will be critical to implementing effective cross-disciplinary care. Moreover, an effective program will need to expand far beyond KCMC and ALMC and include education, prevention, and screening measures that link to the "hub" facility via integrative referral processes.

Yet the research and recommendations in this paper demonstrate that investments in cancer care in northern Tanzania will pay off in lives saved. Some of the most common cancers in Tanzania—like cervical cancer—are highly curable if detected early, and patient outcomes will improve dramatically with effective screening and improved access to continuous care. The financial model in Section V demonstrates the impact of a $350,000 investment in cancer patients in northern Tanzania: over 1,000 life years added and 42 lives saved, outcomes that are many times higher than a similarly sized donation would bring in a high-income country.

With the number of new cancer cases worldwide threatening to increase by 70% over the next two decades, and low-income countries shouldering much of the burden, the potential impact of comprehensive cancer care programs in under-resourced regions cannot be disregarded. FCCT will partner with individuals and organizations in Tanzania, the US and around the world to improve patient outcomes and save lives in one such region: the Northern Healthcare Zone of Tanzania.

citations

1. Abdel-Wahab, M., et al. (2006). "Status of radiotherapy resources in Africa: an International Atomic Energy Agency analysis." THE LANCET Oncology 2006; 7: 584—9.
2. American Cancer Society website (2010). "The global economic cost of cancer."
3. Bowa, K., (2010). "An overview of the diagnosis and management of prostate cancer in Nigeria: Experience from a north-central state of Nigeria." Annals of African Medicine Vol. 9, No. 3; 2010:111-2.
4. Bowman, R.J.C., et al. (2008). "Outcome of Retinoblastoma in East Africa Pediatric Blood Cancer." 2008 Jan;50(1):160-2.
5. Brinton, L., et al. (2014). "Breast cancer in Sub-Saharan Africa: Opportunities for Prevention. Breast Cancer Research and Treatment." 2014 144:467—478.
6. Casper, C., et al. (2011). "Uganda Program on Cancer and Infectious Diseases." GTF.CCC Working Paper and Background Note Series, No. 2, Harvard Global Equity Initiative 2011.
7. Farmer, P., et al. (2010). "Expansion of Cancer Care and Control in Countries of Low and Middle Income: A Call to Action." THE LANCET 2010; 376:1183-1186.
8. Ferlay, J., et al. (2012) GLOBOCAN 2012 v1.0, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 11 [Internet]. Lyon, France: International Agency for Research on Cancer; 2013. Available from: http://globocan.iarc.fr Accessed on Sept. 18, 2014.
9. Haazen, D., (2012). "World Bank: Making Health Financing Work for Poor People in Tanzania."
10. Hadley, L.G., et al. (2012). Challenge of pediatric oncology in Africa. Semin. Pediatric Surgery 2012; 21: 136—41.
11. Halfani, C., et al. (2014). "Tanzania survival and its determinants of Kaposi sarcoma in Tanzania: Retrospective study." Journal of Clinical Oncology 32, 2014 (suppl; abstr e20607).
12. Israels, T., et al. (2012). "Management of children with a Wilms' tumor in Malawi, Sub-Saharan Africa." Journal of Pediatric Hematology/Oncology. Nov. 16, 2012.
13. Khimji, Z., (2011). "Tanzania is taking cancer care seriously and creating more treatment centres", The Guardian, Feb. 4, 2011.
14. Kingham, P., et al. (2013). "Treatment of cancer in Sub-Saharan Africa." The LANCET Oncology 2013; 14: e158—67.
15. Knaul, F., et al. (2010). "Cancer survival need not be determined by income: lessons from developing countries and focusing on children". 42nd Congress of the International Society of Paediatric Oncology, Oct. 2010, Boston, MA. Data from Globocan 2010 and WHO Global Health Observatory (http://Apps.who.int/ghodata).
16. Levin, V., et al. (2001). Improving cancer care increased need for radiotherapy in developing countries. IAEA Bulletin, 43/2/2001.
17. Lingwood, R., et al. (2008). "The challenge of cancer control in Africa." Nature Reviews Cancer 8, 398—403 2008.
18. Lyimo, F. & Beran T. (2012). "Demographic, knowledge, attitudinal, and accessibility factors associated with uptake of cervical cancer screening among women in a rural district of Tanzania: three public policy implications." BMC Public Health. 2012; 12: 22. Published online Jan. 10, 2012.
19. Malik, K., et al. (2014). "Human Development Report 2014: Sustaining human progress reducing vulnerabilities and building report." United Nations Development Programme.
20. Mchembe, M.D. et al. (2013). "Endoscopic and clinicopathological patterns of esophageal cancer in Tanzania: experiences from two tertiary health institutions." World Journal of Surgical Oncology 2013.
21. Mgaya, E.M. & Kitinya J.N. (2000). "Histopathology of malignant tumours of childhood in Tanzania." East African Medical Journal, 2000 Aug;77(8):435-9.

22. Ngoma, T. et al. (2010). "Evaluation of cervical visual inspection screening in Dar es Salaam, Tanzania." International Journal of Gynecology Obstetrics. Published online: Feb. 15, 2010.
23. Ntirenganya, F., et al. Prevalence of breast masses and barriers to care: results from a population-based survey in Rwanda and Sierra Leone. Journal of Surgical Oncology, 2014 Dec.; 110(8):903-6. doi: 10.1002/jso.23726. E pub 2014 Aug 2.
24. Parkin, D.M. et al. (eds) (2003). "Cancer in Africa: Epidemiology and Prevention." IARC Scientific Publications No. 153 (International Agency for Research on Cancer, Lyon, 2003).
25. Ravichandran, R. (2009). "Has the time come for doing away with Cobalt-60 teletherapy for cancer treatments." Journal for Medical Physics. 2009 Apr. —Jun.; 34(2): 63—65.
26. Scheffler, R.M., et al. (2008). "Forecasting the global shortage of physicians: an economic- and needs-based approach." Bulletin, World Health Organization 2008; 86: 516—523B.
27. Schroeder, K., Pediatric Oncologist at Bugando Hospital in Mwanza Tanzania and Duke University, North Carolina. Interviewed Nov. 15, 2014.
28. Stefan, D. & Lutchman, R. (2014). "Burkitt lymphoma: epidemiological features and survival in a South African centre." Infectious Agent Cancer. 2014; 9: 19. Published online Jun. 10, 2014.
29. Strother, R.M., et al. (2013). "AMPATH-Oncology: a model for comprehensive cancer care in Sub-Saharan Africa." Journal of Cancer Policy 1 (2013) e42— e48.
30. Stulac, S., (2012). "A global challenge: treating children with cancer in developing countries." HemOnc Today, Apr. 25, 2012.
31. United Republic of Tanzania National Bureau of Statistics website: 2012 Census http://www.nbs.go.tz. Accessed Sept. 24, 2014.
32. United Republic of Tanzania National Bureau of Statistics: Population Distribution by Administrative Unit: Arusha, Kilimanjaro, Tanga and Manyara http://50.87.153.5/~eastc/sensa/index.php/home/BookOne. Accessed Sept. 18, 2014.
33. United Republic of Tanzania Ministry of Health and Social Welfare website: http://www.moh.go.tz/index.php/health-services-in-tanzania. Accessed Oct. 18, 2014.
34. Vandenberg, T., et al. (2009). "A framework for the organization and delivery of systemic treatment." Practice Guideline Series: Volume 16, Number 144444, 2009 Multimed Inc.
35. World Bank website http://data.worldbank.org/country/tanzania, Cancer Country Profiles, 2014, accessed Sept. 24, 2014.
36. World Health Organization website: Globocan factsheet: cervical cancer. http://globocan.iarc.fr/old/FactSheets/cancers/cervix-new.asp. Accessed Oct. 22, 2014.
37. World Health Organization website: Globocan factsheet: breast cancer. http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx. Accessed Sept. 30, 2014.
38. Yohana, E., et al. (2011). "Availability and affordability of anticancer medicines at the Ocean Road Cancer Institute in Dar es Salaam, Tanzania." East African Journal of Public Health. 2011 Mar;8(1):52-7.

FOUNDATION FOR CANCER CARE IN TANZANIA
5101 Vernon Avenue South, Suite 501
Edina, MN 55436
TanzaniaCancerCare.org