REPUBLIC OF KENYA

Ministry of Health

Consolidating And Expanding Radiotherapy Services In Kenya

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Abbreviations And Acronyms

CT	Computed Tomography
CBA	Cost Benefit Analysis
CRH	County Referral Hospital
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
ESG	Environmental, Social and Governance
EBRT	External Beam Radiation Therapy
DALY	Disability-adjusted life year
GLOBOCAN	Global Cancer Observatory
HDR	High Dose Rate
HDI	Human Development Index
imPACT	Integrated Mission of Program of Action for Cancer Therapy
ICCs	Interagency Coordination Committees
IAEA	International Atomic Energy Agency
KEBS	Kenya Bureau of Standards
KEMRI	Kenya Medical Research Institute
KENCO	Kenya Network of Cancer Organizations
KENRA	Kenya Nuclear Regulatory Authority
KNH	Kenyatta National Hospital
KUTRRH	Kenyatta University Teaching, Referral and Research Hospital
LINAC	Linear Accelerator
MRI	Magnetic Resonance Imaging
MP	Medical Physicist
MoH	Ministry of Health
MTRH	Moi Teaching and Referral Hospital
NCCP	National Cancer Control Program
NCCS	National Cancer Control Strategy
NCI-K	National Cancer Institute of Kenya
NACOSTI	National Commission on Science, Technology and Innovation

NEMA	National Environment Management Authority
NPV	Net Present Value
NCD	Non-communicable Diseases
NUPEA	Nuclear Power and Energy Agency
OSHA	Occupational Safety and Health Administration
PET	Positron Emission Tomography
RO	Radiation Oncologist
RTT	Radiation Therapy Technician
RT	Radiotherapy
RB	Regulatory Body
TSAs	Thematic Safety Areas
UNICRI	United Nations Institute of Interregional Crime
UHC	Universal Health Coverage
WHO	World Health Organization
YLDs	Years lived with a disability
YLL	Years of life lost

Foreword

The Kenyan government is committed to achieving the highest possible health standards by providing equitable, affordable, and quality healthcare services that are responsive to the population's needs as stated in the constitution. The primary focus is on implementing programs that increase health insurance coverage, improve access to quality healthcare services, and offer financial protection to those accessing healthcare, all with the goal of achieving Universal Health Coverage (UHC).

Cancer is a major public health concern in Kenya with an estimated 42,116 cases and 27,092 deaths annually, based on data from GLOBOCAN. Low awareness, late diagnosis, and challenges in access to screening, diagnosis and treatment are some of the key obstacles in cancer control. The impact of cancer on population health and development is linked to the increased medical costs, lost income, and physical, emotional, and financial burden placed on families and caregivers. If control efforts remain static and the disease burden continues to rise with population growth and aging, the projected economic cost of cancer is estimated to rise.

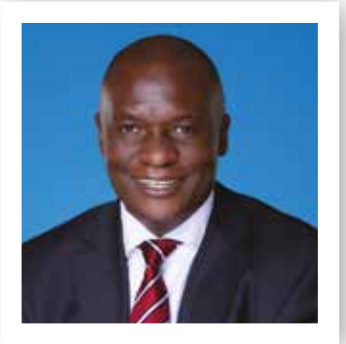
The healthcare system in Kenya faces a limited capacity in infrastructure and resources to effectively manage cancer. Three main treatment modalities, surgery, radiotherapy and chemotherapy remain the cornerstones of cancer treatment today. About 60% of cancer patients will require radiotherapy during their treatment. It is, however, estimated that only 23% of cancer patients currently have access to comprehensive cancer treatment services including radiotherapy. There is also a critical shortage of both radiotherapy personnel and megavoltage machines required to treat approximately 21,549 patients with curable cancers. This bankable document has been developed with the support of the IAEA to outline the investments required both for the consolidation of existing radiotherapy facilities as well as expansion to new centers as per the National Cancer Control Strategy 2023-2028.

The document will be used to strategically guide investments and areas of focus as the Ministry seeks to strengthen the availability of comprehensive cancer services for cancer patients in a sustainable manner. The facilities will go a long way towards improving access to care and reducing the negative impact of social determinants on health outcomes, while also positioning Kenya as a regional hub for cancer treatment, ensuring economic growth and achievement of Vision 2030. Furthermore, the centers will be invaluable in the stimulation of cancer research for quality cancer care and innovation.

This project will be implemented with the new National Cancer Control Strategic Plan 2023-2028 to achieve our goals and aspirations of improving access to comprehensive cancer care in Kenya.

Peter Tum, CBS
Principal Secretary for Medical Services

Executive Summary



Non-communicable Diseases and Injuries are responsible for 35% of all deaths in Kenya, with 22% occurring before the age of 40, contributing to premature mortality. This threatens global commitments such as the achievement of Sustainable Development Goal 3.4, which aims to reduce premature mortality by one-third by 2030. Cancer cases in Kenya are projected to rise from 42,017 in 2020 to 95,000 in 2040, largely due to lifestyle-related risk factors and an ageing population. Radiotherapy is required in the treatment of about 60% of cancer patients and is proven to be a cost-effective component of cancer care. However, providing radiotherapy requires an adequate number of trained healthcare professionals and significant investment in infrastructure with high initial and operational costs.

There are currently 12 institutions providing radiotherapy services in Kenya, with 6 being public (Kenyatta National Hospital, Kenyatta University Teaching research and Referral hospital, Moi Teaching and referral Hospital and 3 regional cancer centers: Nakuru, Garissa and Mombasa), and 6 private ones (Texas Cancer Center, MP Shah Hospital Cancer Care Kenya, Aga Khan University Hospital, Nairobi West Hospital, Eldoret Equra Cancer Center, and Nairobi Hospital).

IAEA recommends a phased expansion to strengthen the national referral hospitals and regional cancer centers and improve access to comprehensive cancer management services. In the interim, there is a need for urgent prioritization of staff training to increase the number of specialized personnel and the sharing of specialized human resources, while optimizing the use of existing treatment infrastructure. In total, it will cost an estimated 39,4 million Euros to establish the new radiotherapy centers and consolidate existing ones as outlined in this document while running all the centers will cost about 8 million Euros annually. The facilities will go a long way towards improving access to cancer care and reducing the negative impact of social determinants on health outcomes, while also positioning Kenya as a regional hub for cancer treatment and ensuring economic growth. Furthermore, it is expected that the centers will be invaluable in the development and implementation of cancer education programs and research activities stimulating quality cancer care provision and innovation.

The Ministry of Health has partnered with the IAEA to enhance Kenya's capacity in the safe use of nuclear technology for radiotherapy and medical imaging (radiology and nuclear medicine). Over the years, the IAEA has conducted several technical cooperation projects, providing capacity building and technical supportto strengthen the national capacity for early detection, diagnosis, management, prevention and research on cancer and radiation safety.

The Ministry is grateful for the IAEA's support in creating this document, which will provide guidance on strategic investments needed to strengthen radiotherapy services for cancer patients in Kenya.

Dr. Patrick Amoth, EBS
Ag. Director General for Health

Acknowledgements

This National Radiotherapy Bankable Document was developed through an extensive process involving experts and stakeholders from the Ministry of Health, Ministry of Public Works, the International Atomic Energy Agency and the World Health Organization, and from public and private sector institutions. We sincerely appreciate the support from the offices of the Cabinet Secretary, Principal Secretary, Director General, Department of Preventive and Promotive Health and Head, Department of Non- Communicable diseases for their strategic guidance and support for the development of this document.

We express our gratitude to the members of the National Radiotherapy Technical Working Group for their valuable contributions in providing the necessary technical feedback for the development of this document. We also extend our appreciation to the National and County Referral Hospitals as well as the private facilities providing radiotherapy services for their inputs.

In a special way, I wish to acknowledge the nominated officers who attended the IAEA workshop in Vienna, Austria from 30th January 2023 to 4th February 2023 who put together this document. They included Dr. Mary Nyangasi(Head, National Cancer Control Program) who was the Team Lead, Mr. Aggrey Wakhule (Senior Medical Physicist, Kenyatta National Hospital), Mr. Antony Shadrack (Kenya Nuclear Regulatory Authority), Architect David Kangethe from the Ministry of Public Works, and Mr. Kizito Kiguta from the National Treasury. Their dedication and efforts was instrumental in developing this document.

We also wish to recognize the support of our dedicated consultant Dr. Florencia Borrescio Higa who guided the entire process for the smooth completion of this task as well as Mr. Neil Victor Javis the Section Head TCAF2, Division of Africa Development of Technical Cooperation who coordinated the entire process under the overall strategic guidance of Prof. Shaukat Abdulrazak, the Director for the Division for Africa at the IAEA. Their inputs, contributions and guidance were instrumental in the development of this document which will be implemented alongside the new National Cancer Control Strategic Plan 2023-2028.

Dr. Andrew Mulwa
Ag. Director, Directorate of Family Health

The Kenyan Bankable Document Development Team at the IAEA headquarters in Vienna, Austria, February 2023

CHAPTER 1

Background And Justification

Kenya is a lower middle-income economy in Sub-Saharan Africa with a total population was 55 million. Kenya's life expectancy at birth was 66.1 years in 2021. As of 2023, 16.1% of Kenyans live below the international poverty line. Kenya's 2021 Human Development Index (HDI) is 0.575, positioning it at 152nd out of 191 countries and territories.

Kenya's economy grew at an average of 4.8% per year from 2015 to 2019, but the COVID-19 pandemic disrupted international trade and transport, tourism, and urban services, the agricultural sector remained resilient. The economy recovered strongly in 2021 with a growth rate of 7.5%, and the poverty rate is expected to continue declining in 2022 after a temporary increase due to the pandemic, with GDP growth projected at 5.5%.

There have been many advances in cancer prevention and control since the Integrated Mission of Program of Action for Cancer Therapy (imPACT) report of 2016, with establishment of five new radiotherapy facilities within the public sector, strengthening of cancer prevention programs for cervical and breast cancer and the recent completion of the third National Cancer Control Strategic Plan by the Ministry following the new imPACT assessment conducted by the WHO, IARC and IAEA between June and December 2022. However, with 42,116 new cancer cases in 2020 and 95,200 new cases expected by 2040, it becomes urgent to further strengthen the existing health services to adequately address the growing cancer burden.

1.1. Health Institutional Context

Kenya is organized into 47 county governments, with 72% of the population living in rural areas. The health system is a 6–tier health system, and different services are offered at different levels of care, from community health units up to national level of cares and tertiary facilities.

Kenya's Vision 2030 is a major policy driving force and its aim is to transform the country into a middle-income country by 2030 and provide its people with a high quality of life. Improving the health of all its citizens falls within this plan. The Government is strongly committed to improving the cancer situation and is aware of the strategies that are needed in order to advance cancer control.

The goal of the National Cancer Control Strategy 2017-2022 is to reduce cancer incidence, morbidity, mortality and cancer down-staging, and improve the survival rate in Kenya through access to population-based primary prevention, early detection, quality diagnostics, treatment and palliative care services.

1.1.1 Policy framework

In response to the growing challenge of cancer, the government of Kenya has made tremendous progress in developing national policies, strategies, and legislation to address cancer control. The Kenyan constitution guarantees all citizens the right to the highest attainable standards of healthcare, and the enactment of the Cancer

Control Act in 2012 signified a jumpstart to the government's commitment to addressing cancer.

The Kenya Health Policy 2014-2030 identifies the rising burden of NCDs, including cancer, and outlines various strategies to halt and reverse this trend. These strategies include promoting universal access to interventions that address priority non-communicable conditions, as well as mental disorders.

The Kenya Health Sector Strategic Plan 2018-2023 summarizes various interventions implemented to address cancer control in the country. These interventions include preventive measures to reduce the incidence of cancer such as education on how to modify risk factors, vaccination, and the scaling up of screening. The plan also includes measures to reduce late diagnosis of cancer and the decentralization of cancer management.

The Kenya Cancer Policy 2019-2030 identifies eight themes for cancer control in the country. These themes include the prevention and mitigation of risk factors, access to cancer screening and early detection, access to quality, affordable, and sustainable cancer care, improved survivorship care coordination, strengthened regulation for quality cancer care, promotion of cancer surveillance and research, support for sustainable financing for cancer prevention and control, and effective governance, oversight, and coordination of cancer control. Decentralization of cancer care is also a priority, to improve access to cancer treatment in the spirit of universal health coverage and in line with the government manifesto.

1.1.2 Health system and service delivery

Kenya has a devolved governance system consisting of the National Government and 47 semi-autonomous County Governments, which are responsible for managing health facilities, providing healthcare services and managing pharmacies. The National Government provides policy and strategic guidance, technical assistance, standards, quality control, national referral services, and control of pharmacies and medicine. These roles are coordinated through Interagency Coordination Committees (ICCs).

The health system is organized into 6–tiers: community health units, dispensaries, health centers, subcounty hospital, county hospitals and national referral hospitals. Level 1 refers to community health unit where primary prevention services and health education is delivered to 50 000 people; Level 2 has dispensaries or basic health facilities and offers cervical cancer screening services, and Level 3 includes the health centers where cervical cancer screening and cervical pre-cancer treatment services are offered. At Level 4 which is at the Sub-County level, imaging, surgery, and radiology services are offered in addition to cancer screening services. At the Level 5 or County referral Hospitals, all services found in level 4 are also available, and Level 6 corresponds to the national level of care and the Tertiary facilities. While there is a good healthcare structure in place, the challenge often lies in reaching remote hard-to-reach populations especially in the upper northern regions. Figure 9.1 in Annex 9 shows the geographical distribution of access to services.

1.1.3 Health financing

Total health expenditure has been growing in recent years, with health expenditure as % of GDP currently at 4.59.[1] The government expenditure on health as a percentage of total government expenditure increased from 10.8 % in 2016/17 to 11.7 % in 2018/19. Per capita, spending was $97.4 in 2016/17 and $105.8 in 2018/19. Further, out-of-pocket expenditure as a percentage of current

1 https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS?locations=KE-SN

health expenditure is 24.30. The Universal Health Coverage Advisory Panel singled out cancer as a major cause of catastrophic health expenditures in the country, accounting for approximately 30% of total healthcare spending.

The treatment cost is about 27 euro for each radiotherapy session at a public institution, and almost 76 euro per session at a private one. The National Health Insurance Fund reimburses $27 per session of radiotherapy up to a maximum of 20 sessions while majority of patients will need at least 25 sessions to complete treatment. The cost of brachytherapy is $305 per session which is the amount reimbursed by the National Health Insurance Fund. According to the latest data released by the Kenya National Bureau of Statistics in March 2023, health insurance covers only 20% of the population, leaving a significant portion of healthcare expenses to be paid out of pocket. Even with insurance, payments are often capped, and patients may face additional costs for transport, accommodation, and nutrition that are not included in coverage. In a context where 16.1% of the population lived below the poverty line of $1.90 per day in 2022, cancer care contributes to a significant portion of health expenses and can be a cause of catastrophic health expenditures for many families.

1.2 Cancer Profile

Cancer has become a major cause of death, in addition to the existing burden of communicable diseases towards which a large portion of the health budget is allocated. Based on GLOBOCAN 2020 figures, there are 42,116 new cancer cases per year and 27,092 cancer deaths.

The leading cancers in women are breast, cervical and esophageal cancers. In men, prostate, esophageal and colorectum cancer are the most common types of cancers.

Women are disproportionately affected by cancer with a higher incidence recorded in women as compared to men. The risk of developing cancer before the age of 75 years in Kenya is 18% among women and 14.3% among men. The overall five-year cancer prevalence rate was 82,620 cases, reported as 54,156 cases among women and 28,464 cases among men.

1.3 Cancer Therapy

The healthcare system in Kenya has limited capacity in infrastructure and resources to effectively manage cancer.

There are 10 regional cancer centers, formerly provincial hospitals, that offer chemotherapy services, and have infrastructure and human resource capacity to provide surgical, pediatric, gynecologic, radiologic, and palliative care services to support cancer therapy. Three of the regional cancer centers have been upgraded and are now also providing radiotherapy services.

There are six public institutions currently providing radiotherapy services in Kenya: Kenyatta National Hospital, Kenyatta University Teaching Research and Referral Hospital, both located in Nairobi, Moi Teaching and Referral Hospital, and three county referral facilities in Nakuru, Garissa, and Mombasa. There are also six private facilities that provide radiotherapy. All six public cancer centers also provide brachytherapy services for patients with cervical cancer. Plans are underway to establish more centers in Kakamega, Kisii, Kisumu, Meru and Nyeri.

There is a critical shortage of cancer treatment personnel with only about 30 radiation oncologists,14 medical physicists and 45 therapy radiographers currently available in the public cancer centers to operate the existing nine external beam radiotherapy treatment machines.

Three external beam/megavoltage machines are set to be installed in Nakuru and Mombasa through the IAEA support under the "Rays of Hope" project in October 2023 and one additional Linac at KNH through support from the exchequer.

There are plans to establish five additional regional comprehensive cancer centers. The selection of regional centers was based on the cancer burden, distribution of cancer cases, and existing infrastructural and human resource capacity. These centers already have existing services critical in the cancer patient care journey such as radiology, pathology, surgery, palliative care, pediatrics, gynecology, and chemotherapy available and enable a multidisciplinary team management for these patients. Regional cancer centers are expected to lead the development of regional systems of cancer care, with care ranging from complex to basic interventions and community-based care. The current status in each facility is summarized in the table below:

Table 1: Description of status of each facility and estimated requirements

		Available					Required					
	Name of Center	Equipment		HR			Additional Equipment			Additional HR		
		EBRT	HDR	RO	MP	RTT	EBRT	CT sim	HDR	RO	MP	RTT
Consolidation facilities	KNH	3 (+1)	1	6	4	19	2	0	1	6	6	12
	KUTRRH	1(+1)	1	5	3	8	2	1	1	4	4	8
	MTRH	2	1	2	1	5	0	0	1	6	4	8
	GARISSA	1	1	3	2	4	0	0	0	0	0	4
	MOMBASA	1(+1)	1	4	2	4	0	0	0	0	2	8
	NAKURU	1(+1)	1	3	2	5	0	0	0	2	1	8
Expansion facilities	KAKAMEGA	0	0	1	0	0	2	1	1	4	4	8
	KISII	0	0	1	0	0	2	1	1	4	4	8
	KISUMU	0	0	1	0	0	2	1	1	4	4	8
	MERU	0	0	1	0	0	2	1	1	4	4	8
	NYERI	0	0	0	0	0	2	1	1	4	4	8
	Total	**9+(4)**	**6**	**27**	**14**	**45**	**14**	**6**	8	38	37	**880**

KEY: (+) means under procurement; the second LINACs for Mombasa and Nakuru are under procurement by IAEA through the KEN6024 "Rays of Hope" project.
*Only one with MSc in academic MP and clinical training, but four more assistant physicists.
**Further training required to meet definition of CQMP. () denotes not in clinical service when observed.

1.4 Stakeholder Analysis

1.4.1 Beneficiaries

The expansion of cancer services will benefit Kenya's patients by improving access to care and reducing the time and costs associated with accessing cancer services. Additionally, the expansion will lead to economic growth through increased economic activity and the influx of highly educated and highly paid healthcare workers. Crucially, health staff that will receive training will be benefited. Further, there will benefits associated with the creation of health infrastructures that may become regional centers for education and referrals.

The demand for quality services will create opportunities for investment in structures such as hostel facilities, which will increase household incomes in local communities and improve social welfare. The project is expected to support small and medium-sized enterprises, may lead to appreciation of land value, increase employment opportunities, and raise the health standards of the population in the counties it serves. Overall, this expansion will have a significant positive impact on the wealth and basic welfare of the community.

1.4.2 Internal Stakeholders

Name	Role
National Cancer Control Program - Ministry of Health	Focal point for policy formulation, planning, coordination of the project implementation and technical guidance
National Cancer Institute (NCI-K)	Regulation, oversight and certification of all cancer treatment facilities
Kenyatta National Hospital	Operationalization of the project
Moi Teaching Hospital	Operationalization of the project
Kenyatta University Teaching, Referral & Research Hospital (KUTRRH)	Operationalization of the project
Council of Governors and County Governments	Implement government policies and guidance provided by national government
Kenya Network of Cancer Organizations (KENCO)	Cancer advocacy and awareness creation, patient representation.
Kenya Medical Research Institute (KEMRI)	Support research and development
State Department for Public Works	Responsible for construction work and overall project management
National Treasury and Economic Planning	Funding and Financing, project approvals
Kenya Nuclear Regulatory Authority	Regulatory, oversight and licensing of RT facilities
National Environment Management Authority	Environmental impact assessment
Kenya Bureau of Standards (KEBS)	To establish standards for radiation quality assurance
Nuclear Power and Energy Agency (NuPEA)	Link between the country and IAEA
National Commission on Science, Technology and Innovation (NACOSTI)	Coordination of AFRA Project
Ministry of Education	Conduct academic training of Staff
Professional Associations	Professional development of the staff

1.4.3 External Stakeholders

Name	Role
World Health Organization (WHO)	Provide technical assistance
Development partners	Collaboration in strengthening cancer care services

Name	Role
World Bank	Collaboration in providing funding, finance and technical support
International Atomic Energy Agency (IAEA)	Provide technical assistance, capacity building and support for equipment and accessories
United Nations Institute of Interregional Crime (UNICRI)	Monitor interregional movement of radioactive sources
Private Sector partners	Engagement through pledges/legacy income from individual donors, philanthropy, foundations and business partners on diverse modalities for engagement on cancer; provision of relevant technologies.

1.5 Environmental, Social And Governance (ESG) Analysis

1.5.1 Environment

Special care shall be taken during the construction Special care shall be taken during the construction phase and the operational phase to ensure protection of the environment. The project shall comply with all legal requirements, including the Environmental Management and Coordination Act (EMCA) of 1999, appropriate National Environment Management Authority (NEMA) guidelines, Public Health Act Cap. 242 of 2007, and Occupational Safety and Health Act, 2007. EMCA provides the legal and institutional framework for environmental management and recognizes the right to a clean and healthy environment for every person in Kenya. An Environmental Impact Assessment will be conducted and submitted to NEMA, who is in charge of issuing licenses.

Site selection will avoid ecologically fragile areas, and thorough analysis and surveys will be conducted before construction begins. Building design and specifications will be modified to suit each site's conditions. Low-impact construction methods will be used, with reinforced concrete only in the bunker area. Locally and sustainably sourced materials will be used, and energy and water-saving fittings will be incorporated.

The construction sites are expected to encounter common environmental challenges, such as the emission of fumes, noise, and particulate matter from heavy machinery. Proper disposal of construction waste, including debris, packaging, and unusable materials, will be critical to prevent environmental harm. Contractors will be responsible for disposing of excavation materials and performing necessary landscaping activities. The project will explore the use of greenery, solar panels, and smart air conditioning systems to reduce energy costs and mitigate climate change impacts.

To prevent exposure to harmful radioactive materials and radiation during operation, the equipment will be housed in specially designed bunkers with appropriate specifications for walls, doors, ceiling, and access control systems. The design and construction of these bunkers will ensure that there is no harmful exposure to people or the environment. Waste management for the centers will be integrated with that of the existing facilities to ensure compliance with environmental regulations. Foul drainage from the hospital will be separated into radioactive foul drainage and normal foul drainage, which will be treated and disposed of appropriately. Approvals from the National Environment Management Authority will be sought to ensure adherence to environmental laws and regulations. An air pollution control system will be installed with the incinerator to further purify the toxic gases and meet environmental quality standards.

The radiotherapy facility will undergo testing to ensure there is no radiation leakage to neighboring

surroundings. Health workers will be monitored for occupational safety using dosimeters, and a radiation safety officer will oversee the program.

1.5.2 Social

The projects will be implemented in various counties with diverse socio-cultural and religious backgrounds. Key stakeholders include the Ministry of Health, County Governments, NEMA, and KENRA. Structured engagement and coordination with stakeholders, including community participation forums, are critical for success and sustainability. Following local provisions, community participation forums will be arranged to gather feedback from the community and ensure public participation. The design of the buildings will be modified to suit the social-cultural backgrounds of different locations.

The cancer centers will create permanent jobs for highly skilled personnel and employment for low skilled and temporary workers in support units like cleaning, grounds maintenance, kitchen, laundry, and clerks. The establishment of academic programs and research facilities will also be possible.

The centers will serve inpatients and outpatients daily, with outpatients typically accompanied by relatives and caregivers. This will create opportunities for SMEs and the local community to invest in the region, providing conveniences and facilities for visitors, improving the overall wealth and welfare of the community. The projects will also enhance access to timely, quality cancer care, reduce costs, improve training and research, and generate solid ground to advance cancer screening and prevention strategies.

1.5.3 Governance

The project will follow guidelines from the Department of Planning at the National Treasury and be overseen by the office of the Principal Secretary, who will appoint a Project Implementation Committee with members possessing diverse experience and skills specific to cancer projects. The committee will have several responsibilities, including ensuring compliance with agreements and legal requirements, providing policy guidance, overseeing and approving project milestones through the Principal Secretary of the Ministry of Health, advising the Ministry of Health and Treasury on financing requirements, and ensuring the center's operationalization and sustainability.

The County Health management teams will Identify the locations for the facilities and be involved in construction and operation. Legal requirements include approvals from various regulatory bodies/agencies such as the Kenya Nuclear Authority and the National Environmental and Management Authority. The Ministry of Health will prepare concept notes, provide project approval, and request funding for the projects. County Government approval of building plans and agreements between levels of government are also necessary.

Policy Framework	
Kenya Vision 2030	Kenya Cancer Policy 2019-2030
Kenya National Strategy for the Prevention and Control of Non-Communicable Diseases 2015–- 2020	National Cancer Control Strategy 2023-2027
Kenya Health Policy 2014-2030	National Environment Management Authority (NEMA) guidelines
National Guidelines for Cancer Management	National Guidelines for Establishing Cancer Centers
Universal Health Coverage (UHC)	National Cancer Treatment Protocols

Legal framework	
Constitution of Kenya, 2010	Environmental Management and Coordination Act, 1999 (Revised 2012) and its amendment (2015)
Nuclear regulatory Act No. 29 of 2019	Occupational Safety and Health Act, 2007
Architects and Quantity Surveyors Act, Cap 525	Public Health Act Cap. 242 of 2007
Physical Planning and Land Use Act of 2019	Health Act, No.21 of 2017
National Construction Authority Act, No. 41 of 2011	The Health Act, Cap 427
Public Procurement and Asset Disposal Act, No. 33 of 2015	Engineers Registration Act 2011
Cancer Prevention and Control Act, Cap 426b	Public Procurement and Asset Disposal Act, 2015 (PPDA, 2015)
NCA Regulations of 2014	Public Finance Management Act No. 18 of 2012

Institutional Framework	
Kenya Nuclear Regulatory Authority	County Governments
Division of National Cancer Control Program (Department of Non-Communicable Diseases, Ministry of Health) & Department of Health Infrastructure	National Construction Authority
National Cancer Institute of Kenya	Ministry of Public Works
National Environment Management Authority	Ministry of Health

CHAPTER 2

The Radiotherapy Facility Project

2.1 Expected Results

The **main goal** of the proposed project is:

To contribute to the reduction in cancer mortality, improved survival rates of cancer patients and the improvement of quality of life of cancer patients in Kenya by facilitating the consolidation and expansion of radiotherapy facilities that will provide outpatient radiotherapy services to a far higher number than what is attainable at present.

The **main objective** of the project is:

To consolidate and expand radiotherapy services which will provide quality cancer care to patients in Kenya.

More specifically, the project intends to:

- Design, build, equip, and consolidate/ expand operations for a modern radiotherapy service that meets the future needs of cancer patients in Kenya;
- Facilitate the delivery of RT services to the patients in need with utmost attention to excellence in clinical practices, quality assurance and safety;
- Contribute to the workforce development of professional groups (radiation oncologists, medical physicists, radiotherapy technicians and oncology nurses) involved in treatment service delivery in Kenya.

The **main impact** of the project will be increased capacity to treat cancer patients in Kenya resulting in improved quality of life for patients and their families.

The Logical Framework Matrix for the project is presented in Annex 2.

This document utilises IAEA guidance on the assessment of radiotherapy needs and recommendations on setting up a radiotherapy program.[2]

The consolidated/expanded radiotherapy facilities will be designed to respond to the needs of the country's cancer profile – i.e., to treat the patients most likely to be seen. An appropriate package of equipment will be procured for each facility that will aim to deliver the most net good to the most net patients possible, consistent with reasonable quality.

There are two aspects to the project: establishment of new facilities (expansion facilities) outside the capital city that will improve access to radiotherapy for patients in remote areas, and the consolidation of existing facilities, that will strengthen their current treatment capacity.

(a) Expansion Facilities

There project aims to establish five new radiotherapy facilities outside of the capital city. Therefore, the new facilities will initially house 2 Linear accelerators (a 6MV and a 15MV linear accelerator with MLC, EPID and RVS) and 1 HDR brachytherapy unit, with supporting equipment. Through IAEA support, the Government will also develop the human resources needed to operate this type of facilities. The equipment and

2 International Atomic Energy Agency, Setting Up a Radiotherapy Program: Clinical, Medical Physics, Radiation Protection and Safety Aspects, IAEA, 2008.

human resource requirements for each facility is summarized in Table 1. The IAEA recommends one radiation oncologist per 200-250 patients. In terms of medical physicists, the IAEA recommends one medical physicist for each megavoltage unit or brachytherapy afterloader or one medical physicist for every 400 patients per year. This translates into a need for 4 radiation oncologists and 4 medical physicists per facility. Concerning radiation therapy technologists (RTTs), the IAEA recommends two RTTs per megavoltage unit with up to 25 patients treated daily, or four RTTs per unit with up to 50 patients treated per day. Therefore, 8 RTTs are initially required for the external beam treatment machines and to cover the mould room, simulator and brachytherapy in each facility. Three oncology nurses will also need to be assigned to the facility. Each new radiotherapy facility will then have sufficient equipment and human resources to treat about 800-1000 patients per annum.

(b) Consolidation Facilities

The project aims to consolidate the treatment capacity of five institutions: Kenyatta University Teaching (KUTRRH) Research and Referral Hospital, Kenyatta National Hospital (KNH), Moi Teaching and Referral Hospital (MTRH), and three comprehensive regional cancer care facilities, Garissa County Referral Hospital (GCRH), Nakuru County Referral Hospital (NCRH) and Mombasa County Referral Hospital (MCRH). Baseline information on existing equipment and human resources is presented in Table 1. Each facility will house linacs (6MV and 15 MV linear accelerator with MLC, EPID and RVS) and HDR brachytherapy units.

The equipment and human resource requirements based on IAEA recommendations for each facility are summarized in the table 3 below.

Table 2: Equipment and HR needs for New Facilities

	Equipment			Human Resources				
Location	**Linac**	**Brachytherapy**	**CT Sim**	**RO**	**MP**	**RTT**	**ON**	**Engineer**
MERU	2	1	1	4	4	8	3	2
KISII	2	1	1	4	4	8	3	2
KISUMU	2	1	1	4	4	8	3	2
KAKAMEGA	2	1	1	4	4	8	3	2
NYERI	2	1	1	4	4	8	3	2
TOTAL	**10**	**5**	**5**	**20**	**20**	**40**	**15**	**10**

Table 3: Equipment and HR needs for Consolidation Facilities

	Equipment			Human Resources				
Institution	**Linac**	**Brachy**	**CT Sim**	**RO**	**MP**	**RTT**	**ON**	**Engineer**
KNH	2	1	0	6	6	12	5	1
KUTRRH	2	1	1	4	4	8	3	1
Moi TRH	0	1	0	6	4	8	3	1
Garissa CRH	0	0	0	0	0	4	3	1
Mombasa CRH	0	0	0	0	2	8	3	1
Nakuru CRH	0	0	0	2	1	8	3	1
TOTAL	**4**	**3**	**1**	**18**	**17**	**48**	**20**	**6**

This translates into an overall need for 38 radiation oncologists and 37 medical physicists required in total for the project. Further, the project requires 88 therapy radiographers. At least 3 oncology nurses will also need to be assigned to each of the facilities to provide services both in external beam and brachytherapy translating to an estimated total of 35 nurses, and 16 engineers.

Given that an estimated 50-60% of new cancer cases – approximately 21,058 to 25, 269 patients– in Kenya require radiotherapy and that one radiotherapy machine can treat an average of 500 patients per year, it is estimated that Kenya requires between 42 and 50 treatment machines.. Furthermore, GLOBOCAN projections of 95,217 new cases by 2040 implies that 95 to 114 treatment machines will be needed in the future. About 40% of cancers can be prevented through strategic investments in establishing organized cancer screening programs for all eligible persons as per the National Cancer Screening Guidelines.

Local education and training capabilities are crucial for the success of this project. There are accredited local training programs in place for:

1. **Radiation oncology:** MMED Radiation Oncology programme for four years at the University of Nairobi. The first cohort to graduate in 2023.
2. **Medical Physics:** MSc. Medical Physics at the Technical University of Kenya in collaboration with KNH currently in its second year
3. **RTTs:** There is a program at Jomo Kenyatta University of Agriculture and Technology that has graduated 35 RTTs so far
4. **Oncology nurses:** various programs available at the University of Nairobi (MSc), Kenyatta University, MTRH, Kenya Medical Training College (HND)
5. **Paediatric Oncology:** new program established at the Moi Teaching and Referral Hospital

These programs will be expanded and consolidated as needed.

2.2 Geographic Location And Architectural Plan

There project aims to establish five new radiotherapy facilities outside of the capital city and. andconsolidate the treatment capacity of six institutions: Kenyatta University Teaching (KUTRRH) Research and Referral Hospital, Kenyatta National Hospital (KNH), Moi Teaching and Referral Hospital (MTRH), and three county referral facilities: Garissa County Referral Hospital, Mombasa County Referral Hospital, and Nakuru County Referral Hospital.

The conceptual architectural plans for the consolidated and new radiotherapy facilities are presented in Annex 5.

The design and construction of the radiotherapy facilities (both for expansion and consolidation units) will be done according to the IAEA publication, *Radiotherapy Facilities: Master Planning and Concept Design Considerations, 2015*. Bunkers will be generic in design so as to accommodate a wide range of appropriate teletherapy and brachytherapy machines and provide maximum flexibility for procurement of equipment and future developments.

2.3 Implementation Modalities

The project plan in the form of a Gantt chart is presented in Annex 3.

It is anticipated that the Ministry of Health will oversee the management of this project. A project manager is required to oversee and supervise the project. In close coordination with the donor(s), a Steering Committee comprised of members from Ministries of Finance, Health, Works, Environment and Radiation Protection Authority and others will

coordinate project preparation and supervise the logistics and management of the project.

The Steering Committee is expected to be coordinated by the Division of Non-Communicable Diseases through the National Cancer Control Program and chaired by the Project manager and comprised of members from the following entities:

- The Ministry of Health
- The Ministry of Finance
- The Ministry of Environment
- The Ministry of Public Works

The regulatory authorities such as Kenya Nuclear Regulatory Authority and the National Cancer Institute-Kenya will play a critical role in all aspects related to oversight, radiation protection, safety and security and accreditation for service provision in KENYA and will additionally be charged with the licensing and accreditation of the facility and equipment that use ionizing radiation and conducting inspection procedures throughout the lifetime of the centers.

The MoH, being the project holder, in collaboration with the Ministry of Works will monitor construction. The MoH will establish a Project Implementation Team to develop and oversee the development of the civil works chaired by the Principal Secretary of Health or his Designate. The team will include an architect, structural engineer, mechanical engineer, electrical engineer, radiation oncologist, medical physicist and cost consultant with relevant technical support from IAEA experts during the project and submit project progress reports through the Steering Committee. It will be coordinated by the Division of Non-Communicable Diseases in close liaison with support departments including the Division of Health Infrastructure and the Procurement, Finance and Legal Divisions.

Implementation of the project is expected to be conducted through the supervision of the Steering Committee. Until the center(s) is completed, the Steering Committee will serve as lead administrator for the Center. Upon completion of the center(s), it is anticipated that the management of the facilities will take over the administration of the center.

The Project Steering Committee will submit quarterly reports on progress through the National Cancer Control Program in the Division of Non-Communicable Diseases for onward briefing to the Principal Secretary who is the Accounting Officer. The Project Manager will regularly draft and present the reports to the coordinator of the Steering Committee for review.

2.4 Monitoring And Evaluation Framework

A Monitoring, Evaluation and Research and Development directorate should ideally be mandated to provide cancer information in a timely manner to enable the country have information necessary to fight the cancer threat and plan for the future of its patients. This is achieved through improved data collection processes, management and reporting of reliable data for fact-based decision-making and policy making and research to reduce the incidence, morbidity and mortality associated with cancer and to improve the lives of all people of Kenya.

All M&E will be conducted by the Ministry of Health's Division of Health Infrastructure who will directly supervise the work progress and review and approve completion certificates submitted by the Steering Committee.

The reporting schedule will be as follows:

- Initial baseline surveys to assess starting point from where to measure progress

- Monthly progress report to the Steering Committee
- Quarterly progress report to Principal Secretary for Health and Minister of Health
- Six-monthly progress report to the IAEA (and respective donors, as applicable)
- Annual progress report to National Treasury and Planning as needed
- Final project report

2.5 Radiation Safety

According to IAEA safety standards, the country is required to establish and sustain an effective legal, governmental and regulatory framework for radiation safety, including a fully functional independent regulatory body. The regulatory body should fulfil its core regulatory functions, in particular: establish regulations that set out requirements for radiation protection and safety (General Safety Requirements Part 3); establish a process for notification and authorization, including a review and assessment of applications for authorization; perform regulatory inspections and take necessary enforcement actions. For facilities such as radiotherapy, the regulatory body may require a multistep process of authorization, including a pre-construction license (to assess the design of facility and structural shielding) and licence to operate the facility. The current status of regulatory infrastructure is summarised in Annex 7.

The prime responsibility for radiation protection and safety rests with the person or organization responsible for the medical radiation facility (e.g., radiotherapy facility), normally referred to as the licensee. The licensee should ensure that all requirements addressing medical exposure, occupational exposure, and exposure of members of the public are fulfilled.

2.6 Sustainability

The Ministry of Health is committed to prioritizing Universal Health Coverage (UHC) in accordance with the Government of Kenya's development plan. One critical component of achieving universal access to cancer management is the decentralization of specialized cancer care by expanding cancer management infrastructure throughout the country.

Kenya's Vision 2030 envisions a globally competitive and prosperous nation with a high quality of life beyond 2030. To achieve this, the country aims to establish an efficient and high-quality healthcare system that meets the best standards, improving the overall livelihoods of Kenyans.

Furthermore, Kenya aims to prioritize becoming a regional provider of highly specialized healthcare services, with a particular focus on providing quality cancer care. Doing so has the potential to reverse the estimated economic losses arising from the rising cancer burden, which is projected to increase to 95,000 new cases per year by 2040, due to population growth and unhealthy lifestyles. Furthermore, a sustainable solution to the cancer burden has the potential to generate revenues from medical tourism and support economic growth and development.

The Kenyan economy has grown steadily at an average of 5.62% over the past five years. In line with the objective of improving health quality and access, the National Hospital Insurance Fund, supported by the government of Kenya, covers a significant portion of cancer treatment offered by registered facilities, both public and private. Accordingly, the government's expenditure on health services has increased steadily in the period, growing almost threefold since 2015.

2.7 Risk Assessment

The following are considered the most important risks to be managed by the Government:

Risk management framework					
Event	**Category**	**Risk evaluation**		**Priority**	**Response**
		Probability	**Impact**		
Enter a brief description of the risk. Risk description should include possible future events, cause and effect.	*Define*	***Indicate likelihood for the event to happen****	***Indicate impact level***	*low (2-3); medium (4); high (5)* critical (6)	Mitigation measures
The Radiotherapy facility is developed in isolation from a comprehensive cancer control strategy, thus rendering a sub-optimal service in terms of the number of patients treated and the types of cancers seen	Policy	**1**	**1**	**2**	The setup of each radiotherapy center will be comprehensively planned and executed professionally to avoid any issues. Each center will be located in a facility at level 5 or higher, with the necessary institutional and human resources to provide multidisciplinary cancer care. These resources include radiology, pathology, surgery, chemotherapy, palliative care services, gynecology, and more.
There are insufficient supporting services such as diagnostic radiology and pathology	Institutional Capacities	**1**	**2**	**3**	The proposed site for radiotherapy facility will be required to have all the necessary support services before being established.
There are no locally experienced project managers acquainted with the complex nature of planning and developing a radiotherapy facility	HR	1	1	2	**Technical guidance from the Ministry of Health is necessary during the establishment of any radiotherapy facility.**
Qualified professionals (RO, MP, RTT) to be hired may not be easily findable	HR	**2**	**2**	**4**	Adequate education and training activities are already established and will be consolidated as needed.
Project management is uncoordinated	Management	**1**	**2**	**3**	Ensure project management structures are formalized and well represented before project commences.
The site may be found to be geotechnically inappropriate	Technical	**1**	**3**	**4**	Undertake geotechnical surveys of proposed site before project commences and obtain alternative site if site is found unsuitable.
The site is subject to environmental hazards and/ or has problems related to soil conditions and potential road access	Environment	**1**	**1**	**2**	Get an alternative site without environmental threat.
Highly qualified (and therefore mobile) staff may not be retained	Technical	**2**	**3**	**5**	Bonding of qualified staff and planning for succession.

Risk management framework					
Event	**Category**	**Risk evaluation**		**Priority**	**Response**
		Probability	**Impact**		
Enter a brief description of the risk. Risk description should include possible future events, cause and effect.	*Define*	***Indicate likelihood for the event to happen****	***Indicate impact level*** **	*low (2-3); medium (4); high (5)* critical (6)	Mitigation measures
The required civil works are specialized in nature and there is limited technical competence within the country to design and construct the facility	Institutional Capacities	**1**	**1**	**2**	There is adequate capacity already in this area
Project financing is beyond the means of the Government	Finance	**2**	**2**	**4**	Radiotherapy anchored on the National Cancer Control Strategic Plan and Medium-Term Plans
The cost of running and maintaining the facility will be beyond the means of the Government	Finance	**2**	**2**	**4**	Ministry of Health and County Governments have framework agreement for cost sharing
The project will be driven by technology considerations	Technical	**3**	**3**	**6**	In line with current government manifesto on digitalization of all services
The regulatory authority currently does not yet have the capacity to perform licensing or inspection services for a radiotherapy facility	Institutional Capacities	**1**	**1**	**2**	Training of the technical staff on inspection for radiotherapy facilities and employ special cadre (Medical Physicist)
The decentralized health services in the counties do not diagnose the cancer patients in time	Institutional Capacities	**1**	**1**	**2**	Most centers have adequate radiology and pathology capacity
Cultural factors of stigma associated with cancer and fears associated with radiation can affect cancer care seeking behavior	Patient	**2**	**2**	**4**	Address misinformation and disinformation by enhancing public awareness
Financial barriers for patients limit access to the Center's services	Patient	**2**	**2**	**4**	Chronic disease fund under establishment as well as improving current oncology package in the national health insurance fund
Possible political instability	Policy	**1**	**1**	**2**	Kenya has stable political environment.
Limited access to facility by patients from remote areas of the country.	Patient	**2**	**3**	**5**	Hostel facilities should be established to provide accommodation, especially for patients who have to travel for over an hour or more than 5 kilometers to reach the facility.
Possible electricity instability in remote areas.	Institutional Capacities	**3**	**3**	**6**	Stand-by generators to be included in the project, UPS installations

* **Probability:** how probable is it that the event will take place? (if possible, refer to historical data): 1 - low: 0-25%; 2 - medium, 26-75%; 3 - high, over 75%

** Impact level: 1 - low, this event will delay project results; 2 - medium, the event will reduce project results; 3 - high, the event will hamper project resultsBudget And Financial Requirements

CHAPTER 3

Budget And Financial Requirements

3.1 Cost Rationale

Each new radiotherapy facilities will be able to treat approximately 800-1000 new patients per year. Altogether, the establishment of new radiotherapy facilities combined with the consolidation of the existing ones will contribute to public savings and produce enough benefits estimated at **Net Present Value (NPV) of at least 195,5 million euro** discounted for a period of 15 years. This project will make cancer treatment available to **33 percent** of the population in need. The new facilities and the consolidated ones will provide treatment to approximately 9200 patients per year once all external beam units are operative.

The total costs for the establishment of the new radiotherapy facilities and the consolidation of existing ones will be about **€39,4 million.** This mainly includes construction, equipment, and staff training. It is estimated that after the establishment it will cost about **€8 million per annum** to run all the Radiotherapy Centers in the project. This translates to a cost of treating a patient that is approximately €1000. As the cancer burden is projected to increase, consideration will have to be given to investing in further radiotherapy machines..

3.2 Cost Description And Financial Requirements

Overall, the project requires approximately 39,4 million euro of investment to cover construction, equipment procurement and human resource training, and 8 million euro per year afterward to operate. Detailed costs are detailed below. Additional detail on civil works, equipment and training costs are provided in Annex 4.

New facilities

The total capital cost of the project to establish new radiotherapy facilities, including civil works, human resource training and equipment is estimated as:

Component	Estimated Cost (€)
Construction Phase (infrastructure cost)	8,000,000
Radiotherapy Equipment	19,125,000
Human Resource training	675,000
TOTAL	**27,800,000**

Running cost per annum, once the facilities are established is estimated to be:

Item	Amount (€)
Equipment maintenance and contingency fund (including utilities and other operational expenses)	2,521,875
Salaries	2,200,000
CPD: Continuous Professional development	4,650
TOTAL	**4,726,525**

Consolidation of existing facilities

The total capital cost of the project to consolidate the existing radiotherapy facility, including civil works, human resource training and equipment is estimated as:

Component	Estimated Cost (€)
Construction Phase (infrastructure cost)	2,580,000
Radiotherapy Equipment	8,288,000
Human Resource training	651,750
TOTAL	**11,519,750**

Running costs per annum, once the consolidated facilities are established is estimated to be:

Item	Amount (€)
Equipment maintenance and contingency fund (including utilities and other operational expenses)	1,119,120
Salaries	2,205,000
CPD: Continuous Professional development	4,605
TOTAL	**3,328,725**

3.3 Cash Flow Analysis

The cash flow analysis presented as Appendix A is based on the following assumptions.

Cost–Benefit analysis involves the measurement and valuation of all outcomes of interest in monetary terms, with the objective of identifying the net economic benefit associated with the project.

The project comprises the construction of five new radiotherapy centres and the consolidation of six existing facilities, which are analyzed in detail below.

A. New facilities

In order to develop the cost-benefit analysis (CBA), we present a standard model for all new facilities to assess project detailed costs. These costs, which are summarized in Annex 4, follow the sequence of activities in the Gantt Chart presented in Annex 3.

Each new facility will be equipped with 2 EBRT and complementary equipment (see Annex 4 for the equipment list) and will have the capacity to treat approximately 1,000 patients per year. The cost projections encompass the initial two units, equipment operation and maintenance costs, as well as training and operational expenses for the human resources. The investment for the first units will be completed within the initial four years, and it is anticipated that each new radiotherapy facility will be fully operational, with trained personnel, by year five when the initial benefits will be observed.

Projected costs are discounted and compared with estimates of (discounted) anticipated benefits from these investments, which include a cost recovery scheme, and an estimation of the socio-economic benefits associated with the survival of patients. Once each new facility is operational, it is estimated that it will charge patients a basic treatment fee of €675. The projection assumes that 10% of all patients treated will be foreign, who will be charged €1000, which is lower than the current treatment cost in other countries.

The methodology to calculate the socio -economic benefits is as follows, and will also be used to estimate the benefits associated with the consolidation facilities below. First, the overall burden of disease is assessed using the disability-adjusted life year (DALY), a time-based measure that combines years of life lost due to premature mortality (YLLs) and years of life lost due to time lived in states of less than full health, or years of healthy life lost due to disability (YLDs).[3] One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality (YLLs) and the years

3 World Health Organization. WHO Methods and Data Sources for Global Burden of Disease Estimates.; 2020.

lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population.

We use country-specific DALY (disability-adjusted life year) values for each type of cancer, based the Lancet Global Burden of Disease (GBD) Resource Center.[4] Combined with incidence, one can compute the DALY value associated with each case, per type of cancer, in each country.

To estimate the population benefit, we calculated the total benefit of radiotherapy for each indication by multiplying the proportion of patients with that indication by its associated 5-year overall survival benefit.[5] We then added up these benefits to determine the overall population survival benefit of a new radiotherapy center.

We follow two methods to estimate the economic benefits associated with a new radiotherapy center.[6] First, we use Human-Capital approach, which assigns the economic value of life according to a person's economic contribution to the gross domestic product, and is calculated by multiplying the per capita GDP to the extra life-years provided by radiotherapy treatment of cancer.[7] This method provides a lower bound to economic benefits in the CBA analysis.

The second approach, known as the value-of-life-years method or full-income approach, considers the societal value of a lifesaving intervention, regardless of whether the recipient is able to contribute to the workforce or not. This value is estimated to be 2.3 times the GDP per person in a given year.[8] This approach provides an upper bound to economic benefits in the CBA analysis. For the GDP, the per capita gross domestic product (GDP) at purchasing power parity (PPP) (constant 2017 international) is utilized.

B. Consolidation of existing facilities

For the six consolidation facilities a cost-benefit analysis (CBA) similar to the above one is performed. The key difference is that construction, equipment and human resources requirements differ for each facility, and we present a summary of those below. Therefore, each facility is analyzed separately.

The rest of the procedure is the same as the one already presented: costs follow the sequence of activities in the Gantt Chart presented in Annex 3. The investment and training phase will be finalized within the first four years, and it is expected that each consolidated radiotherapy facility will be fully operational, with trained staff, by the fifth year, resulting in initial benefits. The projected costs are then discounted and compared to estimates of expected benefits from these investments, which include a cost recovery scheme and an assessment of the socio-economic benefits associated with patient survival. The recovery scheme and socio-economic benefit estimation follow the same detailed procedure as explained for the new facilities above.

Kenyatta University Teaching (KUTRRH) Research and Referral Hospital

For this centre, an expansion in the building is needed to accommodate new equipment. Details

4 Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle; 2020. https://vizhub.healthdata.org/gbd-results/

5 Atun R, Jaff DA, Barton MB, et al. Expanding global access to radiotherapy. 2015:1153-1186. doi:10.1016/S1470-2045(15)00222-3

6 Atun R, Jaff DA, Barton MB, et al. Expanding global access to radiotherapy. 2015:1153-1186. doi:10.1016/S1470-2045(15)00222-3; and Ward ZJ, Scott AM, Hricak H, Atun R. Global costs, health benefits, and economic benefits of scaling up treatment and imaging modalities for survival of 11 cancers: a simulation-based analysis. The Lancet Oncology. 2021;22(3):341-350. doi:10.1016/S1470-2045(20)30750-6

7 The World Bank. World Development Indicators. https://databank.worldbank.org/source/world-development-indicators. Published 2021.

8 Jamison DT, Summers LH, Alleyne G, et al. Global health 2035 : a world converging within a generation. The Lancet. 2014;382(9908):1898-1955. doi:10.1016/S0140-6736(13)62105-4

on the required equipment and human resources in Table 3. Given the equipment, it is projected that this centre will be able to treat approximately an additional number of 1000 patients per year.

Kenyatta National Hospital (KNH)

For this centre, an expansion in the building is needed to accommodate new equipment. Details on the required equipment and human resources in Table 3. Given the equipment, it is projected that this centre will be able to treat approximately an additional number of 1000 patients per year.

Moi Teaching and Referral Hospital (MTRH)

For this centre, an expansion in the building is needed to accommodate new equipment. Details on the required equipment and human resources in Table 3. Given the equipment and human resources, it is projected that this centre will be able to treat approximately an additional number of 1000 patients per year.

Garissa County Referral Hospital

For this centre, construction costs and key equipment costs already have secured sources for funding through other sources, and thus only human resources are required as part of the current project (detailed requirements by centre are presented in Table 3). Given the equipment and available human resources, it is projected that this centre will be able to treat approximately an additional number of 200 patients per year.

Mombasa County Referral Hospital

For this centre, construction costs and key equipment costs already have secured sources for funding through other sources, and thus only human resources are required as part of the current project (detailed requirements by centre are presented in Table 3). Given the equipment and human resources, it is projected that this centre will be able to treat approximately an additional number of 500 patients per year.

Nakuru County Referral Hospital

For this centre, construction costs and key equipment costs already have secured sources for funding through other sources, and thus only human resources are required as part of the current project (detailed requirements by centre are presented in Table 3). Given the equipment and human resources, it is projected that this centre will be able to treat approximately an additional number of 500 patients per year.

In sum, the cash flow analysis confirms the long-term sustainability of the project. Covering a 15-year period, the analysis indicates an internal rate of return (IRR) of 89-147% and a net present value (NPV) on investment of at least 195.5 million euro. From a socio-economic standpoint, the analysis supports the rationale behind the overall investment, as it demonstrates that the benefits outweigh the costs for the population of Kenya.

STATUS QUO

		Y1	Y2	Y3	Y4	Y5	Y6-Y15
Project Costs							
Investment Costs							
Construction costs		3,174,000	3,174,000	3,174,000	1,058,000	-	
	KAKAMEGA	480,000	480,000	480,000	160,000	-	
	KISII	480,000	480,000	480,000	160,000	-	
	KISUMU	480,000	480,000	480,000	160,000	-	
	MERU	480,000	480,000	480,000	160,000	-	-
	NYERI	480,000	480,000	480,000	160,000	-	-
	KNH	258,000	258,000	258,000	86,000	-	-
	KUTRRH	258,000	258,000	258,000	86,000	-	-
	MTRH	258,000	258,000	258,000	86,000	-	-
	Garissa CRH	-	-	-	-	-	-
	Mombasa CRH	-	-	-	-	-	-
	Nakuru CRH	-	-	-	-	-	-
Equipment		-	-	-	8,480,000	18,933,000	
	KAKAMEGA	-	-	-	1,172,500	2,652,500	
	KISII	-	-	-	1,172,500	2,652,500	
	KISUMU	-	-	-	1,172,500	2,652,500	
	MERU	-	-	-	1,172,500	2,652,500	
	NYERI	-	-	-	1,172,500	2,652,500	
	KNH				1,172,500	2,243,500	
	KUTRRH				1,172,500	2,652,500	
	MTRH				272,500	774,500	
	Garissa CRH				-	-	
	Mombasa CRH				-	-	
	Nakuru CRH				-	-	-
Training		202,050	202,050	443,050	359,800	359,800	11,865
	KAKAMEGA	19,800	19,800	42,800	33,800	33,800	1,140
	KISII	19,800	19,800	42,800	33,800	33,800	1,140
	KISUMU	19,800	19,800	42,800	33,800	33,800	1,140
	MERU	19,800	19,800	42,800	33,800	33,800	1,140
	NYERI	19,800	19,800	42,800	33,800	33,800	1,140
	KNH	35,100	35,100	61,100	47,600	47,600	1,590
	KUTRRH	23,400	23,400	50,400	41,400	41,400	1,350
	MTRH	30,600	30,600	49,600	40,600	40,600	1,290
	Garissa CRH	-	-	15,000	15,000	15,000	450
	Mombasa CRH	4,500	4,500	23,500	19,000	19,000	660
	Nakuru CRH	9,450	9,450	29,450	27,200	27,200	825
Sub total investment costs		3,376,050	3,376,050	3,617,050	9,897,800	19,292,800	11,865
Maintenance & Operation costs							
Salaries		-	-	925,000	1,245,000	6,135,000	6,135,000
	KAKAMEGA	-	-	100,000	140,000	590,000	590,000
	KISII	-	-	100,000	140,000	590,000	590,000
	KISUMU	-	-	100,000	140,000	590,000	590,000
	MERU	-	-	100,000	140,000	590,000	590,000
	NYERI	-	-	100,000	140,000	590,000	590,000
	KNH	-	-	150,000	170,000	775,000	775,000
	KUTRRH	-	-	100,000	120,000	680,000	680,000
	MTRH	-	-	100,000	120,000	620,000	620,000
	Garissa CRH	-	-	-	20,000	280,000	280,000
	Mombasa CRH	-	-	50,000	70,000	390,000	390,000
	Nakuru CRH	-	-	25,000	45,000	440,000	440,000
Equipment maintenance & operational costs		-	-	-	-	3,586,495	3,586,495
	KAKAMEGA	-	-	-	-	504,375	504,375
	KISII	-	-	-	-	504,375	504,375
	KISUMU	-	-	-	-	504,375	504,375
	MERU	-	-	-	-	504,375	504,375
	NYERI	-	-	-	-	504,375	504,375
consolidation	KNH	-	-	-	-	457,340	457,340
	KUTRRH	-	-	-	-	504,375	504,375
	MTRH	-	-	-	-	102,905	102,905
	Garissa CRH	-	-	-	-	-	-
	Mombasa CRH	-	-	-	-	-	-
	Nakuru CRH	-	-	-	-	-	-
Sub total Maintenance & operating costs		-	-	925,000	1,245,000	9,721,495	9,721,495
Total Costs		3,376,050	3,376,050	4,542,050	11,142,800	29,014,295	9,733,360

roject Benefits						
Nr of patients receiving treatment	0	0	0	0	5,840	7,300
KAKAMEGA					800	1,000
KISII					800	1,000
KISUMU					800	1,000
MERU					800	1,000
NYERI					800	1,000
Nr of patients receiving treatment with new equipment in consolidation facilities						

	lower bound	upper bound
Net Present Value (10%)	€120,858,084	€356,457,469
IRR	60%	107%
NPVB (10%)	€282,412,808	€627,353,867
NPVC (10%)	€72,033,664	€72,033,664
B/C ratio	3.9	8.7

3.4 Financial Plan

The project is proposed to be financed through several methods, as described below.

3.4.1. Costs And Sources Of Funding(€)

Item	Amount	Source of Funding (eur)		
		Government	Grant/ Concessional Loans	Grant/IAEA
Capital Cost				
Construction cost	10,580,000	1,580,000	9,000,000	0
Equipment	27,413,000	2,741,300	24,671,700	0
Training	1,350,750	0	0	1,350,750*
Total Investment cost	**39,343,750**	**4,321,300**	**33,671,700**	**1,350,750**
Operational Costs (annual)				
Equipment Maintenance, Operational & contingency fund	3,586,495	3,586,495	0	0
Salaries (including CPD)	4,414,255	4,414,255	0	0
Total Operational Costs (annual)	**8,000,750**	**3,586,495**	**0**	**0**

* Amount to be confirmed in the context of future TC projects with IAEA.

CHAPTER 4

Annexes

Annex 1: Cancer Profile

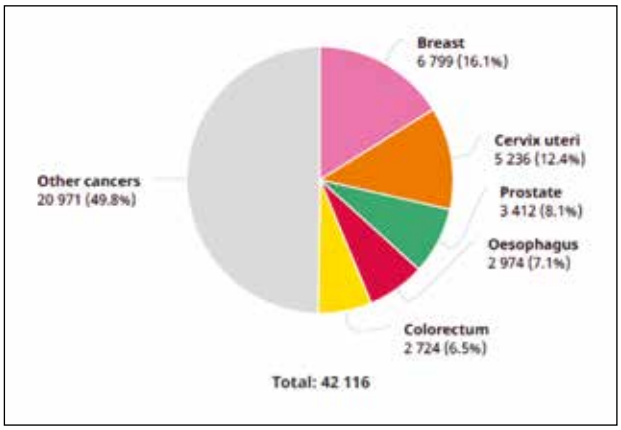


Figure 1: Number of new cases in 2020, both sexes, all ages

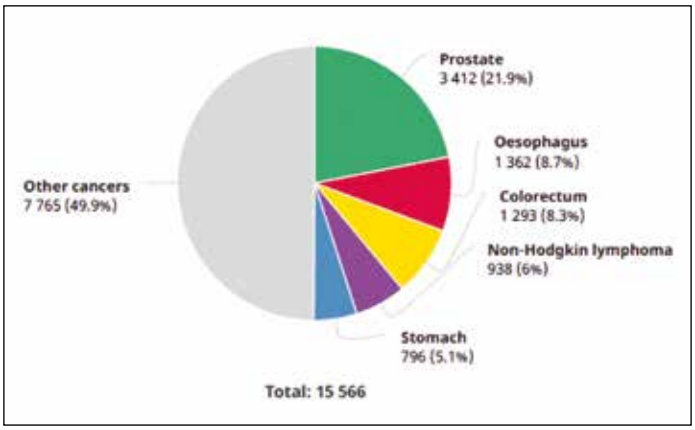


Figure 2: Number of new cases in 2020, males, all ages

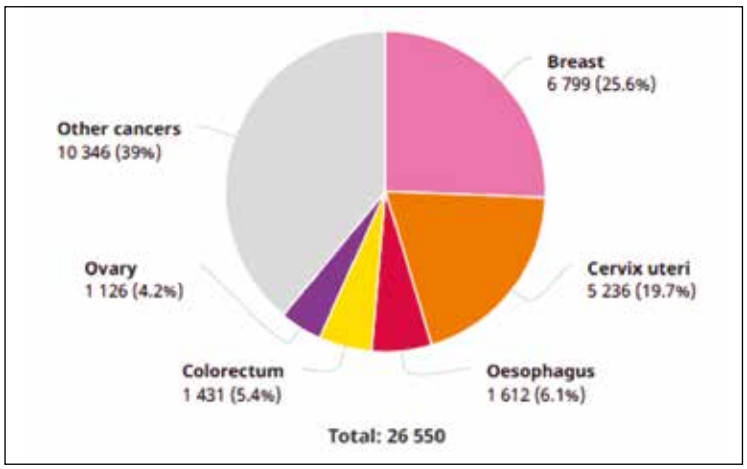


Figure 3: Number of new cases in 2020, females, all ages

Table 4: Summary statistics 2020

	Males	Females	Both sexes
Population	26 718 527	27 052 773	53 771 300
Number of new cancer cases	15 566	26 550	42 116
Age-standardized incidence rate (World)	133.2	168.2	149.2
Risk of developing cancer before the age of 75 years (%)	14.3	18.0	16.2
Number of cancer deaths	10 466	16 626	27 092
Age-standardized mortality rate (World)	96.5	112.6	103.2
Risk of dying from cancer before the age of 75 years (%)	10.3	12.7	11.6
5-year prevalent cases	28 464	54 156	82 620
Top 5 most frequent cancers excluding non-melanoma skin cancer (ranked by cases)	Prostate Oesophagus Colorectum Non-Hodgkin lymphoma Stomach	Breast Cervix uteri Oesophagus Colorectum Ovary	Breast Cervix uteri Prostate Oesophagus Colorectum

Source: GLOBOCAN https://gco.iarc.fr/today/fact-sheets-populations

Annex 2: Project Logical Framework Matrix

	Design Element	Indicator	Target	Means of Verification
Outcome	New radiotherapy (RT) services have made it possible for treatment of cancer patients with improved opportunity for delivery of curative treatment for some common cancers.	Consolidated and new facilities in place, with adequate and appropriately qualified personnel and equipment by **Q4 year 5**.	Target: 5 new RT operational facilities in place, 6 consolidated facilities in operation.	The facilities are formally opened by the Government.
Output	A functional consolidated existing radiotherapy facility with the required therapy equipment and with qualified personnel	Civil works, conforming to International Basic Safety Standards completed by **Q4 year 4** Equipment installed and commissioned by **Q3 year 5** All personnel trained and qualified by **Q2 year 5**	Target: building in place following standards Target: equipment delivered Target: 18 Radiation Oncologists; 17 Medical Physicists, 60 RTT and 60. oncology nurses trained	Architect signs off on completed building; Reports of manufacturers and acceptance testing expert reports; University degree and diploma certificates.
	A functional new radiotherapy facility(s) with the required therapy equipment and with qualified personnel	Civil works, conforming to International Basic Safety Standards completed by **Q4 year 4** Equipment installed and commissioned by **Q3 year 5** All personnel trained and qualified by **Q2 year 5**	Target: building in place following standards Target: delivered Target: 16 Radiation Oncologists; 20 Medical Physicists, 60 RTT and 45 oncology nurses trained	Architect signs off on completed building; Reports of manufacturers and acceptance testing expert reports; University degree and diploma certificates.
Activities	Construction of civil works (including planning)	Civil works completed by **Q4 year 4** Conform to International Basic Safety Standards by **Q4 year 4**		Architect signs off on completed building; IAEA expert mission to assess radiation protection aspects of the building;
	Procurement and installation of equipment, commissioning and acceptance testing	External Beam Radiation and Brachytherapy and supporting equipment installed and commissioned by **Q3 year 5**		Reports of manufacturers and acceptance testing expert reports.
	Training and qualification of professional staff	The following staff have been trained and qualified by **Q2 year 5** • 33 Radiation Oncologists; • 37 Medical Physicists; • 100 RTTs; • 75 Oncology therapy nurses • 16 Engineers.		University degree and diploma certificates. Academic programs, and clinical training and residency programs are already established in Kenya (described in more detail in Section 2.1)

Annex 3: Generic Gantt Chart To Be Used For Consolidation And Expansion Projects

Activity	Year 1				Year 2				Year 3				Year 4				Year 5			
1. Preparation phase: Set up project management team, finalize site selection, develop architectural plans, secure funding, architectural plan cleared by regulatory body and construction license secured	x	x	x	x																
2. Construction of civil works (including planning)					x	x	x	x	x	x	x	x	x	x	x	x				
3. Procurement and installation of equipment													x	x	x	x				
4. Commissioning and acceptance testing of equipment																	x	x	x	
5. Training and qualification of professional staff																				
Radiation oncologists	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Medical Physicists	x	x	x	x	x	x	x	x	x	x	x	x								
RTTs									x	x	x	x	x	x	x	x	x	x		
Oncology nurses															x	x				
Regulatory body staff	x	x									x	x								

Annex 4: Detailed Cost Estimates

Capital Costs for New Facilities

INVESTMENT

Component	Estimated Cost (€)
Construction Phase (infrastructure cost)	8,000,000
Radiotherapy Equipment	19,125,000
Human Resource training	745,500
TOTAL	**27,870,500**

Equipment	Price (EUR)	Quantity	Total
Major equipment			
Linac	900,000	2	1,800,000
Brachytherapy	545,000	1	545,000
Accessory equipment			
Treatment Planning Stations	272,000	3	816,000
Record & verify system (Oncology Inf. system)	130,000	1	130,000
Dosimetry (Dosimetry & QA equipment)	100,000	1	100,000
CT Simulator	409,000	1	409,000
Mould Room/Immobilisation devices	25,000	1	25,000
TOTAL for 1 new facility			**3,825,000**
TOTAL for all new facilities			**19,125,000**

Estimated Training Costs

The required personnel include the following:

1. **Radiation Oncologists** -These experts are to provide services on 8-hour basis on ERBT and HDR Brachytherapy machines. Their training takes 4 years in total.
2. **Medical Physicists** – who can be trained first at Bachelor of Science (Physics major) level, then continue to train for 2 years as a medical physicist and 2 years clinical training.
3. **Radiation Therapy Technicians** – who can be trained first at Bachelor of Radiography level, then continue to train for 2 years as RTTs.
4. **Oncology Nurses**

These personnel will undergo training locally, as accredited training programs for RO, MP, RTT and ON are already established in Kenya. These are described in more detail in Section 2.1.

Training	Quantity	Duration (years)	Individual costs (€) per year	Estimated total costs (€) per year
Radiation Oncologist	15	4	4,500	288,000
Medical Physicist	20	3	2,250	135,000
RTTs	40	2	1,500	180,000
Oncology nurses	15	2	1,500	135,000
Engineer	10	1	1,500	7,500
TOTAL				**745,500**

The estimated costs will be the total investment over a period of 5 years and will be broken down into costs per year when the trainings commence. The personnel will not all undergo training at the same time.

Capital Costs for Consolidation of Existing Facilities

Investment

Component	Estimated Cost (€)
Construction Phase (infrastructure cost)	2,580,000
Radiotherapy Equipment	8,288,000
Human Resource training	807,750
TOTAL	**11,675,750**

Equipment	Price (EUR)	Quantity	Total
Major equipment			
Linac (6MV)	900,000	4	3,600,000
HDR Brachytherapy	545,000	3	1,635,000
Accessory equipment			
Treatment Planning Stations	272,000	7	1,904,000
Record & verify system (Oncology Inf. system)	130,000	3	390,000
Dosimetry (Dosimetry & QA equipment)	100,000	3	300,000
CT Simulator	409,000	1	409,000
Mould Room/Immobilisation devices	25,000	2	50,000
TOTAL for all consolidation facilities			**8,288,000**

Estimated Training Costs

The required personnel include the following:

1. **Radiation Oncologists** - These experts are to provide services on 8-hour basis on ERBT and HDR Brachytherapy machines. Their training takes 4 years in total.
2. **Medical Physicists** – who can be trained first at Bachelor of Science (Physics major) level, then continue to train for 2 years as a medical physicist and 2 years clinical training.

3. **Radiation Therapy Technicians** – who can be trained first at Bachelor of Radiography level, then continue to train for 2 years as RTTs.
4. **Oncology Nurses**

These personnel will undergo training locally, as accredited training programs for RO, MP, RTT and ON are already established in Kenya. These are described in more detail in Section 2.1.

Training	Quantity	Duration (years)	Individual costs (€) per year	Estimated total costs (€) per year
Radiation Oncologist	18	4	4,500	324,000
Medical Physicist	17	3	2,250	114,750
RTTs	60	2	1,500	180,000
Oncology nurses	60	2	1,500	180,000
Engineer	6	1	1,500	9,000
TOTAL				**807,750**

The estimated costs will be the total investment over a period of 5 years and will be broken down into costs per year when the trainings commence. The personnel will not all undergo training at the same time.

Running Costs Per Annum – New Facilities

Human Resources Costs

The estimated human resources cost in terms of annual salaries is as follows:

Personnel	Quantity	Basic Annual Salary	Total (€)
Radiation Oncologist	15	30,000	480,000
Medical Physicist	20	25,000	500,000
RTTs	40	15,000	900,000
Oncology Nurses	15	20,000	1,080,000
Engineer	10	20,000	200,000
TOTAL			3,160,000

Operational costs per annum

In line with IAEA guidance, the annual cost of maintenance for radiotherapy and auxiliary equipment is set at 10% of the purchase cost.[9] Estimates of other operational costs such as overhead costs (including utilities, general administration, building maintenance, security etc), consumables and social services are based on the cost structure for the recently established cancer centers.

9 International Atomic Energy Agency Planning National Radiotherapy Services: A Practical Tool, IAEA Human Health Series No. 14, 2011.

Item	Amount (€)
Equipment Maintenance And Contingency Fund (Including Utilities And Other Operational Expenses)	2,521,875
Cpd: Continuous Professional Development	5,700
Total	**2,527,575**

Running Costs Per Annum – Consolidated Facilities

Human Resources Costs

The estimated human resources cost in terms of annual salaries is as follows:

Personnel	Quantity	Basic Annual Salary	Total (€)
Radiation Oncologist	18	30,000	540,000
Medical Physicist	17	25,000	425,000
RTTs	60	15,000	900,000
Oncology Nurses	60	20,000	1,200,000
Engineer	6	20,000	120,000
TOTAL			**3,185,000**

Operational costs per annum

In line with IAEA guidance, the annual cost of maintenance for radiotherapy and auxiliary equipment is set at 10% of the purchase cost.[10]Estimates of other operational costs such as overhead costs (including utilities, general administration, building maintenance, security etc), consumables and social services are based on the cost structure for the recently established cancer centers.

Item	Amount (€)
Equipment maintenance and contingency fund (including utilities and other operational expenses)	1,119,120
CPD: Continuous Professional development	6,165
TOTAL	**1,125,285**

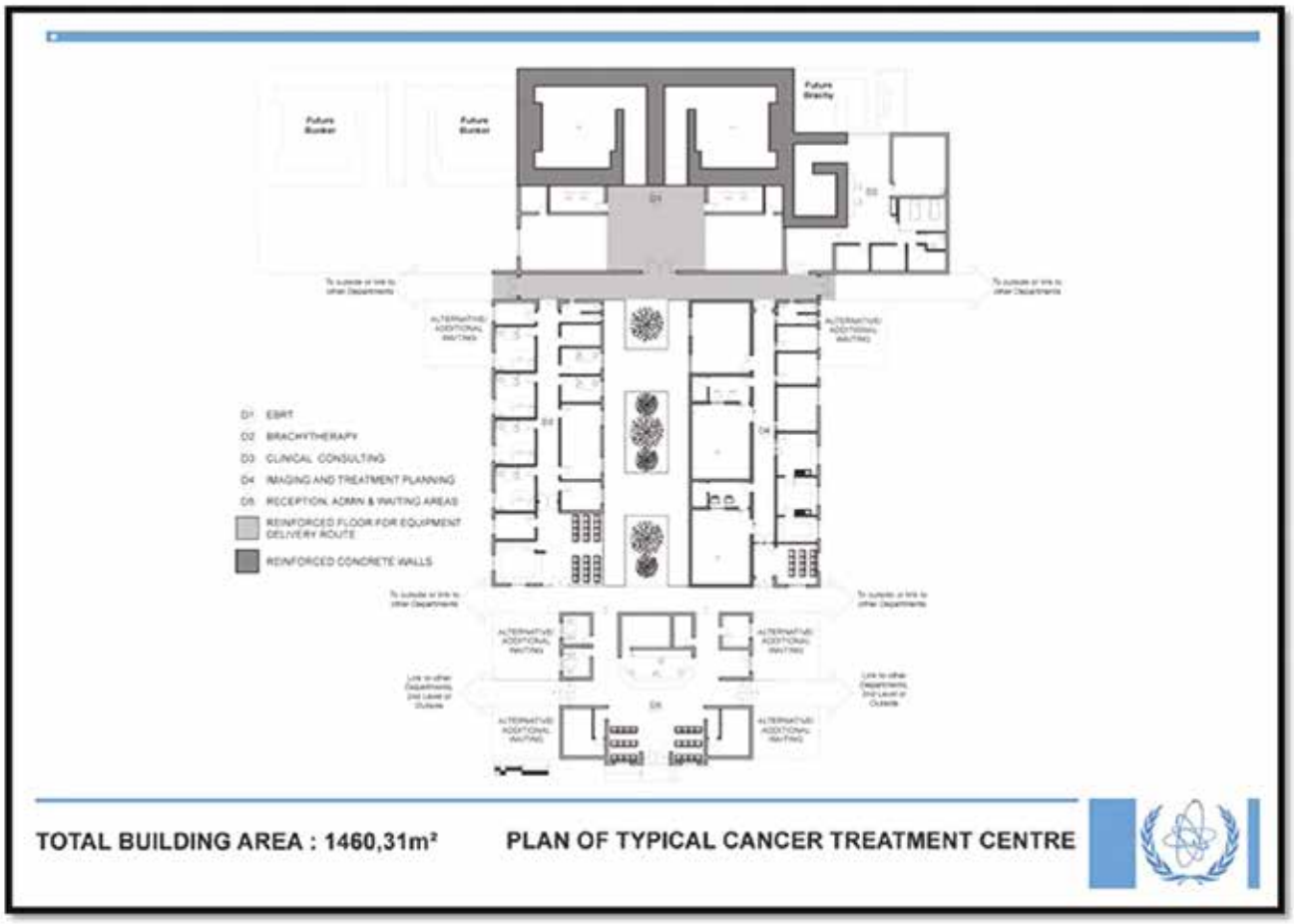
10 International Atomic Energy Agency Planning National Radiotherapy Services: A Practical Tool, IAEA Human Health Series No. 14, 2011.

Annex 5: Architectural Plans for the Project Site – Consolidated Facility

Each consolidated facility design will be based on the IAEA "Master Planning" (IAEA Human Health Report 10) document.

Architectural Plans For The Project Site – New Facilities

The Facility design will be based on the IAEA "Master Planning" document:



Annex 6: Licensing Activities

Type of Activity	Time Period
MoH submits an initial application for license to the RB, containing information about the design of the facility and a description of its equipment before construction begins.	Q1, Year 1
RB evaluates the application and grants license for construction (from radiation safety point of view)	Q1, Year 1
The construction license is granted by relevant authority(s)	Q2,Year 1
MoH submits an application to construct the facility to the relevant building and construction authority*.	Q3, Year 1
During the construction phase, on-site supervision is conducted by the RB and the relevant building and construction authority (specialized knowledge is required)	Q4, Year 1
RB grants license to import sources.	Q4, Year 3
MoH submits an application for license for operation to the KNRA (The documents should contain all relevant information to demonstrate that that the operation the radiotherapy facility is in accordance with the relevant regulatory requirements)	Q3, Year 4
RB conducts the review and assessment of an application and grants license for use.	Q3, Year 4
RB is capacitated to regulate the radiotherapy facility	Ongoing
Regular inspection during operation.	Ongoing
*Usually the general construction license is not issued by the regulatory body for safety, but by a relevant building and construction authority in the country. The regulatory body issues a license that the radiotherapy facility design, including shielding is adequate, which is important prerequisites for a general construction license. Therefore, we should not mix these two licenses, as a general construction license includes many other conditions that are not within the jurisdiction of the regulatory body.	

The regular timing required for licenses and permits are as follows:

Licenses and permits	Duration
County Governments Development Permits	4 weeks
National Environmental Management Authority Licensing	16 weeks
National Construction Authority License	4 weeks
Kenya Nuclear Regulatory Authority	2 weeks

Annex 7: Radiation Safety Regulatory Infrastructure

Regulatory Infrastructure (TSA 1 – 12 elements)	Infrastructure in place Laws/ Regulation	Comments
Governmental and Legal Framework for Safety **Element 2**	Kenya Nuclear Regulatory Act, Laws of Kenya	Kenya has Law already in place, the NRA Act Other laws are also available
Effective Independence of the Regulatory Body **Element 6**	Semi-autonomous	Depends on Government financing and funding Authority allowed to use AIA available
Authorization and Review and Assessment **Element 8**	KNRA has the authority to grant license/ approvals/permits	KNRA grants licenses/permits once utilities comply with regulatory requirements
Inspection **Element 9**	KNRA has the authority to inspect facilities and activities. Inspection program in place. Trained Radiation Inspectors	Around 30 trained radiation officers in place More staff training on radiotherapy required
Enforcement **Element 10**	Relevant enforcement provisions are documented in the Nuclear Regulatory Act 2019. KNRA has the authority to revoke or deny license/approvals/permit	Enforcement policy, including the criteria for corrective action is not in place.
Regulations and Guidance **Element 11**	KNRA is responsible to draft regulations, guides and standards	Aa set of 9 regulations are place. Other regulations and guides are under development
Safety Related Records and Inventory of Radiation Sources **Element 12**	The provisions for establishing, maintaining and retrieving adequate records relating to the safety of facilities and activities are in place.	KNRA has a register of radiation sources, using IAEA RAIS 3.3
Occupational radiation protection (TSA 2 – 12 elements)	**Infrastructure in place Laws/ Regulation**	**Comments**
Regulatory infrastructure for occupational radiation protection **Element 1**	Requirement for personnel monitoring results is in place	Database of personnel monitoring services in place
Requirements for monitoring and recording of occupational exposures **Element 2**	Requirements are in place, prerequisite for licensing.	Occupational exposed workers are monitored
Radiation protection program **Element 6**	Requirement by all radiotherapy facilities to have radiation safety code of practice	Radiation protection surveillance is in place
Assessment of occupational exposure and workers' health surveillance **Element 7**	Assessment of radiation exposure results submitted to the authority is required	Workers doses are submitted to the Authority every month

Radiation Protection in Medical Exposure (TSA 3 – 14 elements)		
Legal and regulatory framework **Element 1**	Regulatory framework under development	Legal framework on going Regulatory framework completed ?
Education, training, and competence **Element 2**	Health professionals with responsibilities for medical exposure are specialized in the appropriate area and that they fulfil the requirements for education, training and competence in the relevant specialty	Education for the health professionals
Optimization **Element 4**	National regulations require that registrants and licensees and radiological medical practitioners ensure that protection and safety is optimized for each medical exposure.	
Unintended or accidental medical exposures **Element 6**	Registrants and licensees to ensure that all practicable measures are taken to minimize the likelihood of unintended or accidental medical exposures and to promptly investigate and implement corrective actions, if appropriate	
Qualified medical personnel in radiotherapy **Element 13**	Regulatory requirements which stipulate responsibility of licensees to ensure sufficient medical professionals available in facilities that perform radiation therapy – should be implemented	
Optimization in radiotherapy **Element 14**	Registrants and licensees and radiological medical practitioners ensure that protection and safety for radiation therapy is optimized – should be implemented.	

Annex 8: Summary of Related IAEA Technical Cooperation Projects

Under its TC program, the IAEA has supported national projects as follows:

Project	Title	Comments
KEN6020	Establishing National Capacity for an Integrated Approach to Early Detection, Diagnosis, Management, Prevention and Research on Cancer and Radiation Safety	• The project was approved for 2012-2015 (the project was closed in 2021). Project outputs: Several staff were trained and qualified through fellowship placements abroad. Kenya has established local training schemes for radiation therapy technicians and radiation oncologists. A training program for medical physicists was initiated with its first intake of five students, one of which came from abroad. The project recorded an increase in the number of cancer patients receiving radiotherapy and reduced waiting period for cancer treatment. Thanks to upgrades and equipment provided, the waiting period for radiotherapy has been reduced from over one year to one month by 2018. It has been further reduced with the opening of the radiotherapy center at Moi Teaching and Referral Hospital (MTRH) in February 2021 when the first patient was treated. The official inauguration of the center took place in August 2021. Dosimetry equipment has been procured and introduced into the service. Protocols are being developed for 3D CRT. • Project Outcomes: Upgraded radiotherapy service was at Kenyatta National Hospital (KNH) and enhanced access of patients to radiotherapy was achieved through new facilities at MTRH, Eldoret, and efforts were underway for the establishment of three new regional centers (Mombasa, Nakuru, Garissa). IAEA support for the latter is being provided through project KEN6024.
KEN6021	Establishing Training Programs for Radiation Oncologists, Medical Physicists and Oncology Nurses for Sustainable Expansion of Radiotherapy Services	• The project was approved for 2016-2019. Project outputs: An agreement between partner institutions running training programs was concluded. The Radiation Oncology (RO) and Medical Physics (MP) programs have been formalized between KNH and relevant academic institutions. Curricula for RO and MP programs were developed and approved. Support was provided for the lead radiation therapy technologist (RTT) trainer and two lead RO trainers through scientific visits to the UK. In terms of clinical settings, there is sufficient equipment for the students to do their practice. Students have been enrolled in the RO program. The MP program had not yet started. The RTT program has been running since 2012 and each year it takes some foreign students as well. • Project outcome: Enhance capability for local training and qualification of key personnel for radiotherapy services.
KEN6023	Capacity Building in Radiotherapy at the Moi Teaching and Referral Hospital	• The project was approved for 2018-2019. Project outputs: Five RTT received refresher training. Roadmaps for expanding radiotherapy in KNH and MTRH were finalised. All procured equipment at MTRH has been installed and commissioned. The services started in February 2021 with the first patient being treated. The official inauguration took place in August 2021 attended by high level government officials. • Project outcome: Increased access of cancer patients to radiotherapy services.

Project	Title	Comments
KEN6024	Supporting the Expansion of Radiotherapy Delivery	• The project was approved for 2020-2022. Project outputs: Three radiotherapy centers were constructed (Nakuru, Mombasa and Garissa) using Government resources. All three centers have been equipped each with 1 LINAC, 1 Brachytherapy unit and 1 CT Simulator fully funded by the Government of Kenya. Installation and commissioning were carried out for all the three centers. All the three centers are treating patients with radiotherapy and brachytherapy. • Further linacs are being procured for Nakuru and Mombasa and installation is planned for May 2023. • Project outcome: Increased access of cancer patients to radiotherapy services.
KEN6026	Strengthening Nuclear Medicine Services for Cancer Control	• The project was approved for 2022-2023 and is under implementation with the planned outcome of enhanced human, technical and institutional capacity for radiology and nuclear medicine services in Kenya.

Annex 9: Country Context

At a glance[11]:

- Total population (2021) 53,005,614
- Per capita GDP (current US$) 2,081.8
- 71.4% of the population with access to electricity
- Human Capital Index (HCI)[12] (scale 0-1) 0.5

Country overview[13]:

Kenya adopted a new political and economic governance system with the introduction of a new constitution in 2010. This system includes a bicameral legislative house, devolved county government, and constitutionally tenured judiciary and electoral body. The first election under this new system was held in 2013, and the latest was in August 2022.

Kenya's economy has experienced significant growth from 2015 to 2019, averaging 4.8% per year, which has reduced poverty to an estimated 34.4% at the $1.9/day line in 2019. However, the COVID-19 pandemic caused disruptions to international trade and transport, tourism, and urban services in 2020. Fortunately, the agricultural sector remained resilient, limiting the contraction in GDP to only 0.3%. The economy staged a strong recovery in 2021, growing at 7.5%, although some sectors such as tourism remained under pressure. In 2022, GDP growth is projected at 5.5%, and the poverty rate is expected to continue declining after a temporary increase due to the pandemic. Despite the generally positive economic outlook, there is elevated uncertainty due to Kenya's dependence on imported fuel, wheat, and fertilizer.

Location of radiotherapy centers

There are 12 institutions currently radiotherapy services in Kenya:

Public

- Kenyatta National Hospital
- Kenyatta University Teaching research and Referral hospital
- Moi Teaching and referral Hospital
- 3 regional cancer centers: Nakuru, Garissa and Mombasa

Private

- Texas Cancer Center
- MP Shah Hospital Cancer Care Kenya
- Aga Khan University Hospital,
- Nairobi West Hospital
- Eldoret Equra Cancer Center
- Nairobi Hospital

11 https://data.worldbank.org/country/kenya

12 The HCI calculates the contributions of health and education to worker productivity. The final index score ranges from zero to one and measures the productivity as a future worker of child born today relative to the benchmark of full health and complete education.

13 https://www.worldbank.org/en/country/kenya/overview

Figure 4: Location of RT Centers

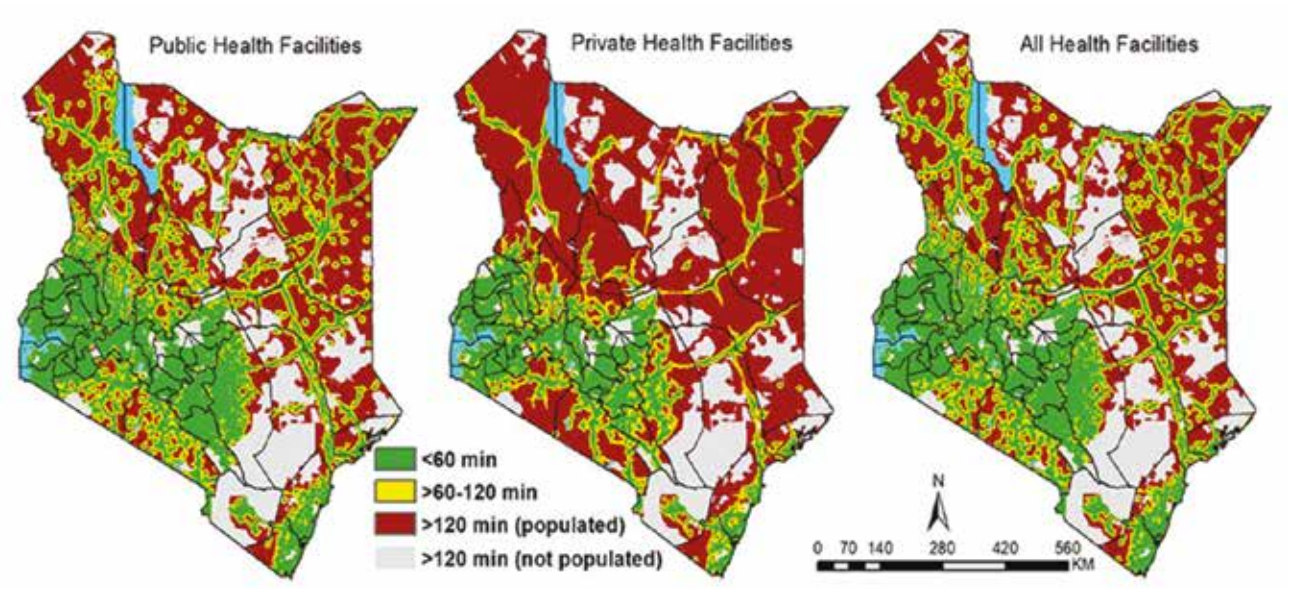


Figure 5: Geospatial data shows access to health care services is not equal

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