

ZAMBIA COLLEGES OF MEDICINE & SURGERY

(Registered Society)



MINISTRY OF HEALTH



Advancing Specialist Care & Professional Growth

Specialty Training Programme (STP) Curriculum & Learning Guide for Clinical Oncology (2017)

Table of Contents

GENERAL INTRODUCTION.....	1
Vision.....	1
Mission Statement.....	1
Values:	1
RATIONALE FOR THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY	2
Outcome 1. Apply, at mastery level, Biomedical Sciences, Behavioural & Sociology, and Scientific Principles to the Practice of Clinical Oncology.....	2
Outcome 2. Competence, at mastery level, in Clinical Oncology Clinical Practice.	3
Category I: Scientific foundations	4
Category II: Clinical Skills	4
Category III: Communication and Interpersonal Skills	4
Category IV: Prevention	5
Category V: Diagnosis	5
Category VI: Treatment, Acute and Chronic.....	5
Category VII: Patient Safety	5
Category VIII: Information Management	5
Category IX: Ethics, Humanities, and the Law	5
Category X: Professionalism	5
Category XI: Leadership & Management.....	6
ADMISSION CRITERIA TO THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY	6
CURRICULUM DESIGN/MODEL OF THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY	6
TEACHING METHODS IN THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY	6
SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY CURRICULUM STRUCTURE AND MAP.....	7
ASSESSMENT IN THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY	7
Grading Scheme.....	8
CLINICAL ONCOLOGY HANDBOOK & CURRICULUM.....	9
1.0 INTRODUCTION AND BACKGROUND.....	13
1.1 Introduction.....	13
1.2 Background.....	14
2.0. GOALS OF THE FELLOWSHIP PROGRAM IN CLINICAL ONCOLOGY	14
3.0 JUSTIFICATION	14
4.0 GENERAL OBJECTIVES OF THE TRAINING.....	15
6.0 VISION OF THE PROGRAMME.....	17
The vision of this programme is to become a center of excellence for specialist training in Clinical Oncology in the region.....	17
7.0 MISSION OF THE PROGRAMME.....	17
To equip trainees with outstanding and relevant training and competencies in Clinical Oncology	17

8.0 PHILOSOPHY	17
9.0 VALUES	17
10.0 TITLE OF PROGRAMME	18
11.0 CURRICULUM MODEL	18
12.0. CURRICULUM REGULATIONS	18
12.1 GENERAL REGULATIONS	18
12.2 ADMISSION REQUIREMENT	19
13.0 CURRICULUM DELIVERY	19
13.1 Teaching methods	19
13.1.1. Lectures	19
13.1.2 Clinical Apprenticeship	19
13.1.3 Tutorials	20
13.1.4 Clinical oncology case descriptions	20
13.1.5 Logbook	20
13.1.6 Portfolio	20
14.0 ASSESSMENT AND EXAMINATION	22
14.1 Part 1: Basic sciences	22
14.2 Part II: Clinical oncology	22
15.0 CURRICULUM STRUCTURE AND MAP	24
PART 1: BASIC SCIENCES	25
APPLIED ANATOMY AND PHYSIOLOGY	26
PATHOLOGY AND CANCER BIOLOGY	31
RADIOBIOLOGY	37
RADIATION PHYSICS	41
CANCER EPIDEMIOLOGY AND RESEARCH	51
Part II	56
Clinical curriculum	56
CLINICAL ONCOLOGY I	57
CLINICAL ONCOLOGY II	62
B) Palliative Care	65
D) Chemotherapy	66
9.2. Infrastructure	72
9.3. Equipment	72
REFERENCES	74
Appendix 1: Curriculum development team	75
INDICATIVE RESOURCES	78

GENERAL INTRODUCTION

This Curriculum and Learning Guide describes the work-based competence-based professional training programme for the Specialty Training Programme (STP) in Clinical Oncology (CO) in Zambia. The intended readership for the curriculum and guideline include the following:

- Trainees, host departments and managers of CO healthcare services;
- STP CO trainers, which includes all those involved in supervising, coordinating, assessing and delivering specialist education and training in Clinical Oncology;
- Academic, administrative and professional staff within Higher Education Institutions (HEIs), the Higher Education Authority (HEA), and the Zambia Qualifications Authority (ZAQA);
- Strategic partners involved in supporting cancer diagnosis and treatment care and the training of healthcare practitioners in these related fields.

Zambia Colleges of Medicine and Surgery (ZACOMS) advances professional training of medical specialists using the professional competence-based certification model beyond traditional university-based specialist training. It promotes specialist training as a vital pursuit for a successful professional medical career. The ZACOMS also promotes the increase of universal health coverage (UHC) by promoting equitable access to cost-effective quality specialist care as close to the family as possible for people in Zambia at all levels of socioeconomic status and geographical location. The ZACOMS certifies and admits members and/or fellows as specialists in a medical and/or surgical specialty in any of the various specializations of medicine and surgery.

The Zambia Colleges of Medicine and Surgery (ZACOMS) oversees the training of Clinical Oncology specialists working through the College of Clinical Oncologists of Zambia (CCOZ).

Clinical Oncology encompasses the diagnosis, assessment and management of cancer diseases. The STP CO training provides specialist training in Clinical Oncology.

Vision

Our vision is to be innovative in providing a teaching and support structure that will empower every trainee to excel in Clinical Oncology knowledge, skills and research through internal and external collaboration.

Mission Statement

The mission of the STP CO training in Zambia is to train specialists who shall endeavour to improve the Clinical Oncology health care services to all by providing safe, evidence-based, humanistic specialist care in the field of Clinical Oncology in an efficient and proficient manner to meet the needs of the Zambian community, and contribute to the field of Clinical Oncology in the region and globally.

Values:

- Professional excellence
- Integrity
- Sensitivity to reproductive health needs

- Interdisciplinary, inter institutional collaboration
- Continuous professional development
- Innovation
- Academic Excellence
- Self and peer review

RATIONALE FOR THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY

The STP CO aims to train specialists in Clinical Oncology in order to prepare them for specialist service in the healthcare service. The curriculum is informed by the training requirements of the Health Professions Council of Zambia (HPCZ) and the professional creed of the College of Clinical Oncologists of Zambia (CCOZ). The training programme encourages self-directed learning, life-long learning, and student-centred approaches while providing robust and structured guidance. The key outcomes are twofold as stipulated in Outcomes 1 and 2.

Outcome 1. Apply, at mastery level, Biomedical Sciences, Behavioural & Sociology, and Scientific Principles to the Practice of Clinical Oncology

1. The graduate should be able to apply to Clinical Oncology practice biomedical scientific principles, method and knowledge relating to anatomy, biochemistry, cell biology, genetics, immunology, microbiology, nutrition, pathology, pharmacology and physiology. The graduate should be able to:
 - a) Explain normal human structure and function relevant to Clinical Oncology.
 - b) Explain the scientific bases for common diseases and conditions' signs, symptoms and treatment relevant to Clinical Oncology.
 - c) Justify and explain the scientific bases of common investigations for diseases and conditions relevant to Clinical Oncology.
 - d) Demonstrate knowledge of drugs, drug actions, side effects, and interactions relevant to Clinical Oncology.

2. Apply Behavioral and Sociology Principles to the Practice of Clinical Oncology
 - a) Explain normal human behavior relevant to Clinical Oncology.
 - b) Discuss psychological and social concepts of health, illness and disease relevant to Clinical Oncology.
 - c) Apply theoretical frameworks of psychology and sociology to explain the varied responses of individuals, groups and societies to Clinical Oncology.
 - d) Explain psychological and social factors that contribute to illness, the course of the disease and the success of Clinical Oncology interventions.

3. Apply Population Health to the Practice of Clinical Oncology
 - a) Discuss population health principles related to determinants of health, health inequalities, health risks and surveillance relevant to Clinical Oncology.
 - b) Discuss the principles underlying the development of health and health service policy, including issues related to health financing, and clinical guidelines relevant to Clinical Oncology.

- c) Evaluate and apply basic principles of infectious and non-communicable disease control at community and hospital level relevant to Clinical Oncology.
 - d) Discuss and apply the principles of primary, secondary, and tertiary prevention of disease relevant to Clinical Oncology.
4. Apply Scientific Method and Approaches to Clinical Oncology Research.
 - a) Evaluate research outcomes of qualitative and quantitative studies in the medical and scientific literature relevant to Clinical Oncology.
 - b) Formulate research questions, study designs or experiments to address the research questions relevant to Clinical Oncology.
 - c) Discuss and apply appropriate research ethics to a research study relevant to Clinical Oncology.

Outcome 2. Competence, at mastery level, in Clinical Oncology Clinical Practice.

On successful completion of the work-based Clinical Oncology STP:

1. The trainees should have clinical and specialist expertise in Clinical Oncology, underpinned by broader knowledge, skills, experience and professional attributes necessary for independent practice;
2. The trainees should be able to undertake complex clinical roles, defining and choosing investigative and clinical options, and making key judgements about complex facts and clinical situations.
3. The trainees should contribute to the improvement of Clinical Oncology services in the context of the national health priorities, by means of outstanding scientific research and application of safe, high quality, cost effective, evidence based practice within the Zambian health system.
4. The trainees should possess the essential knowledge, skills, experience and attributes required for their role and should demonstrate:
 - A systematic understanding of clinical and scientific knowledge, and a critical awareness of current problems, future developments, research and innovation in Clinical Oncology practice, much of which is at, or informed by, the forefront of their professional practice in a healthcare environment;
 - Clinical and scientific practice that applies knowledge, skills and experience in a healthcare setting, places the patient and the public at the centre of care prioritizing patient safety and dignity and reflecting outstanding professional values and standards;
 - Clinical, scientific and professional practice that meets the professional standards defined by the Health Professions Council of Zambia (HPCZ);
 - Personal qualities that encompass self-management, self-awareness, acting with integrity and the ability to take responsibility for self-directed learning, reflection and action planning;
 - The ability to analyze and solve problems, define and choose investigative and scientific and/or clinical options, and make key judgments about complex facts in a range of situations;
 - The ability to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and to communicate their

- conclusions clearly to specialist and non-specialist audiences including patients and the public;
- The ability to be independent self-directed learners demonstrating originality in tackling and solving problems and acting autonomously in planning and implementing tasks at a professional level;
 - A comprehensive understanding of the strengths, weaknesses and opportunities for further development of Clinical Oncology as applicable to their own clinical practice, research, innovation and service development which either directly or indirectly leads to improvements in clinical outcomes and scientific practice;
 - Conceptual understanding and advanced scholarship in their specialism that enables the graduate to critically evaluate current research and innovation methodologies and develop critiques of them and, where appropriate, propose new research questions and hypotheses;
 - Scientific and clinical leadership based on the continual advancement of their knowledge, skills and understanding through the independent learning required for continuing professional development.
5. Once registered as a specialist in Clinical Oncology, a range of career development options will be available including sub-specialist training. Alternatively, others may opt to undertake further career development in post, as specialist, through structured Continuing Professional Development (CPD), provided by Accredited CPD providers. Specialist clinical oncologists who have successfully completed the STP CO will be eligible to compete for available Consultant positions in Clinical Oncology.

The outcomes of the STP CO training are affiliated to the following curriculum outcome categories:

Category I: Scientific foundations

- Goal 1:** Understand the normal structure and function of the human body, at levels from molecules to cells to organs, to the whole organism.
- Goal 2:** Understand the major pathological processes and their biological alterations.
- Goal 4:** Understand how the major pathologic processes affect the organ systems.
- Goal 5:** Integrate basic science and epidemiological knowledge with clinical reasoning.
- Goal 6:** Understand the principles of scientific method and evidence-based medicine including critical thinking.

Category II: Clinical Skills

- Goal 7:** Obtain a sensitive, thorough medical history.
- Goal 8:** Perform a sensitive and accurate physical exam including mental state examination.
- Goal 9:** Establish and maintain appropriate therapeutic relationships with patients.

Category III: Communication and Interpersonal Skills

- Goal 11:** Develop the knowledge, skills, and attitudes needed for culturally- competent care.
- Goal 12:** Participate in discussion and decision-making with patients and families.
- Goal 13:** Work effectively with other providers in the health system.

Goal 14: Clearly communicate medical information in spoken and written form.

Category IV: Prevention

Goal 15: Develop knowledge, skills, and attitudes to practice the basic principles of prevention.

Goal 16: Practice personalized health planning for long-range goals.

Goal 17: Understand the planning for communities and populations.

Category V: Diagnosis

Goal 18: Elicit and correctly interpret symptoms and signs of Clinical Oncology conditions.

Goal 19: Diagnose and demonstrate basic understanding of common disease and conditions.

Goal 20: Appropriately use testing to help guide diagnostic and therapeutic decisions.

Goal 21: Demonstrate sound clinical reasoning.

Category VI: Treatment, Acute and Chronic.

Goal 22: Understand therapeutic options and participate in the multidisciplinary care of patients with complex problems.

Goal 23: Recognize acute life-threatening medical problems and initiate appropriate care

Goal 24: Acquire the knowledge and skills necessary to assist in the management and rehabilitation of chronic diseases.

Goal 25: Participate in care in a variety of settings; including knowledge about palliative care.

Category VII: Patient Safety

Goal 26: Identify and remove common sources of medical errors.

Goal 27: Understand and apply models of Quality Improvement.

Goal 28: Appreciate the challenges associated with reporting and disclosure.

Category VIII: Information Management

Goal 29: Use information and educational technology to facilitate research, education, and patient care.

Category IX: Ethics, Humanities, and the Law

Goal 30: Develop a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to diversity.

Goal 31: Develop a critical understanding of the multiple factors that affect the practice of medicine, public health and research.

Goal 32: Incorporate ethical principles in clinical practice and research.

Category X: Professionalism

Goal 33: Develop healthy self-care behaviours and coping skills.

Goal 34: Model service to patients and community.

Category XI: Leadership & Management

Goal 35: Develop interpersonal and communication skills that result in leadership in patient health service delivery and health human resource management.

ADMISSION CRITERIA TO THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY

Applicants to the STP CO must possess a primary qualification in medicine, that is, Bachelor of Medicine and Bachelor of Surgery (MB ChB) or equivalent, from a recognized university. Additionally, they must have completed internship and retain full registration and a practising licence issued by the Health Professions Council of Zambia. Other Ministry of Health policies and directives, for example, completion of rural posting, may apply.

CURRICULUM DESIGN/MODEL OF THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY

The STP CO Curriculum is a work-based professional competence-based training situated in an accredited training facility managed by specialists in Clinical Oncology with oversight by the Zambia Colleges of Medicine and Surgery (ZACOMS) working through CCOZ.

During the STP CO programme the specialty registrar is an integral member of the clinical work of the department in which they are training to gain the required clinical experience and competence. The STP CO programme is a work based professional competence-based training leading to the award of the Certificate of Completion of Specialty Training (CCST) by the Zambia Colleges of Medicine and Surgery (ZACOMS). Graduates are then eligible to apply to the Health Professions Council of Zambia to enter the Specialist Registers in Clinical Oncology.

TEACHING METHODS IN THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY

The STP CO training is a work-based professional competence-based programme and should encompass diverse teaching and learning approaches that are appropriate for the target educational domain, i.e., cognitive (knowledge), psychomotor (practical), or affective (attitude) domain. The teaching methods may include, but not limited to, the following: expository lectures, tutorials, seminars, practical classes, skills laboratories, clinical demonstrations, clinical clerkships (bedside teaching, ward rounds, ambulatory care teaching, operating theatre experience, post-mortem, and on-call duties), field and community based learning, and ICT supported learning experiences.

The Health Professions Specialty Training Guidelines for Zambia and Zambia Colleges of Medicine and Surgery Society Objectives and By-Laws provide detailed guidance to the trainee about the STP and ZACOMS, respectively.

SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY CURRICULUM STRUCTURE AND MAP

Curriculum Map for the STP CO Programme

STP YEAR 1		STP YEAR 2		STP YEAR 3		STP YEAR 4	
Applied Anatomy & Physiology	ZACOMS PT 1 ARCP	Clinical Oncology I	ARCP	Clinical Oncology I	ARCP	Clinical Oncology I	ZACOMS CCST Exams
Pathology and Cancer Biology		Clinical Oncology II		Clinical Oncology II		Clinical Oncology II	
Radiobiology							
Radiation Physics							
Cancer Epidemiology and Research							
Part 1: Generic Education & Training	Part 2: Themed & Specialist Education & Training						

N.B. The total number of years, in particular, the themed specialist education and training may vary between different specialties.

1. ARCP = Annual Review of Competence Progression
2. CCST = Certificate of Completion of Specialty Training Examination;
3. STP = Specialty Training Programme;
4. ZACOMS PT 1 = Zambia Colleges of Medicine and Surgery Part 1 Examinations in Basic Sciences, Behavioural Sciences, Health Population Studies, and Professionalism & Ethics; ZACOMS CCST Examinations = Certificate of Completion of Specialist Training in Clinical Oncology Examinations

ASSESSMENT IN THE SPECIALTY TRAINING PROGRAMME IN CLINICAL ONCOLOGY

Progression to the next level of training is NOT automatic and is dependent on the trainee satisfying all the competency requirements of each defined level as per this curriculum and learning guide. The assessment framework is designed to provide a coherent system of assessing both formative and summative assessment which are workplace based and in examination settings.

Each training site must ensure that they use valid, reliable and appropriate methods for assessing the knowledge, clinical skills and attitude domains. The continuous assessments and final annual assessments are weighted at 40% and 60% of the final mark of Annual Review of Competence Progression, respectively. Assessment methods may include, but are not limited to, the following: Log of experiences and procedures completed, case reports, portfolios, project reports, multiple choice questions, essay questions, short answer questions, modified essay questions, short and long cases, objective structured clinical examinations (OSCE), practical examinations, objective structured practical examinations (OSPE), Mini-clinical Examination (MiniCEX), and Viva Voce, etc.

It is emphasized that marks from theory examinations **may not** compensate for poor scores in the clinical examinations; Students **MUST** pass the clinical examinations in order to progress to the next stage of training or completion.

Assessment	Knowledge, Skill and Attitude Domain	Examining Body
Formative Workplace Based Assessments	Outcome 1 & 2	Training Site
Annual Review of Competence Progression	Outcome 1 & 2	Training Site in conjunction with ZACOMS
ZACOMS Part 1 Examination	Outcome 1	ZACOMS working through CCOZ
ZACOMS Certificate of Completion of Specialist Registration Examinations	Outcome 2	ZACOMS working through CCOZ

A candidate shall be allowed a maximum of three attempts for ZACOMS Part 1 and/or Part 2 Examinations. Candidates must have submitted a completed log book to be eligible to attempt the ZACOMS Part 2 Examination.

For ease of tracking progress and planning for Clinical Oncology care, all STP CO trainees will be registered with ZACOMS and CCOZ for the duration of their training and will be allocated a Health Professions Council of Zambia Specialty Registrar Index Number.

Grading Scheme

The STP CO Curriculum and Guide are the basis for all specialty training which contextualize the standards of proficiency set down by the Zambia Colleges of Medicine and Surgery (ZACOMS) in consultation with the Society of Clinical Oncology of Zambia (CCOZ) in a way that is accessible to the profession and the public. The Certificate of Completion of Specialist Training (CCST) is not graded. Separate assessments and examinations may be graded to show the level of achievement of the trainee in a particular course or assignment.

Assessment of Attainment of Competence in an Academic Subject

Status & Level	Description of Competence Features	% Range
Outright Fail [D]	<ul style="list-style-type: none"> Has poor and inaccurate command of the subject vocabulary Has poor and inaccurate command of the concepts (knowledge, skills and attitudes) of the subject across a broad range of topics. 	44.9% & Below
Bare Fail [D+]	<ul style="list-style-type: none"> Has the basics of subject vocabulary Has the basics of concepts (knowledge, skills and attitudes) of the subject across a broad range of topics Unable to transfer and apply knowledge, skills and attitudes of the subject in a range of situations. Unable to exercise independent judgement in a range 	45 – 49.9

	of situations	
Clear Pass [C]	<ul style="list-style-type: none"> • Has sound command of subject vocabulary • Has sound command of concepts (knowledge, skills and attitudes) of the subject across a broad range of topics • Able to formulate responses and demonstrate skill and exhibit appropriate attitude in well-defined and abstract problems/professional settings across a broad range of topics of the subject 	50 – 64.9
Meritorious Pass [B]	All of above in level 3 and: <ul style="list-style-type: none"> • Able to transfer and apply knowledge, skills and attitudes and exercise significant independent judgement in a broad range of topics of the subject 	65 – 74.9
Distinction Pass [A]	All of the above in level 4 and: <ul style="list-style-type: none"> • Displays masterly of complex and specialised areas of knowledge, skills and attitudes in a broad range of topics of the subject. 	75% & Above

CLINICAL ONCOLOGY HANDBOOK & CURRICULUM

The detailed STP Clinical Oncology Handbook and Curriculum is presented in full in the next section.



Ministry of Health
CDH Training College
College of Clinical Oncologists of
Zambia

PROPOSED CURRICULUM

for

Clinical Oncology

(2017)

Table of contents

<u>1.0 INTRODUCTION AND BACKGROUND</u>	13
<u>1.1 INTRODUCTION</u>	13
<u>1.2 BACKGROUND</u>	14
<u>2.0. GOALS OF THE FELLOWSHIP PROGRAM IN CLINICAL ONCOLOGY</u>	14
<u>3.0 JUSTIFICATION</u>	14
<u>4.0 GENERAL OBJECTIVES OF THE TRAINING</u>	15
<u>6.0 VISION OF THE PROGRAMME</u>	17
<u>THE VISION OF THIS PROGRAMME IS TO BECOME A CENTRE OF EXCELLENCE FOR SPECIALIST TRAINING IN CLINICAL ONCOLOGY IN THE REGION.</u>	17
<u>7.0 MISSION OF THE PROGRAMME</u>	17
<u>TO EQUIP TRAINEES WITH OUTSTANDING AND RELEVANT TRAINING AND COMPETENCIES IN CLINICAL ONCOLOGY</u>	17
<u>8.0 PHILOSOPHY</u>	17
<u>9.0 VALUES</u>	17
<u>10.0 TITLE OF PROGRAMME</u>	18
<u>11.0 CURRICULUM MODEL</u>	18
<u>12.0. CURRICULUM REGULATIONS</u>	18
<u>12.1 GENERAL REGULATIONS</u>	18
<u>12.2 ADMISSION REQUIREMENT</u>	19
<u>13.0 CURRICULUM DELIVERY</u>	19
<u>13.1 TEACHING METHODS</u>	19
<u>13.1.1. Lectures</u>	19
<u>13.1.2 Clinical Apprenticeship</u>	19
<u>13.1.3 Tutorials</u>	20
<u>13.1.4 Clinical oncology case descriptions</u>	20
<u>13.1.5 Logbook</u>	20
<u>13.1.6 Portfolio</u>	20
<u>13.1.7 Research project</u>	<i>Error! Bookmark not defined.</i>
<u>14.0 ASSESSMENT AND EXAMINATION</u>	22
<u>14.1 PART 1: BASIC SCIENCES</u>	22
<u>14.2 PART II: CLINICAL ONCOLOGY</u>	22
<u>15.0 CURRICULUM STRUCTURE AND MAP</u>	24
<u>PART 1: BASIC SCIENCES</u>	25
<u>APPLIED ANATOMY AND PHYSIOLOGY</u>	26

<u>PATHOLOGY AND CANCER BIOLOGY</u>	31
<u>RADIOBIOLOGY</u>	37
<u>RADIATION PHYSICS</u>	41
<u>CANCER EPIDEMIOLOGY AND RESEARCH</u>	51
<u>PART II</u>	56
<u>CLINICAL CURRICULUM</u>	56
<u>CLINICAL ONCOLOGY I</u>	57
<u>CLINICAL ONCOLOGY II</u>	62
<u>B) PALLIATIVE CARE</u>	65
<u>D) CHEMOTHERAPY</u>	66
<u>9.2. INFRASTRUCTURE</u>	72
<u>9.3. EQUIPMENT</u>	72
<u>REFERENCES</u>	79
<u>APPENDIX 1: CURRICULUM DEVELOPMENT TEAM</u>	75

1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

Cancer is the second leading cause of death globally, with 8.2 million cancer-related deaths worldwide in 2012. The annual number of new cases is projected to rise from 14.1 million in 2012 to 21.6 million in 2030. Around 75% of cancer deaths occur in low- and middle-income countries, where the number of cancer cases is rising most rapidly. In Zambia, Cancer is becoming a major public health problem and the Zambia National Cancer Registry (ZNCR) recorded 17795 new cancer cases between 2008 and 2014. In 2013, ZNCR recorded 3176 new cancer cases while at the Cancer Diseases Hospital (CDH), the number of new patients seen in 2013 was 2049. This indicates that most cancer patients do not access cancer treatment services at CDH. Of the new cancer patients, more than 40% come from within Lusaka Province. The number of cancer cases being diagnosed annually has been increasing due to the improved diagnostic power of the country, the increase in population, ageing and the other risk factors that influence risk of cancer. According to GLOBOCAN the estimated number of new cancer cases in Zambia by 2030 will be approximately 20 000. This means that to offer quality cancer treatment, the country will need approximately 120 oncologists by 2030

Because of the estimated increases in cancer incidence and poor access to diagnosis and treatment, the Government of the Republic of Zambia (GRZ) recognizes the need to decentralize radiotherapy and chemotherapy services on one hand and as well as establish innovative training programs for clinical oncologists.

Human resource capacity for cancer services remains the most important component in the health system for cancer control, therefore there is need to accelerate production and improve quality of human resource for cancer control. In line with the Ministry of Health's' Human Resources for Health Planning and development strategy framework 2017-2021., the Cancer Diseases Hospital will embark on professional training of clinical oncologists in conjunction with the college of clinical oncologist of Zambia. This fellowship training will confer a Fellowship of the college of clinical oncologists of Zambia (FC Clin. Onc. {ZM})

1.2 Background

Clinical oncology is the discipline of clinical medicine that uses both ionizing radiation and chemotherapy with other modalities for the treatment of patients with malignant or other diseases. It is concerned with the generation and dissemination of knowledge concerning the causes, prevention and treatment of cancer and other diseases involving special expertise in the therapeutic applications of ionizing radiation and chemotherapy. As a discipline that exists at the juncture of physics and biology, radiation oncology addresses the therapeutic uses of ionizing radiation alone or in combination with other treatment modalities such as surgery, chemotherapy and targeted therapy. Furthermore, clinical oncology is concerned with the investigation of the fundamental principles of cancer biology, the biologic interaction of radiation with malignant and normal tissue, and the physical basis of therapeutic radiation as well as the use of chemotherapy and other modalities in the treatment of cancer.

2.0. GOALS OF THE FELLOWSHIP PROGRAM IN CLINICAL ONCOLOGY

To achieve an appropriate level of specialists in Clinical Oncology through implementation of a local training program in order to provide effective and efficient cancer treatment and care towards universal health coverage and achieve the reduction of cancer mortality by one-third by 2030

3.0 JUSTIFICATION

Currently, the demand for oncology services is on the increase as evidenced by the number of new cases of cancer recorded per year. This growing increase in the number of cancer cases coupled with the planned infrastructure investment to decentralize cancer services to all provinces of Zambia is going to increase the demand for trained cancer services personnel in the country. To date, Zambia only has 7 Clinical oncologist vs the target of 120. Currently no local training programme in clinical oncology exists in Zambia and as such all specialists are trained abroad. This approach to training is unsustainable as it is cost prohibitive. Therefore establishing a local training program in Clinical oncology is a cost effective and a sustainable intervention for

the development of specialized human resource in cancer care with a high chance of retaining these specialists in the country.

4.0 GENERAL OBJECTIVES OF THE TRAINING

The objective of the training programme is to educate and train physicians in clinical oncology up to the level of being recognized as a specialist capable of practicing the specialty competently and independently. They will be specially empowered to manage cancer patients with radiation and chemotherapy in a multidisciplinary manner.

5.0 CORE CURRICULUM GENERAL COMPETENCIES

Following successful completion of their training, the trainees should have the following competencies:

- I. Enough theoretical knowledge and practical skills for the competent, safe, ethical and compassionate practice of Clinical Oncology
- II. A capability to manage cancer patients comprehensively, including:
 - a. the complications associated with malignant disease and its treatment;
 - b. rehabilitation and palliative care;
 - c. psychosocial aspects
- III. Knowledge of the epidemiology, etiology, pathology and natural history of human Neoplasia, especially of those common in Zambia.
- IV. Familiarity and skills in the choice of all necessary and available diagnostic aids in the diagnosis and management of cancer.
- V. Technical expertise in Clinical Oncology and the adverse effects of radiation and chemotherapy including radiation related complications.
- VI. Familiarity with the role of surgery, and other medical disciplines involved in the management of neoplastic diseases.
- VII. Capacity to interpret current advances in cancer care and research (clinical, laboratory or basic).

- VIII. A basic knowledge of the different statistical methods used in the interpretation of data related to cancer (with special emphasis on planning and interpretation of clinical trials).
- IX. Sufficient interest, knowledge and skills to contribute to future developments in radiation oncology.
- X. They will participate in supervision and conducting research that will be beneficial to the Cancer Diseases Hospital and cancer control in Zambia.

Specific Clinical Competencies

The trainee should be able to

- i. Understand Principles of genetics, cancer prevention and screening
- ii. Initiate and interpret staging investigations including pathological reports, imaging and tumor markers where applicable and other prognostic factors
- iii. Make a diagnostic plan for suspected tumors or metastases and perform staging and classification of manifested tumors.
- iv. Perform a prognostic assessment, define the treatment aim
- v. Decide on the roles of surgery, radiotherapy and cytotoxic chemotherapy in a multimodality approach
- vi. Choose the radiation modality (or interdisciplinary modality), plan and apply optimal radiation therapy
- vii. Radiation Treatment planning of patient and dose prescription including simulation, patient positioning, immobilization techniques, target volume delineation, field arrangements and beam modifiers and follow-up during and after treatment.
- viii. Apply radiobiological skills in clinical practice.
- ix. Diagnose, score and treat side-effects of radiation therapy
- x. Assess the impact of radiation oncology on quality of life.
- xi. Communicate adequately and accurately with cancer patients and their families.
- xii. Manage common psychological reactions to crises and to the final stage of life.
- xiii. Perform supportive care/symptomatic treatment and terminal care.

- xiv. Recognize own limitations and refer to appropriate allied staff and colleagues when appropriate and available (other clinical oncologists, surgical or gynae oncologists, radiologists, Physicians, specialists in palliative care, pain specialists)
- xv. Practice medicine in accordance with medical ethics and patients' rights.

6.0 VISION OF THE PROGRAMME

The vision of this programme is to become a center of excellence for specialist training in Clinical Oncology in the region.

7.0 MISSION OF THE PROGRAMME

To equip trainees with outstanding and relevant training and competencies in Clinical Oncology

8.0 PHILOSOPHY

The philosophy of the programme is based on an eclectic model which blends traditional and innovative approaches. The tilt is towards an innovative approach (70%). It is anticipated that a trainee-centred learning approach will contribute to a more critical and informed approach to professional practice. Integration of academic and clinical education will be reinforced to facilitate better appreciation of the relationship between theory and practice, thereby adopting a cyclic model of teaching and learning that builds on experience gained during clinical placements.

9.0 VALUES

The values embraced by the programme include; Accountability, Effective communication, Originality, Integrity, Creativity, Discovery, Innovativeness, Competence, Scientific evidence and Gender equity.

10.0 TITLE OF PROGRAMME

Fellowship in Clinical Oncology (FC Clin Onc)

Once completed the trainee will be a specialist in Clinical Oncology and registered on the specialist register of the Health Professions Council of Zambia

11.0 CURRICULUM MODEL

The programmes of college of oncology will use a hybrid approach in which innovative teaching methods are encouraged while retaining a minimum of traditional teaching approaches (70% innovative methods to 30% traditional).

12.0. CURRICULUM REGULATIONS

12.1 GENERAL REGULATIONS

A period of four (4) years will be regarded as the minimal period of time to cover the suggested curriculum. Over this full-time equivalent of four (4) years, the candidate will be expected to gain a sound knowledge of radiation oncology as part of the comprehensive management of cancer as well as other diseases. During this period, the candidate will work at an accredited training site specialised in oncology services and will gain competencies in oncology. The trainee will participate in research, seminars, conferences, teaching assignments and interdepartmental clinics. It will be divided into 2 parts:

Part 1: Basic Sciences

Part 2: Clinical Oncology

At the end of each part, all candidates will be required to sit for written, oral and practical examinations (where applicable) for each course. Forty percent will be from progressive and continuous assessment (course work). The written, oral and practical exam will constitute 60% of total marks.

12.2 ADMISSION REQUIREMENT

The program is open to applicants who fulfill the admission requirements. The requirements described below are only the minimum academic conditions for admission and only make one eligible for consideration. A candidate is eligible for admission if he/she has the following: -

- (a) A degree in medicine (MB. ChB. Or equivalent)
- (b) A duly completed period of internship
- (c) Rural posting post internship or equivalent will be an added advantage
- (d) Two references, one for professional (preferably from the last supervisor) and the other academic, are also a necessity. The college will review all applications for admission to the fellowship and may also review the ethical and professional standing of candidates

13.0 CURRICULUM DELIVERY

13.1 Teaching methods

13.1.1.Lectures

These will give theoretical knowledge in applied clinical anatomy, applied physiology, applied pathology, medical physics, biostatistics, radiobiology, imaging techniques, radiotherapy treatment techniques and planning, basic principles and practice of radiation oncology and the principles of chemotherapy. This section is expected to be completed in the first two semesters.

13.1.2 Clinical Apprenticeship

This will involve the supervised trainee in the clerking of patients, running clinics for new patients and those on follow-up, treatment simulation and planning, carrying out brachytherapy and chemotherapy treatments. The trainee will also write and present reports describing what has been done. The trainee should acquire both adequate knowledge and clinical skills in the management of that disease/site. To acquire sufficient clinical skills a minimum number of patients should be treated by the trainee under qualified supervision. The number of patients seen by a trainee is defined as the equivalent to a completely treated patient from the first visit until

follow-up ('full case equivalent'). Each trainee should see at least 500 full case-equivalents during the total clinical radiation oncology training course and rotations. The trainee will be familiar with all aspects of brachytherapy planning, treatment and supervision, including demonstrating familiarity with those tasks of the brachytherapy treatment which are normally performed by the radiation oncologist.

13.1.3 Tutorials

Trainees will hold tutorials with their tutors and other trainees during which they will present and discuss case reports as well as topics of general interest as agreed upon with their supervisors using evidence based clinical oncology approach.

13.1.4 Clinical oncology case descriptions

A guided description and write up of cases clearly documented with pictures planning/simulation films will be expected per level. Each case write-up will be selected to depict the trainee's level of participation and highlight the appropriateness of the modalities used. These cases will be examined and marked and will contribute to the overall assessment of the trainee. They comprise separate integral courses on their own. Examples of case reports forms per category must be provided.

13.1.5 Logbook

A detailed logbook indicating trainee participation in the management of different cancers will be kept from the beginning to the end of the programme. These will be signed by a qualified clinical oncologist/supervisor.

13.1.6 Portfolio

The portfolio is a document collection kept by the registrar in training in which the following items are kept during the duration of the training. The resident in training keeps the portfolio up-to-date himself/herself and regularly reflects, with others in training and with his/ her tutor (s), upon his competency development.

- Personal details
- The instruction model

- Training schedule
- Evaluations and reports of assessment interviews by the tutor undertaken in accordance with
 - national guidelines
 - Workplace-assessment sheets/mini-CEX (Clinical Evaluation Exercise)
 - Possibly competency card modules with report of progress interviews by the tutor
 - Possibly report of 360 degree observation
 - Results of tests and examinations that are part of the postgraduate medical course
 - Submitted papers
 - Publications, articles, abstracts, poster
 - Attended conferences, courses, reference meetings, scientific meetings
 - Special activities or reflections on significant incidents and the learning gained from these
- Tutor declaration regarding the completeness and accuracy of the portfolio

14.0 ASSESSMENT AND EXAMINATION

14.1 Part 1: Basic sciences

(a) Continuous assessment: -This will contribute 40% of the total marks and will constitute the following: -

- I. General daily performance based on logbook
- II. Assignments
- III. Case reports
- IV. Tests

(b) Final examination:-This will contribute 60% of total marks and will constitute the following: -

- | | | |
|-----------------------------|-----|-----|
| I. OSCE/Practical/Oral exam | 40% | |
| II. Theory exam | | 60% |

14.2 Part II: Clinical oncology

For admission to Part II examination a candidate must have:

- Have completed Part I
- Produce evidence of having completed three years instruction and training in fulltime posts in a recognised department of radiation therapy
- Provide a list of required case reports
- Oncology article for statistical review
- The full Portfolio will include, inter alia, a logbook of procedures, marked case reports, signed logbook of procedures, and a statistical review of an article.
- A sub-minimum of 50% in each of the papers AND a sub-minimum of 50% in 75% of written questions is required to be eligible to be invited to the oral and OSCE examination.
- There must be a minimum of 10 stations in the OSCE examination. Candidates must pass a minimum of 75% of the OSCE stations in order to pass the OSCE.

- Candidates who achieve the required marks in the written component of the examination but who fail the oral and clinical examinations will be exempt from the written component of the next examination session.
- Such exemption applies to one sitting only and must be exercised in the following semester.
- If a candidate passes the written with an average of $\geq 60\%$, and passes the OSCE with an average of $\geq 60\%$, but fails one of the 3 oral stations with $\geq 45\%$, then examiners can agree to moderate the failing oral to 50% OR if this is not agreed to then a repeat oral will be done immediately by a second set of examiners and will be attended by the Part II moderator. The second oral must be passed with $\geq 55\%$.

The examination will consist of three written papers as follows:

- Paper 1 – Clinical oncology I (3 hours)
- Paper 2 and 3 – Clinical oncology II (3 hours each)
- A viva voce examination. This examination has to be passed.
- A practical examination (OSCE) which will be concerned with proficiency in clinical examination, technical aspects of radiotherapy as well as the investigation and treatment of patients, this will contain a minimum of 10 stations and will be conducted over a minimum of 2 hours. The candidate has to pass a minimum of 75% of OSCE stations.

15.0 CURRICULUM STRUCTURE AND MAP

Part	Year	Courses
Part 1: Basic Sciences	Year 1	Applied Anatomy and Physiology
		Radiobiology
		Radiation Physics
		Epidemiology and Research
		Pathology and cancer biology
Part 2: Clinical Oncology	Year 2,3 and 4	Clinical oncology I
		Clinical oncology II

PART 1: BASIC SCIENCES

APPLIED ANATOMY AND PHYSIOLOGY

Introduction

The course introduces students to principles of anatomy and physiology as it applies to clinical oncology.

Aim

To provide a foundation upon which a student will be able to relate the concepts and principles of anatomy and physiology to clinical oncology practice.

Objectives

- Describe general and special anatomy relevant to the practice of oncology
- Describe physiology relevant to the practice of oncology
- General and Cross sectional anatomy

CONTENT

1. ANATOMY

For each region or organ the candidate has to have knowledge of:

- Gross Anatomy
- Location and relations
- Surface anatomy (landmarks)
- Possible routes of cancer spread
- Neurological pathways
- Blood supply
- Lymphatic drainage
- Cross-sectional imaging
- Localization and contouring of tumors and critical structures

1.

Region	Site
Neuro-anatomy	Neuro-anatomy Cerebrum, cerebellum, brainstem, ventricular system Cranial nerves including origin and supply Spinal cord, cauda equine, meninges Brachial plexus, sacral plexus Innervation of upper and lower limbs Autonomic nervous system
Head and Neck anatomy	Nasopharynx, oropharynx, oral cavity Tongue, paranasal/facial sinuses, salivary glands, larynx, hypopharynx thyroid, parathyroid, pituitary gland orbits, anterior and posterior triangles of the neck, supraclavicular, pterygopalatine, temporal and infratemporal fossae skull base, vascular and neural foramina
Thoracic anatomy	Mediastinum, trachea, main bronchi, lung Pleura and pleural cavities, heart and great vessels, pericardium, azygos vein, oesophagus, thoracic duct, breast, chest wall
Abdominal anatomy	Stomach, duodenum, liver, spleen, gall bladder and biliary

	tract, pancreas, kidneys, adrenal glands, ureters, cysterna chyli, abdominal wall
Pelvic anatomy	Rectum, anal canal, bladder, male and female urethra, prostate, testes, epididymis, vas deferens, seminal vesicles, penis ovaries, fallopian tubes, uterus, cervix, vagina, vulva
Upper and lower limbs	Axilla, inguinal and femoral canals, dermatomes and myotomes, muscular compartments and major limb muscles
Skin	Layers, Vasculature, lymphatics, accessory organs

2. PHYSIOLOGY AND PATHOPHYSIOLOGY

a. Physiology of oncologic symptoms and syndromes

- Pain
- Nausea and vomiting
- Tumour lysis syndrome
- Hypercalcaemia

b. Physiology relevant to oncology

- Cell
- Cell membrane and transport
- Cell cycle and genes

- Endocrine systems – particularly the thyroid and Pituitary adrenal gonadal axis
- The immune system as (applied to Oncology – especially HIV infection)
- Haematopoiesis
- Metabolism
- Salivary gland
- Brain and spinal cord
- Cardiac
- Kidney

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations
- Practical/Rotation in clinical sites
- Bed side teaching

ASSESSMENT

- Continuous Assessment (40%)
 - Assignment
 - Tests
- Examination (60%)
 - Written Examination (60 %)

PRESCRIBED READING

1. Barette KE, Barman SM, Boitano S, Brooks H. (2012). Ganong's Review of Medical Physiology 24th Edition. Mc Graw Hill Medical. 978-0071780032.
2. H Ellis - Clinical Anatomy
3. KL Moore, AM R. Agur AF. Dalley II - Clinically Oriented Anatomy

RECOMMENDED READING

1. Drake R.L., Vogl W. and Mitchell A.W.M. (2005), *Gary's Anatomy for Students*, Churchill Livingstone. ISBN-0443066124

PATHOLOGY AND CANCER BIOLOGY

Introduction

Pathology and cancer biology provides the basis for understanding disease process in malignant conditions. Pathology describes the functional and structural changes caused by various conditions and this provides the indication for therapeutic interventions.

Aim

To equip trainees with knowledge of pathophysiological responses, clinical manifestations, and appearance of malignant diseases.

Objectives

At the end of the course, the trainees will be able to;

- Identify normal, normal-variant, and abnormal biophysical appearances and physiological manifestations.
- Identify complications associated with repair and replacement of tissue.
- Describe various systemic classifications of malignant disease, types, common sites, relationships, and prognosis.

CONTENT

CELL INJURY, CELL DEATH, AND ADAPTATIONS

- Cellular adaptations to stress
- Cell injury
- Morphology of cell and tissue injury
- Necrosis
- Intracellular accumulations
- Extracellular accumulations (calcification, amyloidosis, etc.)
- Cellular aging and apoptosis

ACUTE AND CHRONIC INFLAMMATION

- Acute inflammation
- Morphologic patterns of acute inflammation
- Mediators of inflammation
- Chronic inflammation
- Morphologic patterns of chronic inflammation
- Systemic effects of inflammation

TISSUE HEALING AND REPAIR

- The control of cell proliferation
- Repair by regeneration
- Repair by connective tissue
- Cutaneous wound healing
- Pathological aspects of repair

HAEMODYNAMIC DYSFUNCTION, THROMBOSIS AND SHOCK

- Hyperaemia and congestion
- Oedema
- Haemorrhage
- Haemostasis and thrombosis
- Embolism
- Infarction
- Shock

IMMUNE DYSFUNCTION

- Hypersensitivity diseases
- Autoimmune diseases
- Immune deficiency diseases

NEOPLASIA

- Nomenclature

- Characteristics of neoplasms
- Epidemiology of neoplasms
- Aetiology and carcinogenesis
- Oncogenes and tumour suppressor genes
- Host defence against tumours
- Clinical aspects of neoplasia
- Cancer biology
 - Tumour physiology
 - Angiogenesis
 - Microenvironment
 - Hypoxia and re-oxygenation
 - Cell proliferation in tumours
 - Cell cycle and cell cycle control
 - Proliferation and cell death
 - Tumour heterogeneity
 - Metastasis
 - Hereditary cancer
 - Cancer genetics
 - Clinical syndromes related to cancers

SYSTEMIC PATHOLOGY

- Central Nervous System
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Head and Neck
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology

- morphology
 - Clinical presentation
 - Staging classifications
- Respiratory
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Gastrointestinal
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Urinary
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Reproductive
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications

- Endocrine
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Musculoskeletal
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Haematological
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications
- Skin
 - Natural behaviour of tumours
 - aetiology
 - incidence and epidemiology
 - morphology
 - Clinical presentation
 - Staging classifications

- Gross and microscopic pathology of tumours
- Tumour markers.
- Specialized pathology techniques
 - Immunocytochemistry
 - Flow cytometry
- Interpretation of clinic pathological data

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations
- Practical/Rotation in clinical sites
- Bed side teaching

ASSESSMENT

- Continuous Assessment (40%)
 - Assignment
 - Tests
- Examination (60%)
 - OSCE/Practical/Oral exam 40%
 - Theory exam 60

PRESCRIBED READINGS

Robbins, S.L, Angell, M and Kumar, V (2012). Basic Pathology. W. B Saunders Company, Philadelphia

RECOMMENDED READINGS

McSween, R.M.N and Wharley, K (2008). Muir's Textbook of Pathology. Edward Arnold, London.

RADIOBIOLOGY

Introduction

Radiation therapy is premised on the adequate understanding of the principles of radiobiology. This will provide trainees with the theoretical principles that underpin the radiobiological models used in radiotherapy.

Aim

The aim of the module is to equip trainees with the necessary competencies in radiobiology that provides the foundation for effectively designing and implementing a course of radiotherapy.

Objectives

At the end of the course, the trainees will be able to;

- Relate cell structure and function to oncology practice
- Relate radiation effect at molecular level
- Analyse the effect of radiation at cellular, tissue, organs, systemic and malignant tissues
- Apply the concept of radiosensitivity
- Relate mechanism of cell survival following a radiation insult to clinical practice
- Apply the principles of fractionated radiotherapy
- Use radiobiological models in clinical practice
- Use biological modifiers in radiotherapy
- Apply radiobiological principles used in Brachytherapy and Targeted therapies

CONTENT

Structure and functioning of a human cell

- Cell structure

- Structure and function of DNA
- Cell cycle and its control
- Signal transduction

Radiation effect at the molecular and cellular level

- Direct and indirect action of radiation
- Molecular effect of radiation action (DNA damage)
- Chromosomal damage
- Types of cellular damage
- Cell response to a radiation insult
- Cell survival curves

Effect of radiation on normal human tissue

- Types of cell population
- Radiosensitivity
- Tissue response to radiation
- Radiation effects in specific tissues and organs
- Radiation effect on developing embryo and foetus
- Acute whole body irradiation

Properties of radiation

- Linear Energy Transfer (LET)
- Relative Biological Effectiveness (RBE)
- Factors influencing RBE

Radiation effects

- Types of cell death
- Somatic effects
- Genetic effects
- Stochastic effects
- Non stochastic effects
- Factors influencing response to ionizing radiation
- Late effects of radiation

Effect of radiation on malignant cells and tissues

- General characteristics of tumours
- Factors influencing tumour growth rate
- End points of measuring radiation effects on tumours
- Dose-response relationships

Fractionated radiotherapy

- 5 Rs of radiobiology
- Fractionation regimes
- Oxygen effect

Radiobiological models in clinical practice

- Types of models
- Linear Quadratic model
- Biological effect calculations

Biological modifiers in radiotherapy

- Categories of biological modifiers
- Radiosensitizers
- Radioprotectors

Radiobiological principles of brachytherapy and targeted therapies

- Dose rate effect
- Linear Energy Transfer
- Relative Biological Effect
- Radiobiological aspect of brachytherapy
- Radiobiological factors in proton and neutron therapy
- Radiobiological factors in targeted therapies

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations

- Practical/Rotation in clinical sites
- Bed side teaching

ASSESSMENT

- Continuous Assessment (40%)
 - Assignment
 - Tests
- Examination (60%)
 - Written Examination (60 %)

PRESCRIBED READINGS

1. Hall, E.J. and Giaccia A.J (2012) Radiobiology for the radiologist. 7th Ed.
Philadelphia Lippincott Williams & Wilkins ISBN 978-1-60831-193-4
2. Joiner M. and van der Kogel. A (2009) Basic Clinical Radiobiology. Anorld. ISBN
978 0 340 929 667

RECOMMENDED READINGS

1. Washington C. and Leaver D. (2016) Principles and practice of radiation therapy. 4th
Ed. St Louis. Mosby.

RADIATION PHYSICS

Introduction

Radiotherapy is premised on the adequate understanding of the principles of radiation physics. This course introduces the trainees to the study of the physics underlying the physical principles upon which equipment and the practice of medical imaging and radiotherapy is based.

Aim

To equip trainees with the necessary knowledge and competencies in radiation physics that provides the foundation for effectively implementing a course of radiotherapy.

Objectives

At the end of the course the trainee should be able to;

- Describe radioactive decay and structure of the atom
- Explain the production of photons and electrons
- Analyse the interaction of x-rays, gamma rays and particulate radiation with matter
- Outlines the design and explains the mechanism of action radiotherapy equipment
- Defines, explains and discusses radiation beam quality and dose
- Analyse radiation measurement and calibration
- Applies photon beam treatment and electron beam treatment
- Evaluates external beam quality assurance
- Discusses the general philosophy radiation protection and shielding
- Applies treatment planning principles
- Assesses patient setup and verification
- Outlines and analyses brachytherapy planning
- Applies IMRT, special procedures and particle therapy

CONTENT

Structure of the atom

- Nucleus, orbital shells, energy levels, binding energy
- Particles - proton, electron, neutron, positron
- Atomic number, atomic mass, isotopes

Radioactivity

- Decay processes
- Half life
- Parent – daughter relationships and equilibrium
- Nuclear reactions, bombardment and reactors

Production of photons and electrons

- **X-Ray production**
 - X-ray tube design
 - Characteristic radiation
 - Bremsstrahlung
 - Energy spectrum
- **Attenuation of beams**
 - Half value layer
 - Beam geometry
 - Attenuation, energy transfer, and absorption
 - Attenuation co-efficients
 - Inverse square law

Interaction of x-rays and gamma rays with matter

- Absorption and scatter of x-rays in matter
- Photoelectric effect
- Compton effect
- Coherent scatter
- Pair production
- Photodisintegration

Interactions of particulate radiation

- Direct and indirect ionisation

- Elastic and inelastic collisions
- Linear energy transfer
- Heavy particles interactions
- Interactions of Neutrons
- Interactions of Electrons

Radiotherapy equipment

- Linear accelerator
- Cobalt units
- Conventional Simulators
- CT simulation
- Other imaging modalities
 - Ultrasound
 - CT
 - MRI
 - SPECT
 - PET
 - Applications and limitations of above imaging to radiotherapy
- Brachytherapy
- Equipment selection and specifications

Radiation beam quality and dose

- Mono energetic and heteroenergetic beams
- Dose quantities and units
 - Kerma
 - Exposure
 - Absorbed dose
 - Dose equivalent
 - Calculation of absorbed dose from exposure
 - Relationship between kerma, exposure and absorbed dose

Radiation measurement and calibration

- Ionisation chambers

- Principles of beam calibration
- Other methods of measuring absorbed dose
 - Calorimetry
 - Chemical dosimetry
 - Solid state detectors
 - Film dosimetry

Photon beam dosimetry

- Relative dosimetry
 - Backscatter factor
 - Electron build up
 - Percentage depth dose
 - Tissue-air ratio
 - Tissue Maximum Ratio
- Dose calculations
 - Monitor unit and treatment time calculations
 - Output factor
 - Field size correction factors
 - Collimator and phantom scatter factor
 - Beam modifier factors
 - Patient attenuation factors
 - Calculations in practice
 - Equivalent squares
 - SSD technique
 - SAD technique
- Translation of planning to calculations
 - Beam parameters
 - Beam weighting
 - ARC rotation therapy
 - Irregular fields

Electron beam dosimetry

- Basic characteristics

- Depth-dose curves
- Interactions
- Obliquity
- Treatment planning principles
 - Selection of energy, field size
 - Skin dose
 - Bolus
 - Field shaping
 - Field-matching
 - Inhomogeneities

Principles of radiotherapy planning

- Technology and methods for planning
- Target volume definitions
 - Gross Tumour Volume (GTV),
 - Clinical Target Volume (CTV),
 - Planning Target Volume) PTV and relevant
 - Organ motion and internal margins
 - Set up variations and set up margins
 - Treated volume conformity index
 - Irradiated volume
 - Organs at risk
 - ICRU (International Commission for Radiation Units and Measurements) recommendations
- Immobilisation
- Data acquisition
 - Conventional simulator
 - CT scanning
 - CT simulator
 - Virtual simulation
- Computerised treatment planning
 - Contouring

- Volume definition
- Isodose curves (beam characteristics)
- Surface dose
- Parallel opposed beams
- Wedge techniques, isodose curves, angles
- Beam combinations
 - Conventional
 - Conformal
 - Complex
- Beam junction
- Surface corrections and heterogeneities
 - Surface obliquity
 - Inhomogeneity correction
- Adjoining fields and special dosimetry problems
 - Two-fields
 - Three-fields
 - Craniospinal gaping
 - Pacemaker
 - Gonadal dose
 - Pregnant patient
- Special techniques
 - Protons
 - Stereotactic techniques
- Dose specification
- Optimisation methods
 - Uniform vs non-uniform delivery
 - Margins
 - DVH'
- Implications of treatment variabilities
 - Set-up
 - Patient factors

- ICRU 50 and 62 prescribing recording and reporting

Assessment of patient setup and verification

- Immobilisation devices and methods
- Positioning devices and methods
- In-room treatment imaging
 - Cone-beam CT
 - Ultrasound
 - Fiducials
 - On-line correction of set-up errors
 - Adaptive planning concepts
- Informatics (DICOM, networking, PACS, data management)

Brachytherapy planning

- Calculation of dose distribution
- Calculation of dose from a point source/line source
- Systems of implant dosimetry
- Implantation techniques
 - Surface
 - Interstitial
 - Intracavitary
- Gynaecological implants
 - Manchester system
 - Bladder and rectal dose
 - ICRU

Intensity Modulated Radiotherapy

- Delivery systems
- Principles of dose prescription and inverse planning
- QA

Special procedures

- Stereotactic radiosurgery
 - Delivery systems
 - Principles of planning and delivery

- QA
- Total body irradiation
 - Principles of planning and delivery

Particle therapy

- Protons
 - Energy deposition
 - Equipment
 - Beam dosimetry
 - Principles of production and delivery
- Neutrons
 - Basic interactions
 - Principles of production and delivery

Radiation protection and shielding

- Definitions and standards
- Dose equivalent and effective dose equivalent
- Types of radiation exposure
 - Background
 - Man-made
 - National recommendations on exposure limits
- Protection regulations
- Administrative requirements
 - Safety programme
 - Staff monitoring
- Radiation shielding principles
 - Treatment room design
 - Types of barriers
 - Neutron shielding for high energy beams
 - Sealed source storage
 - Protection equipment and surveys
 - Monitoring equipment
- Safe operation of equipment

- Safe operation of Radiation therapy equipment
- Radiation protection issues with imaging technology
- Prevention of accidental exposures

Quality management

- Quality improvement
- Quality assurance programme
 - Goals
 - Roles and duties
 - Staffing
 - QC

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations
- Practical/Rotation in clinical sites

ASSESSMENT

- Continuous Assessment (40%)
 - Assignment
 - Tests
- Examination (60%)
 - Written Examination (60 %)

PRESCRIBED READINGS

1. Khan F. and Gibbons J (2014) Khans' Physics of radiation therapy. Wolters Kluwer. ISBN 978-1-4511-8245-3

2. CA Perez, LW Brady, EC Halperin, Schmidt - RK Ullrich: Principles and Practice of Radiation Oncology,
3. A Barrett, J Dobbs and T Roques - Practical Radiotherapy Planning.

RECOMMENDED READINGS

1. SA Leibel and TL Phillips - Textbook of radiation oncology
2. JJ Lu; LW Brady - Decision making in Radiation Oncology
3. Gunderson and Tepper - Clinical Radiation Oncology
4. EB Podgorsak Radiation Oncology Physics: A Handbook for Teachers and Students; IAEA

CANCER EPIDEMIOLOGY AND RESEARCH

Introduction

This course introduces the trainee to the fundamentals of cancer epidemiology and Research by providing the theoretical and practical knowledge.

Aim

To equip trainees with the necessary knowledge and competencies in Cancer Epidemiology and research

Objectives

At the end of this module the trainee will be able to;

- Describe the epidemiological profile of cancers at a global, Regional and national level
- Examine cancer control strategies
- Interpret cancer classification and staging systems
- Describe principles of cancer treatment
- Design structures for oncology services
- Apply Principles of cancer treatment
- Apply Research methods to clinical research
- Apply Biostatics in research
- Apply measures of association in the design of research
- Performs evidence searches
- Describes different types of trials and summarises their roles knowledge
- Discusses and appraises study design
- Performs reporting writing
- Undertake basic data analysis

CONTENT

Cancer epidemiology

- Terminologies in research

- Incidence
- Prevalence
- Aetiology
- Risk factors
- Prognostic indices
- Mortality
- Morbidity
- Survival analysis

Cancer control strategies

- Primary prevention
 - Awareness
 - Risk avoidance
 - Vaccination
 - Environmental strategies
- Secondary prevention
 - Screening
- Tertiary
 - Early detection

Tumour classification and staging systems

- AJCC
- FIGO
- WHO
- OTHERS

Principles of cancer treatment

- Surgery,
- Chemotherapy
- Endocrine therapy,
- Radiotherapy
- Targeted therapies
- Immunology

- Other forms of treatment and combined modalities
- Multidisciplinary care

Research methods

- Research paradigms
- Research designs
- Research Ethics
- Good Clinical Practice

Biostatistics

- Terminologies
- Descriptive and analytical statistics
- Inferential statistics
- Statistical test to evaluate end-point
 - Null and alternative hypotheses
 - Type I and II errors
 - Significance level
 - Statistical power
 - p-values
 - T test
 - Z test
 - Chi-squared test
 - Analysis of variance (ANOVA)
- Statistical software used in research

Measures of Association

- Risk ratio (relative risk)
- Rate ratio
- Odds ratio
- Hazard ratio
- Attributable proportion (attributable risk percentage)

Searching for evidence

- Source of information

- Search engines
- Search techniques

Clinical Trials

- Types
- Design
- Patient-based endpoints in clinical trials

Critical appraisal

- Tools
- Scientific papers
- Presentations
- Level of evidence
- Systematic reviews and meta-analysis
- Clinical decision analysis

Grant writing

Report writing

- Structure of reports
- Evaluation report

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations
- Journal club
- SOP development

ASSESSMENT

- Continuous Assessment (40%)

- Assignment
- Tests
- Examination

PRESCRIBED READINGS

1. Hulley SB, Cummings SR, Designing Clinical Research (2007) ISBN-13: 978-0-7817-8210-4
2. PG Supino, Borer JS Principles of Research Methodology, A guide for Clinical Investigators
3. BK Mahajan, AB Khanal Methods in Biostatics for medical students and Research workers
4. Adami HO, Hunter D, Trichopoulos D Textbook of cancer epidemiology

RECOMMENDED READINGS

1. Kothari, C. R (2012). Research Methodology Methods and Techniques (2nd Edition) New Age International, New Dehli. ISBN: 978-81-224-1522-3
2. Creswell J.W., (2009). Research design Qualitative, Quantitative and Mixed Methods Approaches. Sage publications, London. ISBN: 1412965578 /9781412965576
3. Colquhoun D, Kellehear A. (2007) Health research in Practice. Political, Ethical and Methodological Issues. Chapman & Hall Publication. ISBN-0412474700
4. Bell J. (2005) Doing Your Research Project. 4th Open University Press. ISBN-0335215041
5. SA Leibel and TL Phillips - Textbook of radiation oncology
6. JJ Lu; LW Brady - Decision making in Radiation Oncology

Part II

Clinical curriculum

Course	Content /Sites
Clinical oncology I	Head and neck
	GIT
	Thorax
	Bone and soft tissue
	Skin cancer, including malignant melanoma and non-melanoma tumor's
	Breast cancer
	Gynecology
	Genitourinary (GU) tract
	Paediatrics tumor's
Clinical oncology II	Lymphomas & Leukemia's
	Central nervous system
	Cancer of unknown primary
	Radiotherapy for palliation
	Benign disease
	Palliative care
	Nuclear medicine
	Chemotherapy

CLINICAL ONCOLOGY I

Introduction

This section is designed to prepare trainees with skills required to manage patient in a clinical setting. It incorporates theoretical knowledge and clinical skill of clinical oncology practice.

Aim

To acquire in-depth knowledge in the management of cancer

Objectives

At the end of this course, the trainee should be able to;

- Apply related anatomy, physiology and pathology to cancer management
- Recognize symptoms and signs of cancer
- Initiate and interpret staging investigations including pathological reports, imaging and tumor markers where applicable and other prognostic factors
- Make a diagnostic plan for suspected tumors or metastases and perform staging and classification of manifested tumor's.
- Perform a prognostic assessment, define the treatment aim
- Decide on the roles of surgery, radiotherapy and cytotoxic chemotherapy in a multimodality approach
- Choose the radiation modality (or interdisciplinary modality), plan and apply optimal radiation therapy

CONTENT

For each the diseases sites the trainees should be able to:

- Describe and apply anatomy, physiology, and pathology principles,
- Perform Clinical Assessment
 - History
 - Physical examination
 - Investigation and Evaluation

- Decide on Management plan
 - Role of Surgery
 - Radiotherapy
 - Choose the radiation modality, plan and apply optimal radiation therapy
 - Perform radiation Treatment planning of patient and dose prescription including simulation, patient positioning, immobilization techniques, target volume delineation, field arrangements and beam modifiers
 - Diagnose, score and treat side-effects of radiation therapy during and after treatment and assess the impact of radiotherapy on quality of life
 - Cytotoxic chemotherapy
 - Choose chemotherapy regimen
 - Prepare patient and prescribe appropriate chemotherapy regimen
 - Diagnose, score and treat side-effects of chemotherapy during and after treatment and assess the impact of chemotherapy on quality of life
 - Multimodality approach
 - Recognize own limitations and refer to appropriate allied staff and colleagues when appropriate and available (other clinical oncologists, surgical or gynae oncologists, radiologists, Physicians, specialists in palliative care, pain specialists)
 - Outcomes
 - Determine prognosis
 - Follow up the patient
 - Determine cancer treatment outcomes (side effects and response)

The diseases sites include:

1) **Head and Neck Cancer**

- Oral cavity
- Oropharynx
- Nasopharynx
- Hypopharynx
- Larynx
- Nasal cavity and paranasal sinuses

- Eye and orbit
- Salivary glands
- Thyroid gland
- Others (e.g. cervical lymph node metastases, melanoma)

2) Gastrointestinal (GI) tract

- Esophagus
- Stomach
- Liver and biliary tract
- Pancreas
- Colon/rectum
- Anus

3) Thorax

- Non-small cell lung cancer
- Small cell lung cancer
- Thymomas and/or mediastinal tumor's
- Mesothelioma

4) Bone and soft tissue

5) Skin cancer, including malignant melanoma and non-melanoma tumor's

6) Breast cancer

7) Gynaecology

- Cervix
- Endometrium
- Ovaries and fallopian tubes
- Vagina
- Vulva

8) Genitourinary (GU) tract

- Prostate
- Bladder
- Testes/seminoma
- Testes/ non-seminoma

- Kidneys
 - Ureter
 - Urethra
 - Penis
- 9) Paediatrics tumor's
- Central nervous system
 - Wilm's tumour
 - Neuroblastoma
 - Rhabdomyosarcoma
 - Ewing's tumour
 - Lymphomas in children
 - Unusual tumours in children

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations
- Practical/Rotation in clinical sites
- Bed side teaching

ASSESSMENT

- Continuous Assessment (40%)
 - Assignment
 - Tests
- Examination (60%)
 - OSCE/Practical/Oral exam 40%
 - Theory exam 60

PRESCRIBED READING

1. SA Leibel and TL Phillips - Textbook of radiation oncology
2. CA Perez, LW Brady, EC Halperin, Schmidt - RK Ullrich: Principles and Practice of Radiation Oncology,
3. A Barrett, J Dobbs and T Roques - Practical Radiotherapy Planning.

4. JJ Lu; LW Brady - Decision making in Radiation Oncology
5. Halperin EC, Constine LS Paediatric Radiation Oncology-

RECOMMENDED READING

1. V De Vita, S Hellman, SA Rosenberg - Cancer: Principals and Practice of Oncology,
2. Gunderson and Tepper - Clinical Radiation Oncology

CLINICAL ONCOLOGY II

Introduction

This section is designed to prepare trainees with skills required to manage patient in a clinical setting. It incorporates theoretical knowledge and clinical skill of clinical oncology practice. It further grounds them with the competencies in Palliative care, Nuclear Medicine and Chemotherapy

Aim

To equip trainees with knowledge and competence in clinical oncology, palliative care Nuclear Medicine and chemotherapy

Objectives

At the end of this course, the trainee should be able to;

- Apply related anatomy, physiology and pathology to cancer management
- Recognize symptoms and signs of cancer
- Initiate and interpret staging investigations including pathological reports, imaging and tumor markers where applicable and other prognostic factors
- Make a diagnostic plan for suspected tumors or metastases and perform staging and classification of manifested tumors.
- Perform a prognostic assessment, define the treatment aim
- Decide on the roles of surgery, radiotherapy and cytotoxic chemotherapy in a multimodality approach
- Choose the radiation modality (or interdisciplinary modality), plan and apply optimal radiation therapy
- Describe the principles of Nuclear medicine
- Discuss and apply the use of radionuclide imaging techniques
- Discuss general radiation protection principles of handling radionuclides

- Explain treatment options in nuclear medicine
- Discuss principles of cytotoxic chemotherapy
- Discuss different types of chemotherapy drugs
- Discuss principles of combination chemotherapy
- Discuss principles of chemoradiation
- Role of hormonal and biological drugs therapies in radical and palliative management
- Recent advances in treatment of malignant diseases using chemotherapy

CONTENT

A) Specific diseases sites

For each the diseases sites the trainees should be able to:

- Describe and apply Anatomy, Physiology, and pathology principles,
- Perform Clinical Assessment
- History
- Physical examination
- Investigation and Evaluation
- Decide on Management plan
 - Role of Surgery
 - Radiotherapy
 - Choose the radiation modality, plan and apply optimal radiation therapy
 - Perform radiation Treatment planning of patient and dose prescription including simulation, patient positioning, immobilization techniques, target volume delineation, field arrangements and beam modifiers
 - Diagnose, score and treat side-effects of radiation therapy during and after treatment and assess the impact of radiotherapy on quality of life
 - Cytotoxic chemotherapy
 - Choose chemotherapy regimen
 - Prepare patient and prescribe appropriate chemotherapy regimen
 - Diagnose, score and treat side-effects of chemotherapy during and after treatment and assess the impact of chemotherapy on quality of life

- Multimodality approach
 - Recognize own limitations and refer to appropriate allied staff and colleagues when appropriate and available (other clinical oncologists, surgical or gynae oncologists, radiologists, Physicians, specialists in palliative care, pain specialists)
- Outcomes
 - Determine prognosis
 - Follow up the patient
 - Determine cancer treatment outcomes (side effects and response)

The diseases sites include:

- 1) Lymphomas and leukemia's
 - Hodgkin's disease
 - Non-Hodgkin's lymphoma
 - Leukemia
- 2) Central nervous system
 - Intracranial tumor's in the adult including pituitary tumor's
 - Intracranial tumor's in childhood
 - Spinal cord tumor's
- 3) Cancer of unknown primary
- 4) Radiotherapy for palliation
 - Skeletal metastases
 - Brain metastases
 - Spinal cord compression
 - Superior vena cava syndrome
 - Obstructive syndromes
- 5) Bleeding syndromes
- 6) Benign disease

B) Palliative Care

- Communication skills in cancer management
- Palliative care
- Principles of pain control
- Symptoms Control
- Holistic approach to a patient
- Counselling and breaking bad news
- End of life care
- Bereavement care
- Palliative care emergencies

C) Nuclear Medicine

- Principles of nuclear medicine
- Indication in oncology
 - Diagnostic
 - Therapy
 - Theranostics
- Contraindications
 - General
 - Specific
- Therapy
 - DTC
 - NET
 - Bone palliation
 - Neuroblastoma
- Instrumentation
 - Gamma Camera

- SPECT
- PET
- PET/CT
- Radiopharmacy
- Safe use and handling of radionuclides used in nuclear medicine
- Nuclear medicine treatment for malignant conditions

D) Chemotherapy

- Principles of cytotoxic chemotherapy
- Chemotherapy drugs
- Principles of combination chemotherapy
- Hormonal and biological therapies recent advances in treatment of malignant diseases using chemotherapy
- Regimens in common use including dosage, scheduling, toxicities and outcome
- The techniques of stem cell mobilization and the procedures for stem cell and bone marrow harvesting

TEACHING METHODS

- Lectures
- Tutorials
- E-resources
- Seminars and presentations
- Practical/Rotation in clinical sites
- Bed side teaching

ASSESSMENT

- Continuous Assessment (40%)
 - Assignment
 - Tests
- Examination (60%)
 - OSCE/Practical/Oral exam 40%

- Theory exam 60

PRESCRIBED READING

1. SA Leibel and TL Phillips - Textbook of radiation oncology
2. CA Perez, LW Brady, EC Halperin, Schmidt - RK Ullrich: Principles and Practice of Radiation Oncology,
3. A Barrett, J Dobbs and T Roques - Practical Radiotherapy Planning.
4. JJ Lu; LW Brady - Decision making in Radiation Oncology
5. Ziessmann.HA, O'Malley JP Nuclear medicine The Requisites 4th ed. ISBN 978-0-323-08299-0
6. Handbook of cancer chemotherapy
7. Watson M, Lucas C, Hoy A, Adult palliative Care guidance

RECOMMENDED READING

1. V De Vita, S Hellman, SA Rosenberg - Cancer: Principals and Practice of Oncology,
2. Gunderson and Tepper - Clinical Radiation Oncology
3. Physics in nuclear medicine
4. E-resource – IEAE human health
5. Cherny N, Fallon M, Kaasa S, Oxford Textbook of Palliative Medicine (5 ed.)
- 6.

RESOURCES

The Cancer Diseases Hospital has a full complement of teaching resources including:

Human resources, Infrastructure and Equipment

9.1. HUMAN RESOURCES

The course will be run on a multi-disciplinary basis using specialists from Cancer Diseases Hospital and elsewhere. These include:

- Clinical and Radiation Oncologists
- Medical Physicists
- Educationist
- Radiation Therapists

Name	Qualifications	Position	Department
Dr Lewis Banda	BSc, MB ChB, M.Med, FC Rad Onc (SA)	Senior Medical Superintendent, Consultant Clinical & Radiation Oncologist, Physician	Clinical Oncology – CDH
Dr Kennedy Lishimpi	BSc, MB ChB, M.Med, FC Rad Onc (SA)	Director Cancer Control, Clinical & Radiation Oncologist, Paediatrician &	Clinical Oncology – CDH
Dr Citonje S Msadabwe	BSc, MB ChB, M.Med, FC Rad Onc (SA)	Head Clinical Care, Deputy National Coordinator Cancer Control, Consultant Clinical and Radiation Oncologist	Clinical Oncology – CDH
Dr Catherine K Mwaba	MD, FC Rad Onc (SA)	Head Consultant Clinical and Radiation Oncologist	Clinical Oncology – CDH

Dr. M. Mwale	BSc, MB ChB, M.Med, FC Rad Onc (SA)	Consultant Clinical and Radiation Oncologist	Clinical Oncology – CDH
Dr. Dorothy Lombe	MD, FC Rad Onc (SA), M. Med	Consultant Clinical and Radiation Oncologist	Clinical Oncology – CDH
Dr. G. Pupwe	MD, FC Rad Onc (SA), M. Med	Consultant Clinical and Radiation Oncologist	Clinical Oncology – CDH
Dr Aaron L Shibemba	BSc, MB ChB, M.Med (Anat Path)	Consultant Pathologist	Pathology – CDH
Dr Veronica Sunkutu	BSc, MB ChB, FC Rad (SA)	Consultant Radiologist	Radiology – UTH
Dr. Musonda	BSc, MB ChB, M.Med, FC Rad Onc (SA)	Nuclear Medicine Physician	Nuclear Medicine - UTH
Dr Nason Lambwe	BSc, MB ChB, M.Med, Dip Nuc Med	Consultant Physician and Nuclear Medicine Physician	Medicine and Nuclear Medicine - UTH
Ms Kanduza Mulape	BSc, MSc (Med Physics)	Chief Medical Physicist	Medical Physics - CDH
Mr Augustine Mwale	BSc, MSc (Med Physics)	Senior Medical Physicist	Medical Physics - CDH

Ms Barbara Mule	BSc, MSc (Med Physics)	Senior Medical Physicist	Medical Physics - CDH
Mr James M Sichone	Dip Rad., Dip Ther., BTech, MTech	Chief Radiation Therapist	Radiation Therapy - CDH
Ms Ncebe Sindaza	Dip Rad., Dip Ther., BTech, MTech	Chief Imaging Officer	Clinical Care and Diagnostic Services - MoH
Mr Harry Munkupa	Dip Rad., Dip Ther., BTech, MTech	Principal Therapy Radiographer	Radiation Therapy - CDH
Mrs Mercy Chipampe	Dip Rad., Dip Ther., BSc, MSc (Diag Rad)	Principal Diagnostic Radiographer	Diagnostic Radiology – CDH
Mrs. P. M. Simunza		Palliative Care nurse specialist	Palliative care, CDH

9.2. Infrastructure

The programme shares the same physical facilities with the Radiation Oncology, Chemotherapy, Pathology and Radiology departments of Cancer Diseases Hospital and University Teaching Hospital. Infrastructure at the cancer diseases hospital also includes a Lecture room, Tutorial rooms and Library

9.3. Equipment

Cancer Diseases Hospital is equipped with diagnostic and therapeutic facilities for the training of oncologists. These include

- Linear accelerator,
- 2 cobalts,
- 2D and CT simulator
- Treatment planning
- brachytherapy
- MRI
- X-ray
- ultrasound
- mammography

- Nuclear medicine equipment and others.

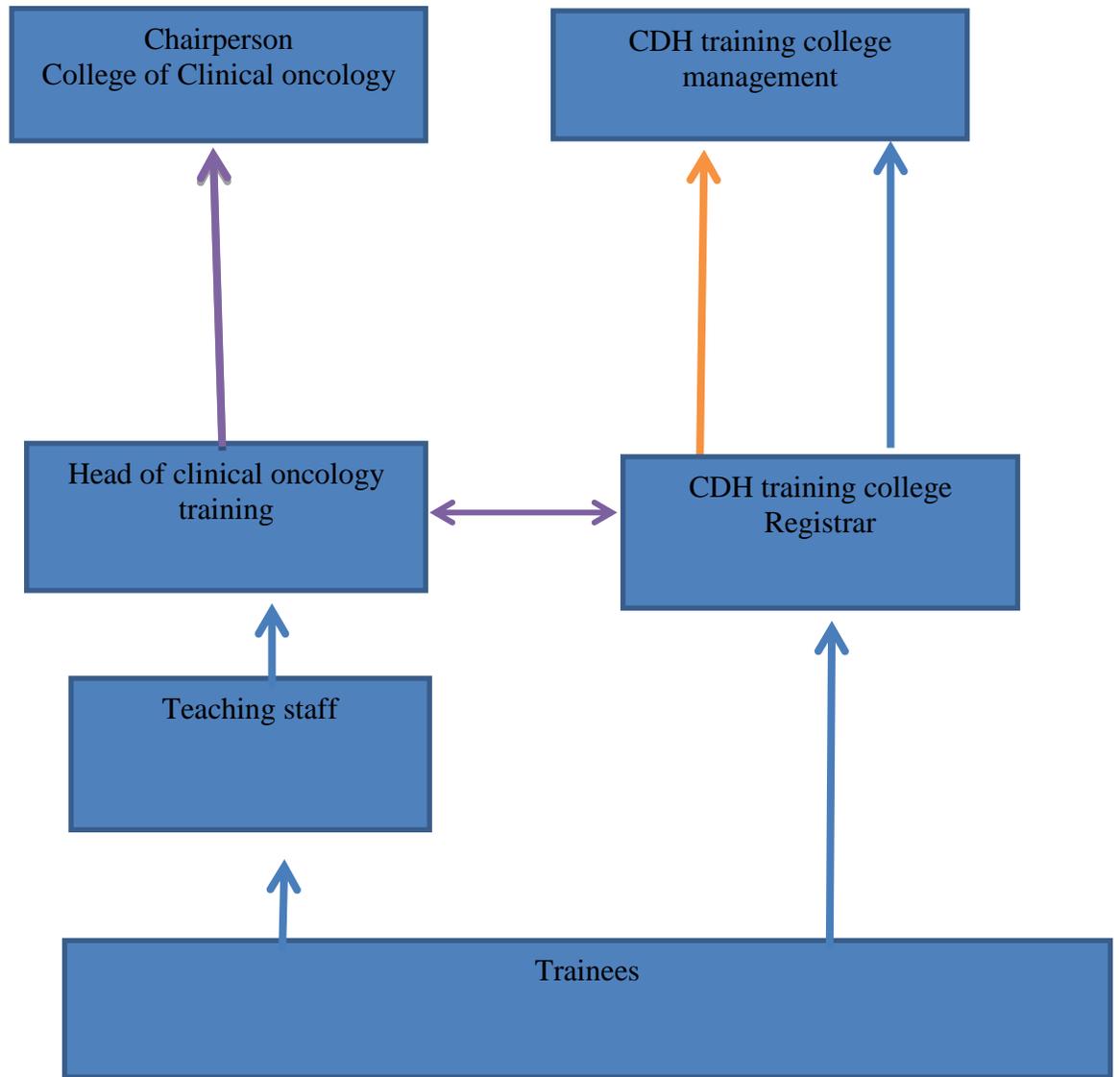
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1. <http://globocan.iarc>.
2. Perez C.A.,Brady L.W. Halperin E.C. Principles and Practice of Radiation Oncology, 5th ed. Lippincott Williams and Wilkins, 2007.

Appendix 1: Curriculum development team

Name	Institution	Specialty
Dr. L. Banda	CDH	Clinical oncology and internal medicine
Dr. S.C. Msadabwe	CDH	Clinical oncology
Dr. K. Lishimpi	CDH	Clinical oncology and Paediatrics
Dr. C. Mwaba	CDH	Clinical oncology
Dr. M. Mwale	CDH	Clinical oncologist and Public health
Dr. D. Lombe	CDH	Clinical oncology
Dr. G. Pupwe	CDH	Clinical oncology
Dr. A. Shibemba	UTH	Pathology
Ms. Barbara Mule	CDH	Medical physics
Mr. J. Sichone	CDH	Radiation therapy
Ms. Mulape Kanduza	CDH	Medical physics

Appendix II Governance structure



INDICATIVE RESOURCES

4. A Barrett, J Dobbs and T Roques - Practical Radiotherapy Planning.
5. Adami HO, Hunter D, Trichopoulos D Textbook of cancer epidemiology
6. Barrett KE, Barman SM, Boitano S, Brooks H. (2012). Ganong's Review of Medical Physiology 24th Edition. Mc Graw Hill Medical. 978-0071780032.
7. Bell J. (2005) Doing Your Research Project. 4th Open University Press. ISBN-0335215041
8. BK Mahajan, AB Khanal Methods in Biostatistics for medical students and Research workers
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11. Creswell J.W., (2009). Research design Qualitative, Quantitative and Mixed Methods Approaches. Sage publications, London. ISBN: 1412965578 /9781412965576
12. Drake R.L., Vogl W. and Mitchell A.W.M. (2005), Gray's Anatomy for Students, Churchill Livingstone. ISBN-0443066124
13. EB Podgorsak Radiation Oncology Physics: A Handbook for Teachers and Students; IAEA
14. E-resource – IAEA human health Cherny N, Fallon M, Kaasa S,
15. Gunderson and Tepper - Clinical Radiation Oncology
16. H Ellis - Clinical Anatomy
17. Hall, E.J. and Giaccia A.J (2012) Radiobiology for the radiologist. 7th Ed. Philadelphia Lippincott Williams & Wilkins ISBN 978-1-60831-193-4
18. Halperin EC, Constine LS Paediatric Radiation Oncology-
19. Handbook of cancer chemotherapy
20. Hulley SB, Cummings SR, Designing Clinical Research (2007) ISBN-13: 978-0-7817-8210-4
21. JJ Lu; LW Brady - Decision making in Radiation Oncology
22. Joiner M. and van der Kogel. A (2009) Basic Clinical Radiobiology. Anorl. ISBN 978 0 340 929 667
23. Khan F. and Gibbons J (2014) Khans' Physics of radiation therapy. Wolters Kluwer. ISBN 978-1-4511-8245-3
24. KL Moore, AM R. Agur AF. Dalley II - Clinically Oriented Anatomy
25. Kothari, C. R (2012). Research Methodology Methods and Techniques (2nd Edition) New Age International, New Dehli. ISBN: 978-81-224-1522-3
26. McSween, R.M.N and Wharley, K (2008). Muir's Textbook of Pathology. Edward Arnold, London.
27. PG Supino, Borer JS Principles of Research Methodology, A guide for Clinical Investigators
28. Physics in nuclear medicine
29. Robbins, S.L, Angell, M and Kumar, V (2012). Basic Pathology. W. B Saunders Company, Philadelphia
30. SA Leibel and TL Phillips - Textbook of radiation oncology

31. V De Vita, S Hellman, SA Rosenberg - Cancer: Principals and Practice of Oncology,
32. Washington C. and Leaver D. (2016) Principles and practice of radiation therapy. 4th Ed. St Louis. Mosby.
33. Watson M, Lucas C, Hoy A, Adult palliative Care guidance
34. Ziessmann.HA, O'Malley JP Nuclear medicine The Requisites 4th ed. ISBN 978-0-323-08299-0

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3. <http://globocan.iarc>.
4. Perez C.A.,Brady L.W. Halperin E.C. Principles and Practice of Radiation Oncology, 5th ed. Lippincott Williams and Wilkins, 2007.