HONG KONG COLLEGE OF RADIOLOGISTS

SPECIALTY TRAINING : CLINICAL ONCOLOGY
TRAINING OBJECTIVES & REQUIREMENTS, EXAMINATION FORMAT, EXIT ASSESSMENT AND SYLLABUS

OBJECTIVES OF TRAINING

(A) *Basic Specialist Training*

1.0 To acquire a broad background knowledge and practical skills relating to the management of patients with cancer.

2.0 To have a detailed knowledge of the basic sciences on which Clinical Oncology is based, and a sound understanding of the pathogenesis of neoplastic diseases, clinical physiology and immunology.

3.0 To develop the power of logical thinking and analysis of scientific and clinical data.

4.0 To acquire adequate knowledge on epidemiology, prevention, screening, early detection, diagnosis and work-up of neoplastic disease with detailed knowledge on the principles and practice of radiotherapy, chemotherapy, hormonal therapy and biologic therapy of neoplastic diseases and other morbid conditions, palliative care of the terminally ill, rehabilitation and survivorship of cancer patients.

5.0 To be conversant with the updated practice guidelines and current literature on relevant subjects, particularly with internet skills.

(B) *Higher Specialist Training*

1.0 To be confident as an independent practitioner in Clinical Oncology and be able to give expert advice on appropriate diagnostic and therapeutic modalities.

2.0 To be an effective and efficient member or leader in the multidisciplinary teams on the management of neoplastic diseases.

3.0 To provide evidence-based radiotherapy, chemotherapy, hormonal therapy and biological therapy for neoplastic diseases.

4.0 To provide total patient care including rehabilitation, survivorship and palliative care service for cancer patients.

5.0 To acquire skills for future in-depth commitment to scientific research, teaching, clinical audit and management activities.

6.0 To be motivated towards cancer prevention and screening activities, continuous professional development and subspecialization.

TRAINING REQUIREMENTS

(A) *Entry Requirement & Duration of Training*

1.0 All trainees must hold registration with the Medical Council of Hong Kong that is deemed acceptable by the College and must enrol with the Hong Kong College of Radiologists at the commencement of their training. The duration of training shall last for a minimum of 6 years, with 4 years of Basic Specialist Training including a minimum of 3 years of full time bedside and practical training in an accredited Clinical Oncology training centre and its satellite facilities with a structured programme covering

radiotherapy, chemotherapy, hormonal therapy, biological therapy, palliative medicine, cancer rehabilitation and survivorship; and 2 years of Higher Specialist Training. Trainees should have a minimum of 80% attendance rate for the structured training courses organized by the College. The overall minimum trainer to trainee ratio of the training centre and its satellite facilities should be 1:3.

2.0 Trainees in Clinical Oncology should have a regular on-call commitment for their specialty.

3.0 Absence from training of more than 90 calendar days during the period of Basic or 60 calendar days during the period of Higher Specialist Training would affect the training period requirement. Such absences must be notified to the College as soon as possible.

4.0 At the discretion of the College, trainees with previous oncology training outside the College may have part of their training exempted. Each application will be individually considered.

(B) *Basic Specialist Training*

1.0 Clinical experience outside Clinical Oncology is desirable. This may involve previous training in other specialty or elective training to other specialty, with the accepted specialty and duration at the discretion of the College.

1.1 Structured training courses on basic science and on clinical practice are organized by the College, which should be attended by registered trainees. A minimum of 80% attendance on such structured training courses will be required before trainees are allowed to attempt the respective Part I & Part II examinations.

2.0 Basic Science training

2.1 A thorough knowledge on the basic sciences on which Clinical Oncology is based is required including radiation physics, radiation protection and related legislation, medical statistics, radiobiology, cancer biology, clinical physiology and immunology, principles of chemotherapy (including drug preparation and administration), biological and hormonal therapy, interaction of systemic anti-cancer therapy with other treatment modalities, adverse reactions and reporting. Other aspects include chemotherapy safety, modes of action of anti-cancer therapies, mechanism of resistance, international guidelines that are designed to prevent potential causes of medication error, methods of assessing tumour response (clinical, radiological and biochemical) and treatment-related toxicities.

2.2 Structured courses on Medical Physics, Medical Statistics, Radiobiology & Cancer Biology, and Clinical Pharmacology are provided for the trainees.

2.3 The Part I Fellowship Examination may be attempted after completing the respective basic science courses organized by the College.

3.0 Clinical Practice training

3.1 This will lead up to the Part II Fellowship Examination of the College.

3.2 The trainee should receive a comprehensive grounding in all subjects related to Clinical Oncology, including radiation oncology, chemotherapy, hormonal therapy, biological therapy, palliative medicine, cancer rehabilitation and survivorship, fully integrated at all times. This may require rotation to other accredited Clinical Oncology training centres to ensure wide exposure to various diseases and treatment modalities.

3.3 A comprehensive knowledge on the aetiology, pathology (including staging procedures, and classifications of various tumours), epidemiology, natural history, prevention, screening, early detection, staging work-up and management of cancer is acquired. The ability to deal with general acute and chronic problems relating to either the diseases or treatment complications, including rehabilitation, survivorship, palliative care and symptom control of the advanced and terminal cancer patients, are expected.

3.4 A detailed knowledge with hands-on experience on the more practical aspects of radiotherapy is required, including the whole process of simulation, contouring, treatment plan creation and selection, setting up procedures and verification, radiation dosage and scheduling, and toxicities of treatment.

3.5 A detailed knowledge with hands-on experience on the use of chemotherapeutic, biological and hormonal agents on the treatment of neoplastic diseases is also required. This would include detailed knowledge of various regimes, dosages, and side effects of commonly used agents, physiology and immunology. Knowledge on combined modalities in various diseases is required. The trainee should have sufficient practical experience on the prescription and delivery of cytotoxic, hormonal and biologic agents and management of their toxicities.

3.6 Active participation in drug trial / research is strongly encouraged.

3.7 Management of in-patients under Clinical Oncology for such conditions as delivery of chemotherapy, treatment related complications, oncological emergencies, symptom control supportive care and rehabilitation would be required, with regular on-call commitment. Training and assessment of practical skills including bone marrow biopsy, methods of vascular access, pleural and abdominal tapping and drainage, lumbar puncture, anti-cancer drug administration including intrathecal chemotherapy are provided.

3.8 The concept of total patient care would be reinforced, emphasising on the physical, psychosocial and spiritual aspects of care for cancer patients. Quality of life assessment should be included.

3.9 The trainee will be expected to be familiar with up-to-date literature and current trends, and be able to discuss intelligently various treatment options and modalities in a wide variety of clinical settings.

3.10 During the whole period of clinical training, emphasis would be put on the cultivation of a high level of professional conduct and ethics. Communication skills should be developed to ensure good doctor-patient relationship and understanding among colleagues.

3.11 After at least 3 years of Basic Specialist Training in an accredited Clinical Oncology training centre, and with prior success at the Part I Fellowship Examination, trainees are allowed to attempt the Part IIA Fellowship Examination. After passing the Part IIA Examination and having completed the required minimum of 4 years in Basic Specialist Training including a minimum of 3 years of full time clinical training in an accredited Clinical Oncology training centre and its satellite facilities, trainees are allowed to attempt the Part IIB Examination.

(C) *Higher Specialist Training*

1.0 In this stage of training, which comprises the final two years of the whole training period after passing the Final Fellowship Examination, more emphases will be made on providing trainees with opportunities for independent practice.

2.0 Confidence and maturity would be cultivated, resulting in better clinical judgement and more effective problem solving and decision making. Special skills on at least two sub-specializations would be developed.

3.0 Team work would be emphasised, including organizing and running of combined clinics towards the multidisciplinary approach to cancer management.

4.0 Evidence-based practice would be emphasised. Sound knowledge on literature including cost-effectiveness of various treatment modalities and options would be required.

5.0 Theoretic and practical knowledge on clinical research would be acquired. Opportunities would be provided for trainees to experience the whole process of running clinical trials, performing statistical analyses and writing up treatment protocols.

6.0 Involvement in teaching and training of junior colleagues would be required in the form of formal lectures, tutorials, organization of seminars, clinical pathological conferences and bedside teaching.

7.0 **During the entire period of Basic and Higher Specialist Training, trainees should participate actively in research activities.**

1) **At least one project** must be accepted at scientific meetings organised by the College, or regional / international scientific conferences with the trainee as the oral presenter or first author of a poster presentation; and
2) **At least one radiological / oncological / nuclear medicine article** with the trainee as the first author, must be published / accepted for publication in the Journal of the College or other indexed medical journals.

Training centres should facilitate trainees to participate in research projects.

8.0 Management training would be initiated, with participation in departmental meetings, clinical audit and quality assurance programmes, risk management, handling of complaints and conflicts, resource allocation and planning in the delivery of professional service. Attendance of management courses would also be encouraged.

(D) *Minimum Exposure to Essential Oncology Treatments*

1.0 Trainees should have minimum exposure / hands-on experience in radiotherapy and systemic anti-cancer treatments for common cancers before the Exit Assessment.

2.0 **External RT Planning Cases** (trainees should be involved in the whole planning process, starting from decision on the treatment technique and setup, through contouring the target volumes and appraisal of the radiotherapy plan(s)).

3.0

Minimum Number of Radiotherapy Cases Planned	
3.1 Radical intent	
Head & Neck: (20)	
Nasopharynx	8
Oral cavity	2
Oropharynx	2
Larynx	2
Hypopharynx	2
Thorax (20)	
Lung	10
Esophagus	4
Pelvis (40)	

Colorectal	10
Gynaecological	10
Urogenital	10
Breast (20)	
CNS (10)	
GBM	4
Meningioma	2
Cranial Prophylaxis	2
Lymphoma (2)	
Soft tissue Sarcoma (2)	
Primary Skin Cancer (4)	
3.2 Palliative RT : (50)	

4.0 **Brachytherapy Cases** (The cases include those which trainees personally perform or assist in the brachytherapy procedures or prescribe the radioactive isotope under supervision)

4.1 Gynaecological cases - Remote/Manual Afterloading Intracavitary: 4

4.2 Radioisotopes – RAI: 10

5.0 **Systemic Anti-cancer Treatments including Chemotherapy, Hormonal and Biological therapy** (The cases include those which trainees has involved in the first prescription or obtaining informed consent from patients for the treatment)

6.0 **NPC (10)**
Head and Neck Cancer (10)
Brain Tumor (2)
Lung Cancer (Non-small Cell) (30)
Ca Lung (Small Cell Lung Cancer) (2)
Ca Esophagus (5)
Ca Breast (30)
Gastric Cancer (5)
Ca Pancreas / Cholangiocarcinoma (5)
Hepatocellular Carcinoma (5)
Colorectal Cancer (30)
Renal Cell Carcinoma (5)
Ca Prostate (20)
Ca Ovary (10)
Ca Cervix (5)
GIST (3)
Lymphoma (5)
Germ Cell Tumor (2)

EXAMINATION FORMAT

1.0 The College examination for Basic Specialist Training will be in 2 parts.

2.0 Format of Part I Examination:

2.1 The examination consists of written papers of single best answer (SBA) questions in the following 4 subjects:

- ♦ Cancer Biology and Radiobiology
- ♦ Clinical Pharmacology
- ♦ Medical Statistics
- ♦ Physics

2.2 The examination will be held twice a year in spring and autumn. Candidates may enter the examination at any four sittings.

2.3 Candidates may enter any number of subjects at a single sitting. For each subject, there is a single paper of single best answer questions.

2.4 The total number of attempts is restricted to 4 sittings. An attempt at the examination is any occasion when a Part I examination paper is taken (i.e. any of the four subjects listed in 2.1), not four attempts at each subject.

2.5 There is no requirement to re-sit a subject once a pass in that subject has been achieved; a candidate will be deemed to have achieved success at the Part I Examination once all four modules have been passed.

2.6 Candidates who have exhausted their four permitted attempts at the examination will not be eligible to enter on a fifth occasion, and there is no mechanism to request an additional attempt at the examination.

3.0 *Format of Part II Examination:*

3.1 The Part II Examination is a two-part examination: Part IIA and Part IIB. Part IIA comprises two papers of Single Best Answer questions. Candidates who have passed the Part I Examination are permitted to enter the Part IIA Examination on completion of three years of supervised clinical oncology training covering the examination syllabus.

3.2 Part IIB comprises the clinical and the structured oral examination, which will be examined by pairs of examiners, with one local and one overseas clinical oncologist. The local examiner should not be the trainer of the candidate.

3.3 A candidate must pass the Part IIA Examination and have completed the required minimum of 4 years in Basic Specialist Training including a minimum of 3 years of full time bedside and practical training in an accredited Clinical Oncology training centre in order to be permitted to attempt the Part IIB Examination.

3.4 A pass in the Part IIA Examination will remain valid, i.e. permit entry to the Part IIB Examination which is currently held yearly, for three consecutive sittings, starting from the sitting at which the Part IIA Examination is passed. Otherwise the candidate will be required to sit and pass the Part IIA Examination again before being permitted to re-enter the Part IIB Examination. From Spring 2015, no candidate will automatically be permitted more than six attempts at any examination or examination module.

3.5 The two parts of Part II Examination will be marked independently. Candidates will not be able to carry forward any credit for scoring above the required standard in the Part IIA Examination to compensate for the deficiency in the Part IIB Examination.

3.6 Candidates who passed only part of the old combined Part II Examination prior to 2011 cannot carry their success forward to the current two part format examination.

4.0 *Review of Performance at Examinations:*

4.1 Candidates who fail the Part IIB Examination will be informed of their performance at each paper/session. It is expected that counseling will be provided by the Training Head at each training centre.

4.2 After 2 unsuccessful attempts at Part IIB Examination, a candidate's performance will be reviewed by the Warden, one examiner of the examination together with the trainee and the respective supervisor, to advise on the required improvement areas and remedial actions.

4.3 The Review Committee of the College will consider queries and appeals.

EXIT ASSESSMENT FOR COLLEGE FELLOWSHIP

1.0 After completion of the required period of Higher Specialist Training, a trainee can apply for consideration of the Fellowship of the College.

2.0 Exit Assessment exercises are conducted by the College twice a year, normally in January and July.

3.0 A panel of assessors comprising the following members would carry out a formal assessment of the trainee's completion of training:

(i) The Warden.

(ii) Two experienced College Fellows of the trainee's profession, who should NOT be the trainee's supervisors, appointed by the Education Committee and approved by the Council.

4.0 The procedure of assessment would include:

(i) Scrutiny of the training records of the trainee for completeness of training.

(ii) Appreciation of the regular continuous appraisal reports of the respective supervisor.

(iii) Further supportive documents may need to be furnished by the trainee or the respective training centre on request.

(iv) A 40-minute oral assessment of the trainee by the panel of assessors will be held to evaluate the trainee's professional attitude, ability in communication skill, solving clinical or management issues and appreciation of oncology literature.

5.0 After an unsuccessful attempt at Exit Assessment, a candidate's performance will be reviewed by the Warden, one assessor of the Panel together with the trainee and the respective supervisor, to advise on the required improvement areas and remedial actions.

ACADEMIC HONESTY

1.0 The College will strictly observe the academic honesty of all trainees during the entire Basic and Higher Specialist Training period.

2.0 Plagiarism refers to the process or practice of using another person's ideas or work and pretending that it is one's own.

3.0 The principle of academic integrity requires trainees to avoid plagiarism and refrain from presenting others' work as their own or taking credit for scientific data that they did not produce. Examples of such misconduct include but are not limited to using someone else's work without proper attribution or permission, whether by direct

copying (in whole or part), paraphrasing, or employing AI-based tools. It is essential to acknowledge and respect the intellectual contributions of others, and failure to do so can result in serious consequences for the trainee's academic and professional development.

4.0 Self-plagiarism refers to reuse of one's own work without properly acknowledging that the pertinent work has already been submitted elsewhere.

5.0 The College will seriously investigate all incidents of suspected plagiarism. Disciplinary actions will be taken at the discretion of the College Council if the accusation of plagiarism is substantiated. In group projects, all group members may be held responsible and potentially liable to disciplinary actions should the accusation of plagiarism be substantiated.

SYLLABUS

1.0 PART I EXAMINATION

1.1 *PHYSICS*

General Remarks

- The course aims at getting the trainees to acquire a broad knowledge of physics relevant to the clinical practice of radiotherapy, including the application of physical principles and methods in clinical radiotherapy, physical basis of the therapeutic uses of radioactive isotopes, radiation hazards and protection.
- A basic knowledge of physics is assumed. A mathematical approach to the syllabus is inappropriate. The emphasis would be placed on a clear understanding of the physical basis of radiological practice in a qualitative sense.
- The whole of the syllabus should be covered by formal teaching, tutorials and demonstrations sessions. During the course, therapeutic and related equipment and procedures will be demonstrated to illustrate the importance of the subject to daily practice.

Scope of the Syllabus

1.1.1 Basic physics relevant to radiotherapy

- Atomic structure, atomic and mass numbers
- Electron shells and energy levels
- Electromagnetic radiation
- Electromagnetic spectrum
- Energy quantitisation
- Relationship between wavelength, frequency and energy
- Description of an x- or gamma-ray beam (quality, energy, intensity, size)
- Basics of production of x- or gamma-rays
- Continuous and discrete spectra
- Attenuation, absorption, scattering of x-rays
- Attenuation coefficients, half value layer

1.1.2 Electromagnetic Radiation and its interaction with Matter

For each of the following understand the nature of the effect and its dependence on the properties of the irradiated material (e.g. density, atomic number), its variation with energy and the relative importance in therapy and imaging.

- Elastic scattering
- Compton effect
- Photoelectric effect
- Pair production
- Photonuclear interactions
- Auger effect
- Scattered radiation
- Secondary electrons
- Range versus energy
- Linear energy transfer

1.1.3 Interaction of sub atomic particles with matter

- Ionisation and excitation due to charged particles
- Electrons
    - collision loss
    - radiative loss
    - stopping power due to each and total stopping power
    - particle range

- Bremsstrahlung
- Neutrons: elastic and inelastic collisions
- Protons, ionisation profile, Bragg peak
- Elementary knowledge of heavy ions

1.1.4 Radiation Dosimetry

- Concept of absorbed dose
- Definitions and units
- Variation of absorbed dose in different tissues and materials
- Concept of exposure and KERMA
- Simple introduction to the relationship between exposure, KERMA and absorbed dose
- The physical principles underlying radiation dose measurement
- Relationship between measurement of ionisation and derived measurement of dose
- Methods of measurement
- Elemental knowledge of the construction, advantages and disadvantages of the following:
  - ionisation methods (ionisation chamber, Geiger counter, diodes)
  - chemical methods, primarily films
  - thermoluminescence (TLD)
  - scintillation counters
  - calorimetry
- Calibration methods
  - intercomparisons
  - standards (local and national)
  - corrections (temperature, pressure, beam direction etc)
  - constancy checks
- Practical dose measurements
  - introduction to the derivation of isodose curves
  - central axis depth dose profiles
  - use of phantoms

1.1.5 Teletherapy beams physics (x-rays)

- Energy range of X-rays beams used in clinical practice
- Dose distribution (percentage depth dose and profiles) and isodose curves
- The effects of:
  - Energy
  - Build up and skin sparing
  - FSD
  - Beam modifying devices such as wedges and compensators
  - Surface obliquity and inhomogeneities
  - Trays and blocks
- Output factors
  - Cone and insert factor for superficial x-ray
  - Simple monitor unit calculation
- Beam geometry
  - magnification and penumbra
  - field size definition

1.1.6 Electron Beam Physics

- Electron beams used in clinical practice
- Dose distribution (percentage depth dose and profiles) and isodose curves
- The effects of:
  - Energy
  - Factors affecting dose at depth (e.g. lung)
  - Field size
  - Build up and skin sparing

- Surface obliquity and inhomogeneities
- Shielding

1.1.7 Radiotherapy treatment planning

- Data required for treatment planning
- Immobilisation (techniques and accuracy)
- Effects and management of patient and organ movement
- Tumour localisation: clinical examination, radiograph, simulator, CT, MRI, ultrasound, functional imaging
- Concept of planning volumes (ICRU 50, 62):
  - Gross Tumour Volume (GTV)
  - Clinical Target Volume (CTV)
  - Planning Target Volume (PTV)
    - Internal Target Volume (ITV)
    - Set-up Margin (SM)
  - Treated Volume
  - Irradiated Volume
  - Organs at risk (OAR)
  - Planning organ at Risk Volume (PRV)
- Planning volume localisation:
  - Clinical mark-up
  - CT, MRT or PET Simulation
  - Ultrasound
- Separation and contour information (uniplanar, multiplanar)
- Transposition of patient data: magnification, target volumes, sensitive structures, dose modifying structures
- Structure and use of a simulator
- Use of a CT scanner in radiotherapy planning
- CT simulator
- MRI simulator
- Fixed FSD vs. isocentric planning
- Coplanar planning
- Isodose distributions in each of the following situations, their uses and critical assessment:
  - single field
  - multifield planning (coplanar and non-coplanar)
  - arc and rotational therapy
  - weighting
- The use of bolus
- Surface obliquity
- Inhomogeneous media
- Principles of electron beam therapy
- Principles of superficial x-ray beam therapy
- Principle of non-coplanar planning
- Principles of conformal therapy
- Principles of arc and rotational therapy
- Principles of forward and inverse planning
- Principles of intensity modulated radiotherapy including IMRT and VMAT
- Principles of stereotactic radiosurgery and radiotherapy
- Robust optimization of IMRT and VMAT
- Basics of dose calculations in the presence of extensive shielding (e.g. sector or Clarkson integration)
- Field matching
- Dose prescription (various methods including ICRU 50, 62, 83)
- Basics of different dose calculation algorithms
- Total body irradiation (TBI) and total skin electron treatment (TSET)
- Principles of CT treatment planning
  - acquisition of data and data transfer
  - image manipulation and image fusion

- defining the volume, growing tools
- beam placement using beam's eye view
- plan verification and evaluation using isodose display, dose volume histograms (DVH cumulative and differential), conformity index, gradient index, and digitally reconstructed radiographs (DRR)

- Concepts of biological indices (TCP, NTCP)
- 4-dimensional CT acquisition and interpretation
- Motion-compensated treatment (gating, breath-holding, abdominal compression, tracking)

1.1.8 Beam Therapy Equipment

- Principles of superficial and orthovoltage x-ray production
- Basic construction of a cobalt machine
- Construction of a linear accelerator
- Principles of operation of the linear accelerator, including:
  - electron beam production
  - x-ray beam production, beam control and stability
- Basics of the linear accelerator head construction
- The concept of monitor unit
- Beam quality
- Flattening filter free beam
- Concept and definition of the isocentre
- Beam geometry and shaping:
  - source size
  - penumbra, factors influencing penumbra
  - collimators, applicators, multileaf collimators, cast blocks
  - wedges: types, construction, action
  - shielding: techniques, materials, transmission, scatter, doses under shields
- Factors involved in accurately irradiating the target
  - the treatment couch
  - positioning the patient
  - lasers
  - light fields
  - MV imaging panel
  - kV source and imaging panel
  - Radiation output and monitor units
  - control of the accelerator
  - intensity modulation in IMRT and VMAT modes
- Multileaf collimators: edge definition, leaf leakage, influence of leaf size
- Stereotactic equipment
- Principles of Tomotherapy, MR Linac, proton therapy

1.1.9 Quality Assurance in Radiotherapy

- Definition of quality assurance and quality control
- The processes for ensuring the correct implementation of the prescription
- The role of computer verification
- Manual checking
- Monitoring accuracy of treated volume: verification films and mega-voltage imaging, CBCT, off-line and on-line IGRT
- Monitoring accuracy of positioning (laser, light-fields, tolerances)
- In-vivo dosimetry
- Patient specific quality assurance of delivered dose with 2D/3D detector arrays or EPID devices
- Monitoring accuracy of treatment delivery: beam energy, radiation output, field size, symmetry, field flatness, tolerances for each parameter
- Rules for reporting near misses and errors including the legal requirements

1.1.10 Radioactive sources

- Basics of radioactivity, including

- types of radiation and radioactive decay
- isotopes
- concepts, definitions and units of activity and half-life.
- characteristics of radiation
- parent and daughter decay series
- radioactive equilibrium
- sealed and unsealed sources

- Types of sources and their construction (seeds, tubes, needles, ovoids, etc)
- Requirement for clinical sealed sources
- Specific forms of sealed and unsealed sources (^{223}Ra, ^{192}Ir, ^{137}Cs, ^{131}I, ^{125}I, ^{90}Y, ^{90}Sr, ^{89}Sr, ^{60}Co)
- Inverse square law
- Specifications of source strength, air KERMA rate
- Measurement of source activity and reference air KERMA rate
- Calculation of absorbed dose from a sealed source
- Dose distributions around sealed sources
- Design of sealed source encapsulation
- Hazards with sealed and unsealed sources
- Control and testing of sealed sources
- Storage and movement control
- Method of source handling
- Leak testing, inspection
- Safety devices

1.1.11 Brachytherapy

- Principles for clinical use
- Distribution rules and dose calculation basis for Paris system
- Gynaecological intracavitary brachytherapy (Manchester system and 3D Image-guided brachytherapy)
- Dose specification
- Principles of afterloading
- Types of afterloading (manual, remote, low, medium and high dose rate)
- Principles of brachytherapy treatment planning
- Safety devices and emergency handling

1.1.12 Unsealed sources

- Stability, shelf life
- Physical v biological half life
- Radiopharmaceuticals
- Use in imaging and therapy
- Clinical applications, prescription and dose calculations

1.1.13 Radiation Protection

- Radiation risks
- Stochastic and non-stochastic processes
- Quality factors and dose equivalent
- Equivalent dose and effective dose
- Statutory framework
- Background radiation
- Low level exposure effects
- Classification of staff and designated areas
- Ionising Radiations Regulations 2017 (IRR 2017)
- Working with ionising radiation. IRR17 Approved Code of Practice and guidance
- The Ionising Radiation (Medical Exposure) Regulations (IR(ME)R 2017)
- ARSAC (Administration of Radioactive Substances Advisory Committee)
- Local Rules
- Dose limits and dose constraints
- Controlled areas
- Protection mechanisms: time, distance, shielding

- Design of treatment rooms
- Primary/secondary barriers
- Transmission through barriers, elementary calculations
- Mazes, doors and interlocks
- Leakage and scattered radiation
- Monitoring of personnel: construction and operating of TLD badge, direct reading dosemeter
- Dose reporting mechanisms and dose levels

1.2 *MEDICAL STATISTICS*

General Remarks

- The course aims at providing the trainees with sufficient knowledge to enable them to study critically the statistical validity of published investigations with emphasis on the requirements needed to design, monitor and assess clinical trials and epidemiological studies.

Scope of the Syllabus

1.2.1 Basic concepts of biostatistics

- Categorical data (nominal, ordinal) & numerical data (discrete, continuous).
- Presenting and summarizing individual variables
- Qualitative data: proportions, bar charts and histograms, contingency tables and relative risk
- Quantitative data: define and apply measurements of location and dispersion histograms, transformations, scatter diagram, biological variation and the normal distribution, measures of central tendency and spread, recognized symmetric and skewed distribution
- Interpret bar charts and histograms
- Types of clinical studies (observational vs interventional; case report, case series, cross-sectional study, case-control study, retrospective cohort study, prospective cohort studies, clinical trials, systematic reviews and meta-analysis)
- The concept of confounding bias
- Other common types of bias (e.g. selection bias, information bias, recall bias, detection signal bias etc.)

1.2.2 Sampling

- Concept of a source population
- Sampling: random, non-random
- Estimation of population statistics
- Standard error of sample mean and of a proportion, and their differences
- Level of confidence, confidence intervals
- References ranges

1.2.3 Principles of statistical inference

- Hypothesis testing and estimation
- Type I and II errors
- Interpretation of p-values and confidence intervals
- One or two tailed tests
- Define and identify the difference between statistical and clinical significance
- Statistical power

1.2.4 Comparing 2 or more groups

- One-sample t-test, paired and two-sample t-tests, non-parametric analogues of t-tests
- Single proportion z-test, McNemar and Chi-square test, Yates correction, Fisher's exact test, 2 x 2 contingency table, extension to analysis of variance and larger

tables

1.2.5 Measures and tests of association between variables

- Correlation (Pearson's and Spearman's correlations)
- Scatter plots
- Linear and logistic regression
- Screening tests
- Trend test
- Sensitivity and specificity
- Positive and negative predictive values and accuracy
- Receiver operating characteristic (ROC) curve, likelihood ratio

1.2.6 Survival Analysis

- Types of time-to-event data (survival data, recurrence data)
- Understand censorship
- Summarising, measurement and presentation of survival data: prediction model, crude and age-adjusted survival rates, failure time, censoring, survival curve, life table (actuarial) and Kaplan-Meier (product limit) estimates
- Comparing groups, comparison of two curves, log-rank (Mantel-Haenszel) test for 2 or more groups, including ordered groups
- Use of Cox's proportional hazards regression model, hazard ratios and their interpretation
- Concept of a cured group and recurrence-free rates.

1.2.7 Clinical trials

- Phases I – IV of clinical trials
- Randomization: needs, problems with non-randomized studies and historical controls, methods (simple, block, stratified minimisation), biases, blinding/masking
- Sequential trials, multi-centre studies
- Explained concept of blinding (single and double blind)/masking
- Designs: parallel group, cross-over, factorial and Latin Square
- Protocol: aims of study, inclusion and exclusion criteria, sample size calculation, informed consent, ethical considerations, methods of allocating treatment options, allocation concealment, primary vs secondary endpoints, interim analyses, intent-to-treat vs per-protocol analysis, pre-planned vs exploratory subgroup analysis, prognostic factors, interim analysis and early stopping rules
- Measures of response, tumour progression, local and regional recurrence, distant metastases, death
- Adverse event (AE), serious adverse event (SAE), adverse reaction (AR), serious adverse reaction (SAR), suspected unexpected serious adverse reaction (SUSAR); and their reporting
- Quality of life, patient reported outcomes
- Reporting of clinical trial: CONSORT statement
- Role and basic principles of systematic review and meta-analysis; the PRISMA checklist and flow diagram
- Critically review and evaluate papers

1.2.8 Epidemiology

- Design and interpretation of retrospective (case control) and prospective (cohort) studies
- Odds ratios and relative risks
- Crude, age-specific and age-standardized incidence, mortality and prevalence rates
- Standardised mortality ratio (SMR)
- Cancer registration and follow-up
- Cancer incidence and mortality rates for major anatomical sites, trends in cancer incidence and mortality, aetiological studies, screening and diagnostic tests

1.3 *CANCER BIOLOGY AND RADIOBIOLOGY*

General Remarks

- Trainees will be required to have understanding on carcinogenesis, cellular and molecular features of malignancy, including biochemical control, signalling and cell death. Knowledge on tumour development, growth kinetics, micro-environmental changes, metastasis and immune response. Common laboratory techniques to demonstrate these features. A knowledge of the cellular and molecular basis for the response of cells, tissues and tumours to ionising radiation and chemotherapy. A knowledge of current models of radiation response and the biological principles underlying the application of radiotherapy to the treatment of disease, including normal tissue responses.

Scope of the Syllabus

1.3.1 General principles of tumour biology

- The cell cycle, basic cell kinetics, including parameters associated with cell cycle times
- Definitions of and distinctions between different types of growth disorder, dysplasia and carcinoma-in-situ
- Mechanisms of spread, local invasion/migration, metastasis
- Tumour vasculature and angiogenesis
- Effects of tumours: local (e.g. pressure), distant (metastatic and non-metastatic)

1.3.2 General principles of radiobiology

- Cellular systems (hierarchical, flexible) and their response to radiation
- Parallel and linear systems
- Radiation biology models (monolayer, spheroids, animal (normal and transgenic), regrowth curves, clonogenic assay, MTT
- LET and its relevance to cellular damage
- Radiation damage at the cellular level (membrane, cytoplasmic, nuclear)

1.3.3 Techniques in molecular biology

Principles and use of technique only, not details of execution

- Nucleic acid analyses including electrophoresis, hybridisation, blotting, PCR, sequencing, transfection
- Micro-array techniques
- Transgenic models

1.3.4 The genetics of normal and malignant cells

- Normal chromosomal structure and function, normal gene transcription and its control
- Normal DNA repair mechanisms
- Polymorphisms, mini and microsatellites
- Chromatin structure and function
- Methylation, hypomethylation and methylation reversal
- Chromosomal and genetic changes in malignancy, point mutations, translocations, deletions, gene amplification and over-expression
- Oncogenes, proto-oncogenes, tumour suppressor genes (a knowledge of well-established examples in each class is expected)
- Protein-protein interactions

1.3.5 Molecular biology of radiation damage and repair

- The basics of experimental molecular radiobiology
- Molecular processes involved in radiation damage and repair
- Molecular biology of chemotherapy drug resistance
- Time course of repair

1.3.6 Normal and aberrant mechanisms of cell growth control

- Control of normal cell growth and behaviour
- Autocrine, paracrine and endocrine growth factors
- Altered expression, function and control of these mechanisms in malignancy
- Signal transduction (MAP kinases)
- The role of cyclin kinases
- Gene promoters and their activity in normal and malignant cells

1.3.7 Normal tissue radiobiology

- Normal tissue damage, early and late
- The concept of normal tissue tolerance, factors influencing tolerance
- The biological hazards of irradiation, effects of radiation on different tissues and organs
- Dose protraction and LET
- Tolerance levels for different tissues and organs
- Organ tolerance to retreatment with radiation
- Schemes for reporting normal tissue damage
- Systemic irradiation and toxicities, whole body syndromes
- Biological basis of radiological protection. Effects on the embryo and the foetus; life shortening, leukaemogenesis and carcinogenesis, genetic and somatic hazards for exposed individuals and populations

1.3.8 Population radiobiology

- Production of the cell survival curve
- Descriptive models, e.g. linear quadratic model
- The concept of damage (lethal, sublethal, potentially lethal) and repair (early and late)
- 5Rs of radiobiology
- Effect of cell cycle on radiation sensitivity
- The cell survival curve as a basis for fractionation
- Terms describing cellular sensitivity (SF2, α , β , mean inactivation dose)
- α/β ratio and its relevance to acute and late responding tissues
- Isoeffect curves (various forms) and formulae, including BED
- Fractionation and its influence on outcome with varying α/β ratio
- Altered fractionation: - Hyperfractionation, Hypofractionation, Accelerated fractionation
- Repopulation. Influence of gaps in radiotherapy and their management
- Influence of time on radiation response including dose rate effects
- Relative biological effect (RBE), linear energy transfer (LET), and their relationship
- Oxygen effect: influence of oxygen on radiosensitivity, oxygen enhancement ratio (OER), relationship between OER & LET, reoxygenation, methods of identifying hypoxia experimentally
- Hypoxic cell sensitiser and cytotoxins
- Radiation protectors
- Use of high LET radiation
- Dose rate effect, low dose rate, high dose rate and pulse dose rate radiotherapy

1.3.9 Interaction between radiation and other agents

- Chemotherapy (before, during and after radiation)
- Basic principles of hyperthermia

1.3.10 Causation of human cancers

- Environmental factors and influences
- Carcinogenesis in-vitro and in-vivo
- Viral carcinogenesis: viruses firmly associated with cancer (HPV, EBV etc)
- Radiation carcinogenesis:- ionising and non-ionising radiation associated with carcinogenesis, DNA damage and repair (differing effects with various radiation types), nucleotide excision repair, genes and products associated with repair

1.3.11 Cancer genetics

- Inherited syndromes associated with cancer: ataxia telangiectasia, xeroderma pigmentosa, Nijmegin break syndrome, Li-Fraumeni, Lynch, MEN, Cockayne's, familial polyposis coli, inherited breast cancer syndromes
- Genes conferring susceptibility to cancer
- Mechanisms whereby such genes can be associated with neoplasia
- Linkage analysis
- Principles of genetic counselling

1.3.12 The physiology of haemopoiesis

- Marrow structure and organisation
- The haemopoietic microenvironment
- Cell lineages and hierarchies
- Control mechanisms in normal haemopoiesis

1.3.13 The immune system

- Cellular involvement in the immune system
- Antigen recognition and processing
- Dendritic cells
- Clonal expansion of lymphoid cells in response to stimulation
- Immunological surveillance
- Tumour immunology

1.3.14 Growth of normal and malignant cells

- Growth kinetics: cell cycles, growth fraction recruitment, cell loss, and their study through MI, LI, autoradiography, and flow cytometry
- Tissue classification and cell replacement, apoptosis, cell lineages, stem cells, and proliferative units
- Signal transduction (MAP kinase)
- The role of cyclin kinases
- Gene promoters and their activity in normal and malignant cells

1.4 *CLINICAL PHARMACOLOGY*

General Remarks

- The emphasis is on clinical use of cytotoxic drugs, hormones and biological therapies, their structure, mode of action, toxicities and side effects.
- Also include basic principles of pharmacokinetics and pharmacodynamics, evaluation of drugs used in the cancer treatment, and the basic pharmacology of drugs used in the supportive care of cancer patients.

Scope of the Syllabus

1.4.1 Mode of action of cytotoxic drugs

- Classification of cytotoxic drugs
- Mechanisms of action
- Phase specific and cycle specific drugs
- Mechanisms of cell death
- Drug resistance: mechanism and methods to overcome, drug resistance modifiers

1.4.2 Drug design and development

- Novel therapeutic targets
- New drug discovery and development
- Preclinical assessment of candidate compounds

- Clinical studies (Phase I, II, III, IV)

1.4.3 Pharmacokinetics and pharmacodynamics

- General principles of pharmacokinetics
- Factors affecting drug concentration in-vivo: route and timing of administration, drug activation, plasma concentration, metabolism and clearance
- Plasma concentration and its relationship to drug actions
- AUC
- Protein and tissue binding
- Drug concentration at target site

1.4.4 Principles of clinical use

- Dose response curve
- Dose intensity
- Single agent and combination therapy
- Adjuvant and neo-adjuvant therapy
- Maintenance therapy
- High dose chemotherapy
- Regional therapy
- Targeting of drugs
- The clinical pharmacology and technology of continuous infusion
- Sanctuary sites and the clinical pharmacology of intrathecal treatment
- Modification of drug resistance

1.4.5 Toxicity of chemotherapy

- Mechanisms of toxicity
- Dose limiting and common toxicities
- Dose-related and idiosyncratic toxicity
- Early, intermediate and late genetic and somatic effects of common classes of anti-cancer drugs
- Chemical and other factors modifying drug toxicity
- Safe handling of cytotoxic drugs

1.4.6 The clinical pharmacology of analgesics

- Weak and strong opioids including morphine
- Medications for neuropathic pain
- Drug combinations
- Different formulations, e.g. slow release and patch formulations

1.4.7 The clinical pharmacology of steroids and anti-emetics

1.4.8 Drug interactions in cancer treatment

- potentiation, antagonism
- common or important interactions between drugs used in cancer therapy and other commonly used agents, e.g. increased toxicity in patients receiving methotrexate who are taking NSAIDs

1.4.9 Hormonal therapy

- Mechanisms of action
- Mechanisms of resistance
- Common side effects
- Combination with other therapies

1.4.10 Biological and novel therapies

- Biological therapies, their mechanism of action, combination with standard therapy
- The mode of action of interferons, interleukins, growth factors, antibody therapy, gene therapy, immunotherapy

- Novel targets for anti-cancer drugs, including vasculature, cell signal control and oncogene products. DNA repair pathways. Protein kinase signalling pathways. ErbB2 and EGFR pathways. Signal transduction inhibitors
- Bioreductive drugs
- Cancer vaccines

1.4.11 The basic principles of high dose therapy

- The clinical pharmacology and rationale of high-dose therapy
- Methods for protection / rescue of stem cells
- Unusual toxicities, e.g. veno-occlusive disease etc

2.0 PART II EXAMINATION

Candidates are expected to have a wide knowledge of neoplastic diseases and the management of patients with cancer of all organ systems. The main emphasis is put on radiotherapy, drug therapy, palliative care, cancer rehabilitation and survivorship, but a good knowledge of other specialties is expected.

Scope of the Syllabus

2.1 *KNOWLEDGE*

Candidates for the Part II Examination need to have a broad knowledge relating to all aspects of the investigation and management of patients with cancer.

2.1.1 Prevention

- A broad knowledge of the environmental causes of cancer and possible strategies for prevention

2.1.2 Screening

- Details of screening programmes, including the advantages and disadvantages, for common cancers, such as cervical, breast and colorectal cancers, in different populations stratified by risk

2.1.3 Cancer Genomics and Genetics

- Appreciation of the clinical use of genomic data to inform diagnosis, identify personalised treatment options, and to predict and monitoring treatment response, with the opportunities to improve response and reduce side effects.
- The familial aspect of some cancers is required (such as colorectal, breast, ovary, retinoblastoma, multiple cancer syndromes) and the management of high risk families and genetic counselling

2.1.4 Anatomical Sites and Types of Tumours

- Head and Neck
  - *Lip*
  - *Oral cavity*
  - *Oropharynx*
  - *Hypopharynx*
  - *Nasopharynx*
  - *Supraglottis*
  - *Vocal cord*
  - *Sub-glottis*
  - *Middle ear*
  - *Nose and nasal sinuses*
  - *Orbit and optic nerve*

- *Lachrymal gland*
- *Salivary gland*
- *Glomus jugulare tumours*
- *Carotid body tumours*

- Gastro-Intestinal Tract
  - *Oesophagus*
  - *Stomach*
  - *Liver*
  - *Pancreas and biliary tract*
  - *Small bowel*
  - *Colon and rectum*
  - *Anal canal and peri-anal region*
- Chest
  - *Pleura*
  - *Trachea*
  - *Lung*
  - *Mediastinum and thymus*
- Genito-Urinary Tract
  - *Kidney*
  - *Ureter*
  - *Bladder*
  - *Urethra*
  - *Prostate*
  - *Penis*
  - *Testis*
- Female Genital Tract
  - *Uterine cervix*
  - *Uterine body*
  - *Vagina*
  - *Vulva*
  - *Ovary*
  - *Fallopian tube*
- Central Nervous System
  - *Brain*
  - *Spinal cord*
  - *Craniopharyngioma*
  - *Chordoma*
  - *Schwannomas including acoustic neuroma*
  - *Meninges*
- Soft Tissue Sarcomata and Bone Tumours
  - *Adult soft tissue sarcoma*
  - *Childhood/adolescent sarcoma*
  - *Chondrosarcoma*
  - *Osteosarcoma*
  - *Ewing's tumour*
- Paediatric Tumours
  - *Medulloblastoma*
  - *Neuroblastoma*
  - *Nephroblastoma*
  - *Retinoblastoma*
- Lymphoproliferative and Myeloproliferative Disorders
  - *Hodgkin's lymphoma*
  - *Non-Hodgkin's lymphomas*
  - *Plasma cell malignancies*
  - *Acute and chronic leukaemias*
- Skin
  - *Basal cell carcinoma*
  - *Squamous cell carcinoma*
  - *Malignant melanoma*
  - *Cutaneous lymphoma*

Kaposi's sarcoma
- Endocrine
  Breast
  Thyroid
  Parathyroid
  Pituitary
  Adrenal
- *Cancer of unknown primary*

For each of the tumour types and sites listed at paragraph 2.1.4:

(a) Management
- Staging investigations including imaging, tumour markers and molecular tests
- Relevant prognostic and predictive factors
- Assessment for treatment
- Role of surgery
- A management plan, or, where applicable, a range of such plans
- Roles of surgery, radiotherapy and systemic anti-cancer drugs in multi-modality approaches to cancer treatment
- Rehabilitation after treatment and survivorship of the survivors

(b) Pathology
- The range of tumours
- Their aetiology, incidence, mortality and epidemiology
- A brief morphology of the common tumours
- The natural history of the disease including likely presentation, characteristic growth and metastatic pattern
- Staging classifications, e.g. TNM, FIGO
- Use of tumour markers and molecular tests in management of tumours
- Use of specialised pathology techniques, e.g. immunohistochemistry and FISH test
- Interpretation of clinicopathological data in the tumour site specialised multidisciplinary approach to patient management

(c) Radiotherapy
- Ionising Radiation Regulations
- The role of irradiation in radical and palliative management
- Knowledge on:
  - Staging investigations
  - Tumour volume, target volumes and treatment volume
  - ICRU reports 50, 62 and 83
  - An acceptable radiotherapeutic technique, or, where applicable, a range of such techniques
  - The correct treatment position
  - Details of the target volume localisation process
  - Use of CT and MRI images in 3D planning
  - Verification techniques such as laser alignment, skin tattoos, orthogonal and portal films
  - The approximate dose distributions for the chosen technique
  - An appropriate dose/fractionation regime
  - Relevant dose modifying factors (changes in fractionation, age, target volume, intercurrent infections, concurrent chemotherapy and previous therapies)
  - Details of the set-up instructions for radiographers
  - Appropriate responses to changes of patient parameters or interruptions during treatment
  - The possible acute and late side effects of the irradiation
  - The threshold dose of the respective organs at risk in the irradiated area
  - Radiation dose modifying factors, chemotherapy timing in all forms of chemoradiation schedules

(d) Drug Therapy
- The role of cytotoxic, hormonal and biological drugs in radical and palliative management
- The commonly used radical and palliative regimes including dosage, scheduling, toxicities and outcomes

(e) Outcomes
- The expected outcomes of treatment

2.1.5 Drug Therapy

(a) Cytotoxic Chemotherapy
- A basic knowledge of the pharmacokinetics, therapeutic uses, dose ranges and toxicities of the currently used cytotoxic agents
- Where applicable, a range of multi-agent chemotherapy regimens and details of their administration
- Knowledge of high dose chemotherapy using peripheral blood stem cell or bone marrow transplantation, including stem cell mobilisation, the procedures for stem cell and bone marrow harvesting, re-infusion of bone marrow and stem cells and patient support during engraftment
- The timing of total body irradiation and total lymphoid irradiation for bone marrow transplantation

(b) Hormone Therapy
- A basic knowledge of the therapeutic use and toxicities of the currently used hormone therapy

(c) Biological Therapies
- A basic knowledge of the clinical uses of the currently used biological therapies including interferons, targeted therapy, immunotherapy including cell-mediated immunotherapy such as CAR-T cell therapy, colony stimulating factors, and other growth factors.

2.1.6 Oncological Emergencies
- The management of the following complications when they are related to cancer:
  - Ureteric obstruction
  - Spinal cord compression
  - Haemorrhage
  - Mediastinal obstruction

2.1.7 Radiotherapy for Benign Disease
- The indications for radiotherapy in the treatment of benign conditions, including suitable techniques and dosage schedules, and likely benefits and risks

2.1.8 Complications of Treatment
- The acute and late complications of oncological treatment and their management including:
  - Skin reactions
  - Nausea and vomiting
  - Diarrhoea
  - Oedema
  - Bone marrow toxicity
  - Neutropenic sepsis
  - Drug reactions
  - Cytotoxic extravasation
  - Alopecia
  - Cataract
  - Skin atrophy and ulceration
  - Colitis, proctitis, gut strictures and perforation

- Renal effects
- Cardiac effects
- Pulmonary effects
- Fibrosis and lymphoedema
- Endocrine effects (thyroid, pituitary and salivary gland)
- Effects on fertility
- Incidence of second and radiation induced cancers
- Immune-related adverse events

2.1.9 Symptom Control and Continuing Care

- The available pharmacological and non-pharmacological interventions as well as procedures for symptom control such as pain, nausea, vomiting and shortness of breath
- Treatment of various cancer related conditions and paraneoplastic syndromes including:
  - Hypercalcaemia
  - Ectopic hormone production
  - Raised intra-cranial pressure
  - Anaemia
  - Cancer-associated thrombosis

2.1.10 Current Research and Literature

- Ongoing major multi-centre clinical trials
- Recent major publications in medical journals

2.2 *SKILLS AND CLINICAL EXPERIENCE*

Candidates is expected to have acquired effective communication skills in breaking bad news, discussion of treatment options and prognosis, and obtaining consent from patients for treatment. Candidates need to have gained a wide range of practical experience in the areas of investigation, diagnosis, treatment with radiation, chemotherapy, hormonal therapy, biological therapy, and palliative and supportive care, as detailed below.

2.2.1 Radiotherapy Basic Techniques

(a) Positioning the Patient

- Setting up patients in each of the three basic treatment positions (supine, prone and lateral) to allow patients to be planned and treated effectively and without discomfort
- Setting up the source skin distance for fixed FSD, and extended FSD treatment
- Setting up for iso-centric treatment
- Setting up patients using laser beam alignment
- Setting up patient using kV and MV imagers
- Making temporary and permanent marks on patients for field positions (gentian violet, tattoo)

(b) Immobilisation Techniques

- Application of the following immobilisation techniques: head-clamp, ~~Velcro strap,~~ polystyrene beads, vac-lock, alpha-cradle, breast armrest
- Application of thermoplastic casts
- The construction of thermoplastic casts

(c) Motion Management

- Application of 4DCT with and without synchronized contrast injection
- Application of motion effect suppression techniques (e.g. abdominal compression, breath-hold and respiratory-gating)

(d) Simulation

- Knowledge of simulation techniques (conventional simulator, CT simulator and MRI simulator)

(e) Methods of Target Volume and Critical Structures Determination

- Performance of planning
- using direct vision of the tumour (e.g. skin tumours)
- from surface landmarks (e.g. the parotid bed, breast tumours)
- by volume transfer to radiographs (e.g. head and neck tumours, brain tumours)
- Volume determination from planning CT scans for creating a central axis plan and for 3-dimensional CT planning
- Registration of planning CT images with images from MR scans and CT-PET scans for treatment planning

(f) Outline Techniques

- Use of CT derived outlines
- Knowledge of manual techniques (flexi-curves, plaster of Paris bandage)

(g) Basic Field Arrangements

- Planning of treatments (under supervision where necessary) using the following field arrangements:
- Single direct field
- Opposed pair of fields using equal and unequal weightings
- Opposed pair using wedges
- Wedged right-angled pair
- Wedged oblique pair
- Plans using 3 and 4 fields
- Plans using non-coplanar multiple field (>3) arrangement
- Plans using Arc

(h) Tissue Compensation

- Planning of patients requiring tissue compensation using bolus, wedges or remote tissue compensators

(i) Shielding

- Planning of patients using metal cut outs / insert or masks for simple superficial tumours
- Knowledge of the thickness of lead required for superficial, orthovoltage and electron treatments at various energies
- Prescription and insertion of eye shields knowledge of intra-nasal shields

(j) Megavoltage x-ray Techniques

- Knowledge on lead blocking techniques, cast blocks from templates, and MLC
- Knowledge on possible radiotherapy delivery techniques, including static and rotational IMRT / SBRT / SRS
- Knowledge of Total Body Irradiation
- Knowledge of Image-Guided Radiotherapy, adaptive radiotherapy and evaluation of the methods available

(k) Electrons

- The indications for, and planning of, electron treatments, including the selection of electron energy
- Knowledge of Total Skin Electron Therapy

(l) Dose Calculation

- Proficiency in the use of equivalent square tables, output factors, wedge factors, applicator / insert / cutout factors
- Performance of depth dose calculations for single field and opposed fields using various energies
- The principles of computer-based treatment planning

(m) Radiotherapy Prescriptions

- Writing radiotherapy prescriptions (countersigned where necessary) for all the field arrangements mentioned above
- Understanding of dose specification as in ICRU 50, 62 and 83
- Description of treatment intent by specifying dose levels, dose constraints and dose-volume constraints of target volume and critical normal structures
- Application of Biological Effective Dose (BED)

(n) Radiotherapy Treatment Plan Assessment

- Treatment plan assessment using the following tools:
  - Isodose lines and isodose colour wash
  - Dose volume histogram, including dose-volume indices, (near) maximum and (near) minimum doses
  - Conformity index, gradient index, target dose uniformity
  - Dose level at prescription point (e.g. ICRU reference point)
- Knowledge on the usage of biological indices (e.g. TCP, NTCP)

(o) Radiotherapy Machines

- Planning of patients for treatment on a full spectrum of equipment, including megavoltage x-ray therapy and megavoltage electron therapy (also superficial x-ray therapy, orthovoltage x-ray therapy and cobalt-60 therapy, if available)

(p) Quality Assurance in External Beam Therapy

- Requesting treatment setup verification imaging including planar kV / MV image and CBCT / MVCT, and interpretation of their appearance satisfactorily in all relevant sites
- Principles of in vivo dosimetry and interpretation of results

(q) Brachytherapy

- The insertion and removal of radioactive sources manually or using an appropriate afterloading device
- Interpretation of subsequent check films / images
- Interpretation of the corresponding dose calculation and writing of an appropriate prescription
- Prescription and treatment plan assessment of 3D image-guided brachytherapy
- Removal of live sources (if applicable) and the afterloading device
- Knowledge of the placement of implants
- Principles and experience of prescribing oral and intravenous radionuclide therapy

(r) Radiation Safety

- The role of the radiation safety and radiation protection supervisor
- The meaning of and requirements for controlled and supervised areas and their location
- The procedure to be adopted in the case of a spill of radioactive material
- Quality assurance practices in radiotherapy and the procedures for dealing with errors in treatment delivery

(s) New Radiotherapy Techniques

- Knowledge of MRI linear accelerator and proton beam therapy
- Potential application of artificial intelligence in radiotherapy

2.2.2 <u>Radiotherapy Assessment and the Care of Patients on Treatment</u>

(a) Treatment Review Clinics

- Regular treatment review clinics

(b) Treatment Checks

- Assessment of patient position and treatment field placement(s) in relation to the target volume at the start of treatment
- Performance of checks during the course of treatment on the implementation of the treatment plan, position of shielding(s) for critical normal structures and the use

of portal imaging
- Assessment of changes occurring in patient parameters during treatment and resultant modification of treatment when appropriate
- Assessment of normal tissue reactions to radiotherapy
- Use of in vivo radiation dosimetry techniques
- Management of un-planned treatment interruption

(c) Symptom Control
- Giving advice on skin care during radiation treatment and on the management of skin reactions, including desquamation
- Managing mucosal reactions in oral cavity, oropharynx, nasopharynx, trachea, oesophagus, anus and vagina
- Giving dietary advice during radiotherapy
- Managing radiation-induced nausea and vomiting, diarrhoea, odynophagia, xerostomia and cystitis
- Giving prophylaxis for radiation-induced cerebral oedema
- Giving advice on timing and extent of hair loss with respect to radiation dose

(d) Follow-up
- Managing acute and chronic radiation sequelae, such as pneumonitis, cystitis, chronic bowel complications and gynaecological sequelae (vaginal stenosis, vaginal dryness, infertility and dyspareunia)

2.2.3 Drug Therapy

(a) Access Technique for Sampling and Delivery
- Insertion and maintenance of intravenous lines for both sampling of blood and delivery of systemic anti-cancer drugs, including temporary sharp cannulation (butterfly type) and intermediate term flexible cannulation (venflon type)
- Arrangement of the insertion of Hickman or temporary long lines (PICC) and subcutaneous implanted lines (portacath type), their use for sampling (where possible) and the delivery of systemic anti-cancer drugs and maintenance for protracted used
- Principles, regulations and guidelines for the delivery of intrathecal chemotherapy

(b) Drug Delivery
- The indications and eligibility of a wide variety of systemic anti-cancer drugs, and their side-effect profiles as single agents and in combinations
- Prescription and delivery of drugs in current usage

(c) Support Techniques
- Pre-hydration and maintenance of urine flow and modification of urine pH during chemotherapy delivery
- Prescription of protective agents, e.g. folinic acid (oral and iv) with MTX level monitoring or Mesna with appropriate chemotherapy regimens
- The use of anti-emetics
- The appropriate use of colony stimulating factors, prophylactic antibiotics and pre-emptive use of anti-viral drugs
- The appropriate use of bone marrow reconstitution techniques after high dose chemotherapy/TBI

(d) Monitoring during drug therapy and management of Acute Complications
- Managing extravasation reactions caused by vesicant drugs
- Managing patients with systemic anti-cancer treatment-induced neutropenia, with and without pyrexia
- Managing systemic anti-cancer treatment-induced thrombocytopenia, including the use of platelet transfusions
- Managing immune-related adverse effects

(e) Chemotherapy Safety
- Principles and practice of chemotherapy safety

- The procedure to be adopted when a spillage of cytotoxic drugs

2.2.4 Supportive and Palliative Care

(a) Pain Relief

- Drug treatment
  - A wide-range of analgesic including non-opioid analgesics, mild and strong opioids, given by a variety of routes
  - Prophylactic measures and management of the complications of analgesics, including constipation, nausea and vomiting, and analgesic intolerance
- Non-pharmacological interventions
  - Referral of patients to other healthcare profession, such as physiotherapists and occupational therapists for non-pharmacological interventions for pain control, and social workers and clinical psychologists for psychosocial support.
  - Referral of patients with refractory pain to pain specialists for procedures such as a nerve block, intrathecal analgesia, rhizotomy or orthopaedic stabilisation
- Oncological treatment including radiotherapy
  - Use of irradiation to treat painful metastatic disease with single-fraction, fractionated, and hemi-body radiotherapy

(b) Nausea and Vomiting

- Treatment of nausea and vomiting arising in advanced illness using anti-emetics
- Palliative management of intestinal obstruction

(c) Anorexia and Dysphagia

- Management, where appropriate, with corticosteroids, progestogens and nasal gastric feeding

(d) Pleural Effusions and Ascites

- Drainage of pleural effusions and ascites
- Other treatments, such as talc pleurodesis

(e) Depression and Anxiety

- Treatment of depression at all stages of cancer management, using counselling and drug techniques with anti-depressants
- Treatment of anxiety with counselling, anxiolytics and major tranquillisers

(f) Hospice Care

- Awareness of local palliative care / hospice facilities
- At least one-week clinical training in a palliative care team
- Principles and practical experience (optional) in discussing advance directive and DNACPR, and carry out advance care planning for patients with terminal cancer

(g) Breaking Bad News

(h) Counselling

- Counselling of patients and relatives at all stages of the neoplastic disease

2.2.5 Investigational Techniques

(a) Laboratory Investigations

- Interpretation of the results of haematological, biochemical, radio-immune assay and molecular investigations

(b) Radiology

- Regular attendance at radiological meetings involving a clinical radiology specialist for the review of plain x-rays, CT scans, magnetic resonance imaging, PETCTscan and/or ultrasound covering the whole spectrum of cancer radiology

- Current indications and techniques in interventional procedures

(c) Pathology

- Attendance at regular pathological review sessions / clinico-pathological conferences

(d) Other Procedures

- Experience in performing the following procedures:
  - Indirect laryngoscopy
  - Lumbar puncture
  - Fibreoptic naso-endoscopy (optional)
  - Laryngoscopy (optional)
  - Pelvic EUA and cystoscopy (optional)

2.2.6 Site or Disease Specific Procedures

- Assessment, treatment and follow-up, in detail, for each of the anatomical sites and types of tumour listed at paragraph 4 of the "Knowledge" section above
- Presentation and assessment of patients discussed at multidisciplinary team meeting
- Staging
- Radiotherapy:- neo-adjuvant, adjuvant, radical and palliative
- Chemotherapy:- neo-adjuvant, adjuvant, radical and palliative
- Hormone and biological therapy
- Palliative care
- Rehabilitation
- Survivorship
- Acute and late side effects of treatments

2.2.7 Clinical Trials, Literature and Research

- The aims and format of Phase I to IV clinical trials
- Obtaining informed consent, following study protocols and using data forms
- Research programmes (although research experience is not a prerequisite)
- Major areas of current research and of recent important publications
- Submission of a research project to an ethics committee
- Structure and functioning of clinical and research cancer networks

2.2.8 Communication and Publication

- Effective communication with colleagues, patients and their carers
- Giving clear and comprehensive descriptions of disease processes, investigations and treatment
- Clear expression in English and production of legible script
- Preparing work for publication

2.2.9 Outpatient and Joint Clinics

- Participation in joint consultative clinics and regular general oncology outpatient sessions
- Seeing review and new patients and planning their overall management
- Attending multidisciplinary meetings

2.2.10 Resource Management and Quality Assurance

- Introduction to the resource management and quality assurance of an oncology service, so as to be able to develop these skills at a later stage

3.0 HIGHER SPECIALIST TRAINING PRIOR TO EXIT ASSESSMENT

3.1 The two-year Higher Specialist Training aims at providing a broad knowledge-based

exposure to various aspects of oncology including the development of subspecialization in two fields of interest such as Breast, Gastrointestinal, Genitourinary, Head & Neck, Lung, Gynaecological, Neuro-oncology, Musculoskeletal, Palliative care etc.

3.2 The program differs from Basic Specialist Training in that more emphasis will be put on independent performance and supervising responsibility.

3.3 In addition to clinical training, trainees are given the opportunities to lead or involve in:

- Teaching activities: (to clinicians, junior trainees, radiographers, nurses, interns, medical students and other discipline whenever required) to attain in-depth knowledge of a subject, to improve on presentation skills and to manage and contribute to teaching materials.
- Audit and quality assurance activities: Before Exit Assessment, trainees should submit at least one **original** audit report in which they take up independent leading role in the submitted audit project. The pertinent audit project should be clinically oriented and is recommended to be related to their subspecialty training.
- Academic activities: research techniques, presentation skills, appraisal of literature. (Please refer to P.4: Training Requirements – (C) Higher Specialist Training – Item 7.0)
- Nurture of professional attitude (ethical standards, legal responsibility, professional image, contribution towards professional organizations and activities, co-ordination with clinical colleagues for better healthcare).
- Administrative skills and practice.

3.4 Subspecialization training during Higher Specialist Training with a defined period and documented workload. Sessional attachment to other accredited Clinical Oncology training centres may be required.

3.5 Trainees who are interested in subspecialty development can enter Subspecialty Training in conjunction with Higher Specialist Training in general oncology. (Please refer to the training guidelines for the corresponding subspecialty.)

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