CERTIFIED FELLOWSHIP IN NUCLEAR THERANOSTICS

[Syllabus Approved by Board of Studies, Medical & Health Sciences]

Programme Code	:	HLTH14A11
Programme Details	:	2-YEARS HBNI CERTIFIED FELLOWWSHIP IN NUCLEAR THERANOSTICS
Programme Learning Outcomes (PLOs / PSOs)	:	MENTIONED [COMMON FOR ALL 2 YRS HBNI CERTIFIED FELLOWSHIPS OFFERED AT TMC]
Eligibility Criteria	:	MD/DNB IN NUCLEAR MEDICINE.
Duration of the Course	:	2 YEARS
Programme Structure (Credit-Based)	:	NA
Detailed Course Syllabus	:	ATTACHED
Teaching–Learning Methodologies	:	2 YEARS PROGRAM
Examination & Evaluation System	:	ANNUAL APPRAISAL FOLLOWED BY UNIVERSITY FINAL EXAMINATION
Internship / Project / Dissertation Guidelines	:	NA
Program In Charge	:	PROF. VENKATESH RANGARAJAN (***drvrangarajan@gmail.com*** ***)***

CERTIFIED FELLOWSHIP (NUCLEAR THERANOSTICS)

Programme Code: HLTH14A11

Programme Outcome:

- The HBNI Fellowship Programmes at Tata Memorial Centre are designed to develop competent, ethical, and academically oriented healthcare professionals with advanced knowledge and skills in their respective specialties and subspecialties.
- At the completion of the fellowship, candidates are expected to demonstrate excellence in clinical practice, patient-centered care, multidisciplinary teamwork, communication, professionalism, and evidence-based decision-making.
- Fellows shall acquire the ability to independently evaluate, diagnose, plan, and manage patients while adhering to institutional protocols, quality standards, patient safety practices, and ethical principles in healthcare delivery.
- The fellowship programmes also aim to foster academic growth, research aptitude, lifelong learning, and leadership qualities among trainees.
- Fellows are expected to actively participate in teaching, seminars, journal clubs, conferences, audits, and research activities, thereby contributing to the advancement of medical science and institutional development.
- Upon successful completion of the programme, the fellow should be capable of functioning independently as a skilled specialist/subspecialist with competence in clinical services, academics, research, and collaborative healthcare practice in tertiary care and oncology-focused settings.

DETAILED SYLLABUS

TITLE: TWO YEAR HBNI FELLOWSHIP IN NUCLEAR THERANOSTICS

- **Introduction:**
  - Theranostics means therapy & diagnostics. This is achieved by many modalities, but in this fellowship, we will cater to the Theranostics Programme using radioisotopes only. In the MD/DNB curriculum, while this topic is well covered, Many important areas like Research and Process of Bench to bedside, are not adequately covered due to nonavailability of resources. At Tata Memorial Centre, Mumbai units of TMH & ACTREC, excellent facilities and infrastructure exists to expose the fellows to multidisciplinary Theranostics. The 42-bed high dose isotope therapy unit at RRU block of ACTREC, which also has integrated Interventional radiology unit, comprehensive hybrid imaging units consisting of PET/CT, SPECT/CT & PET/MRI. Also, the unit has the necessary infrastructure of Hospital Radiopharmacy and a comprehensive preclinical imaging unit.

- **Prospect of the Programme, outcome and job opportunity**
  - The programme prepares the candidate in diagnostics and therapy of Cancer patients. Nuclear Medicine in Oncology is the fastest growing subspeciality in Nuclear Medicine. The programme prepares the candidate to work effectively in cancer centres and in research Institutes, to undertake, desk to bedside- research.
  - Outcome: At the end of the programme, the candidate will be a successful specialist with comprehensive knowledge of NuclearTheranostics. he will be able to setup Regulatory compliant facility for Theranostics Practice and research. This will groom the Candidate to take up academic research in comprehensive nuclear medicine.
  - Job Opportunity: There is ample job opportunity in both academic – both private and government centres at least for a decade. Excellent opportunity exists in any cancer hospital or oncology unit of a large hospital. In the last decade it is seen that Nuclear Theranostics is one of the fastest growing subspeciality of oncology.

- **Total duration of the Programme**
  - TWO ACADEMIC YEARS for Nuclear Physicians with MD or DNB in Nuclear Medicine.
  - Daily ward rounds, scan sessions, journal club, seminars, review of Projects, teaching MD Residents would be the core activity. Capsules of Hospital Radiopharmacy, quality control, dosimetry and preclinical imaging are the special areas of training that will be offered.

- **Detailed academic curriculum with syllabus and semester wise distribution of courses**

SYLLABUS: FIRST YEAR

- **Basic Science aspects of Nuclear Medicine Therapy**
  - Characteristics of Therapeutic radionuclides and radiopharmaceuticals, methods of production of radionuclides, quality control measures of new radiopharmaceutical development.
  - Tracer Kinetic Models, compartmental analysis and software-based dose estimates
  - Principles of Internal Dosimetry: Calculation of the radiation dose from internally administered radionuclide
  - Radiobiology and Health physics
  - Radiation Protection in therapeutic set up: Design of Isolation ward as per the norms of AERB. Principle of waste management and decontamination.
  - Principal of Out Patient Department and ln-door therapy. adrnlntstratlon
  - Nuclear Accidents: nuclear fallouts, either due to nuclear reactor accidents or due to war-time events, protection measures and preparedness, treatment at the time of over radiation exposure and dealing with long-term sequelae.
  - Research methodology. Good clinical Practice, Institutional ethics committee, regulatory process for research in clinical nuclear medicine.
  - BIOSTATISTICS FOR IMAGING
  - EBM - Evidence based Medicine & EBM in imaging
  - HTA Health technology Assessment

- Hierarchy of studies on Diagnostic Tests
- Diagnostic Performance: gold standard or reference Measures of diagnostic performance sensitivity, specificity,FN-FP rate Predictive values, Diagnostic accuracy and disease prevalence Bayes' Theorem, Likelihood Ratios, Graphs of conditional Probability Cut-off & ROC curves.
- Variables and measurement scales, Normal distribution, and Confidence Intervals. Variables and measurement scales: Categorical Variables, Discrete Numerical Variables , continuous Numerical variables, Measurement Scales.
- **Gaussian Distribution**: Basics of Descriptive statistics: — Measurement of central Tendency, -variance & standard deviation- standard error of mean confidence intervals and of proportion
- Null Hypothesis, statistical significance and power principle of falsification- Type 1 error, type 2 error, statistical power, value of 0.05,p value.
- Parametric statistics comparison between 2 sample means: student's T test the link with confidence intervals comparing 3 or more sample means: analysis of variance, ANOVA for independent groups and for Paired data. Parametric statistics in radiology.
- NON PARAMETRIC STATISTICS One sample with two paired Measurements: variables measured with Dichotomous scale- Ordinary scale- internal. or Rational scales Two independent sample:- measured with Nominal or ordinal scales/ Interval or Rational scales test of significance Rank Correlation Three or more (k) dependent sample.
- **LINEAR CORRELATION & REGRESSION**: association & causation correlation between continuous variables interpretation of r value
- Quality of life analysis
- Survival analysis
- Writing systematic reviews, funding proposals and other papers.
- Cause of death reporting.
- **PRECLINICAL IMAGING & RESEARCH:** Principles and practice of preclinical research. – technologies
- Preclinical/animal Imaging with Isotopes and Radiopharmaceuticals. Imaging technics in preclinical imaging, sedation of animals, animal preparation Animal Ethics committee and regulatory aspects of preclinical research.

- **HOSPITAL RADIOPHARMACY**: Principles of Hospital Radio pharmacy. Radiation safety and principles of safe handling in Hospital Radio pharmacy Radiopharmaceutical Formulation Active pharmaceutical ingredient Quality control – daily, periodic.
- Good manufacturing Practice – GMP standards
- REGULATORY GUIDLEINES FOR HOSPITAL RADIOPHARMACEUTICALS
- **DOSIMTERY:**
  - Dosimetry with gamma camera- PLANAR & SPECT & CT techniques
  - Models of dosimetry
  - Biological dosimetry
  - Voxel Dosimetry
  - Using TLD for cumulative dosimetry
  - Using Thyroid uptake Probe

Clinical Therapeutic Nuclear Medicine: YEARTWO

- Therapy in Thyroid disorders; benign thyroid diseases, aetiology of hyperthyroidism, various modalities of treatment and follow up strategy, long-term outcome and various national and international guidelines and regulations pertaining to therapeutic administration of radionuclides.
- Etiopathology, classification and diagnosis of thyroid malignancy; various modalities of treatment and follow up strategy, Long-term outcome and various national and
- international guidelines and regulations pertaining to therapeutic administration of radionuclides
- Bone pain palliation using various radionuclides such as P32, Sr89, Sm153, Lu-l77 etc. Patient selection, response evaluation, toxicity identification and care. Narcotics and drug selection Pain control with interventional radiology technics of bone stabilization and cementing.
- Radio synovectomy Intraarticular injections, patient selection, monitoring, post treatment support
- Radiopeptide therapy in Neuroendocrine Tumours Principles, route, for PRRT, selection, sandwich therapies and response evaluation.
- Radio conjugate therapy for Neuroblastoma, paraganglioma and malignant
- Pheochromocytoma 131I MIBG, PRRT, other Radiopharmaceuticals based therapies.

- Imaging with 18 F FDG, 131I MIBG, 18 F DOPA, 68Ga RGD, 68Ga DOTA NOC.
- Radioimmunotherapy for follicular lymphoma and other solid tumours 131I, 177Lu 90Y based formulations Experience reported in literature Patient selection, response evaluation and dosimetry, toxicity
- Locoregional internal radiation therapy for hepatocellular carcinoma and others
- Planning a TARE Hepatopulmonary shunt evaluation and quantification Impact of TACE Radiopharmaceuticals for TARE
- Radionuclide patches for treatment of cutaneous lesions/malignancies
- Research agents in radionuclide therapy eg FAPI, ZOL, RGD etc.

Recent Advance in Nuclear Medicine

Covering all aspects of the following areas:

- **Instrumentation**: Intraoperative probes, imaging PET, SPECT.MRI
- **New Development of Radiopharmaceuticals**: Understanding formulations of various Radiopharmaceuticals used in routine and research therapy.
- **Therapeutic procedures**: Emphasis on safe delivery of Radiopharmaceuticals to intended site, confirming to regulatory principles
- **Post processing techniques of CT, PET & SPECT:** For aid of surgical planning, estimating dose and confirming dose delivery.
- Quantitation techniques RECIST, PERCIST, i-RECIST
- Radiomics and Artificial intelligence. And NLP techniques.

Hybrid Therapies & Multimodality Treatment

- Trans Arterial Radio Embolization & Sandwich Therapy between chemo/targeted therapy & Isotope based therapy. Train in patient preparation and post treatment patient care for first 24 hours. For this fellow will be posted in Interventional radiology department and Day care/medical oncology for a period of at least 4 weeks respectively.
- In day care unit, he will be exposed to patient care especially during infusion of antibodies and other chemotherapeutical agents.
- Be able to perform pharmacological stress to study myocardial perfusion abnormalities and cerebral blood flow.
- Evaluation of completion of RFA and other ablative procedures using 18 F FDG or similar agents.

- Study cerebral blood flow dynamics during intervention like carotid balloon inflation, using SPECT/PET agents and cerebral imaging.
- Identify long term and short-term therapy related toxicities using nuclear medicine techniques.

OTHERS:

- Fellows will also attend DMG meetings and Multimodality therapy meetings of various DMGs. Learn treatment pathways as per Disease management group protocols for various malignancies.
- The fellow will be required to write a review article/ prospective/retrospective study.

- **Meeting of credit requirements: NA**
- **Student selection Procedure: As per existing Procedure for HBNI fellowship- entrance test and interview.**
- **Total intake per year FIVE CANDIDATES**
- **Availability of the faculty members for the programme at Institute:**
  MEDICAL: 5 PROFESSORS, 1 ASSOCIATE PROFESSOR, 3ASSISTANT PROFESSORS
  - Dr Venkatesh Rangarajan Professor Nuclear Medicine
  - Dr Nilendu C Purandare Professor
  - Dr Archi Agrawal Professor
  - Dr Sneha Shah Professor
  - Dr Ameya Puranik Professor
  - Dr Sayak Choudhury Associate Professor
  - Dr Indraja Dev Assistant Professor
  - Dr Suchismita Ghosh Assistant Professor
  - Dr Manikandan Assistant Professor 18 Scientific Officers with minimum qualification of MSc Nuclear Medicine--
  - Assistant Professor (non Medical) : 12
  - TECHNICAL SPECIALISTS: SIX
  - RADIATION SAFETY OFFICERS: SIX

- **Availability of stipend /scholarship for the students (DAE approval if any): Candidates**

will receive stipend as per existing norms for fellows as per TMC for year 1 and 2.

- **Annual Tuition fees: as per existing TMC rules.**
- **Examination Pattern: one exit examination – one theory followed by Practical examination. With one external examiner. Both of 100 marks.**
- **Declaration of results: Results will be declared by the Academics office of the Tata Memorial Centre as per existing norms applicable to HBNI fellowship programs**
- **Draft Ordinance: As per existing norms applicable to HBNI fellowship programs**