GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY
RAJYA SABHA
UNSTARRED QUESTION NO-3206
ANSWERED ON 21/08/2025

DAE ROLE IN CANCER RESEARCH TREATMENT

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Will the PRIME MINISTER be pleased to state:-

(a) the role and contribution of the Department of Atomic Energy (DAE) and its affiliated institutions in the national effort against cancer, particularly in the areas of advanced treatment and research;

(b) the major achievements and advancements in treating complex cancer and the extent of inter-departmental collaboration required for such treatments;

(c) the current status of domestic and international collaborations for cancer research within the DAE, along with the key outcomes of these partnerships; and

(d) Government's strategy for making advanced cancer therapies more accessible and affordable to the general public?

ANSWER

THE MINISTER OF STATE FOR PERSONNEL, PUBLIC GRIEVANCES AND PENSIONS AND PRIME MINISTER'S OFFICE (DR. JITENDRA SINGH)

(a) The Tata Memorial Hospital under the Department of Atomic Energy is providing comprehensive evidence-based cancer treatment. The TMC has established 11 hospitals in which 8 are functional/situated at Mumbai, Varanasi, Vizag, Sangrur, Mullanpur, Guwahati and Bhubaneshwar and 3 are under construction. TMC being a premier cancer centre in the country, provides leadership in guiding the national/international policy and strategy for cancer care by

- Promoting outstanding services through evidence – based practice of oncology
- Commitment of imparting education in cancer to students, trainees, professionals, employees and the public
- Emphasizing on research that is affordable, innovative and relevant to the needs of country.

Over the past few years, Department of Atomic Energy (DAE) has developed several key nuclear medicine ligands and targeted therapeutics towards national effort against cancer, especially in the areas of advanced treatment and research. To cater the demand for import substitute radiation-medicine in India, Department of Atomic Energy (DAE) has developed PSMA-617 as import substitute, for use in prostate cancer therapy. The in-house developed nuclear medicine ligand, ^{177}Lu-PSMA617 is regularly being supplied through BRIT to hospitals pan India. Recently, DAE has also developed another nuclear medicine ligand, PSMA-11, as an import substitute, for production of ^{68}Ga-PSMA11 to be used in diagnosis of prostate cancer. In addition, DAE is focusing on the development of DOTA-TATE, as an import substitute for production of ^{68}Ga-DOTA-TATE used for diagnosis of neuroendocrine tumors. New bifunctional bisphosphonate ligands DOTA-SCN-BP and NOTA-SCN-BP have been prepared, radiolabelled and are under investigative clinical trial for their efficacies towards early diagnosis and therapy of skeletal metastasis. DAE has also developed synthesis protocol for affordable, *sesta*MIBI regularly used as ^{99m}Tc-MIBI for heart imaging.

The Department of Atomic Energy (DAE) is working towards the development of targeted chemotherapy for human triple-negative breast cancer. For treatment of neuroblastoma, a targeted drug delivery system "MIBG conjugated doxorubicin" is developed, which significantly reduces side effects on heart.

The Board of Radiation & Isotope Technology (BRIT), an industrial unit under the Department of Atomic Energy produces and supplies a wide range of radioactive products (sealed and unsealed radioactive sources) to hospitals across the country for management of cancer, details of which are given below.

BRIT fabricates and supplies sealed radioactive sources containing the radioisotope Cobalt-60 for use in teletherapy machines towards treatment of various malignant tumours. ~10-12 numbers of Co-60 Teletherapy sources are fabricated and supplied to various hospitals by BRIT every year. Iodine-125 and Ruthenium-106 based brachytherapy sources are also supplied for treatment of cancers of eye, cervix, prostate etc.

The Varibale Energy Cyclotron Centre (VECC) is one of the R&D unit under DAE developed the proton beams from 30 MeV Medical Cyclotron Facility (MCF) at Chakgaria is producing radioisotopes / radiopharmaceuticals, which are used for cancer diagnostics and are being delivered on regular basis to various hospitals/ Nuclear Medicine Centres. Commercial production and supply of Radiopharmaceuticals, 18F-Sodium Fluoride (for bone scanning), and Gallium-68-PSMA (for diagnostics of Prostate cancer) have been started.

(b) In Department of Atomic Energy (DAE), extensive research is focused on the development of indigenous nuclear medicine ligands for the treatment of complex and therapeutically resistant cancers like Neuroendocrine tumor (NET), Pancreatic ductal carcinoma (PDAC) and Triple negative breast cancers (TNBC). In this pursuits, research and development work is going on to develop targeted/precision therapeutics to cancer with significantly lower side effects. Therapeutics are developed at preclinical levels to target specific mutations or higher dependency on specific organelles.

Some of the of achievements and advancements in treating complex cancer by TMC are:

- National Facility for Hadron Beam Therapy at ACTREC
- India's first homegrown CAR T-Cell therapy for cancer treatment
- PREVALL – First and only oral suspension of Mercaptopurine used in the treatment of Acute Lymphoblastic Leukemia developed by TMC, DAE.
- Breakthrough Nutraceutical AKTOCYTE by the Department of Atomic Energy set to Transform Cancer Care
- RANS-ARTERIAL Radioembolisation Using Indigenously Sourced Y- 90 Microspheres (*BHABHASPHERES*)
- Largest Radiological Research Unit (Therapeutic Nuclear medicine unit)

(c) Within DAE, active collaborations between Bhabha Atomic Research Centre (BARC), Board of Radiation and Isotope Technology (BRIT) and Tata Memorial Centre (TMC) are ongoing for developing nuclear medicines and targeted medicines. Currently, several in-house developed nuclear medicine ligands are used for the diagnosis and therapy of thousands of cancer patients at hospitals pan India. BARC, in collaboration with Tata Memorial Centre (TMC), has also developed chlorophyllin based nutraceutical tablets to reduce the long-term side effects of radiotherapy in pelvic cancer patients.

National and International collaborations for cancer research within the DAE and the details of key outcomes of these partnerships:

Participation in Collaborative Programmes involving the R&D units of DAE

Name of the R&D unit: Bhabha Atomic Research Centre

1. **Nature of the collaboration**: The collaboration is primarily for research cooperation to develop drugs and devices. Two important gains in the field of drug development include the launch of chlorophyllin as a nutraceutical for radioprotection following the successful completion of a phase 2 clinical trial in radiotherapy-induced hemorrhagic cystitis, and the completion of preclinical investigations of diselenodipropionic acid (DSePA) as a lung radioprotector.
In addition, four task forces have been created involving scientists from TMC and BARC to spearhead development work in novel drugs, radiopharmaceuticals, biomarkers and AI/ML. The progress is being overseen by a steering committee comprising of senior scientists from both institutions.

2. Stereotactic Nuero Navigation System with BARC

Passive serial arm-based coordinate measuring mechanism was finalised, the development for the same was initiated. Further the scope of research work was extended to incorporate a robotic system which can be used minimally invasive neurosurgical procedures (biopsy sample collection) with high accuracy. At this stage the "Robot assisted Neurosuit" was formulated

3. Collaboration with Institute for Plasma Research (IPR) for setting up of a Bio Medical Waste Treatment Facility at TMC at Varanasi

TMC Has entered into a MoU for setting up of Bio Medical Waste Treatment facility based on 200 kgh plasma pyrolysis system at Varanasi. The facility is echo friendly disposal technique. The technology has been approved by MoEF for biomedical waste

disposal. IPR has transferred this technology at a lower scale to several industrial partners.

4. Tata Memorial Centre (TMC) collaboration research with the **Heavy Water Board (HWB), Department of Atomic Energy**, to investigate the potential anticancer effects of **Deuterium-Depleted Water (DDW)**.
The study result was presented in a 'Symposium on Synthetic Biology' organized by Society of Biological Chemistry India (SBCI). Other high throughput molecular assessments such as genomic sequence analysis of DDW treated vs normal water treated condition are ongoing. The study is currently ongoing, with planned sample size of 228 patients. Results and statistical analysis will be available on completion.

5. Indigenous developed neuronavigation system (TMC – BARC)
The results, including accuracy, reachability, and ease of use, were documented and used to evaluate the system's performance.

6. Collaboration with ACTREC- TIFR
Standardization of bioassay and Development of peptide based rapid test monitoring of inflammation status and screening of potential efficacy drugs for Cancer management.

Potential therapeutic drugs (ayurvedic compositions, chemical-based) can be tested in rapid test to predict if these drugs would show efficacy consequently upon treatment

7. Collaboration with Assam Cancer Care Foundation
A joint venture of Government of Assam and Tata Trusts, is executing a project called Distributed Cancer Care Model to build affordable cancer care network with 17 cancer care hospitals spread across the State. Recently a gap analysis was done by this ministry regarding the infrastructure for cancer treatment in the country.

It is seen that in many of the States/UTs the cancer care facilities need to be done much. A letter has been sent to all States/UTs on the Assam Cancer Care Model of the State Government of Assam and asked the States/UTs to implement as per their State specific adaptation.

8. Collaboration with Govt. of Bihar for setting up of Palliative Care Facility:
Homi Bhabha Cancer Hospital Muzaffarpur has received INR 112 Cr Grant from Bihar Government to establish a Model Palliative Care Centre with 100 Beds facility & dedicated Academic Block to start Course's on Palliative Medicine for Medical & Nursing Students. It will be First such Centre of India Constructed & Managed by Govt. entity. The work is under progress.

9. Strengthening Cancer Care in Arunachal Pradesh
A Memorandum of Understanding was signed between the Department of Health and Family Welfare, Government of Arunachal Pradesh, through the State Cancer Society of Arunachal Pradesh, and Tata Memorial Centre, Mumbai, through Dr. B. Borooah Cancer Institute (BBCI), Guwahati. The aim of this partnership is to strengthen the State Cancer Institute (SCI) and establish it as an autonomous, state-of-the-art, tertiary cancer care facility. Key Initiatives & Activities include holding Cancer Screening Camps with SCI and TRIHMS, Arunachal Pradesh, Total 1266 persons were screened and Indian Medical Council, SCI and TRIHMS, Arunachal Pradesh, Total 1000 persons were screened. Online District-wise training for early detection of common cancers for

all Community Health Officers (CHOs) in Arunachal Pradesh. Conducting Cancer Awareness program for teachers across the state in collaboration with Department of Education**,** Government of Arunachal Pradesh – 800 participants

10. Gastric Cancer Study (Pilot Phase): Endoscopic screening of **203 volunteers initiated**, Biopsy performed for all 203 participants, one patient diagnosed with gastric cancer and successfully treated at BBCI.

11. Collaboration with Ministry of AYUSH

DAE/TMC is setting up a medicinal plant with cancer research facility at Khopoli, near Mumbai, in collaboration with the ministry of AYUSH to conduct research on AYUSH formulations and their utility in cancer management. The work is under progress.

International collaborations

1. MoU with Roche (Indonesia) for the Training of General Practioners & Nurses in Indonesiain the field of Patient Navigation (oncology). The oncology services in Indonesia are still underdeveloped & there is a request to TMC for collaboration in the field of developing Cancer Care facilities; Training of Oncologists; development of Cancer Registries; upgradation of Preventive Oncology services in Indonesia. A total of 72 observers/trainees have been benefited in the financial year 2023-2024.

2. Collaboration with IAEA & WHO Activities/contributions by Department of Nuclear Medicine & Molecular Imaging TMC

- ✓ Beneficial change in the behavior of an organisation, community, individual as a result of adoption or use of project outputs
- ✓ National level training workshops in theranostics. For Imparting uniformity of training and education in RCA member countries.
- ✓ Project contributed by imparting training to project team members through its various meetings
- ✓ Project in Neurooncology and paediatrics: Participants from India in RTC; sin Kyoto and Yogyakarta were trained and are now leading investigators of projects in Neurooncology and pediatrics. Institutional review board submissions and approvals are now available.

3. FARO Research Network (FERN) coordinates research activities in Asian region FERN secretariat is located in ACTREC, Tata Memorial Centre, Navi Mumbai, since 2023 and coordinates activities in collaboration with the research committee and FARO secretariat. FERN is organized into various working groups.

- ✓ **FERN GYN 001:** Impact Of Molecular Pathological And Clinical Features For Adjuvant Treatment Selection In Endometrial Cancer: Multicentric Asian Registry (IMPACT Endo Asia. (**Project Coordination: India, Thailand, Indonesia)**
- ✓ **FERN GYN 002:** Asian Gynecological Brachytherapy Registry (**Japan, India, Thailand, Indonesia)**
- ✓ **FERN BR 001:** Burden of Financial toxicity in breast cancer patients treated with curative intent: a multinational study from low- and middle-income countries.
- ✓ **FERN HN 001:** Development and Validation of Multicentric Prognostic Model for Oral Cavity Cancers to predict response to postoperative RT
- ✓ **FERN GI 001:** Asian Wait and Watch registry for Locally Advanced Rectal Cancers

4. The International Collaboration for Research Methods Development in Oncology (CReDO) initiative is a collaboration between the National Cancer Grid (NCG) and the Tata Memorial Centre (TMC)

These studies have brought out intervention and practices which will be useful globally. These studies are reviewed and monitored by the NCG-CRO to ensure stringent data quality and adherence to the regulations.

The network now has a robust infrastructure and trained staff to conduct clinical trials for biosimilars and other investigator-initiated studies. The network has developed common SOPs for clinical trials and Ethics committee. The NCG has developed training modules for all aspects of clinical trial conduct which are open access through the NCG MOOCs platform. The network has created registries for breast, lung, gall bladder, colorectal cancers, lymphomas and CML.

5. Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)

Tata Memorial Hospital in Mumbai today launched a specialised cancer care training programme for BIMSTEC countries, aimed at strengthening regional cooperation in healthcare. The initiative will not only help improve cancer care but also help establish a network for further collaboration and research among BIMSTEC countries.

The four-week program at TMC focuses on Radiation Oncology, Nuclear Medicine, and Radiology, providing hands-on experience with advanced diagnostic and therapeutic techniques. The initiative is expected to have a lasting impact by improving cancer care, expanding the reach of cancer control activities, and strengthening the overall BIMSTEC partnership. The Tata Memorial Centre emphasizes a multidisciplinary approach to cancer care, which is also being shared with the participating BIMSTEC countries.

6. The collaboration between IAEA and Tata Memorial Hospital (TMC) focuses on enhancing global cancer care, with TMC designated as an IAEA "Anchor Centre".

This partnership aims to train healthcare professionals, organize specialized training programs, and support radiotherapy and medical imaging facilities, particularly in low-and-middle-income countries (LMICs). The outcome includes strengthening cancer treatment and research capabilities, and expanding access to cancer care globally, leveraging TMC's expertise and resources. TMC has been recognized for its contributions to IAEA activities and its role as a leading cancer center in India and globally.

7. IAEA's Ray's of Hope Initiative – Anchor Centre' Between IAEA & TMC

The Anchor Centres will train fellows, organize training courses for healthcare providers, participate in IAEA Coordinated Research Projects, promote networking, and provide experts and mentorship to other radiotherapy and medical imaging centres in the neighboring countries. India actively collaborated for IAEA's PACT by donating radiotherapy machines like the Bhabhatron to several developing countries including Mongolia, Sri Lanka, and Madagascar. Experts from Tata Memorial Centre has been serving as global experts in the IAEA imPACT missions for at least 8 countries so far.

VECC is collaborating with BRIT for various radioisotope production at 30 MeV Medical Cyclotron Facility using proton beam. The following R&D efforts have been carried out at the 30 MeV Medical Cyclotron Facility of VECC:

- PET radiopharmaceutical, Copper-64-Chlodide (for Therapy + Diagnostic of cancer) produced on trial basis from solid target of Zinc-68 (Jointly with BRIT)

- SPECT radioisotope Iodine-123 (for Diagnostics of thyroid cancer) produced on trial basis from solid target of Tellurium-124 (Jointly with BRIT).

- Germanium-68/Gallium-68 generator produced on trial basis from solid target of Gallium-Nickel alloy electroplated target (Jointly with BRIT). It will minimize import cost of generator.

- SPECT radioisotope Lead-203 (Pb-203) (for imaging and also cancer therapeutic applications) produced, first time in India, on trial basis from low-cost natural thallium target (Jointly with BRIT).

(d) DAE has remained in the forefront of R&D and production of a variety of nuclear medicines for supply to hospitals and nuclear medicine centers across the country, rendering the treatment in an affordable manner. However, the cost of the treatment is majorly dented by the import cost of the "targeting ligands", one of the key components of nuclear medicines. DAE has been working to indigenize the synthesis and development of nuclear medicine ligands, thus playing a major role in making the treatment cost–effective to the general public. To augment the radio-isotope production capacity, efforts are underway in setting up new isotope production reactor. BARC also collaborates with different hospitals and nuclear medicine centres like AIIMS (Delhi, Bhubaneswar), PGIMER (Chandigarh), JIPMER (Puducherry), KMCH (Coimbatore), Jaslok Hospital (Mumbai) etc. for bringing the affordable healthcare in nuclear medicine sector to the people of the country.

In order to ensure that the products for cancer therapy more affordable to the general public, BRIT ensures that its products are reasonably priced much below that of equivalent imported products.

TMC has initiated and planned a strategy for making advanced cancer therapies more accessible and affordable to the general public in the country through National Cancer Grid. At present 382 members / organizations are connected with NCG which is providing treatment to approximately 8,50,000 new cancer cases. The NCG has potential of massive and far-reaching impact to cover the large number of general public in the country.

Variable Energy Cyclotron Centre (VECC) a unit under Department of Atomic Energy is also engaged in the development of first indigenous 18 MeV Medical Cyclotron (MC18) in India in collaboration with BARC. With this indigenous development the cost of production of radioisotopes will be reduced and will be more accessible and affordable to the general public.

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