

Status of Nuclear Medicine in Pakistan

In Pakistan history of nuclear medicine (NM) starts in 1960 when Pakistan Atomic Energy Commission (PAEC) established the first nuclear medicine facility in Karachi. It was named as Radioisotope Centre, located in Jinnah Post Graduate Medical Centre (JPMC) Karachi which was the largest healthcare facility. The journey continues and till date PAEC has established 18 state of art nuclear medicine and oncology centers in all provinces of Pakistan. After 2010 provincial governments of Sindh and Punjab also contributed by establishing 09 NM centers as well. In 1993, private sectors embarked the ride and first NM facility in private sector was established at Dr. Ziauddin Medical University, Karachi and now we have at least 11 private NM facilities (06 Sind, 03 Punjab, 02 KPK). Following the steps of predecessors, the Aga Khan University Hospital (AKUH) Karachi established its state of art NM facility in 2000.

Most NM centers of Pakistan use radioactive generators (Technetium-99m) and pharmaceutical cold kits produced by Pakistan Institute of Nuclear Science and technology (PINSTECH), Nilore, Islamabad. PINSTECH is the only state of art isotope production facility of Pakistan which is approved by International Atomic Energy Commission (IAEA). In addition, some NM centers also acquire these consumables from foreign vendors like GE-Healthcare UK, MONROL Turkey, ITG Germany and POLATOM Poland.

Most NM Centers are equipped with dual head digital gamma cameras for general purpose nuclear medicine imaging. Some centers also have dedicated digital cardiac cameras meant for nuclear cardiology imaging and Karachi has 05 dedicated nuclear cardiology services. (03 in public and 02 in private sectors). Most commonly performed NM procedures in all centers are thyroid, bone, renal, lung, GI bleed and radioiodine-131 diagnostic and therapeutic imaging. Some NM facility offer specific NM procedures like sentinel node mapping (breast and head and neck cancers), brain death confirmation, gastric emptying and neuroendocrine tumor (NET) imaging. Some NM facilities offer radionuclide therapy for thyroid (using I-131 for toxic goiters and differentiated thyroid cancers) and painful bony metastasis using Strontium-89. Workload and cost of test charges between public and private sector NM facilities are different. On an average each public sector NM facility performs 20-30 procedures per day while private sector usually performs about 10 procedures /day/center. Public sector NM facilities (primarily owned by PAEC) charge either none (for poor and entitled patients) to Rs. 2500-8000 (15-49 US Dollar). Private sector NM facilities charge Rs. 15000-30,000 (91-183 US Dollar) for same procedures. Cost per procedure is the sole reason of higher patient's referral in public sector facilities.

Pakistan entered in hybrid imaging (PET/CT-positron imaging tomography and computerized tomography) in early 2000 by establishing 02 facilities in Lahore. Till to date Pakistan has 11 PET/CT facilities (public sector: 05 and private sector: 06) and Karachi has the maximum number (05) to cater a metropolis of 30 million Karachites. Pakistan has 08 on-site cyclotrons to provide 18-fluorodeoxyglucose (^{18}F FDG) and out of these 5 are conventional (energy range 9.5 -18 MeV) and 03 are small foot print (energy 7.5 MeV; Advance Bio Technology - ABT USA) cyclotrons. AKUH Karachi is the first healthcare facility in this region which acquired this small foot print and fully automated cyclotron in 2015. All PET/CT imaging facilities are using ^{18}F FDG PET/CT for diagnostic purpose and few like AKUH also using it for radiation treatment planning as well. Some facilities

also offering ^{18}F -prostate specific membrane antigen (^{18}F -PSMA) and Gallium-68 somatostatin receptor (^{68}Ga -DOTATOC) imaging for prostate and NET tumors. Two facilities in Lahore are also offering PET-based theranostics using Lutetium-177 labelled PSMA or DOTATOC therapy to treat metastatic prostate and NET tumors respectively. Workload and cost of PET/CT charges between public and private sector PET/CT imaging facilities are different. On an average each public sector PET/CT facility performs 10-12 procedures per day while in private sector number is about 10 procedures /day/center. Public sector PET/CT facilities (primarily owned by PAEC and JPMC) charge either none (from poor and entitled patients) to Rs. 55000 (333 US Dollar) per procedure. Private sector PET/CT facilities charge Rs. 75000 (455 US Dollar) for same PET/CT procedures.

Pakistan has one regular peer review nuclear medicine journal (Pakistan Journal of Nuclear Medicine; www.pjnmed.com) which is an official publication of Pakistan Society of Nuclear Medicine (www.psnmed.com). Pakistan journal of radiology (www.pakjr.com), an official journal of Radiology Society of Pakistan, also provides platform for NM related manuscripts. On PubMed hit (22.8.2021), 878 nuclear medicine publication have been contributed from Pakistan. Pakistan has a comprehensive nuclear medicine education program. Master Science (MS) which is a 02-year program was started in 1989 and degree is awarded by Pakistan Institute of Engineering and Applied Sciences (PIEAS), Nilore, Islamabad. College of Physicians and Surgeons Pakistan (CPSP) started 04 years fellowship program in NM in 2002. Nuclear medicine MD programs (04 years) are offered by Karachi and Dr Ziauddin Universities). Similarly, Karachi University also offers PhD degree in Nuclear Medicine.

Pakistan society of nuclear medicine (www.psnmed.com) is the only professional body of nuclear physicians, technologists and physicists. It has more than 400 members and office bearers are elected every 02 years through e-voting. In addition, Radiological Society of Pakistan (www.radiologypakistan.org.pk) also offers membership to nuclear physicians. Pakistan Nuclear Regulatory Authority (PNRA: www.pnra.org) is the only statutory body of country. PNRA is primarily a licensing body which also ensures safe radiation handling and practices by its licensees in healthcare and other sectors.

In Pakistan, NM has shown a steady growth in last 2 decades but gap between a population of 220 million and number of facilities is wide. It is imperative that government and PNRA must create conducive environment for private sector to come forward to establish NM and PET/CT imaging facilities to bridge the gap.

Conflict of Interest: None

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