



CURRENT SITUATION OF NUCLEAR MEDICINE IN SAUDI ARABIA

Radiology

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ABSTRACT

Objectives: A survey of nuclear medicine services in Saudi Arabia carried out to provide a baseline data information about the practice of Nuclear medicine (NM) by the beginning of 2018.

Methods: An electronic questionnaire was sent to every NM department in Saudi Arabia. Information requested included the equipment, manpower and type of examinations performed.

Results: All the 58 NM services in Saudi Arabia had responded to the questionnaire by October 2018. The overall functioning manpower included 65 NM physicians, 190 NM technologists, 41 nuclear physicists, and only 9 radio pharmacists. At the end of year 2017 there were 21 PET/CT machines in Saudi Arabia (15 machines in Riyadh, 4 in Dammam and 2 in Jeddah), 55 SPECT/CT, 35 SPECT and Gamma camera Machines, and 77 DEXA machines. When adjusted to population, we found 0.6 PET/CT Unit per 1 M people, 3.4 total units (PET and SPECT Cameras) per 1 M people.

Conclusion: The need for reorganizing the distribution of nuclear medicine services including the cyclotrons to cover the whole kingdom equally. Activation of Saudi Society of Nuclear Medicine (SSNM) is mandatory for establishing well recognized Nuclear medicine residency training program including other academic and scientific activities.

KEYWORDS

Nuclear Medicine, Saudi Arabia, Status

INTRODUCTION:

Nuclear medicine is a multi-disciplinary specialty that had developed dramatically worldwide over the past 50 years. Nuclear medicine uses instrumentation and radiopharmaceuticals to study physiological processes and organs function, providing information that cannot be acquired with other conventional morphological imaging technologies. Nuclear medicine procedures are non-invasive modalities used not only for diagnosis, staging and follow up of various diseases but also for therapy in some conditions (1).

Nowadays, the hybrid imaging like Positron Emission Tomography-Computed Tomogram Scan (PET/CT), Single-Photon Emission Computed Tomography-Computed Tomogram (SPECT/CT) and more recently Positron Emission Tomography-Magnetic Resonance Imaging (PET/MRI) scan play a big role in the development of Nuclear medicine practice. Hybrid imaging combines two or more imaging modalities to take advantage of the characteristics of each. Therefore, hybrid imaging can simultaneously provide high anatomic detail, metabolic and/or physiological function, enabling more accurate diagnosis, better care pathways, refining treatment regimes, and improving patient outcomes.

As a part of the global nuclear medicine adventure, Saudi Arabia has made great strides for the developing of nuclear medicine practice. The Nuclear medicine services in Saudi Arabia is provided by many departments through Ministry of Health (MOH), other governmental sectors hospitals(GSH) including: "Armed forces medical services department, Medical Services of National Guard, Medical Services of Ministry of Interior, King Faisal Specialist Hospitals and Research centers, University Hospitals", and multiple Private Hospitals (PH). These nuclear medicine services and centers distributed all over the kingdom through 13 administrative areas.

METHOD:

An electronic questionnaire was sent to every nuclear medicine department in Saudi Arabia. Information requested included the equipment, manpower and different examinations. Most of nuclear medicine services in Saudi Arabia had responded to the questionnaire by October 2018.

RESULTS AND DISCUSSION:

Nuclear Medicine centers and Manpower:

The integration of NM services in Saudi Arabia was one of the first amongst the Middle East countries and has a superb economic and technical advantages due to the incredible support and funding through both governmental and private sectors.

In Saudi Arabia with population of about 33 millions by the beginning of the year 2018 (2), we found that there are 58 centers of NM (7 of them non-functioning); 25 centers (43%) operated by Ministry of Health, 19 centers (33%) operated by other governmental sectors, and 14 centers (24%) by private hospitals. These centers are functioning with manpower of 65 nuclear medicine physicians (55 consultants and 10 registrars and senior registrars). There are 186 NM technologists in Saudi Arabia, most of them seniors with master degrees and 41 nuclear physicist and only 9 radio pharmacists. If we compare that to Nuclear Medicine in France of 65 million population at the end of 2011 with 600 NM physicians working in 220 centers (3), the NM in Saudi Arabia of 33 million population by 2018 is considered a promising developing market with great potential for future growth.

The Equipment:

At the end of year 2017 there were 21 PET/CT machines in Saudi Arabia (15 machines in Riyadh, 4 in Dammam and 2 in Jeddah), 55 SPECT/CT machines, 35 SPECT and Gamma camera machines, and 77 DEXA machines. There were many other DEXA machines in other departments like radiology and private centers not included in our study, table (1). When we adjusted that for population we found 0.64 PET/CT unit per 1 M people, 3.3 total units (PET and SPECT Cameras) per 1 M people, (Fig1).

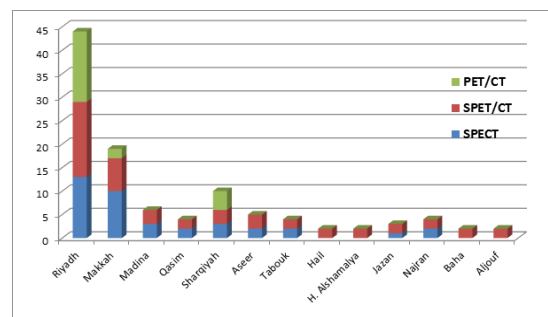


Figure 1: Distribution of NM equipment among the 13 administrative regions within Saudi Arabia, not including DEXA.

Examinations:

Across Saudi Arabia a total of 68135 examinations were done in all services of nuclear medicine including all types of modalities during 2017.

Table 1: Distribution of NM services including equipment and human resources in different regions. Hosp; hospitals, Ctr; center, Dr; doctors, Tec; technologists.

Region	Population	EQUIPMENT & HUMAN RESOURCES									
		Hosp	Beds	NM Ctr	BMD	SPECT	SPECT/CT	PET/CT	Total	Dr	Tec
Riyadh	8002100	47	7937	15	16	13	19	15	63	27	91
Makkah	8325304	41	8457	12	15	10	9	2	36	15	49
Madina	2080436	20	2818	5	5	3	6	0	14	3	6
Qasim	1387996	18	2809	4	4	1	4	0	9	2	11
Sharqiyah	4780619	35	6161	8	8	3	5	4	20	11	17
Aseer	2164172	27	3050	4	6	2	4	0	12	2	4
Tabouk	890922	11	1220	2	4	2	1	0	7	2	4
Hail	684619	12	1175	2	3	0	1	0	4	0	0
Shamalya	359235	9	1310	1	3	0	1	0	4	0	0
Jazan	1533680	21	2225	2	3	1	2	0	6	2	2
Najran	569332	11	1200	1	4	0	1	0	5	1	2
Baha	466384	10	1165	1	3	0	1	0	4	0	0
Aljouf	497509	12	1770	1	1	0	1	0	2	0	0
TOTAL	31742308	274	41297	58	75	35	55	21	186	65	186

About 68% of nuclear medicine examinations is done in one city (Riyadh), about 85% of nuclear medicine examinations is done in 2 areas of 13 administrative areas (Riyadh and Makkah) and about 94% of all examinations are done in 3 areas of the country (Riyadh, Makkah and Shriqiyah).

PET/CT Examinations:

There are about 18013 PET/CT examinations performed mainly in 2 cities Riyadh and Dammam; 15813 PET/CT examinations (87.4%) in Riyadh and 2200 PET/CT examinations (12.2%) in Dammam. Only 80 cases of PET/CT were done in one center in Jeddah as FDG is being delivered from Dubai.

Table 2: Number of examinations performed in all NM services across Saudi Arabia during 2017.

Region	Population	EXAMINATIONS			
		General NM	Cardiac	PET/CT	Total (%)
Riyadh	8002100	21397	8937	15813	46147 (67.7)
Makkah	8325304	8524	2878	80	11482 (16.8)
Madina	2080436	1661	201	0	1862 (2.7)
Qasim	1387996	921	NA	0	921 (1.4)
Sharqiyah	4780619	3974	291	2200	6465 (9.5)
Aseer	2164172	831	NA	0	831 (1.2)
Tabouk	890922	347	80	0	427 (0.6)
Hail	684619	0	0	0	0
Alhamalya	359235	0	0	0	0
Jazan	1533680	NA	NA	0	0
Najran	569332	NA	NA	0	0
Baha	466384	0	0	0	0
Aljouf	497509	0	0	0	0
Total	31742308	37655	12387	18093	68135 (100)

The average number of exams per unit PET/CT was 861 studies/unit during 2017. When we adjusted for the population there were 55.6 PET/CT examinations per 100,000 people.

SPECT and SPECT/CT Examinations:

Across Saudi Arabia, about 37655 examinations of general nuclear medicine (GNM) and 12387 examinations of cardiac NM during 2017, about 61% of these studies done in Riyadh. The average number of general and cardiac exams per unit was 556 examinations per unit SPECT or SPECT/CT. When we adjusted for the population there were 152 examinations per 100,000 people.

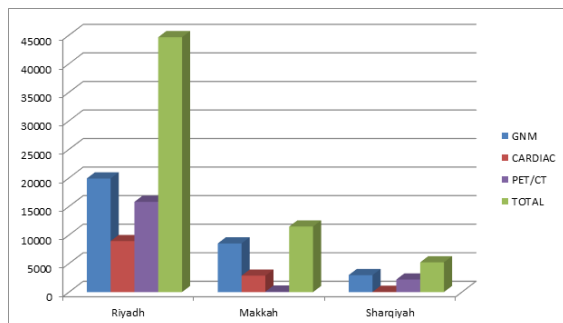


Figure 2: Distributions of NM examinations among the biggest 3 regions of Saudi Arabia.

Personnel:

In Saudi Arabia, nuclear medicine is practiced by nuclear radiologist and nuclear medicine physicians. By the end of 2017, there were about 65 physicians all over the country. The Saudi physicians with board certified Nuclear Medicine are not more than 9 doctors. Across the country there were about 186 technologists with minimum bachelor certification in radiography. By the end of 2017 we found 41 medical physicists, 9 radiopharmacists and 51 nurses.

Cyclotrons and Radiopharmaceuticals:

Currently there are 7 cyclotrons in Saudi Arabia led by King Faisal Specialist hospital and research center in Riyadh which has 3 cyclotrons:

- 1- CS30 cyclotron from Cyclotron Corporation (USA), Beam energy 27 MeV, beam current 150 uA, and capable of accelerating 4 particles, proton, deuteron, helium and alpha. (one of few cyclotrons that accelerate these particles), Installed in 1979, start production 1982.
- 2- RDS cyclotron (Siemens, USA), Beam energy 11 MeV, beam current 60 uA, accelerate only protons, installed 2005, start production 2006.
- 3- Cyclon 30 from IBA (Belgium), Beam energy 30 MeV, Beam current 350 uA, and capable of accelerating protons, installed in 2010, start production 2011.

Targets and Radioisotopes for radiopharmaceuticals produced by these cyclotrons:

- 1- Tl-201 TICl
- 2- In-111 InCl3
- 3- Ga-67 GaCl3 and Ga-67 citrate
- 4- Rb-81/Kr-81 generator
- 5- I-123 NaI (capsules and oral solution)
- 6- I-124 NaI (capsules and oral solution)
- 7- F-18 FDG
- 8- F-18 FDOPA
- 9- F-18 Fcholine
- 10- F-18 NaF
- 11- N-13 ammonia
- 12- Cu-64 CuCl2 and Cu-67 CuCl2 (for research)
- 13- Zr-89 ZrCl4 (for research)
- 14- C-11 (for research)

Other cyclotron in Saudi Arabia which is mainly for F-18 FDG:

- 1- King Fahad Spec. Hosp. Dammam, IBA 18 MeV cyclotron, they produce FDG-18 and others in small quantity.
- 2- Saad Spec. Hosp. AlKhobar, RDS cyclotron (Siemens, USA), Beam energy 11 MeV. produce FDG-18 and others in small quantity (currently out of service).
- 3- King Saud University, Riyadh, ACSi 24 MeV, from Canada, still in the installation phase.
- 4- King Abdulaziz University, Jeddah, GE 16.5 MeV, from USA, still in the installation phase.

Nuclear Medicine Training:

There is no recognized NM residency training program yet in Saudi Arabia. However, nuclear medicine is a part of radiology residency training program which is not less than 4 month training in four years. There is a national post residency fellowship of 2 years held in combination between KFSHRC and NGH in Riyadh.

Some of Saudi nuclear medicine physicians make their residency and fellowship trainings in some well-organized institutions around the world with full governmental sponsorship and scholarship.

Saudi Society of Nuclear Medicine (SSNM) is held under umbrella of King Abdul-Aziz University is currently not active due to some administrative obstacles.

Conclusions and Recommendations:

There is a need to know the current distribution of nuclear medicine services in order to recognize the regions of deficient coverage and to rectify this in future planning.

Although nuclear medicine services are available in most Saudi Arabia regions, there is obvious deficiency in NM centers in multiple regions, mainly in north and south regions. The PET/CT machines are only available in 3 regions within the kingdom, partially due to overcrowding of Cyclotrons in Riyadh.

Activation of Saudi Society of Nuclear Medicine (SSNM) is mandatory for establishing well recognized Nuclear Medicine residency training programs and other academic and scientific activities.

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