MEDICAL PHYSICS PROFESSION IN THE KINGDOM OF SAUDI ARABIA

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Abstract— **The field of medical physics in Saudi Arabia has witnessed a significant improvement in the last few decades. There is a good number of medical physicists who have been sent abroad to complete their post-graduate degree/residency in medical physics. The estimated number of medical physicists in Saudi Arabia has surpassed 700 with a slightly growing number of board-certified medical physicists. Universities are continuing to improve and advance their programs through strengthening their connection with medical institutes to provide clinical training for graduates. These graduates are currently being utilized by the growing number of governmental/private hospitals. The national radiation regulatory bodies have gone through various phases of development and improvement. Policies and regulations are being continuously updated and enforced. The IAEA support has its continuous positive impact on the field of medical physics in the Kingdom. There is always room for growth and advancement which the local medical physics community is working on through offering and organizing relevant educational and training programs and events.**

Keywords— **Medical Physics, Medical Physicist, Education, Radiation Oncology Physics, Diagnostic Radiology Physics, Nuclear Medicine Physics**

I. INTRODUCTION:

Several sectors provide health services in the Kingdom of Saudi Arabia. Ministry of Health (MOH), being the main health service provider, provides 60% of the services while the private sector provides 23%[1]. Several other governmental sectors like the Army Forces Medical Services, Ministry of National Guard hospitals, Security Forces Medical Services, University hospitals, King Faisal Specialist Hospital and Research Centre (KFSH&RC) hospitals as well as many others participate in providing primary and specialized medical services [2].

With the continuous expansion of these hospitals and the noticeable increase in the utilization of machines producing or using radiation, the need for medical physics services was deemed necessary. In the second half of the 1970s, two medical physics departments were established in Riyadh. One at KFSH&RC and the other at the Prince Sultan Military Medical City (PSMMC), previously known as Riyadh Military Hospital (RMH). Both departments consisted of main medical physics branches such as radiation oncology physics, imaging physics, nuclear medicine physics and health physics. Since then, awareness of the necessity for having this specialty increased and medical physics departments were established in other hospitals.

In year 2006, a founding committee established the Saudi Medical Physics Society (SMPS) under the umbrella of the Saudi Commission for Health Specialties (SCFHS). In year 2009, the first board of directors (BOD) of the SMPS was elected. Since then, every four years an election is conducted to elect a new BOD. The number of society members increased over the years and reached around 720 members in the year 2020. The society is active in conducting training and educational activitiesin the form of conferences, courses and workshops.

Medical physicists are mainly employed in hospitals providing a wide range of services in all fields of medical physics including radiation oncology, radiology, nuclear medicine as well as health physics and radiation protection. In addition, they play a major role in teaching and training junior medical physicists, along with others from related specialties. They are also involved in research projects and participating in advancing protocols and related clinical procedures. Medical Physicists also involved as teaching staff at local universities teaching this profession to graduate and post-graduate students in the medical physics program along with other related programs.

The Saudi authorities founded the Radiation Protection Unit as part of King Abdulaziz City for Science and Technology (KACST) to work hand in hand with the Ministry of Interior (MOI) to regulate and supervise the use of radiation and its applications. This unit was expanded with time to eventually become the “Nuclear and Radiological Regulatory Commission (NRRC)” which is responsible for the radiation safety regulations in the Kingdom. Recently, they published the “Basic Safety Standards in KSA” (NRRC-RR-01)[3]. The “Saudi Food and Drug Authority” (SFDA) established Radiation Protection and Safety Section in the year 2010. Both commissions regulate the use and the handling of all ionizing and non-ionizing radiation practices and employ several medical and health physicists.

II. EDUCATIONAL PROGRAMS

Pioneers of medical physics in the Kingdom started their studies at western universities in the 1970s. Several students obtained their M.Sc. and Ph.D. degrees in Europe and North America through support from the government. They were the core team that introduced medical physics in hospitals and universities.

The first undergraduate medical physics degree program started in 1982 at Umm Al Qura University, with an average

of 14 - 15 graduates per year. In year 2007, King Abdulaziz University started a medical physics program under the Nuclear Engineering Department with an average of 3 – 5 graduates per year. At the same university, the Science College started a medical physics program in year 2013 with an average of 40 graduates per year.

As for master of science degree in medical physics, King Fahd University of Petroleum and Minerals (KFUPM) started their program in 2002 with an average of 2 – 3 graduates annually. In 1998, Umm Al Qura University also started a master of science program in medical physics with an average of one graduate per year. They redesigned their program recently with an annual intake of around 20 students. Several universities are considering opening new M.Sc. programs in medical physics in the near future. Currently, two universities (King Abdulaziz University & King Saud University) are offering Ph.D. degrees in medical physics as part of other related programs. All these degrees include coursework accredited by the "National Center for Academic Accreditation and Evaluation" (NCAAE). Postgraduate degrees contain a research project as part of their degree requirements.

III. Clinical training

The first formal clinical training program in medical physics started at the RMH in the first half of the 1980s. This program was arranged with the Institute of Physics and Engineering in Medicine (IPEM), England. Several trainees graduated from this program. Unfortunately, at the beginning of the 1990s, this program stopped. In year 2013, the Biomedical Physics Department at KFSH&RC started a residency training program in radiation oncology physics in collaboration with the International Atomic Energy Agency (IAEA). Several trainees graduated from this program. In the same department, a Nuclear Medicine Physics Residency training program started in 2017 with three graduates so far. SMPS and KFSH&RC are working on designing a national residency training program in medical physics under the umbrella of the SCFHS. This program will include all three subdivisions of medical physics, *i.e.,* Radiation Oncology Physics, Diagnostic Radiology Physics and Nuclear Medicine Physics.

Several hospitals require board certification for senior medical physics positions. This encouraged many local medical physicists to obtain their board certification from the American Board of Radiology (ABR) or the International Medical Physics Certification Board (IMPCB). The board-certified medical physicists with the pioneer medical physicists who have long and extensive experience will be the main instructors in the planned national residency programs.

One must mention that since the 1980s, most of the major hospitals and universities have been participating in training and educating local medical physicists through training courses, workshops and conferences. These activities utilize local expertise and/or international experts in the field. A good example of these efforts is the International Conference on Medical Physics (ICRM). This conference has two versions, a major biennial conference which is held on even years and a Courses and Workshops Symposium which is held on odd years. These two series of events are usually conducted in collaboration with the IAEA and the World Health Organization (WHO) along with leading national and international organizations, The conference attracts more than 60 top notched international and 70 local speakers with more than 2,000 attendees. This event runs for 4 – 7 days and includes hundreds of lectures and more than 50 workshops in medical physics and related fields. In years 2019 and 2020, ICRM successfully collaborated with IMPCB to conduct board exams as part of the conference.

IV. Infrastructure

The Kingdom of Saudi Arabia occupies most of the Arabian Peninsula with a total area of approximately 2,150,000 km^2 and a population of 34,218,169 inhabitants in the year 2019[4]. The medical services in the Kingdom grew rapidly in the last several years. There are more than 504 hospitals with 20.4[5] beds per 10,000 inhabitants.

There are around 15 radiation therapy centers distributed mainly among the three major cities i.e. Riyadh, Jeddah and Dammam. The other cities of Tabuk, Taif and Dhahran have one center each with two linear accelerators. The existing systems in these centers include different kinds of radiotherapy machines (conventional linear accelerators, helical tomotherapy, dedicated stereotactic radiosurgery and IORT systems) with an estimated total number of 38 linear accelerators[6]. The total number of brachytherapy machines in major hospitals is estimated to be ten systems. It is worth mentioning that the first proton therapy facility in the Middle East is installed at King Fahad Medical City in Riyadh and will start treatments of patients shortly.

Most of the medium size and major hospitals have various diagnostic modalities, like CT scanners, MRI machines, fluoroscopy machines (C-Arm and Cath Lab,) ultrasound machines, general and mobile X-Ray machines and mammography systems. Main hospitals usually acquire the most advanced technologies available in the market.

In nuclear medicine, the Kingdom is expanding these services by opening new centers and acquiring the most recent and advanced equipment in the market. There are around 60 nuclear medicine centers in the Kingdom covered by 41 medical physicists[7]. Nuclear Medicine systems in the Kingdom include 55 SPECT/CT systems, 35 SPECT

machines, 30 PET/CT systems and 77 DEXA machines[7], in addition to dose calibrators and thyroid uptake systems. The number of cyclotrons in the Kingdom has expanded in the last three years to reach 11 cyclotrons distributed in the three major cities.

The Kingdom also has three secondary standard dosimetry laboratories (SSDL) in Riyadh and Dhahran. Two of these laboratories mainly provide radiation protection calibration services. KFSH&RC's SSDL has a full range of calibration capabilities including; radiation protection, diagnostic radiology and radiation therapy calibrations. These calibration laboratories are traceable to the International Bureau of Weights and Measures (BIPM) through the IAEA.

All these systems and modalities are supported by well-trained medical physicists. Major hospitals usually cover their needs for medical physicists from the local market or contract international experts. MOH has a policy forcing hospitals with 200 beds or more to have a medical physicist. In addition, NRRC and SFDA require each center using radiation-based clinical services to have a radiation safety officer (RSO). They also require centers to perform certain quality control procedures on all radiological machines by a local medical physicist or through a contracted company.

V. Conclusions

Medical physics in Saudi Arabia has noticeably evolved in the last few decades. Facilities expansion, national regulations as well as board certification and program accreditation are expected to contribute to the advancement of the medical physics profession in the Kingdom.

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