

## MEDICAL PHYSICISTS IN JAPAN: PAST, PRESENT AND FUTURE

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**Abstract— This paper includes an introduction of public health involving medical physics, and the status of medical physicists in Japan. The number of patients in Japan is increasing due to the aging of the population. JSMP is an academic society in this field cooperating in the education and research of medical physicists. The educational environment for medical physicists in Japan is changing day-by-day due to the development of novel medical devices and technologies in clinical practice. The number of medical physicists has increased dramatically due to the changes in the criteria for taking the medical physicist exam. Because of this situation, current activities of JSMP are expanding.**

**Keywords— Medical Physics, Education of Medical Physicists, Professional development, Training**

### I. ABOUT JAPAN AND JSMP

The population of Japan is approximately 125 million (median age: 48.4 years) in 2020. The Gross Domestic Product (GDP) in Japan was worth 5081.77 billion US dollars in 2019, according to official data from the World Bank and projections from Trading Economics. The GDP value of Japan represents 4.22% of the world economy [1]. According to the report by Organization for Economic Co-operation and Development (OECD) in 2019, medical costs accounted for 10.9% of GDP, with an average annual medical cost per person was 4766 dollars. Table 1 shows the numbers of medical devices in operation in Japan at the end of 2019. The numbers of LINAC, particle therapy units, brachytherapy units, CT, MR, gamma camera, SPECT and PET was 936, 14, 55, approximately 13,000, 6500, 1500, 1500, 500, respectively. Compared to other countries, a large number of CT, MR, LINAC, and particle therapy units were installed in hospital per population. However, the number of patients in Japan is increasing due to the aging of the population. In particular, the number of patients receiving radiotherapy and/or chemotherapy have dramatically increased due to government policy on cancer treatment since mid-2000's.

Japan society of medical physics (JSMP) is an academic society for physicists in medicine as a science council of Japan. JSMP organize scientific meeting (semi-annually), summer seminar, publication of official journals, committee activities, public lecture and so on. As of June 2020, the

number of JSMP members was 2508 (regular member: 2362, student member: 105, honorary member: 41, supporting member: 12). Many medical physicists are working in the therapeutic field. (Therapeutic field: 90% and Diagnostic field: 10%). JSMP has been one of the National Member Organization (NMO) of AFOMP since 2000.

Table 1 The numbers of medical devices in operation in Japan

	Medical devices	Numbers
	LINAC	936
Radiation therapy field	Particle therapy units	14
	Brachytherapy units	55
Diagnostic field	Computed tomography	Approximately 13,000
	Magnetic Resonance	Approximately 6,500
Nuclear medicine field	Gamma camera	Approximately 1,500
	SPECT	1,500
	PET	500

### II. HISTORY OF JSMP AND RELATED ORGANIZATIONS

The starting point of JSMP was first founded in March 1961 as a special sub-organization of Japan Radiological Society (JRS). Figure 1 shows the history of JSMP. JRS is a science council for radiologists or radiation oncologists in Japan. The first president of the special sub-organization of JRS was Dr. Hideo Eto, the University of Tokyo. Prior to its founding, several physicists and scientists carried out their research and/or clinical practice individually in their institutions. However, the first scientific meeting of this organization was held in Hiroshima, Japan in October 1961. Subsequently their physicists and scientists had the opportunity to share their knowledge and research status on the scientific meeting of the organization. Since the 8th scientific meeting in 1964, general researches have been

presented mainly in addition to special lectures and educational lectures. In April 1965, the organization changed its name to the division of physics in JRS at the 12th scientific meeting in Tokyo. In this term, several topics such as clinical implementation of high energy radiotherapy systems and X-ray TV systems, development of anger type gamma camera were commonly focused on research reports. During this decade, the number of the member of division of physics in JRS increased from 30 to 200 due to interest in research topics and exciting discussions at meeting. By the mid-1980's, the number of organizations gradually increased to 700 members. However, the number of members was stable until 2000. In 1992, the organization name was changed to Japan association of radiological physics (JARP).

On the other hand, looking at the world, the International Organization of Medical Physics (IOMP) was established in 1963 by Canada, Sweden, the United Kingdom and the United States. IOMP hosted the first International Conference of Medical Physics (ICMP) in Harrogate, UK. In response to this situation, some members of the division of physics of JRS established Japanese Association of Medical Physicists (JAMP) in 1979 with the aim of joining Japan to IOMP. With their efforts in joining IOMP, Japan was approved as the 22nd National Organization in February 1980. Since 1984, JAMP has held meetings annually.

These two medical physics organizations continued their academic activities, but in 2000, the two organizations were integrated into one to form JSMP. This is the current form of JSMP. In addition, the number of JSMP members has increased dramatically because of the revision of the medical physicist certification procedure in Japan. Senior radiological technologists could apply for candidates for medical physicists in Japan. With this revision, the distribution of occupational background has now changed (Figure 3). Details of this revision are described at section III of this paper. In 2004, JSMP was certified as a member of Japan Radiological Council (JRC), and every April, annual scientific meeting of JSMP is held as a jointed conference with JRS and Japanese Society of Radiological Technology (JSRT).

Nowadays, the number of participants in the scientific meetings is increasing, and many topics are discussed in several sessions. In the scientific meeting, research reports are generally focused on the development of novel particle therapy systems and the dedicated machines for high precision radiation therapy, clinical implementation of artificial intelligence, big data analysis and radiation protection.

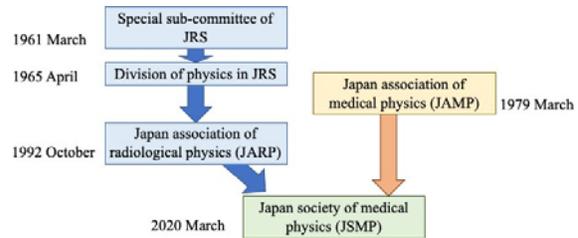


Figure 1 History of Japan society of medical physics

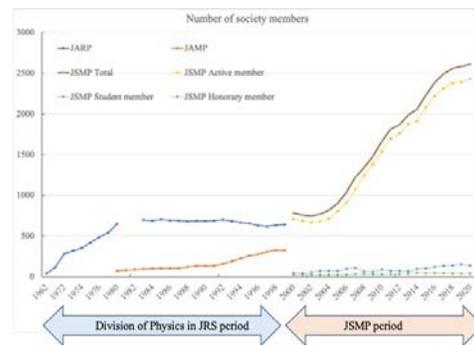


Figure 2 The transitions of number of society members

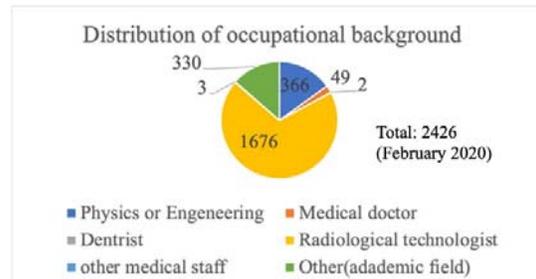


Figure 3 Distribution of occupational background of JSMP members, as of February 2020.

### III. MEDICAL PHYSICISTS IN JAPAN

Japanese medical physicist certification system was established in 1987 by JRS, to ensure the person who contributes to the development and optimization of medical devices are specialists in medical physics. This system was based on specialists of radiation oncologist system. In the 10 years since the first examination, the number of medical physicists certified by JRS was only 100. This was caused by the limitation of exam criteria for occupational/academic background: those majoring in physics and engineering were only allowed to take the exam.

On the other hand, the curriculum of radiological technologist has become more complex and the minimum requirements of subjects has increased due to the needs in clinical practice for radiological technologist since mid-1990's. Because the occupational territory of Japanese radiological technologists covers from the diagnostic field including nuclear medicine to therapy and radiation dosimetry field after obtaining the national license for radiological technologist, absorbed dose measurements and quality assurance in radiation therapy were one of the tasks of senior radiological technologists in Japan. In fact, 4-year semester including clinical practice in hospitals has required for radiological technologist since mid-1990's. In addition, several graduate schools have been established to give master-degree/doctoral-degree to specialist of radiological technology in medicine. Due to these circumstances, the criteria of occupational/academic background for medical physicists were expanded to senior radiological technologist in 2003. That is, senior radiological technologists who became members of JSMP or JRS could challenge the medical physicist's examination even though there were certain requirements regarding their occupational background. As a result, the number of JSMP members (including medical physicist examinee) has increased dramatically since the early-2000's. The number of certified medical physicists was 1252 as of May 2020. Figure 4 shows the transitions of the number of certified medical physicists.

In 2009, Japanese board of medical physicist qualification (JBMP) was established to take over medical physicist certification system. The first president of JBMP was Dr. Shogo Yamada, and the current president is Dr. Hiroki Shirato. Since the establishment of JBMP, a guideline for educational curriculum of medical physicist has been proposed to ensure the educational level of medical physicists and to optimize the curriculum in accordance with the international certification system. Nowadays, there are 22 MS courses and 10 PhD courses as accredited medical physicist educational courses in graduate schools. These courses follow the JBMP guidelines. Actually 60-80 students complete the course each year.

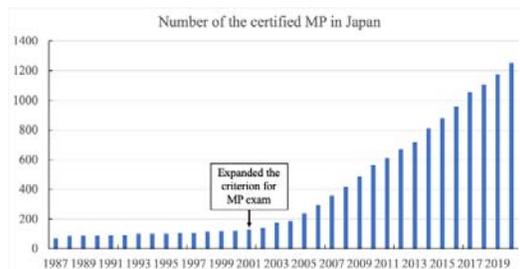


Figure 4 Changes in the numbers of medical physicists in Japan

#### IV. CURRENT ACTIVITIES OF MEDICAL PHYSICISTS IN JAPAN

Recent years, high precision radiation therapy techniques such as intensity modulated radiation therapy, stereotactic radiotherapy, adaptive radiation therapy and particle therapy have been widely applied to routinely clinical procedures. This technological improvement is provided not only by increased development and research, but also by the contribution of medical physicists. Actually, the number of medical physicists has increased dramatically because securing medical physicists is one of the facilities requirements to cover medical insurance for their high precision radiation therapy. Even though many medical physicists in Japan work as clinical medical physicists, the majority of their physicist's challenge to present at scientific meetings including international conference to be evaluated by foreign researchers for their research. Then they try to prepare their manuscript to submit to international journal. Two official journals of JSMP are currently published: Radiological physics and technology (RPT) published jointly with JSRT and Japanese journal of medical physics (JJMP: in Japanese). In particular, RPT journal is now the official journal of AFOMP.

#### V. CONCLUSION

More complex techniques are being applied to clinical practice, higher education and more medical physicists are needed worldwide. In Japan, medical physicist certification system has changed in 20 years, however, despite the increased requirements for medical physicist exams, the minimum requirements for education are stable. Recently the new coronavirus pandemic is a serious problem for implementing the actual curriculum of medical physics courses. However, it is of utmost importance for students or candidates to consider about what to do by themselves, and the faculty staff in school and the related organizations should support their activities. At least, web-based learning is available even though clinical training in hospitals is not available.

Due to new coronavirus pandemic, web-based seminars and events have widely applied in the world. As a result, Japanese medical physicists can attend several international web-based seminars even though they are in Japan. I think this is a good situation for medical physicists to perform continuing education. We, the members of international affairs committee in JSMP, would like to continue to look for ways to strengthen our relationship with AFOMP and enable us to hold a joint scientific meeting as NMO.

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