

MEDICAL PHYSICS IN VIETNAM: THE CURRENT STATUS OF EQUIPMENT, WORKFORCE AND EDUCATION

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Abstract — Since 2010, Vietnam has been working actively to improve the medical system, especially for cancer treatment. Many hospitals have investments by the government or private companies to install new or upgrade their diagnostics and treat-ment facilities. Demand for well-trained medical physicists also increases quickly with the challenge of new technologies applied in medical equipment. This paper reports the updated status of medical physics in Vietnam - in equipment, workforce, and education.

Keywords— Medical Physics Professional Development, Medical Physics Education and Training, Medical Physics Equipment, Medical Physics Vietnam.

I. INTRODUCTION

Located in South-Eastern Asia region, Vietnam is a lower middle-income country with the GDP per capita of 2067.9 USD in 2017. Vietnam has a population of 95.54 million and a surface area of 330,967 km² [1]. It is the fact that Vietnam has a high risk of deaths due to cancers. The age-standardised incidence and mortality rates are 140.4 and 108.7 (per 100,000) respectively [2]. The most frequent cancers are liver, lung, stomach, breast (female), and colorectum [3]. Therefore, the number of oncology centers has been growing rapidly nationwide since 2010.

Many public and private hospitals developed radiation oncology and nuclear medicine departments where physicists are essential members of the medical team. In hospitals, medical physics frequently assess the qualities and performance of the radiotherapy and nuclear imaging equipment. They also ensure clinical radiation protection to patients, staffs and the public. In radiotherapy, medical physicists work closely with oncologists to ensure accurately delivered doses to the patients [4]. The more sophisticated technologies are applied in medicine, especially in radiotherapy, the more professional knowledge and skills are required for medical physicists.

Vietnam Society of Medical Physics (VSMP) was found in 2008 to support medical physicists developing their professional career. In 2018, the Society has nearly 200 members with 149 members are clinical medical physicists.

To update information on medical physics status in Vietnam, a survey was done nationwide by Vietnam Society of Medical Physics. A questionnaire was sent to key persons who work actively as senior medical physicists at local

hospitals. During March and May 2018, 37 public and private hospitals joined the survey. This number of hospitals covers 95% of hospitals in which there are oncology or nuclear medicine departments [5]. The questionnaire covers two main fields: equipment and workforce.

About the equipment - the numbers of radiotherapy and nuclear medicine equipment were collected. For diagnostic imaging machines, only those used for radiotherapy such as simulation CT, 4DCT and MRI were counted.

About the workforce - the data includes information of clinical medical physicists and the university where ones received the highest education degree. The data are analyzed based on regions. It is not surprising to see that the distribution of equipment and medical physicists are not the same between regions. Most of the large oncology centers are located in big cities. Many small provinces still don't have enough facility for cancer diagnostics and treatment. This causes trouble not only in providing early and effective treatment for patients but also in training the local medical team.

II. RADIOTHERAPY EQUIPMENT

The number of radiotherapy equipment in Vietnam inventoried in 2018 is shown in Table 1. Totally, there are 30 radiotherapy centers with 48 linear accelerators and 15 brachytherapy units. Though Ha Noi has a double number of radiotherapy centers in compare to Ho Chi Minh City, the total number of equipment are nearly the same for these two most populated cities. There are 5 hospitals with Gamma knife for radiosurgery. Table 2 shows the number of imaging equipment mainly used for diagnostics and treatment planning in radiotherapy. The survey only counts the number of simulation CT, 4DCT and MRI machines which belong to the radiotherapy centers and are under the care of medical physicists. Most of the hospitals are equipped with simulation CT and MRI. There are five centers which have 4DCT used for therapy. The ratio of radiotherapy equipment per million population is 0.73 - nearly the same as in other Southeast Asia countries [6].

Table 1. The number of radiotherapy equipment by region, inventoried in 2018

Region	Number of radiotherapy centers	Tele Co-balt-60 unit	Linear Accelerator	Brachytherapy, HDR	Brachytherapy, LDR	Gamma knife
Ha Noi	12	0	16	3	1	3
North	6	1	4	1	0	0
South	3	1	3	2	0	0
Middle and highland	4	0	6	2	1	0
Ho Chi Minh City	5	0	19	5	0	2
Total	30	2	48	13	2	5

Table 2. The number of diagnostics equipment used for radiotherapy by region, in 2018

Region	Number of radiotherapy centers	Simulation CT	4DCT for therapy	MRI
Ha Noi	12	12	2	14
North	6	9	0	6
South	3	2	0	4
Middle and highland	4	3	1	6
Ho Chi Minh City	5	11	2	11
Total	30	37	5	41

Table 3. Number of nuclear medicine equipment by region, in 2018

Region	Number of nuclear medicine centers	PET/CT	SPECT	SPECT/CT	Cyclotron
Ha Noi	9	8	11	3	2
North	4	0	4	0	0
South	3	1	3	1	1
Middle and highland	3	1	3	2	1
Ho Chi Minh City	5	3	4	2	1
Total	24	13	25	8	5

III. NUCLEAR MEDICINE EQUIPMENT AND THE PRODUCTION OF RADIONUCLIDES USED IN NUCLEAR MEDICINE

The number of nuclear medicine equipment is shown in Table 3. There are 24 nuclear medicine centers in Vietnam. Most of them have SPECT or SPECT/CT machines, and thirteen hospitals have PET/CT units. To produce fluorine-18 for medical use, four hospitals and the Institute of Nuclear Science and Technology have 05 cyclotrons with energies from 11 MeV to 30 MeV. Besides, the nuclear reactor in Nuclear Research Institute also produces Iodine-131 for thyroid cancer therapy. In total, Vietnam can produce approximately 650 Ci radionuclides per year, response 46% local demand [5].

IV. MEDICAL PHYSICISTS AND THE STATUS OF EDUCATION AND TRAINING

Vietnam Society of Medical Physics has 149 members working in hospitals as clinical medical physicists. Among them, 77% are male and 23% are female. There are 37% of medical physicists have the Master and Ph.D. degrees as shown in Table 4. Currently, only 06 members studied Master programs in medical physics in Thailand, Italia, Taiwan, France, and Australia. Table 5 shows the list of universities from which the clinical medical physicists got their highest education degrees. Most of the medical physicists graduated from the University of Science VNU-Ha Noi, Ha Noi University of Science and Technology, and the University of Science VNU-HCM in Ho Chi Minh city.

So far, Vietnam does not have internal certification of medical physicists. After finishing a four-year bachelor program at the university, students who are interested in

Table 4. Number of medical physicists by region, in 2018.

Region	Number of hospitals	Number of Medical Physicists	Male (%)	Female (%)	Master and PhD. (%)
Ha Noi	13	49	73%	27%	39%
North	6	14	71%	29%	50%
South	6	19	84%	16%	32%
Middle and highland	4	14	86%	14%	7%
Ho Chi Minh City	8	53	75%	25%	42%
Total	37	149	77%	23%	37%

Table 5. List of universities providing training programs for medical physicists in Vietnam

Region	University	Number of MPs	Bachelor	Master	PhD
Ha Noi	University of Science, VNU-Ha Noi	40	25	15	
	Ha Noi University of Science and Technology	18	11	7	
	Ha Noi Pedagogical University II	1	1		
	Institute of Physics	2		2	
	Posts & Telecoms Institute of Technology	1		1	
	Hanoi University of Industry	1	1		
	Military Technical Academy	3	2	1	
Middle and highland	Da Lat University	2	2		
	Da Nang University of Science and Technology	2	2		
	Hue University, College of Sciences	4	4		
	Hue Medicine University	1	1		
Ho Chi Minh City	University of Science, VNU-HCM	60	41	19	
	HCM City University of Science and Technology	3	1	2	
	HCM City University of Pedagogical	2	1	1	
Abroad	Chulalongkorn University, Thailand	2		2	
	Trieste University - ICTP, Italia	1		1	
	Grenoble University, France	1		1	
	Blaise Pascal University, France	1			1
	Belarus National University	1	1		
	Chang Gung University, Taiwan	1		1	
	Wollongong University, Australia	1	1		
	University of Bordeaux I	1		1	
Total		149	94	54	1

medical physics look for jobs in hospitals or medical equipment trading companies. Then they go through on-site training by senior medical physicists or be sent to big oncology centers for training. Medical physicists frequently attend intensive training programs organized by Vietnam Society for Medical Physics or abroad. Besides, workshops or conferences are also good opportunities for medical physicists gathering and sharing knowledge and professional experience with each other.

However, the roles of medical physicists in hospitals are still not recognized appropriately. Officially, the medical physicists work 42 hours per week. In major oncology centers, medical physicists frequently work overtime due to heavy workload. In small hospitals, the medical physicists lack essential equipment and training resource. Medical physicists and the status of education and training

V. CONCLUSION

The expected cancer incidence in Vietnam will be roundly 98,100 cases [7]. To reduce the mortality rate due to cancer, the hospitals will have to upgrade their diagnostics and treatment equipment. The needs of medical physicists still high. However, it takes approximately 2-3 for training a new medical physicist both in theory and clinical. To meet this trend, beside developing good education programs from undergraduate to graduate levels, the university must collaborate with the hospitals in training and research. For certifying the medical physics, Vietnam Society for Medical Physics is organizing the National Certification Board with the help of IAEA.

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REFERENCES

1. United Nations Statistics at <http://data.un.org/en/iso/vn.html>. Retrieved May 10, 2018.
2. International Agency for Research on Cancer, WHO, Globocan 2012: Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2012 at http://globocan.iarc.fr/Pages/fact_sheets_population.aspx. Retrieved May 10, 2018
3. World Health Organization (WHO), Cancer Country Profiles, 2014 at http://www.who.int/cancer/country-profiles/vnm_en.pdf
4. International Organization for Medical Physics (IOMP). The Medical Physicist: Role and Responsibilities. IOMP Policy Statement No. 1, 2012
5. Tran Bich Ngoc, "Ensure radiation safety in medical", Workshop on advanced radiation technology, Da Nang city, 23/11/2017.
6. Kron, T., Azhari, H.A., Voon, E.O., Cheung, K.Y., Ravindran, P., Soejoko, D., Inamura, K., Han, Y., Ung, N.M., Tsendenlsh, B. and Win, U.M.. Medical physics aspects of cancer care in the Asia Pacific region: 2014 survey re-sults. Australasian physical & engineering sciences in medicine, 38(3), 493-501, 2015.
7. Kieu-Trang T. Hoang, Lawrence H Le, Trung-Hieu Nguyen, Tan-Chau Nguyen, Hong-Loan T. Truong, Quang-Linh Huynh, Tao V. Chau (2016), The Development of Medical Physics in Vietnam: the past, the present and the future, BME2016 in Vietnam, IFMBE Proceedings.

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