Oak Ridge

THE RECRUITMENT OF MEDICAL PHYSICISTS IN
THE UNITED STATES

WHO/IAEA Seminar on
Training & Education in
Medical Physics, Kiel,
Federal Republic of
Germany.

10-22 April 1972

(3/23/72)

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ACRH-1000-370
CONF-720435--6

Talk Prepared for WHO/IAEA Seminar
on Training and Education in Medical Physics

Kiel, Federal Republic of Germany

10-22 April 1972

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This paper describes the recruitment of medical physicists in the United States, an assessment of the numbers of medical physicists needed per annum immediately and in the long term, and the problems that will arise in securing the right number of right people.

Recruitment

Until two years ago, recruitment of medical physicists in the United States was an ever-present problem because of the competition for physicists in several other interesting scientific areas. Prominent among these fields were high-energy, solid-state, space, nuclear, and plasma physics. As a result of federal cutbacks in funds for a number of these specialties, there is no shortage of physicists at this time. Thus, we are finding that many physicists, especially the younger ones, are becoming interested in medical physics. Many applications are received from physicists who wish to enter training programs, at both the pre-doctoral and postdoctoral levels, especially at institutions where training fellowships and scholarships are available.

The employment situation in physics was recently surveyed by S. Ellis of the American Institute of Physics. This survey of recipients of the bachelors of science in physics showed that, although the percentage of students going on to graduate school has remained relatively constant for the past five years, an increasing percentage of them are pursuing graduate work in fields other than physics ⁽¹⁾. In the academic year 1967-68, 44% of the graduates were planning to pursue graduate work in physics and 16% in a field other than physics. By the 1970-71 academic year, only 31% (or 1,002) of the graduates intended to go on to physics graduate work and 26% (or 840) to graduate work in another field.

Twenty-nine per cent (or 954) of the 1970-1971 graduates surveyed indicated their desire to find employment after graduation. Of these students, 330 had already accepted employment by June, 150 were continuing in jobs they had held either part or full time while attending school, and 465 (or 49%) had not yet found employment. This 49% marked an unemployment high for physics majors at the time of their graduation. Comparable fractions for one and two years earlier were 20% and 23%, respectively.

By December of 1971, most of the previously unemployed physicists had found jobs, but a minority reported that they were making extensive use of their physics training. It is under these conditions that we find no problem today in recruiting physicists for medical physics.

Assessment of the Numbers of Medical Physicists Needed

In a paper published in 1971, Lanzl, Saenger, and Kereiakes discussed the number of professional medical physicists needed for the decade 1970-1980 (Appendix I). In this paper we defined the term "professional medical physicist" and gave the background data leading to our estimate, which we consider conservative. As a result of this study we consider that we need to more than double the number of professional medical physicists now working. We feel that a growth rate of about seven per cent per year, which would lead to a doubling in a decade, would provide an orderly and reasonable development that is economically justifiable.

Balance Between Supply and Demand for Medical Physicists

At the present time a physicist with training in medical physics can usually find a satisfactory position within a relatively short time. The American Association of Physicists in Medicine maintains a placement service to assist in bringing together medical physicists and prospective employers. In addition, the profession of medical physics is rapidly achieving recognition within both the physics and medical communities.

It is a difficult problem to find an exact balance between supply and demand for professional people over a long period. If there are too many trained persons in a given profession for the employment conditions, the professionals must undertake jobs that are below their capabilities, or they leave their field and possibly undertake further training in a new area. On the other hand, if there are too few, as has been true of medical physicists in the past, inferior and even harmful health care is delivered in those areas (such as radiotherapy and nuclear medicine) which depend upon high-quality physics service.

APPENDIX I

This Appendix was published in the Quarterly Bulletin of the American Association of Physicists in Medicine, Vol. 5, No. 2, p. 129, June, 1971.

ESTIMATE OF MANPOWER NEEDS OF MEDICAL PHYSICISTS IN THE UNITED STATES

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The following is one of a continuing series of reports by the Joint AAPM-ACR Committee on Manpower Needs in Medical Physics.

It is a difficult task to make countrywide estimates of manpower needs in almost any field of endeavor with a high degree of precision. Usually several approaches can be used in making such projections. If all of these yield comparable figures, one has a greater degree of confidence in the results, of course, than if only one method has been employed.

Several reports that include medical physics information in the recent past have contained estimates of manpower needs. For example, the Report of the Medical X-Ray Advisory Committee on Public Health Considerations in Medical Diagnostic Radiology (X Rays), published by the Public Health Service of the U. S. Department of Health, Education, and Welfare in October 1967 stated on p. 24 that there was a current need for at least 500 medical physicists in the fields of diagnostic and therapeutic radiology.

According to a 1969 Treatment Planning Survey by the American College of Radiology carried out by Dr. William E. Powers, 88 full-time and 185 part-time

physicists are needed in radiation therapy in addition to those presently employed. This study was concerned only with needs in radiotherapy. Data were derived from 915 questionnaires from various groups, including 559 therapists.

A systems-analysis approach to needs of physicists in radiotherapy has been carried out on a regional basis by Enviro-Med, Incorporated, of La Jolla, California. This approach holds great promise. As yet, however, it has not been applied to the entire country.

Present Study of Needs

In the present study we suggest that a modern medical institution should consider having at least one medical physicist whose qualifications and experience place him in a role of professional leadership rather than a supportive role in his institution. In such a position, the professional medical physicist has the responsibility for assessing the technical needs of the institution. He also has the authority to recommend what steps should be taken to alleviate shortages of supportive personnel, space, and capital equipment within the province of his expertise.

TABLE I. Various patient procedures per year per full-time-equivalent (FTE) medical physicist for different numbers of FTE medical physicists per institution.

No. of FTE medical physicists	Mean values				Median values			
	0.5	1	2	3	0.5	1	2	3
(a) New radiotherapy patients per year per physicist	1238	691	371	349	1156	600	350	283
(b) Nuclear-medicine procedures per year per physicist	6517	3717	1706	1136	6040	3000	1815	(1210)
(c) Diagnostic radiology								
(1) General examinations per year per physicist	137 000	63 000	31 000	...	165 000	58 000	31 000	...
(2) Special procedures per year per physicist	2914	3033	583	...	2200	1608	600	...

Since the emphasis in this study¹ is somewhat on the medical physicist whose activities are within therapeutic and diagnostic radiology as well as nuclear medicine, we suggest that the minimum training for the professional medical physicist includes a Master's Degree in Physics or Medical Physics and certification as a physicist by the American Board of Radiology, or a Ph.D. in Physics or Medical Physics. In addition, the professional medical physicist should have had experience at a medical institution.

In our estimate of needs for medical physicists, three types of data have been collected. These data are described in the following three paragraphs.

(1) In the course of the study we used the following categories to compile information obtained from AAPM members on the patient load per year per full-time-equivalent (FTE) medical physicist: (a) number of new radiation therapy patients; (b) number of nuclear-medicine procedures; (c₁) number of general examinations in diagnostic radiology; and (c₂) number of special procedures (for example, use of a catheter) in diagnostic radiology. The frequency distributions in the above categories are widespread. Table I lists the mean and median values for the above categories.

(2) Data have also been assembled, for the hospitals of various AAPM members, on the number of new radiation therapy patients per year divided by the number of beds in the hospital. The mean and median of these data as well as data on the number of nuclear-medicine procedures, and general examinations and special procedures in diagnostic radiology, are listed in Table II.

(3) A necessary figure for the estimate is a measure of the number of beds in U. S. hospitals. A listing of health care institutions was published in J. Am. Hosp.

TABLE II. Mean and median number of patient procedures per year per bed in hospitals employing AAPM members.

	Mean	Median	No. of AAPM members answering question
(a) No. of new radiation therapy patients per year per bed	0.95	1.54	177
(b) No. of nuclear-medicine procedures performed per year per bed	6.13	5.00	178
(c ₁) No. of general examinations done in Diagnostic Radiology per year per bed	104	95	150
(c ₂) No. of special procedures in Diagnostic Radiology per year per bed	1.90	2.76	149

TABLE III. Hospital and bed census in the United States.

No. of hospitals in U. S.	Actual No. of beds	No. of beds assumed in calc. for need for med. phys.
622	500 or more	500
227	400-499	450
403	300-399	350
669	200-299	
1389	100-199	
2058		

Assoc. 43, Part 2, 493 (1969). A summary of the listing as a function of number of beds is given in Table III.

The figures of Table III exclude mental hospitals, tuberculosis hospitals, and clinics that do not have a resident physician on their staff. For the purposes of our estimate we shall assume that the 2058 hospitals having less than 300 beds will not require the services of a full-time professional medical physicist at this time.

The number of beds is determined by taking the sum of the following, from Table III: 622 hospitals times 500 beds per hospital, 227 hospitals times 450 beds per hospital, and 403 hospitals times 350 beds per hospital. This figure gives a total of 554 200 beds.

Since many hospitals do not have a medical physicist, it seems reasonable to recommend that those without a physicist seriously consider employing as their first one a professional medical physicist as described above. For the needs estimate (Table IV), therefore, we shall use the data for "1" FTE medical physicist from Table I (see italicized columns).

Tables IV and V were assembled from the data in Tables I-III. In the interest of presenting a conservative estimate, we shall state that, based on institutions that have one FTE medical physicist and using the median data, the minimum need in the United States is for 900 professional medical physicists. The number of medical physicists now practicing in the United States is estimated to be about 350. This estimate was obtained by adding (a) the number of AAPM members who both satisfy our description of professional medical physicist and who are presently employed in hospitals, and (b) the number of physicists certified by the American Board of Radiology who are not AAPM members. The error due to persons falling outside these two categories is expected to be small, especially considering that not all ABR-certified physicists are now practicing medical physics. This means that approximately 550 additional professional medical physicists are needed in the United States.

We have tried to be conservative in making the above estimate by using the more conservative assumptions. We are aware that more than doubling the

TABLE IV. Estimate of need for medical physicists in hospitals based on median data.

Field	From Table III	From Table II	From Table I	
(a) Therapy	554 200 beds $\times$ 0.95	$\frac{\text{therapy patients}}{\text{bed, year}}$	$\times \frac{1 \text{ physicist}}{600 \text{ therapy patients/year}}$	= 877 physicists
(b) Nuclear-medicine procedures	554 200 beds $\times$ 5.00	$\frac{\text{nuclear procedures}}{\text{bed, year}}$	$\times \frac{1 \text{ physicist}}{3000 \text{ nuclear procedures/year}}$	= 922 physicists
(c) Diagnostic radiology				
(1) General examinations	554 200 beds $\times$ 95	$\frac{\text{general exams}}{\text{bed, year}}$	$\times \frac{1 \text{ physicist}}{58\,000 \text{ general exams/year}}$	= 903 physicists
			Average	900 physicists

TABLE V. Estimate of need for medical physicists in hospitals based on mean data.

Field	From Table III	From Table II	From Table I	
(a) Therapy	554 200 beds $\times$ 1.54	$\frac{\text{therapy patients}}{\text{bed, year}}$	$\times \frac{1 \text{ physicist}}{691 \text{ therapy patients/year}}$	= 1240 physicists
(b) Nuclear-medicine procedures	554 200 beds $\times$ 6.13	$\frac{\text{nuclear procedures}}{\text{bed, year}}$	$\times \frac{1 \text{ physicist}}{3717 \text{ nuclear procedures/year}}$	= 915 physicists
(c) Diagnostic radiology				
(1) General examinations	554 200 beds $\times$ 104	$\frac{\text{general exams}}{\text{bed, year}}$	$\times \frac{1 \text{ physicist}}{63\,000 \text{ general exams/year}}$	= 915 physicists
			Average	1023 physicists

number of professional medical physicists employed in hospitals will require considerable funding. We are also aware of the implicit assumption that if 550 more professional medical physicists are to become available, their geographical distribution cannot be controlled any more than the distribution of physicians. It may be that concentrations of physicists in large centers would result, leaving the smaller centers without staff unless they provided incentives to attract physicists.

It should be emphasized that our estimate does not include the need for medical physicists in the non-radiation-oriented departments.

Acknowledgments

The authors wish to thank Robert O. Gorson for helpful advice and William Van de Riet, Postdoctoral Fellow in Radiological Physics at the University of Cincinnati, for valuable aid in data analysis.

* Operated by the University of Chicago for the U. S. Atomic Energy Commission.

¹ Data gathered from studies of the Joint Committee on Manpower Needs in Medical Physics of the American Association of Physicists in Medicine and American College of Radiology. Committee members are L. H. Lanzl, Principal Investigator, E. L. Saenger, Co-Chairman, M. Greenfield, Co-Chairman, J. R. Cameron, D. Childs, E. Christensen, E. W. Webster, and C. Wells.

I. M. Wallach. More New Graduates to Leave Physics. Physics Today, Vol. 23, No. 3, p. 101, March, 1972.