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● *Original Contribution*

THE MANPOWER CRISIS FACING RADIATION ONCOLOGY

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Data from several sources document that the number of radiation oncologists being trained is substantially above the number projected as recently as 1983. This paper addresses the manpower crisis facing radiation oncology and includes information on the supply of and need for specialists, as well as possible courses of action given current circumstances.

Manpower, Radiation oncology.

INTRODUCTION

The quality and availability of radiation therapy to cancer patients has been a long-time and continuing concern of the radiation oncology community. A major shortage of radiation oncologists was recognized in the 60's and 70's. The magnitude and impact of this shortage were detailed in the report by the Committee For Radiation Therapy Studies to the National Cancer Institute (NCI) entitled "*Crisis in Radiation Therapy Training and Practice*".[5] The effect of this shortage on the teaching of oncology to medical students and their subsequent selection of radiation oncology as a specialty was documented by Bakemeier.[10] More recently, in 1983, both the Graduate Medical Education National Advisory Committee (GMENAC) report and the Patterns of Care Study, compared predicted supply with need and indicated a continuing shortage of radiation oncologists until at least 1990.[2,8] Each of these four reports have stimulated training of qualified radiation oncologists. According to the number of radiation oncologists needed and the forthcoming supply, predictions were made on the presumption that the supply would remain relatively stable and the need would increase in keeping with the incidence of cancer in an increasing and aging population.

New data from three independent sources (Flynn, D. F., written communication, July, 1985)[6,7] indicate that the number of radiation oncologists being trained is substantially above the previously predicted rate, and if this continues, the supply will exceed the projected need for 1990. Furthermore, questions are now being raised as to the validity of the earlier estimates of need, particularly as equipment and patterns of practice are changing. In addition, the U.S. population and the number of new radiation oncology patients has not increased as fast as was predicted. For these reasons it is important to reexamine the projected need and supply of radiation oncologists over the next 5 to 10 years.

STATISTICS

Supply of therapeutic radiologists

Three sources of supply information were reviewed. These are the biennial surveys by Cox *et al*,[6] the directory of radiation oncology residents (Flynn, D. F., written communication, July, 1985), and a recent paper by Crowley.[7] Table 1[6] shows that the number of institutions offering training in "straight" therapeutic radiology has decreased from its high point in 1978. However, a striking and potentially important change has taken place in the past 2 years. Of the 501 residencies offered in 1982, one-third or 162 were unfilled. Of the 558 positions listed in early 1984, only one-sixth or 92 were unfilled. Today there are essentially no unfilled positions. Furthermore, the number of residents was stable between 1976 and 1982 at 330 ± 9. However, in January 1984, the number suddenly rose to 466. This entire increase is evident in the PG-2 and PG-3 years, in which the number of residents in training in early 1984 was more than 50% higher than 2 years earlier.

The second source of information, collected by Daniel Flynn, M.D., faculty advisor to the Association of Residents in Radiation Oncology (ARRO), has further doc-

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Table 1. Training positions available and residents in training in "straight" therapeutic radiology in the United States

	1960	1964	1966	1968	1970	1972	1974	1976	1978	1980	1982	1984
Institutions offering training in "straight" radiotherapy	29	45	49	60	66	68	81	101	107	92	89	96
Total number of residencies offered	*	*	*	290	323	497	468	547	595	522	501	558
Institutions training such residents at present	14	26	23	38	50	66	71	88	92	88	85	93
Residents in training in "straight" radiotherapy	25	31	38 (20)	84 (16)	150 (30)	248 (18)	277 (43)	322 (38)	334 (44)	335 (17)	339 (14)†	466 (9)
			PGY 1							57 (2)	64 (3)	65 (1)
			PGY 2	30 (4)	55 (10)	85 (4)	75 (18)	84 (20)	92 (12)	101 (3)	92 (0)	155 (1)
			PGY 3	25 (2)	41 (9)	72 (5)	96 (9)	99 (9)	97 (10)	95 (3)	87 (3)	138 (3)
			PGY 4	15 (4)	34 (7)	60 (2)	82 (9)	90 (5)	97 (12)	87 (9)	84 (4)	96 (1)
			Fellows	14 (6)	20 (4)	31 (7)	24 (7)	49 (4)	48 (10)	15 (0)	12 (4)	12 (3)

Note: During the period between the 1982 and the 1984 surveys, 354 residents engaged in training who had not been listed previously. Of these, 7 finished training, 12 dropped out of straight radiotherapy, and all others are still in training and are included in the 1984 survey.

* No information available.

† Of these: 174 had finished training in January 1984; 43 had dropped out during the period between the 1982 and 1984 surveys; 136 were still in training.

Parentheses include foreign exchange students.

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umented the continued increase in the number of trainees (Table 2) (Flynn, D. F., written communication, July, 1985.) As of July 1985, there were 548 residents/fellows in training in comparison to 532 in July 1984 and 509 in January 1985. The 4% decrease from July 1984 to January 1985 is a typical variation because of: (a) attrition which is highest during the first 6 months of training, (b) training which begins in January and ends in December (5–10 residents each year), and (c) delay of training completion because of leaves of absence. This recent marked increase in trainees is illustrated in Figure 1.

Table 3 indicates that 522 residents/fellows were in training as of September 1984. Table 3 also indicates, that of all the specialties, Therapeutic Radiology has shown the largest percentage growth in numbers of residents between September 1982 and September 1984 especially since Nuclear Medicine and Radiology, Diagnostic–Nuclear are often combined for the purpose of manpower investigations.

Exactly 170 residents entered training in July 1985. Approximately the same number were accepted for training in July 1986. Because most programs in the U.S. are 3 years of training post-internship, by July 1, 1989 as many as 844 residents (*509* in training as of January 1985 + *170* accepted to enter in 1985 + *165* accepted to enter in 1986) will have completed their training and entered the job market. Even considering a 10% attrition rate, 760 trainees will enter the work force in the next 4 years (by July 1, 1989). This is substantiated by data in Table 2.

In October, 1983 the American College of Radiology distributed a position paper regarding the GMENAC Report for Five Hospital-Based Specialties.[2] In that position paper, it was presumed that if 110 trainees entered practice each year, there would be a slight oversupply of therapeutic radiologists by 1990. However, rather than the 110 estimated in that report, we now see that approximately 155 residents on average will complete training programs each year and enter the manpower pool.

Estimates of therapeutic radiologists required

Any estimate of the number of radiation oncologists required must be based on current professional practice and factors that are both increasing and decreasing need. For example, with the wide use of simulators and treatment planning computers along with the availability of certified RTTs, dosimetrists and nurse oncologists, many physicians can spend their time more efficiently and may treat more new patients *more* efficiently than without such assistants. Would these changes decrease the numbers of radiation oncologists needed? On the other hand, modalities such as hyperthermia and intraoperative radiation therapy require large amounts of physician time and may increase staff requirements. In a larger facility, these techniques may result in a need for additional staff members. A further change in practice pattern is seen in the increasing number of free-standing, single treatment unit, single physician facilities being constructed in the suburbs. This substantially fragments the patient population and reduces the patient load per facility and per physician. Will this add to the inefficiency of practice and increase the number of radiation oncologists needed or is this a consequence of training too many radiation therapists? It is obviously very difficult to make projections about future medical staffing requirements.

Table 4 has been adapted from the GMENAC report.[2] It represents one source of projections of the therapeutic

Table 2. Anticipated completion date (month/yr) for the 509 residents physically present in training programs as of July 1985*

	1985	1986	1987	1988
January	2	3	2	2
February	2	0	2	2
March	1	4	0	0
April	2	1	1	1
May	0	0	0	0
June	122	145	141	149
July	1	1	0	0
August	4	5	3	0
September	3	3	1	1
October	2	1	1	1
November	0	0	0	0
December	9	4	2	1
Total	148	167	153	157

* Method of data collection: During January 1985 information was collected from two independent sources (1) the Program Director (or secretary), (2) the Chief Residents. Whenever the information collected independently did not agree, data were resolved by phone. The data were then mailed out to all 509 residents for their final review in the event any error remained uncorrected. Each of the 509 residents received a data sheet with the full names and anticipated month/year completion of training of all residents in their program. They were asked to check the list to see if the information was correct not only on themselves, but also for the other residents in their program. As a result there were only three additional minor corrections: one spelling error and two changes as to the anticipated completion date.

June/July 1985 data collection used the same methods as the January 1985 data collection (i.e. cross checking two independent sources: Chief Residents and Program Directors). Of 548 residents/fellows in training as of July 1, 1985, 51 are scheduled to finish after 1988 and are therefore not included in the above figures; 129 residents/fellows finished training between January and June 1985.

Source: (Flynn, D. F., written communication, July, 1985).

radiologists required, given assumptions about population growth, residency training, and new patients. Several comments concerning this table are necessary:

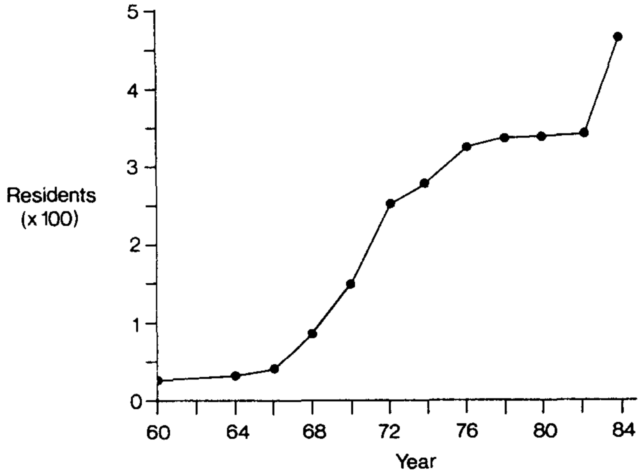

Fig. 1. Residents in training in radiotherapy.

Table 3. Number of residents on duty by specialty* (as of September 1st)

Specialty	1982	1984	Fraction change
Allergy and immunology	236	258	1.09
Anesthesiology	3,369	3,894	1.16
Colon and rectal surgery	46	43	.93
Dermatology	789	782	.99
Dermatopathology	35	23	.66
Emergency medicine	885	1,108	1.25
Family practice	7,040	7,588	1.08
Internal medicine	17,185	18,326	1.07
Neurological surgery	621	688	1.11
Neurology	1,276	1,408	1.10
Nuclear medicine	203	210	1.03
Obstetrics/gynecology	4,702	4,621	.98
Ophthalmology	1,553	1,569	1.01
Orthopedic surgery	2,733	2,854	1.04
Otolaryngology	1,001	1,047	1.05
Pathology	2,437	2,470	1.01
Blood banking	32	34	1.06
Forensic pathology	28	35	1.25
Neuropathology	37	47	1.27
Pediatrics	5,720	6,091	1.06
Pediatric cardiology	104	138	1.33
Neonatal-prenatal medicine	...	231	—
Physical medicine and rehabilitation	624	727	1.17
Plastic surgery	365	430	1.18
Preventive medicine, general	188	198	1.05
Aerospace medicine	46	54	1.17
Occupational medicine	78	87	1.11
Public health	31	25	.81
Combined general preventive medicine/public health	...	58	—
Psychiatry	4,235	4,643	1.10
child psychiatry	528	537	1.02
Radiology, diagnostic	3,155	3,202	1.01
Radiology, diagnostic-nuclear	62	88	1.42
Radiology, therapeutic	388	522	1.35
Surgery	8,064	8,207	1.02
Pediatric surgery	27	27	1.00
Vascular surgery	...	34	—
Thoracic surgery	278	291	1.05
Urology	1,041	1,050	1.01
Transitional year	1,381	1,480	1.07
Total	70,523	75,125	1.065

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1. It assumes that the average FTE Radiation Oncologist will treat 220 new patients per year. However, many well-staffed private practices may treat as many as 300 new patients/year/FTE.
2. It assumes that faculty in teaching institutions treat

Table 4. ACR (1983) estimates of requirements for therapeutic radiologists 1981–1990[2]

Year	U.S. Pop $\times 10^8$	Pt/1000*	Intensity ratio†	TR Reqd.‡	Shortfall§
1981	2.34	1.76	1.00	2017	193
1982	2.37	1.77	1.02	2057	204
1983	2.40	1.78	1.04	2098	179
1984	2.42	1.79	1.05	2118	148
1985	2.44	1.80	1.07	2158	140
1986	2.46	1.81	1.08	2178	105
1987	2.48	1.82	1.10	2219	74
1988	2.51	1.83	1.12	2259	45
1989	2.53	1.84	1.13	2279	—
1990	2.55	1.85	1.15	2320	(23)

* PCS data (current, with increases based upon both population aging and cancer increase in incidence).

† Based upon U.S. Population $\times$ pt/1000 (1982–1990)/Population $\times$ pt/1000 (1981). The intensity ratio uses 1981 as the base year to project the requirement for therapeutic radiologists. For example $1.07 \times 2017 = 2158$ (projection for 1985).

‡ Derivation of total TR requirement. Assume 220 new pt/yr/FTE in pt care only; Faculty pt care contribution 0.5 FTE, resident 0.35 FTE 80% pt care in community hospitals, 20% in teaching centers. Total U.S. RT pts/annum/1981. $2.34 \times 10^8 \times 1.76 \times 10^{-3} = 4.12 \times 10^5$ pts; Community pt care $0.80 \times 4.12 \times 10^5 = 3.29 \times 10^5$ pts/yr; $3.29 \times 10^5/220 = 1495$ community RT required. Academic Center pt care $0.20 \times 4.12 \times 10^5 = 0.83 \times 10^5$ pts/yr. Resident pt care contribution 110/yr $\times$ 3 yr $= 330 \times 0.35 = 116$ FTE. $0.83 \times 10^5/220 = 377$ univ FTE required less 116 resident FTE = 261 faculty FTE/0.5 = 522. Total requirements (other than residents) for teaching, research and pt care 1495 community RT and 522 faculty RT = 2017 Total TR required 1981.

§ Shortfall if 100% of current (110) number of residents/yr are employed.

only 110 new patients per year (i.e. 0.5 FTE) while residents function as a 0.35 FTE.

3. It assumes that 20% of the patients requiring radiation therapy are treated in teaching centers and 80% are treated in non-teaching centers.
4. It assumes that 100 residents are certified each year. However, since an average of 155 residents are now completing training programs each year, this will increase the manpower. Using the GMENAC formula: 155 residents per year $\times$ 3 years $= 465 \times 0.35$ FTE $= 163$ FTE rather than the 116 estimated.
5. The U.S. population data and the new patients/1,000 are probably too high. Although the table estimates 439,000 new patients in 1985, recent data from the American Cancer Society predicts that 410,000 may be more valid.[1] This will further reduce the number of radiation oncologists needed.
6. The projection is based only upon board certified physicians. Whereas 89 radiation oncologists were certified by the American Board of Radiology in 1985, 166 candidates (first time candidates + re-examinations) presented for the oral examination. It is likely that the majority of the 77 candidates who did not pass the examination are in practice since they have graduated from accredited training programs.

Radiation oncologists in practice

Table 5 includes data from the Patterns of Care Study[8] and indicates the number of full-time (FTMD) and part-time (PTMD) radiation oncologists in practice up to January, 1983. (These counts do *not* include residents.) Although the total number of physicians has remained stable at 2200 (FTMD + PTMD), the clinical, full-time equivalency has increased because of the larger proportion of radiation oncologists who practice on a full-time basis.

Cancer incidence figures for 1985 project 910,000 new cases, excluding non-melanoma skin and carcinomas *in situ.* Using this figure, plus findings from the Patterns of Care Study the number of radiation oncologists required can be estimated. Further, the Patterns of Care Study has shown that approximately 45% of the 910,000 new cases will receive radiation therapy or a projection of 409,500 new cases. In addition, in 1983, the Patterns of Care Study documented that the new patients per full-time equivalent physician had remained stable at 210 since 1975.[8] This ratio implies that 1950 full-time radiation oncologists are needed in 1985. The precise number in practice as of January 1985 is not available. However, projections from Table 4 would imply that the specialty may be very close to parity now—an outcome which was projected not to occur until 1990 (based upon 110 trainees entering practice each year, not the actual 155 (average) now entering practice each year).

Table 6 updates the GMENAC projections using the same assumptions as Table 4 but correcting for current U.S. population and cancer incidence estimates. Using this correction, the specialty currently has an oversupply of 47 physicians.

Table 7 includes alternative assumptions to those of the GMENAC report to estimate 1985 requirements. Alternative case loads per full-time equivalent (FTE) physician are used (300 or 200 new patients per year) for those in non-academic facilities (without resident training). Half the case load is used for physicians in academic facilities (as was the case in the GMENAC report). Numbers are calculated with and without the resident contribution to patient care of 0.35. This table could project a range of a 414 physician surplus to a 560 shortfall in 1985 and a 1990 range of a 854 surplus to a 350 shortfall. However, using the caseloads of 200 patients/year for the private practitioner may not be reasonable since this translates to about 17 patients per day. With the changing reimbursement structure, private practitioners may tend

Table 5. Full-time and part-time radiation oncologists 1975–1983

	FTMD	PTMD	FTEMD	New patients
1983	1756	443	1904	400466
1980	1564	600	1764	377837
1978	1414	763	1668	350028
1975	1194	955	1512	312548

Source: Patterns of Care Study.[8]

Table 6. Estimates of therapeutic radiologists required 1985–1990 (using the GMENAC assumptions as per Table 4)

Year	U.S. pop × 10[8]*	Pt/1000†	Intensity ratio‡	TR Req'd.§	TR Supply	Oversupply
1985	2.37	1.71	1.00	2018	2065	47
1986	2.39	1.72	1.01	2038	2210	172
1987	2.41	1.73	1.03	2079	2344	265
1988	2.44	1.74	1.05	2119	2464	345
1989	2.46	1.75	1.06	2139	2585	446
1990	2.48	1.76	1.07	2159	2702	543

Assumptions:
* U.S. Census Bureau figures for 1985 and current projections for 1990.
† Projections from the Patterns of Care Study (PCS) Data.[8]
‡ Based upon U.S. Population × pt/1000 (1985–1990) divided by U.S. Population × pt/1000 (1985). The intensity rate uses 1985 as a base year to project the requirement for another year. For example for 1990: 1.07 × 2018 = 2159.
§ Therapeutic Radiologists (TR) required: (a) 220 new patients/year/FTE in patient care; (b) Academic radiation oncologist patient care contribution 0.5 FTE; (c) Resident patient care contribution 0.35 FTE; (d) 80% of patients are treated outside of academic centers (Patterns of Care Study data),[8] (e) Exact figures used for 1985–1988 and 1989 projections (Flynn, D. F., written communication, July, 1985).

to treat significantly more than 17 patients per day per FTE. In addition, if the proportion of newly diagnosed cancer patients receiving radiation therapy increased to 60% rather than the observed 45%, then an additional 770 physicians would be required in 1985 over the current GMENAC predictions. It is unlikely that this will occur, though, in view of the 45% observed over the 8 years of the Patterns of Care Study surveys.[8]

DISCUSSION

External control of residency programs lies solely with the Residency Review Committee (RRC) for Radiology, a committee of the AMA Accreditation Council for Graduate Medical Education. The RRC assesses the *quality* of training programs with respect to accreditation status, and insofar as it sets educational standards, the RRC has an impact on the number of trainees. The new set of "Essentials and Guidelines" for training programs[3] approved at the Program Director's meeting in 1984 is being integrated into the existing AMA guidelines (Special Requirements for Residency Training in Therapeutic Radiology) and was designed to improve standards for training programs. This may be a factor in terminating a number of marginal programs and will decrease the number of training positions available. Because most of these programs are small, the overall impact is unclear. However, if the new guidelines assuring quality resident education are implemented, more programs may be closed. On the other hand, new programs meeting all of these standards may be approved.

Table 7. Variation in 1985 requirement

	No resident component†		Resident component‡	
Pt/FTE*	300	200	300	200
Non Teaching	1081	1621	1081	1621
Teaching	540	811	377	648
Total 1985	1621	2432	1458	2269
1990 Estimates	2008	3013	1806	2811

New patients per FTE non-teaching facility/teaching facility: *Assumes teaching faculty = 0.5 FTE; †Assumes residents do not contribute to patient care; ‡with GMENAC assumption that 1 resident = 0.35 FTE but with 465 residents in clinical care (155/yr × 3 years) or 163 FTE.

Although assumptions differing from those of the GMENAC report have been examined to determine how such alternatives would affect the projections, it seems that in spite of the flaws, the GMENAC assumptions may be reasonable for planning purposes.

Table 8 indicates the ratio of openings to applications in the ACR placement service for three periods. Although many positions in the United States may not be advertised in the placement service, it is probably significant that 1985 is the first year in which published applicants exceeded advertised positions.

One further point that has not been analyzed and which is significant is the impact of Canadian trainees on the manpower supply. Trainees from Canadian institutions are reasonably mobile and can add to the United States manpower supply. Since approximately 30 trainees per year are available from such programs with a limited demand in Canadian institutions, a proportion of these individuals will add to the United States manpower supply.

In a JAMA editorial, Bryon J. Bailey, M.D. discussed the effect of a surplus of otolaryngologists on medical practice.[4] Many of his points are applicable to radiation oncology including:

Table 8. American College of Radiology placement service

Date	Published openings	Published applicants	Unpublished applicants	Ratio of published openings to published applicants
9/83	69	63	80	1.10
9/84	99	93	98	1.06
9/85	106	140	109	0.76

1. Complex and difficult procedures are performed less frequently by the individual specialist.
2. Certain diagnostic procedures will be performed more frequently by the specialist and referred less often to the nonphysician or to the physician in another field.
3. Patients with medical problems who could be managed by the primary care physician will be encouraged to seek their care from the specialist and will be retained for the care of future similar episodes.
4. Preventive medicine and the maintenance of the healthy state will be given more attention by the specialists.
5. Competitive pressures will increase, and this will heighten the level of conflict between specialties with overlapping interests.
6. Training programs will begin to expand their educational curriculum to include greater emphasis on areas that were previously taught more superficially.
7. The practicing physician will seek more education regarding marketing, advertising, and business management.
8. The trend toward increasing numbers of postresidency fellowships will continue, and the cost of this additional training will be borne by society in general, while the benefit of greater expertise may be incompletely realized.[4]

These are not pleasant thoughts and projections, but they may be more realistic than we are willing to admit.

In 1983 Robert G. Petersdorf, M.D. discussed, in detail, the issue of the oversupply of physicians.[9] His view is applicable to the current situation in radiation oncology. In his analysis, careful manpower planning was an important recommendation.

COURSES OF ACTION

It is already too late to prevent the oversupply that will occur in less than 5 years. If careful planning is executed during the next year, the oversupply will still occur, but at least the magnitude of the flood can be diminished. The sharp rise in the number of trained radiation oncologists, even if they are better qualified trainees, may lead to poorer quality of care for the same reasons listed by Bailey.[4] Most therapists will be treating fewer patients in the future, thus performing certain procedures and going through certain cognitive functions infrequently enough to affect treatment results adversely. This may also lead to more frequent (perhaps inappropriate) use of radiation therapy. The solution requires radical changes. The following are possible courses of action:

1. There is ample justification for upgrading the resident's training. This can be done by increasing the length of residency training by 1 year (3 years post internship to 4 years post internship). For this to be effective in reducing the number of residents finishing, the maximum total number of positions would have to be reduced or frozen.
2. The difficulties FMG's have in passing the ABR written and oral examinations are reflections of our inability to evaluate these trainees prior to entry into the residency. We need a better method for screening trainees prior to acceptance. We must not penalize well-qualified graduates in our process of making changes which are necessary to improve FMG's. An improved screening mechanism would help in the selection of all applicants.
3. We need to implement changes this year. Most of the above will require substantial further study and evaluation, then perhaps months or years before implementation. We will likely get the earliest response by presenting problems related to this impending oversupply to Department Chairmen. They must be convinced of the seriousness of the problem.

Will these types of changes restore a balance to the supply vs need? Clearly, there are so many variables here that it is impossible to predict precisely how factors increasing the number of trainees will balance with factors decreasing the number of trainees. The question for 1985–1990 is no longer whether there will be an oversupply but rather what the impact of the oversupply will be with 600–700 FTE radiation oncologists entering practice (over those leaving practice) before 1990. Program directors should take note of these changes and should weigh them in developing the aims and objectives of their training programs.

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