

Diagnostic Radiologists' Subspecialization and the New Final Board Examination

Jonathan H. Sunshine^{1,2}
 Rebecca S. Lewis¹
 Mythreyi Bhargavan^{1,3}

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¹Research Department, American College of Radiology, 1891 Preston White Dr., Reston, VA 20191. Address correspondence to J. H. Sunshine (jsunshine@acr.org).

²Department of Diagnostic Radiology, Yale University School of Medicine, New Haven, CT.

³Department of Radiology and Radiological Science, Division of Diagnostic Radiology, Johns Hopkins University, Baltimore, MD.

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OBJECTIVE. Recognizing that subspecialization can consist of concentration in multiple fields as well as in a single main field, we conducted this study to profile in detail the subspecialization of diagnostic radiologists in the United States in ways that illuminate issues related to the American Board of Radiology plan for a new final examination.

MATERIALS AND METHODS. We tabulated nonindividually identified data from the American College of Radiology 2003 Survey of Radiologists, a stratified random-sample mail survey with 1,924 responses and a 63% response rate. Respondents were guaranteed confidentiality. Responses were weighted to make them representative of all radiologists in the United States.

RESULTS. Sixty-nine percent of respondents reported specializing at least to a small extent. If concentration in a field is defined as spending 10% or more of clinical work time in the field, 51% of radiologists concentrated in one or two fields, 24% in three or four fields, and 21% in more than four fields. An examination covering a radiologist's four most time-intensive fields would cover 80% of the clinical work of the median radiologist. However, the one fourth of radiologists whose work is most varied would have 40% or more not covered by the examination, but the one fourth with the most concentrated work would have 100% covered.

CONCLUSION. Most radiologists concentrate in a few fields, making the American Board of Radiology plan for an examination that covers four fields—or fewer, at an examinee's discretion—a major step forward in recognizing the nature of current practice. Four fields, however, are too many for the practice patterns of many radiologists but too few for the practice patterns of a substantial minority. We offer for consideration more far-reaching reforms.

In autumn 2007, the American Board of Radiology (ABR) announced two major changes in the final board examination in diagnostic radiology. The changes are to be instituted with residents beginning their studies in 2009 and thus go into effect in 2014. As is common among specialty boards, residents will not be permitted to take the final examination until after residency is completed. The earliest a diagnostic radiology residency graduate will be permitted to take the examination is 15 months after completion of residency. It will be interesting to see the consequences of this timing change.

We focus on the other, more radical change in the ABR examination: the change from covering the whole of radiology to covering a limited number of subspecialty fields. The plan calls for examination in four fields of the examinee's choosing, examinees being free to choose fewer than four fields, making

examinations in at least some of the chosen fields more intensive. This move toward recognizing subspecialization not only is a dramatic departure from the concept of covering the whole profession embodied in the current final ABR examination but also is a major departure from the dominant current concept of subspecialization, which is subspecialization in one field, not several. For example, almost all fellowships, certificates of additional qualification, and subspecialty societies are organized around a single subspecialty, not multiple subspecialties.

We investigate the extent of subspecialization in the current practice of radiology and trends in subspecialization. Our objective is to identify how current practice and trends compare with the new final examination structure, that is, the focus on a few subspecialties. We discuss the implications of these findings and offer recommendations based on our empiric findings.

Materials and Methods

With one exception, our data are from the American College of Radiology 2003 Survey of Radiologists, a stratified random-sample mail survey of U.S. radiologists that had a 63% response rate and 1,924 responses. One tabulation is from the American College of Radiology 2007 Survey of Radiologists, a stratified random-sample telephone and e-mail quota survey of American College of Radiology posttraining nonretired members that had a 20% response rate and 487 responses. Both surveys have been described in detail [1, 2]. In both surveys responses were weighted to make them representative of all U.S. posttraining professionally active radiologists [1, 2]. The 2003 survey asked extensively about subspecialization and division of time among subspecialty fields and general radiology. It listed 17 subspecialties: abdominal, body, breast, cardiac and cardiovascular, chest (thoracic), emergency and trauma, gastrointestinal, genitourinary, interventional and vascular, MRI, musculoskeletal, neurointerventional, neuroradiology, nuclear medicine and nuclear radiology, pediatric, sonography, and women's imaging.

In both surveys, respondents were assured of confidentiality. To enhance confidentiality, an outside contractor conducted the survey operations. Results presented are nonindividually identified aggregates. Data analysis was conducted with SAS software (version 9.1, SAS Institute). In all analyses, we studied how recently graduated radiologists differed from those with progressively more years in the profession. We believed that these differences would be predictive of trends. Similarly, given the slow movement of the profession toward larger practice size [1], we studied differences by practice size as possible indicators of trends.

Results

Subspecialization as Concentration in One Field

Sixty-one percent of posttraining professionally active radiologists had completed a postresidency fellowship, which is the usual training route to subspecialization (Table 1). The percentage varied greatly with years of experience, from 85% for radiologists with three or fewer years since completion of training to 31% for those with 30 or more years of experience (Fig. 1), a range of more than 50 percentage points. Sixty-nine percent of respondents said they specialized to at least a small extent (Table 1). There was a gradient with experience but a much less prominent one than for completion of a fellowship (Fig. 1). At all experience levels of

TABLE 1: Percentage of Radiologists Reporting Workload in General Radiology and Other Fields (Posttraining Professionally Active Radiologists in United States, 2003)

Variable	All	No. of Years Since Completion of Training						
		0-3	4-9	10-14	15-19	20-24	25-29	≥ 30
Unweighted number of survey respondents	1,393	144	246	194	194	148	161	145
Percentage who completed a fellowship	61	85	81	78	71	60	41	31
Percentage even slightly subspecialized	69	78	77	82	78	61	63	53
Percentage of clinical time in at least one field other than general radiology								
≥ 30	68	73	75	78	67	60	61	57
≥ 50	47	55	53	56	49	39	43	44
≥ 70	31	32	33	39	33	25	29	28
≥ 80	25	26	26	31	26	20	26	26
≥ 90	20	23	19	24	20	16	22	22
≥ 100	14	12	14	13	14	14	15	18
Percentage of clinical time in general radiology								
≥ 10	37	36	33	38	38	40	31	46
≥ 20	29	28	22	29	30	35	24	40
≥ 30	21	23	14	18	25	25	16	33
≥ 50	14	15	9	9	17	16	9	24
≥ 70	8	8	3	4	9	9	7	19

Note—The unweighted numbers of survey respondents do not sum to 1,393, as some respondents did not provide responses on years since completion of training.

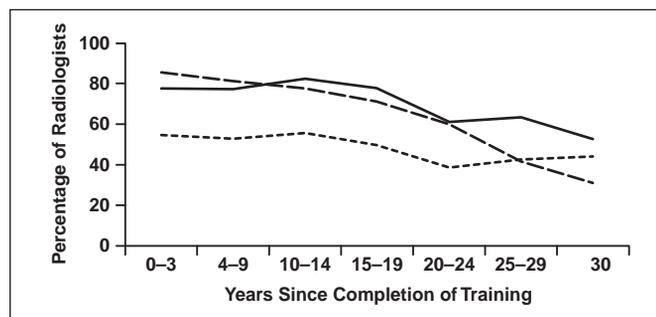


Fig. 1—Measures of subspecialization as concentration in one field in relation to years since completion of training. Graph shows newly graduated radiologists are more likely to have undertaken fellowship than are radiologists long in practice but that difference is smaller for any subspecialization and even smaller for spending large percentage of work time in main subspecialty field. Dashed line indicates fellowship completed; solid line, even slight specialization; dotted line, 50% or more of clinical work time in main subspecialty.

less than 20 years, the percentage was fairly similar, approximately 80%, and the total range from least to most experienced radiologist was only 25 percentage points. There was a large gradient by practice size, from 34% in solo practice and 43% in two- to four-radiologist practices to 90% in practices with 30 or more radiologists (Fig. 2). In the 2007

survey, 81% of respondents said they specialized to at least a small extent (the only data point from the 2007 survey that we used).

Another way to identify subspecialization in keeping with the concept of subspecialization as concentration in one field is to count as subspecialists radiologists who spend at least a certain large percentage of their clinical

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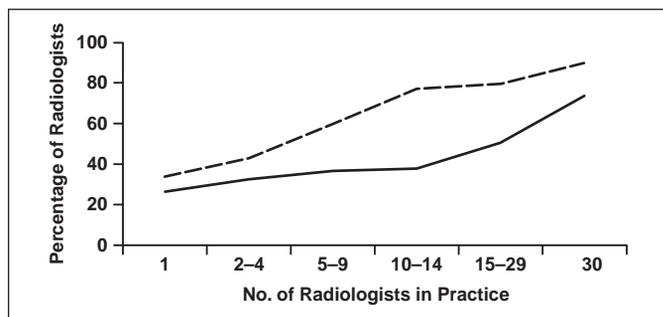


Fig. 2—Measures of subspecialization as concentration in one field in relation to practice size. Graph shows large differences in relation to practice size, subspecialization being increasingly likely with larger practice size. Solid line indicates even slight specialization; dashed line, 50% or more of clinical work time in main subspecialty.

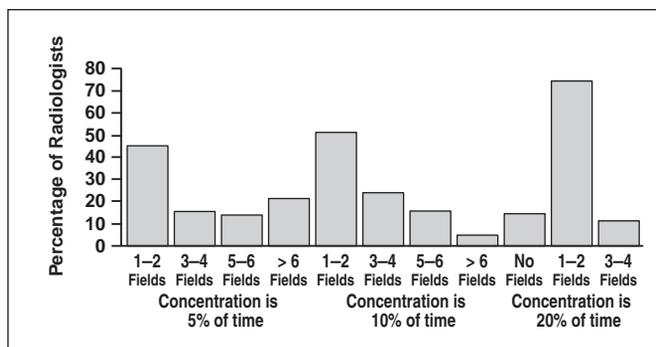


Fig. 3—Number of fields in which radiologists concentrate in relation to definition of concentration. Graph shows that by any definition of concentration, largest fraction of radiologists concentrate in one or two fields. If concentration is defined as spending 10% or more of time or 5% or more of time in field, substantial minority of radiologists concentrate in more than four fields.

work time in one field. Some subspecialty societies use this factor as one criterion for membership. Using a percentage-of-time criterion in 2003, there was a gradient related to experience (Fig. 1, Table 1) but a relatively small one. For example, approximately 55% of radiologists with 14 or fewer years of experience reported spending at least 50% of clinical work time in their main subspecialty field, compared with 43–44% of those with 25 or more years of experience, a difference of only 11–12 percentage points. Again, the gradient with practice size was larger, almost 50 percentage points at maximum (Fig. 2).

In summary, we found that extensive subspecialization in a primary field is widespread among radiologists. It is somewhat more common among radiologists relatively newly graduated than among those longer in practice and is much more common among radiologists in very large practices than among radiologists in the smallest practices.

Subspecialization as Concentration in a Limited Number of Fields

If one defines the fields in which radiologists concentrate as those in which they spend 10% or more of clinical work time, then in 2003, 24% of radiologists concentrated in three or four fields other than general radiology (Fig. 3, Table 2). Three or four fields is in keeping with the intent of the planned new final ABR examination. Fifty-one percent of radiologists concentrated in one or two fields, and 21% concentrated in more than four fields. Five percent concentrated in no fields, meaning that their work was very splintered among a large number of fields, so that no one field took as much as 10% of their time or that they spent a great deal of time practicing general radiology. We did not count gen-

eral radiology as a specialty field. There was relatively little difference according to how recently a radiologist had completed training (Fig. 4). At all levels of experience, concentration in one or two fields was by far most common, 40–61% of respondents being in this category. Substantial percentages reported concentration in more than four fields (16–27%) and in three or four fields (20–29%).

If concentration is defined as spending 5% or more of clinical work time in a field—that is, approximately a day or more a month for radiologists working a conventional schedule—36% of radiologists concentrated in more than four fields other than general radiology, 45% in one or two fields, and 15% in three or four fields (Fig. 3). Again, there was relatively little systematic trend by length of time since completion of training (Fig. 5). At the other extreme, if concentration is defined as spending 20% or more of clinical work time in a field, then in 2003, 74% of radiologists concentrated in one or two fields, 11% in three or four fields, and 14% in no fields (Fig. 3). Again, there was relatively little trend by experience level (Fig. 6).

When radiologists' careers are viewed over time, the number of fields in which they have concentrated at one time or another is increased by changes in focus over time. For example, if a radiologist concentrates in four fields immediately after completing training but 8 years later has shifted concentration from two of those fields to others, then in the first decade in practice, the radiologist has focused on six fields. Because a radiologist does not take a board recertification examination until 10 years after the postresidency final board examination, it would seem that this radiologist should have taken the postres-

idency examination in six fields, not four, although four is the number in which the radiologist concentrated at any one time.

Quantitative evidence of the rate of change in primary specialty comes from combining data on certificates of additional qualification with data on radiologist specialization in 2003. The examination for a certificate of additional qualification in neuroradiology was first administered in 1995, and the interventional radiology certificate examination was added in 1994. By 2003, 24% of certificate holders in each field were not spending even 30% of their clinical work time in the field. The percentages of respondents who did not report the field as their main specialty were even larger, 29% of certificate holders in neuroradiology and 33% in interventional radiology [2, 3]. The number of fields in which a radiologist concentrates showed major trends by practice size (Figs. 7–9). Most prominently, by any definition of concentration, concentration in one or two fields is more common in large practices, particularly practices with 30 or more radiologists, than in medium and small practices.

In total, how much of a radiologist's current work would be missed in a four-field examination?—Table 3 shows that a typical—that is, median—radiologist spent 80% of his or her clinical work time in the four fields that occupied the greatest amount of that time. Thus if the radiologist were examined in these four fields, 20% of his or her work would not be covered by the examination. The median varies little by years of experience, 15% of work not being covered for radiologists with fewer than 10 years of experience and 15–20% for those more experienced.

Much more prominent are the variations among individuals. The one fourth of radiologists

TABLE 2: Percentage of Radiologists Reporting Concentration in Fields Other Than General Radiology (Posttraining Professionally Active Radiologists in United States, 2003)

Variable	All	No. of Years Since Completion of Training						
		0-3	4-9	10-14	15-19	20-24	25-29	≥ 30
Concentration is ≥ 5% of clinical time in a field								
Average no. of fields	3.97	3.51	4.10	3.69	3.71	4.43	4.58	3.33
No fields	4	3	0	1	3	6	3	17
One field	24	29	25	28	26	22	22	24
Two fields	21	25	21	26	26	14	13	22
Three fields	9	8	9	8	9	9	11	4
Four fields	7	6	6	9	6	8	8	3
Five fields	7	7	10	5	5	7	6	4
Six fields	7	3	7	6	7	8	6	8
Seven fields	5	6	4	3	6	5	8	3
More than seven fields	17	12	17	15	13	22	24	15
Concentration is ≥ 10% of clinical time in a field								
Average no. of fields	2.77	2.55	2.92	2.72	2.48	2.98	3.17	2.35
No fields	5	5	1	1	3	6	3	17
One field	29	34	28	34	29	26	29	29
Two fields	22	22	26	25	32	15	12	19
Three fields	13	14	11	13	12	14	10	9
Four fields	11	10	11	7	9	15	19	9
Five fields	10	6	14	9	9	12	12	4
Six fields	6	6	5	3	4	6	9	7
Seven fields	3	3	3	4	1	2	5	3
More than seven fields	2	1	2	4	1	3	1	3
Concentration is ≥ 15% of clinical time in a field								
Average no. of fields	1.68	1.60	1.80	1.65	1.64	1.66	1.85	1.40
No fields	9	9	5	6	6	11	9	21
One field	40	47	36	44	42	42	37	39
Two fields	32	26	39	33	38	28	24	26
Three fields	13	12	14	14	10	11	22	6
Four fields	5	6	6	4	1	8	6	6
Five fields	1	0	0	0	2	1	2	1
Six fields	0	0	0	0	0	0	0	0
Concentration is ≥ 20% of clinical time in a field								
Average no. of fields	1.39	1.35	1.47	1.43	1.34	1.39	1.46	1.16
No fields	14	13	10	10	13	16	18	24
One field	45	50	44	48	50	44	39	44
Two fields	30	28	36	30	29	28	29	25
Three fields	10	8	10	11	8	9	11	6
Four fields	1	1	1	1	0	3	3	1
Five fields	0	0	0	0	1	0	1	0

whose work is most varied—that is, the 25th percentile in Table 3—would have 40% or more of their work not covered by a board examination, whereas the one fourth whose work is most concentrated into relatively few fields would have all of their work covered by even a two-field examination. If it were to involve three fields, which is an option examinees will have, the examination would leave 25% of the median radiologist's work not covered. If the examination were to involve two fields, 35% would not be covered. Again, there is relatively little difference by experience level but much difference among individuals. With a three-field examination, the one fourth of radiologists most varied in their work pattern would have 43% or more of their work not covered. With a two-field examination, 60% of work would not be covered. At the other extreme, the one fourth of radiologists whose work is concentrated in the fewest fields would have all of their work covered in either case. With a five-field examination, the median coverage would be 90%, but one fourth of radiologists would have 35% or more of their work not covered.

How much time is spent in the main individual fields that would be missed in a four-field examination?—Table 2 and Figure 3 show that 36% of radiologists were spending 5% or more of their clinical work time in each of more than four fields. (For “All radiologists” for whom concentration is ≥ 5% of clinical time in a field, the sum of percentages for five fields (7), six fields (7), seven fields (5), and more than seven fields (17) is 36%.) A four-field examination would leave them with at least one field consuming 5% or more of their time but on which they were not examined. Twenty-nine percent of all radiologists would have at least two such fields in which they were not examined, and 22% would have at least three such fields. There was no major trend by experience level.

Table 2 and Figure 3 show that 21% of respondents reported spending 10% or more of their clinical work time in each of more than four fields. (For “All radiologists” for whom concentration is ≥ 10% of clinical time in a field, the sum of percentages for five fields (10), six fields (6), seven fields (3), and more than seven fields (2) is 21%.) Therefore, a four-field examination would leave 21% of all radiologists spending 10% or more of their work time practicing in a field in which they were not examined. Eleven percent would be practicing in at least two such fields in which they were not examined. There was no particular trend by experience level.

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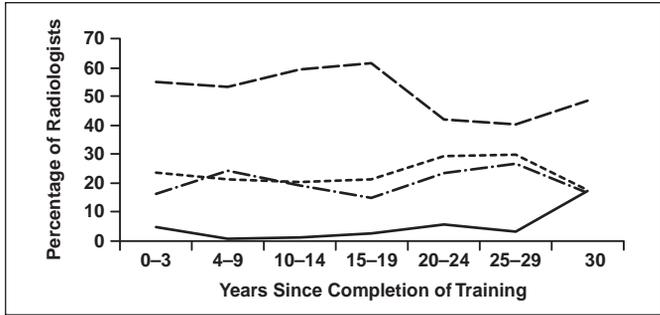


Fig. 4—Number of fields in which radiologists spend 10% or more of clinical work time in relation to years since completion of training. Graph shows little systematic trend according to years of experience, concentration in one or two fields is most common, and substantial minority (typically approximately 20%) concentrate in more than four fields. Solid line indicates concentration in no fields; dashed line, concentration in one or two fields; dotted line, concentration in three or four fields; dotted and dashed line, concentration in more than four fields.

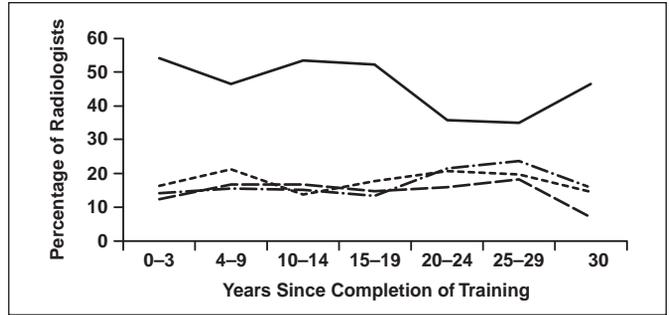


Fig. 5—Number of fields in which radiologists spend 5% or more of clinical work time in relation to years since completion of training. Graph shows little systematic trend in relation to years of experience, concentration in one or two fields is most common, and substantial minority of respondents (typically approximately 30–40%) concentrate in five to seven fields or seven or more fields. Solid line indicates concentration in one or two fields; dashed line, concentration in three or four fields; dotted line, concentration in five to seven fields; dotted and dashed line, concentration in more than seven fields.



Fig. 6—Number of fields in which radiologists spend 20% or more of clinical work time in relation to years since completion of training. Graph shows little systematic trend in relation to years of experience and concentration in one or two fields is most common. Solid line indicates concentration in zero fields; dashed line, concentration in one field; dotted line, concentration in two fields; dotted and dashed line, concentration in three or four fields.

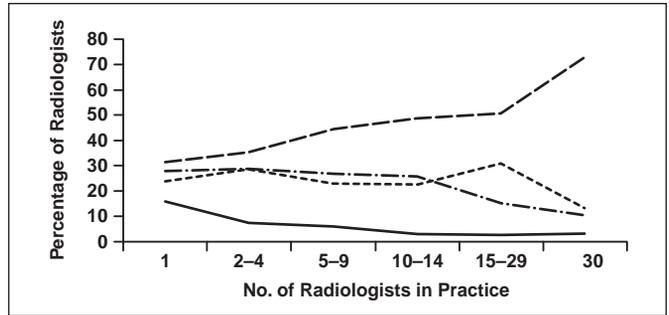


Fig. 7—Number of fields in which radiologists spend 10% or more of clinical work time in relation to practice size. Graph shows concentration in one or two fields is increasingly common with larger practice size. Solid line indicates concentration in zero fields; dashed line, concentration in one or two fields; dotted line, concentration in three or four fields; dotted and dashed line, concentration in more than four fields.

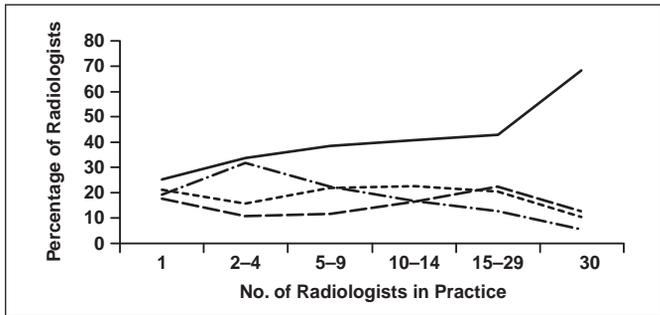


Fig. 8—Number of fields in which radiologists spend 5% or more of clinical work time in relation to practice size. Graph shows concentration in one or two fields is increasingly common with larger practice size. Solid line indicates concentration in one or two fields; dashed line, concentration in three or four fields; dotted line, concentration in five to seven fields; dotted and dashed line, concentration in more than seven fields.

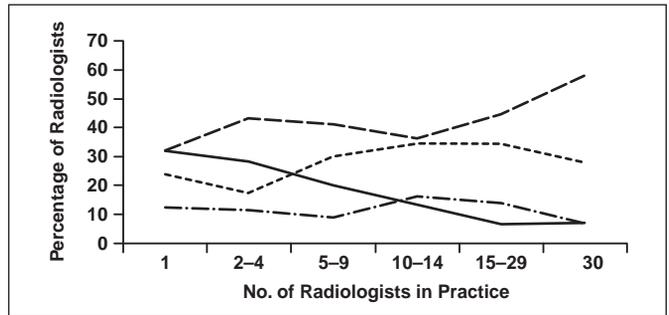


Fig. 9—Number of fields in which radiologists spend 20% or more of clinical work time in relation to practice size. Graph shows concentration in one field is increasingly common with larger practice size. Solid line indicates concentration in zero fields; dashed line, concentration in one field; dotted line, concentration in two fields; dotted and dashed line, concentration in three or four fields.

Only 1% of radiologists reported spending 15% or more of their clinical work time in each of more than four fields (Table 2). Therefore, a four-field examination would very rarely miss a field in which radiologists were spending more than 15% of their clinical work time.

General Radiology

In our analyses of fields, we omitted general radiology because it is not usually regarded as a subspecialization. Thus work spent in general radiology is presumably work that would not be covered by the new final board examination.

As Table 1 shows, 37% of radiologists spent 10% or more, 21% spent 30% or more, and 14% spent 50% or more of their clinical work time practicing general radiology. These percentages are much larger than for any field that we considered a subspecialty [4]. Radiologists

TABLE 3: Percentage of Radiologists Spending Time in Most Time-Consuming Fields (Posttraining Professionally Active Radiologists in United States, 2003)

Time-Consuming Fields	Percentile of Survey Respondents					
	Mean	10th	25th	50th	75th	90th
All radiologists						
Most	51	19	25	44	80	100
Two most	66	30	40	65	100	100
Three most	73	38	53	75	100	100
Four most	78	44	60	80	100	100
Five most	81	50	65	90	100	100
Six most	83	50	70	92	100	100
Seven most	85	50	75	95	100	100
Eight most	86	50	79	100	100	100
0–3 y since completion of training						
Most	54	19	30	50	80	100
Two most	68	30	40	70	100	100
Three most	74	35	55	80	100	100
Four most	78	40	60	85	100	100
Five most	81	44	70	90	100	100
Six most	82	50	71	95	100	100
Seven most	84	50	75	100	100	100
Eight most	84	50	80	100	100	100
15–19 y since completion of training						
Most	52	19	23	50	84	100
Two most	67	30	40	70	100	100
Three most	73	36	50	75	100	100
Four most	76	40	55	84	100	100
Five most	79	40	60	90	100	100
Six most	81	40	68	95	100	100
Seven most	82	40	70	100	100	100
Eight most	83	40	70	100	100	100
≥ 30 y since completion of training						
Most	54	20	25	50	90	100
Two most	67	30	41	63	100	100
Three most	73	40	54	75	100	100
Four most	77	50	60	83	100	100
Five most	81	50	60	90	100	100
Six most	83	50	70	95	100	100
Seven most	85	53	70	100	100	100
Eight most	86	54	79	100	100	100

with 4–14 years of experience seemed somewhat less likely than other radiologists to spend large portions of their clinical work time practicing general radiology, but this was not true of radiologists with 3 years of experience or less. In our analysis, we counted time spent in gen-

eral radiology as part of the work time not covered in a four-field examination.

Discussion

The 2003 survey did not define general radiology. We believe respondents most of-

ten took the term to have its traditional meaning of interpreting radiographs, principally musculoskeletal and chest radiographs. However, respondents might have interpreted it more in a sense of “bits and pieces of this and that.” Because the survey included a list of 17 subspecialties and directed radiologists to report how their clinical work time was divided among the 17 subspecialties plus general radiology, we believe the latter interpretation is unlikely. The 17 subspecialties seem to encompass almost all possible bits and pieces except for those included in the traditional definition of general radiology. Nonetheless, it seems desirable to clarify how much time is spent in general radiology defined in the traditional way—for example, by obtaining the information through a future survey. Despite the limitations, our findings have led to a number of interesting observations with respect to the final board examination.

How Many Fields Should an Examination Cover?

Our data show that a large majority of radiologists subspecialize to some extent, whether subspecialization is defined in terms of the traditional concept of concentration in one field or in terms of concentration in multiple fields. An examination that tests examinees in a limited number of fields, as the new final board examination will do, reflects the current realities of radiology practice.

Because data on the number of fields in which radiologists concentrate generally do not show trends related to recency of training (Figs. 4–6), it seems that the pattern of concentration in multiple fields may not change much, at least in the medium term (that is, approximately 5–8 years). Data on number of fields by practice size (Figs. 7–9) show strong trends, but practice size is increasing surprisingly slowly [1]. It seems likely that changes in the medium term will be modest. Overall, these findings imply that whatever is currently the appropriate number of fields in which to examine may well remain the appropriate number in the medium-term future. Our data also show, however, that there is no easy answer to the question of how many fields an examination should cover.

We used a broad range of definitions of concentration in multiple fields, ranging from fields in which radiologists spend at least 5% of their work time to 20% of work time. Under all the definitions, we found that concentration in one or two fields is the most common pattern among radiologists and that

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concentration in three or four fields, the apparent target range for the planned new final examination, is far less common. The apparent conclusion is that the examination should cover one or two fields.

However, even if one takes the view that radiologists need not be tested in a field on the final board examination if that field constitutes less than 10% of their day-to-day work, there remains the finding that a considerable fraction of radiologists—approximately one fifth of all radiologists by the 10%-of-time criterion—are practicing in more than four fields in which they ought to be examined. The fraction of radiologists who should be examined in more than four fields is even greater, more than one third, if one takes the view that 5% is the threshold at which work in a field is significant enough that the radiologist's skills in the field ought to be examined.

The desirability of examining in a relatively large number of fields is actually even stronger than the foregoing findings suggest. In the analysis it was assumed that the fields in which radiologists choose to be examined are the ones in which they will practice over the next decade, until they take the recertification examination and can be examined in a possibly different set of fields. In contrast, our data comparing certificates of additional qualification with current main specialization show considerable turnover. The amount of turnover seems relatively high given that, first, radiologists are not likely to obtain certificates of additional qualification unless they are strongly committed to a field and, second, the amount of turnover we observed probably reflects turnover in an average period of only approximately 5–6 years. (Although certificates of additional qualification had been available for 8–9 years as of 2003, not all holders of certificates of additional qualification obtained the certificates in the first year they were offered.) Not only is there substantial turnover in primary fields, but also changes in secondary, tertiary, and more fields of concentration are presumably more frequent.

The fact that different perspectives on our data point to different conclusions about the appropriate number of fields for the final board examination suggests the ABR may have been wise in planning to allow examinees to choose one to four fields for examination. On the other hand, offering examinees this choice fails to address the reality that the examination ought to encompass more than four fields for many radiologists.

What Will Examinees Do? What Should Training Programs Do? What Should the Board Do?

We predict that examinees will overwhelmingly opt for an examination in only one field, regardless of the relevance of doing so to their future practice pattern. Examinees typically will be taking the final examination a few months after finishing a fellowship, which means they will have a high degree of expertise and be highly up to date in the fellowship field. Conversely, they will have practiced very little in other fields in the preceding year, meaning they may be less skilled in all the other fields of radiology than they were 2 years earlier, when they took the first board examination.

Pressure to take the board examination in more than one field may arise if radiology practices are reluctant to allow graduates joining the practice to interpret images in fields in which they have not been tested on the final examination. Such reluctance would make a one-field examinee overspecialized and difficult to use in a practice, making employment relatively difficult to find for such a radiologist. We doubt, however, that much reluctance of this type will develop. Currently, residents are examined in all fields at the end of their fourth year, and generally there is not a reluctance to regard the results of that examination as evidence of overall competence. Under the new examination scheme, residents will be examined in all fields at the end of their third year with the initial board examination, which the ABR plans to retain.

To the extent that there is reluctance to employ new graduates in all fields of radiology, it is a reluctance to employ them outside of their fellowship field. Under the new final examination plan, graduates will continue to have a far larger amount of advanced training and experience in their fellowship field than in any other field, and thus the pattern of concern is likely to remain similar. In other words, taking a relatively limited examination in a secondary field is not going to give a radiologist much credibility in a field compared with the situation of a radiologist who has completed a fellowship in that field.

Even in fields in which there is a certificate of additional qualification—a credential reputed to constitute a relatively strong barrier to practice by radiologists who lack it—practices are not negative about allowing radiologists with no particular expertise in a field to practice it. For example, there is a

certificate of additional qualification in neuroradiology, a field in which reluctance to use radiologists with no subspecialty training or qualification is reputed to be particularly strong. Nonetheless, fully three fourths of all U.S. radiologists interpret at least some neuro images. Approximately 30% spend 5% or more of their clinical work time in the field, although only 13% have the certificate of additional qualification, have completed a neuroradiology fellowship, or have a heavy concentration of work time in the field [3].

Recommendation for consideration—Examinees should be required to take the final board examination in at least five fields. The ABR, however, regards it as important that there be a second board examination that covers the majority of fields in which radiologists are going to spend a substantial amount of work time. We agree and, moreover, believe it is important to cover most such fields. In light of actual practice patterns plus the fact that fields of concentration change over time, five fields seem the minimum necessary to cover fields of substantial concentration, and little change is likely in the medium-term future.

Recommendation for consideration—Training programs should reconfigure the final year of residency so that residents can spend that year in rotations in fields other than the fellowship field in which they plan to take the final board examination. The credibility gained by passing the final board examination in a nonfellowship field might be enhanced—and the skills of radiologists in such fields definitely would seem to be enhanced—if the final year of residency had a strong concentration on training in such fields. For example, if residents wanted to be examined in their fellowship fields and in two secondary fields, the ideal arrangement would be to spend 6 months of the final year of residency in each of the secondary fields. Then the credential in the secondary fields would consist not only of passing a less-than-maximal examination but also of extensive additional training in the fields. This measure would require effort and flexibility on the part of training programs. It may also require the Residency Review Committee for Radiology to make changes in the requirements for the residency. From conversations with radiology leaders we understand the Residency Review Committee is already working on this issue and that the changes required are relatively modest.

To implement this recommendation, training programs will need to have a good deal of

individualized scheduling each year for fourth-year residents, because the objectives of each fourth-year class will differ somewhat. Even with flexibility, training programs will probably not be able to perfectly fit fourth-year residents' objectives. Some fields may be oversubscribed in relation to the available case material, so residents will not be able to spend as many months in these fields as they desire. Conversely, there may be undersubscribed fields to which residents will have to be assigned for more time than they desire. These constraints may pose fewer problems if residents are able to do extended rotations in fields of special interest as early as the third year. However, they may not be adequately prepared in all fields at the end of the third year, when they take the first ABR examination.

Recommendation for consideration—Somewhat as the ABR plans, the examinee should have the option of having one field constitute up to one half of the examination and be covered in particular depth and of having the other four or more fields be covered in varying depth. Those who complete a fellowship would generally choose to have the fellowship field constitute one half of the examination. Those not undertaking a fellowship would probably choose equally divided emphasis on the examination fields.

Recommendation for consideration—Retaining certificates of additional qualification should be questioned. Almost all residents who complete a fellowship will take their final board examination with a heavy focus on the subspecialty field. They thus will have a subspecialty credential consisting of a fellowship and a final board examination heavily focused on their subspecialty field. This credential should carry much weight, and it is not obvious that a certificate of additional qualification would serve an additional useful purpose.

Recommendation for consideration—The planned new final board examination should encompass fields that correspond reasonably well to the ways in which subspecialization is actually practiced. Currently, there is a considerable disconnect. Pulmonary, gastrointestinal, genitourinary, and cardiac radiology are four of the 11 fields on the current ABR final board examination, but each is the subspecialty of 1% or fewer of radiologists [4]. Conversely, 7% of radiologists report body imaging is their main subspecialty; 4%, MRI; and 2%, abdominal imaging [4]. None of these fields is addressed on the current board examination.

Recommendation for consideration—General radiology should be added to the list of fields that can be chosen for the final examination. The reason for doing so is that the final board examination needs to deal with the fact that a considerable percentage of radiologists spend large fractions of their time practicing general radiology. This is true both of recently graduated radiologists and those longer in the field.

A Bolder Vision: Recommendations for Consideration

The ABR plan for the final board examination represents a major departure from the present system, a departure that moves in the direction of how radiology is practiced now and is likely to be practiced in the future. We applaud the board for its vision and its bravery in undertaking major change. Nonetheless, both the ABR plans and our recommendations, which include additional changes, have a certain timidity because neither questions whether a preliminary board examination should be administered before the final examination and neither questions whether a radiology residency should be 4 years long. A bolder vision, not tied to these assumptions, yields recommendations that are considerably different.

Freed of these assumptions, we recommend the radiology residency be 3 years long and be followed by an examination covering the whole of radiology. Three years is, in essence, the amount of time needed to complete required rotations. The examination would be much like the current ABR plan for its first examination but with the examination given after the residency is completed instead of after 3 years of residency. With a 3-year residency, residency graduates could, in the number of years now usual for training, overtly devote 2 years to subspecialization. This subspecialization could take the following forms.

First, subspecialization could consist of two 1-year fellowships. A few radiologists now undertake two fellowships, and a two-fellowship pattern would be in keeping with the fact that many radiologists devote a substantial amount of time to their second-most prominent field. Table 3 shows that approximately 20% of a radiologist's time typically is spent in the second field. (Approximate time is the second most time-consuming field = median time in the two most time-consuming fields, 65%, minus the median time in the most time-consuming field, 44%.)

Second, the 2 years of subspecialty training could consist, in part, of brief fellowships of 3–6 months' duration. Residency graduates could then not only undertake a 1-year fellowship in the field planned as their principal subspecialty but also undertake two to four brief fellowships in fields they envisage as secondary fields of concentration. Widespread use of brief fellowships would be an innovation suited to the reality that most radiologists have multiple fields of secondary concentration.

Brief fellowships also should be popular with experienced radiologists who need or desire to make a major commitment to mastering aspects of radiology that have developed in the 10, 20, or more years since they completed training. Brief fellowships also are a solution to the problem of radiologists changing their fields of concentration over time. We know of experienced radiologists who have found or created brief fellowships and used them for these purposes. In short, we believe that widespread availability of brief fellowships would be valuable both for radiologists recently finishing residency and for experienced radiologists. For these reasons, the subspecialties should develop brief fellowships of 3–6 months' duration.

Third, subspecialization could consist of 2 years in a single field in which an individual has a particularly strong interest. There might be concentration in a subfield, such as interventional neuroradiology.

Finally, some graduates will decide to perform fewer than 2 years of postresidency training, perhaps even none. We do not believe this choice will give rise to serious problems. Radiology residency currently requires 5 years of training after medical school, including the clinical year. This requirement is one of the longest for first certification in any physician specialty. Nonetheless, residents overwhelmingly choose to spend another year in training. We therefore expect that with a 3-year residency, few residency graduates would undertake no further training. Even with one specialized or semi-specialized postresidency year, radiologists would be better trained for the specialized character of current and future radiology practice than is today's residency graduate, who has a fourth year of radiology training but generally with little specialized focus.

The richly varied possibilities for postresidency training under this proposal for, first, a 3-year residency and, second, widespread creation of brief fellowships seem a strength given

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the extent to which radiologists vary in degree of subspecialization and given uncertainties about the degree to which subspecialization will—or should—increase in the future.

Limitations

The 18th century philosopher David Hume pointed out that, logically, one cannot get from “is” to “ought.” Our data consist of facts—what is—and alone they do not tell what should be done. Moreover, our facts have only moderate value for predicting where radiology is headed. For example, because our 2003 data show that the percentage of radiologists who subspecialize at least to a small extent increases with recency of completion of training and with larger practice size, we predict that this measure of subspecialization will increase over time. This prediction is borne out by 2007 data showing that 81% of radiologists said they subspecialized at least to a small extent in 2007, up from 69% in 2003. However, the fact that a greater percentage of radiologists 3 years or less out of training were, in 2003, spending 30% or more of their time practicing general radiology than was true of radiologists 4–9 years out of training probably does not herald a future resurgence of general radiology. Quite possibly, it reflects practices organizing their work such that only with some seniority does a member earn the privilege of practicing relatively little general radiology. An added problem

in predicting the future is that our data are already somewhat old, dating from 2003. Unfortunately, the 2007 survey did not ask radiologists about the distribution of their work time, so we do not have 2007 data. It would be very valuable to know the future, given that the new examination will not be offered until at least 2014, 6 years hence.

Conclusions

Many thoughtful individuals and groups have offered ideas on the direction that radiology training and practice should take [5, 6]. The ABR drew more than 100 responses when it requested comments on its plans. Some of those offering views undoubtedly are wiser than we, and almost all are closer to day-to-day training and practice than we are. We, in contrast, may have an advantage in being able to form a broad perspective because of our distance from day-to-day events. The main strength of this study is bringing a large body of facts to bear where little empiric evidence has been previously available. We hope that others will make use of this body of facts. To provide more up-to-date information, we are planning a new survey to obtain data similar to those obtained in 2003.

We found that radiologists subspecialize extensively in the sense that they concentrate in one field. Radiologists also subspecialize in the sense that they spend considerable amounts of work time in a few, but not all, fields. The ABR plan for the final board ex-

amination recognizes both aspects of subspecialization. We believe the board deserves commendation for its willingness to undertake large-scale changes. It seems that even more extensive changes would be desirable. We, however, have the luxury, which the board does not, of suggesting changes without having to be as responsible for the reaction or results.

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