Applying for Residency: Diagnostic Radiology

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Part I: Overview of Diagnostic Radiology (DR)

Description of Specialty, Common conditions, types of patients:
Diagnostic radiology (DR) is a rapidly changing field at the forefront of medical and technological innovation providing non-invasive imaging visualization of the human body and disease processes. From the discovery of the X-ray by Wilhelm Röntgen in 1895, the field of DR has evolved to incorporate advances in ultrasound, radionuclides and magnetic resonance imaging to play a vital role in the diagnosis and treatment of our patients. Radiologists are often described as “the doctor’s doctor,” acting as a consultant to every medical specialty. Due to the fact that the knowledge base for a diagnostic radiologist is broad, the length of a DR residency is 5 years (including the intern year), typically followed by a 1-2 year fellowship. Indeed, the complexity of radiology means that while many radiologists will remain general radiologists, others will specialize in subspecialties based on organ systems such as neuro, chest, body, mammographic and musculoskeletal radiology or subspecialize based on imaging modalities such as nuclear medicine, ultrasound or MRI. Some specialize based on medical services such as ED radiology or women’s imaging. DR also offers minimally invasive procedures such as image guided biopsies and drainages to those who are procedurally inclined.

Career trajectories: academics, clinical, research, teaching, etc.
While the majority of radiologists will enter private practice, devoting their full attention to clinical patient care in the community setting, others will stay in academia, performing research that advances imaging technology, spearheading the next wave of technological breakthroughs such as machine learning to help diagnose disease and conduct clinically oriented research on disease/pathology characterization and diagnosis. Furthermore, academic radiologists will train the next generation of radiologists and clinicians, in addition to their role in delivering leading edge patient care. Those who stay in academics will also find opportunities to participate in the fields of quality improvement/assurance, mentor in humanitarian outreach programs to bring imaging to underserved regions of the world through multiple organizations (such as RAD-AID) and participate in educational exchange programs from hospitals and universities around the world.
Practice Models
Traditional small private practice, hybrid academic/private model, large private practice groups that serve large geographic areas, Health Maintenance Organization and academic medicine models.

Residency: Length, typical curriculum
After one year of internship, DR residency lasts four years. For the internship year, applicants can complete a preliminary medicine year, preliminary surgery year, or transitional year. These experiences build a foundation of general medical knowledge and skills necessary to care for patients. In the first year of the radiology residency (PGY2), the radiology residents will not take call, but will be expected to learn fundamental skills in interpreting radiographs, ultrasounds, CTs and MRIs. Training program curricula may be organized by systems (i.e., rotations through neuroradiology, abdominal imaging, interventional radiology) or modality (i.e., rotations through US, CT, x-rays or MRI). Many programs will combine these approaches. By the 2nd year (PGY3), the resident will begin to take call. In addition to call duties, during the 2nd (PGY3) and 3rd (PGY4) years, the resident will rotate through sections not covered in the 1st year or return to core rotations for further training. As of this writing, PGY 4 residents take the 1st part of a two part board licensing exam called the “Core exam” in late June. During the 4th year (PGY 5), the resident will typically have the opportunity to participate in elective courses, mini-fellowships in addition to continued rotations through core sections. Many programs will offer rotations at multiple hospitals to satisfy specific training needs.

Typical Fellowships offered after residency (Not all fellowships are ACGME-accredited)
● Abdominal Radiology
● Breast/Women's Imaging
● Endovascular Surgical Neuroradiology
● Musculoskeletal Radiology
● Neuroradiology
● Nuclear Radiology
● Pediatric Radiology
● Clinical Informatics

Part II: Life as a Diagnostic Radiologist

Demographics
Per the American College of Radiology Human Resources Work Force Survey of 2016, women make up ~21% and men make up ~79% of the radiologists in the United States. 2/3 of the work force is between 35-55 years old. However, in radiologists 45 years or younger 26% of the workforce are women.

In an article published in 2014 in Radiology (Current status of diversity by race, Hispanic ethnicity, and sex in diagnostic radiology, Chapman et al., Radiology, 270(1):232-40), similar numbers for gender were reported for diagnostic radiology residencies: Male (72.2%), Female (27.8%), white (66.3%), Asian (24.5%), Black (5.6%).
However, many programs, such as BIDMC, boast near gender parity with the average class being made up of ~40% women.

**Earnings Potential**
Please note that the numbers presented reflect an average of private and academic salaries. Academic salaries are lower than private practice. Per Radiology Business ("Demand is up for up for radiology, but salaries are down", 7/27/2018, Michael Walter) citing a report by Merritt Hawkins (a physician recruiting firm), in 2018 the average starting salary is $371,000, which constitutes a 15% drop from $436,000 in 2017. Radiologists’ average starting salary in the Northeast was $375,000. The number was higher in the West ($388,000), Southeast ($400,000) and Midwest ($405,000). However, in another survey by Medscape (Radiologist compensation report 2018, Carol Peckham, 4/18/2018), the mean salary in 2018 was $401,000.

**Lifestyle**
Per the Medscape Radiologist compensation report 2018 (Carol Peckham, 4/18/2018) radiologists report working the following hours/week:
- <30 hours: 30%
- 30-45 hours: 29%
- 46-55 hours: 29%
- 56-65 hours: 7%
- >65 hours: 4%

Hours and call schedules may vary dramatically among subspecialties and whether a radiologist is employed in a private practice, hybrid model or academic setting. Some radiologists may subspecialize and never read studies outside their subspecialty, particularly in the academic setting. Many radiologists may read a greater volume of studies of their subspecialty relative to other kinds of studies, while others will become generalists.

Many practices will employ radiologists for overnight call work (typically with a model of 2 weeks on, 3 weeks off).

**Academic Medicine**
The majority of radiologists will go into private practice. Approximately 20% of radiologists are in academic medicine. The majority of academic radiologists will work predominantly in a specific subspecialty and participate in research, teaching of medical students and residents in addition to providing care to patients. In addition, academic radiologists may participate in quality improvement/assurance, humanitarian outreach programs and participate in educational exchange programs from hospitals and universities around the world.
Part III: Applying in Diagnostic Radiology

How Competitive is Diagnostic Radiology?
Although considered one of the more competitive specialties, requiring high USMLE Steps scores and 10-18 positions to rank, interest in diagnostic radiology historically waxes and wanes in cycles dependent on the post-residency job market, with the most recent downturn in the last 10-15 years. However, as the following chart (modified from the NRMP Results and Data: 2018 Main Residency Match) shows that the trend is reversing, with the 2018 year considered one of the most competitive.

<table>
<thead>
<tr>
<th>Position</th>
<th>2018</th>
<th>2017</th>
<th>2016</th>
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<tbody>
<tr>
<td></td>
<td># of spots</td>
<td>Filled by US grad (%)</td>
<td>Filled Total (%)</td>
</tr>
<tr>
<td>PGY2</td>
<td>944</td>
<td>72.4</td>
<td>99.5</td>
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<tr>
<td>PGY1 (Categorical)</td>
<td>125</td>
<td>61.6</td>
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According to the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), for those who match, the average USMLE Step 1 score is 240 and the average USMLE Step 2 score is 249. The higher the Step 1 score, the higher the likelihood of matching. The NRMP 2018 data also notes that the probability of matching reaches ~100 at 17-18 contiguous ranks.

Planning the post-clerkship and senior years
Once you have decided on a career in diagnostic radiology, you should meet with your academic advisors and your radiology clerkship director for our PCE site. Be prepared to discuss possible research, additional advanced radiology clerkships, away rotations and other opportunities that will improve your curriculum vitae. You may also want to contact the Radiology Residency program directors at affiliated hospitals to discuss your possible candidacy, even if you are not planning to stay in the Boston area.

Clinical Rotations and Sub-Internships
In addition to the core radiology clerkship, it is recommended that you do an advanced elective. Electives that allow you to start or participate in a research project may be especially desirable. For any elective, demonstrating interest through activities like giving a didactic presentation or participating in journal club, are ways to show enthusiasm and leave a positive impression. Electives should be done by July/August of the senior year in order for research projects to be mature or completed, grades to be tabulated and letters of recommendations to written by the time interview season begins in late fall/early winter.

You will want to ask the clerkship director at your PCE site to write a letter of recommendation. You should also ask for letters from radiology attendings who have worked closely with you and can write letters with personal details and touches which may be missing from letters written by clerkship directors or chairs of sections. Unlike in other specialties, it can be difficult to make any sort of meaningful connection with an attending (who could potentially write a letter) and make an impression on them. This is simply because for the most part, even in advanced rotations, medical students only
observe. Thus, it is quite important to start early and try to connect with a particular attending for him/her to get to know you by the end of the rotation. Showing more initiative can also be beneficial (e.g. asking if there are any projects the student could work on/help with during downtime, proposing to make a presentation, etc).

Outside of radiology, program directors place a great deal of emphasis on performance in the Medicine clerkship and required Medicine sub-Internship.

Away electives
Away rotations are useful if you are specifically interested in attending residency at that institution. If your performance is stellar, an away elective can help you to distinguish yourself from other applicants. However, anything short of a stellar performance will diminish your standing as a candidate. Unless there is a pressing need or desire to be at a specific institution (such as family proximity, or a partner in that city) students may stand to lose more than they gain with an away elective in the specialty. Most programs do not consider a visiting rotation as essential when granting interviews.

Other Recommended Electives
Many program directors will recommend electives that will test the applicant’s ability to handle stressful environments and complicated clinical cases such as intensive care/critical care electives. Others may recommend electives that will augment an applicant’s desired career goal or interests; for example, if an applicant expresses early interest in neuroradiology, then an elective through neurosurgery or neurology will serve to broaden their knowledge.

Research
Radiology is a highly competitive field and the most competitive programs will expect that an applicant will have some research experience. According to the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), applicants who match and don’t match have similar numbers of research experience, but successful applicants do have more publications from research projects. On average, those applicants who match have higher numbers of abstracts, presentations, and/or publications compared to those who do not match. The research does not necessarily have to be in the field of radiology. In addition, the research need not be laboratory bench work or clinically oriented studies; public health (global or public), process improvement, or medical education are all desirable. Although it is presumed that most HMS students will have research experience through their Scholars in Medicine project, if you do not have some research experience when you decide on radiology, it is recommended you talk to your clerkship director or specialty advisor to help direct you to a project. A recent graduate suggested, “it’s important to be aware of timing! It’s best to start a radiology research project a few months prior to the application submission for two reasons: (1) your mentor can write a recommendation letter; (2) you will have stuff to talk about in interviews."

National Meetings
Presentations and scholarships at conferences for medical societies at the national or state level, such as the American Medical Association, the Massachusetts Medical Society or radiology specific societies
such as the American College of Radiology (ACR), American Roentgen Ray Society (ARRS) or Radiological Society for North America (RSNA) can help differentiate an applicant’s CV from the rest of the pack. Presentations or attendance at radiology national meetings can provide networking opportunities to meet residency program directors from across the country.

Other degrees
Based on data from the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), in radiology, 4.6% of both matched applicants and unmatched applicants had PhDs, while 16.8% of matched applicants versus 24.6% of unmatched applicants had other post graduate degrees. Thus, there does not appear to be added benefit of additional advanced degrees.

Part IV: Assessing your Competitiveness

What Criteria do Programs Consider?
An applicant’s competitiveness will determine the type and number of programs to which they should apply. USMLE step scores and clinical grades/performance are important determinants to the number and types of programs one should apply. However, research and volunteer experience, participation in leadership or educational activities also play an important part in differentiating applicants from their peers.

If your self-assessment indicates that you may be less competitive, you might consider applying for an away elective at one or more of your desired programs. A stellar performance and a letter of recommendation from a faculty member at the away rotation may get you an interview even at a highly competitive program, although this is not guaranteed.

1. Grades and your DSA
While grades are important, not all grades are equally important. HMS is now using the Department Summary Assessment for 2019 and beyond (a small set of seniors will still be in the New Pathways and will not have a DSA in 2019-2021). The DSA is intended to capture a student’s professional growth over time and includes all clinical coursework in the specialty from the clerkship through July of the application year. It is anticipated that most, but not all, students applying will have an Honors with Distinction in the radiology DSA. Besides the radiology DSA, the medicine DSA, grades in surgery and medicine clerkships are valued by DR residency programs. Poor grades diminish your competitiveness, but many programs (even highly competitive programs) use a holistic approach to evaluating candidates.

2. USMLE Step Scores
According to the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), for those who match, the average USMLE Step 1 score is 240 and the average USMLE Step 2 score is 249. Most programs will use the Step 1 score as a filter to screen applicants. Some highly competitive programs may choose a high score as their filter. Most programs will set the filter at a score 10-20 points lower
than the average score of 240. Furthermore, while many programs will interview applicants without Step 2 scores, a great performance on Step 2 may mitigate the disadvantage of a lower Step 1 score. Finally, less competitive programs are much more likely to interview applicants with low Step scores.

3. Research Experience
According to the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), the mean number of research projects for those who matched in Radiology was 3.7 projects versus 3.2 projects for unmatched applicants.

4. Publications
According to the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), the number of abstracts/presentations/publications for those who matched in Radiology was 6.0 versus 3.9 for unmatched applicants.

5. Extracurricular Activities
According to the NRMP (Charting outcomes in the MATCH: US allopathic seniors 2018), the number of work experiences for those who matched in Radiology was 2.9 versus 3.3 for unmatched applicants.

The number of volunteer experiences for those who matched was 6.4 versus 5.4 for unmatched applicants. Leadership, educational or innovation experience is considered highly desirable by most program directors.

While some program directors may not be interested in an applicant’s hobbies and interests, to this writer, these types of details may offer a jumping-off point for conversation during an interview; a shared interest, or a candidate’s expressed passion for a hobby, may increase the chance for a favorable impression. A recent HMS student wrote about the listing hobbies in ERAS: “In my experience, all program directors and interviewers read that part and this is actually what they wanted to talk about in a good chunk of the interviews. It is also important to not just list a number of things you occasionally do, but put down something you are truly passionate about and can elaborate. Quality and content over quantity. Don’t skip that section!”

Getting an Interview: Attributes Residency PD’s Consider in Granting Interviews
Needless to say, the USMLE Step 1 scores is a highly important determinant in which applicants are granted interviews. While there is typically no officially defined “cutoff” or required Step 1 score, the NRMP data presented above show that the higher the score (with the median score of 240), the higher probability of matching. A high Step 2 score may help to mitigate a low Step 1 score in some programs. Letters of recommendation, the personal statement, the MSPE/Dean’s Letter, honors or awards, and other metrics are considered by many programs to help differentiate between candidates with similar Step scores.

When programs are ranking applicants for the Match, the attributes that further differentiate candidates with similar achievements are interpersonal interactions and skills, characterized by
interactions with faculty, staff and residents during the interview process, and feedback from current residents.

**Letters of recommendation**
An applicant will need at least 3 letters of recommendation (LoR); Radiology programs typically require a Department Chair letter (from the Chair of the Radiology department where you did your PCE), and 2-3 supporting letters. Most HMS students will have 3 supporting letters. You want to choose faculty who will be strong advocates for you as an individual, who know your personal and your clinical strengths. A professor, with whom you have done research, particularly if a paper has resulted, is also a good choice, as they can comment on your work ethic and research experience.

When choosing your writers, consider choosing:
- Faculty member who knows you well
- Research mentors
- Faculty with a national reputation—this may be in research, clinical medicine, or education

If you choose a writer from outside Radiology, the writer should know you very well and be able to comment on your abilities to perform as a resident, even if the writer is junior faculty.

Ask for your letters as soon as you identify the faculty member you want as your letter-writer, which may be months in advance of the deadline. Some faculty members write a LoR at the time they are asked, while others may put this off until the deadline. If the letter writer is among the latter, remember to reach out to them again in May or June to give the writer adequate time to review your record. Give your letter writers your CV and personal statement to review as soon as you have them completed (this may be draft versions if you are asking early in the process). Offer to meet with each writer in the summer to review your portfolio and give them time to write the letter. Ask the writers to submit their letters before August 31. ERAS has a letter request form you should provide to your LoR authors. This form assists your letter writer with submission of the LoR, and includes instructions on how to access and use the ERAS Letter of Recommendation Portal. You should send a reminder to the writers around August 20. Remember summer vacations and other commitments may come up, and you want to be respectful of your writer’s time. You should consider writing a thank you note once the letter is on file with ERAS.

ERAS gives you the option to waive your right to review the LoR. There is no benefit to reviewing your letters, and program directors may be concerned if an applicant did not waive this. It is strongly recommended you waive the review.

**How many programs should you apply to?**
The number of programs to which an applicant should apply depends on your competitiveness, but also depends on other factors such as geographic restriction or participation in the couples’ match. The NRMP 2018 data shows that the probability of matching maximizes at 17-18 contiguous ranked programs for applicants with Step 1 scores of >240. In order to match to a program, both the applicant and the program must rank the other, and programs do not rank applicants they have not interviewed.
Thus, to have 17-18 programs on your rank list, you must apply to many more in order to insure you receive interviews.

The AAMC calculates a “point of diminishing returns” based on Step 1 scores on how many program applications are needed applications. This information is based on all US graduates; students from HMS have recently applied to 20-30 programs for a successful match.

In Radiology, the successful applicant with a score <230 needed to apply to 45 (confidence interval 40-50) programs to reach the highest likelihood of matching successfully at ~60%; adding more applications did not increase the chances of a successful match. Applicants with a score of 230-243 needed to apply to 41 (confidence interval 37-45) programs for a likelihood of matching at ~80%. Students with scores >243 needed to apply to 31 (confidence interval 28-34) programs for a likelihood of matching at ~80%.

Thus, an applicant with a score 245 may wish to apply to approximately 30 programs with the goal of interviewing at and ranking ~17-18 programs.

It may also be prudent to apply to a mix of “reach” and “safety” programs. If an applicant applies to only highly competitive programs, then the number of programs applied may need to be increased.

While most HMS students will likely match in their top 5 ranked programs, be realistic in the rank order and number of programs ranked. Importantly, do not rank a program you do not wish to attend. Rank the programs in your preferred order, and trust that the highly complicated NRMP algorithm, for which one of its creators shared the Nobel Prize in 2012, will provide the best possible match.

Common questions you may be asked at interviews – specialty specific
The entirety of the ERAS portfolio, personal statement, LoR, research projects, interests and hobbies are all topics that may be discussed in an interview. You may wish to participate in mock interviews offered to HMS students- this is highly recommended by recent graduates.

If there are gaps in the education portfolio or low test scores or clinical rotation grade, be prepared to discuss why it happened and what you have learned from the experience.

Interview questions may include:
● Motivation for applying to the program
● Why radiology? Why our program?
● career plans (academic versus private practice), subspecialty interests
● Standardized questions based on STAR (Situation, Task, Action, Result) which posits a scenario or task, what action you took, if any, and what the results of were of the action
  e.g. Tell me about a time you didn’t succeed at a goal and how did you respond?
● Questions regarding achievements or aspects of your career or life you wish to talk about not included in the ERAS portfolio
● What do you do in your free time?
An applicant should have answers ready for such questions, without sounding overly rehearsed. Practicing answering such questions during mock interviews or in the mirror are strategies that many have employed.

Common interview errors include:

● Poor preparation, not being familiar with the program
● Inconsistent or inappropriate answers to questions
● Abrasive, condescending, evasive behavior
● Disinterest or flat affect
● Inappropriate humor
● Negative comments on other programs, candidates, or the program itself

Communication with Programs: NRMP Code of Conduct for Applicants and Programs
Both candidates and programs are governed in their behavior and communication by the NRMP Code of Conduct (see Figure- get from NRMP). This is a contract that you agree to by your participation in the Match. The intent of this Code is to protect applicants’ privacy and confidentiality, to prevent programs from asking illegal or coercive questions, and prevent onerous displays of intent (second interviews or visits, rotations at the program institution, demanding to know how the candidate will rank a program). If you have one clear first choice program, discuss with your specialty advisor whether you should communicate that to the program director. While some programs want to know this information, others may not use that information in their rankings. In most cases it will not help you to inform the program. Do not tell a program you are ranking them first if in fact you are not planning to do so- program directors do talk to one another and to clerkship directors to gather information about candidates, and you do not want a reputation for dishonesty.

Advocating for Interviews
If you do not get an interview offer with a desired program, but you are placed on a waiting list, or if you have not heard back from a desired program, you have several options- acceptance, advocating for yourself, or asking your clerkship director or specialty advisor to advocate for you. We recommend discussing this with your specialty advisor, including a frank discussion of your reasons for wanting a particular program and your competitiveness at that program. If after that discussion you want to approach the program, you may communicate with the residency program director yourself or ask your advisor to contact the program director. It is unusual to get an interview if you are not on the program’s waiting list.