



Practice, Policy &amp; Education



## International survey on residency programs in radiology: similarities and differences among 17 countries

Jacob Sosna<sup>a,\*</sup>, Nadya Pyatigorskaya<sup>b,c</sup>, Gabriel Krestin<sup>b</sup>, Erika Denton<sup>d</sup>, Kim Stanislav<sup>e</sup>, Sergey Morozov<sup>e</sup>, Kanako Kunishima Kumamaru<sup>f</sup>, Bhavin Jankharia<sup>g</sup>, Peter Mildenerberger<sup>h</sup>, Bruce Forster<sup>i</sup>, Elizabeth Schouman-Clayes<sup>j</sup>, Adrian Bradey<sup>k</sup>, Deniz Akata<sup>l</sup>, Boris Brkljacic<sup>m</sup>, Roberto Grassi<sup>n</sup>, Andras Plako<sup>o</sup>, Haris Papanagiotou<sup>p</sup>, Ružica Maksimović<sup>q</sup>, Frank Lexa<sup>r</sup>

<sup>a</sup> Department of Radiology, Hadassah Medical Center, Hebrew University Faculty of Medicine, Jerusalem, Israel

<sup>b</sup> Department of Radiology Pitié-Salpêtrière, Sorbonne Universités, UPMC Univ Paris 6, Paris, France

<sup>c</sup> Department of Radiology, Erasmus Medical Center, Rotterdam, the Netherlands

<sup>d</sup> Department of Radiology, Norfolk & Norwich University Hospital, UK

<sup>e</sup> Radiology Research and Practical Centre, Moscow, Russia

<sup>f</sup> Department of Radiology, School of Medicine, Juntendo University, Hongo, Bunkyo-ku, Tokyo, Japan

<sup>g</sup> Picture This, Mumbai, India

<sup>h</sup> Department of Radiology, Universitätsmedizin Mainz Klinik und Poliklinik Radiologie, Mainz, Germany

<sup>i</sup> Department of Radiology, University of British Columbia, Faculty of Medicine, Vancouver, Canada

<sup>j</sup> Department of Radiology, AP-HP, Bichat-Claude Bernard Hospital, Paris, France

<sup>k</sup> Department of Radiology, Mercy University Hospital, Cork, Ireland

<sup>l</sup> Department of Radiology, Hacettepe University, Ankara, Turkey

<sup>m</sup> Department of Radiology, Dubrava Hospital, University of Zagreb, Croatia

<sup>n</sup> Department of Radiology, Università della Campania Luigi Vanvitelli, Naples, Italy

<sup>o</sup> Department of Radiology, University of Szeged, Hungary

<sup>p</sup> Department of Radiology, Laiko Athens University, Athens, Greece

<sup>q</sup> Department of Radiology, University of Belgrade, Belgrade, Serbia

<sup>r</sup> The Radiology Leadership Institute and Chair of the Commission on Leadership and Practice Development of the American College of Radiology, Reston, VA, United States of America

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### ABSTRACT

**Objective:** With the initiative of the ACR International Economics Committee, a multinational survey was conducted to evaluate radiology residency programs around the world.

**Methods:** A 31-question survey was developed. It included: economic issues, program size and length, resident's activities during daytime and call, academic aspects including syllabus and examinations. Data was tabulated using the forementioned thematic framework and was qualitatively analyzed.

**Results:** Responses were received from all 17 countries that were invited to participate (France, Netherlands, Israel, UK, Russia, USA, Japan, India, Germany, Canada, Turkey, Croatia, Serbia, Italy, Ireland, Hungary, and Greece). Residency length varied between 2 and 5 years. The certificate of residency completion is provided by a local hospital [4/17 (23%)], University [6/17 (36%)], National Board [6/17 (36%)], and Ministry of Health [1/17 (6%)]. There was variability among the number of residency programs and residents per program ranging from 15 to 300 programs per nation with a 1–700 residents in each one respectively. Salaries varied significantly and ranged from 8000 to 75,000 USD equivalent. Exams are an integral part of training in all surveyed countries. Length of call varied between 5 and 26 h and the number of monthly calls ranged from 3 to 6. The future of radiology was judged as growing in [12/17 (70%)] countries and stagnant in [5/17 (30%)] countries.

**Discussion:** Radiology residency programs worldwide have many similarities. The differences are in the structure of the residency programs. Stagnation and uncertainties need to be addressed to ensure the continued development of the next generation of radiologists.

\* Corresponding author.

E-mail address: [jacobs@hadassah.org.il](mailto:jacobs@hadassah.org.il) (J. Sosna).

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**Summary statement:** There are many similarities in the academic aims and approach to education and training of radiology residency programs worldwide. The differences are in the structure of the residency programs and payments to individual residents.

### 1. Introduction

Radiology education and training encompass a complex interaction between undergraduate and postgraduate training in the USA and university level education in other European and Asian countries. The aim of the residency period is to train an independent radiologist that would benefit the medical specialty as well as our clinical colleagues and of course the patients they treat [1].

Residency in radiology is a demanding time including high expectations for increasing knowledge, skills and competencies. There appear to be many different training regimens for residency worldwide with no uniformly accepted length nor educational composition for this training period [2]. The variability is not only in the educational aspects but also in organizational aspects such as number of residents, call number and economic issues. Under the initiative of the ACR we conducted an international survey on radiology residency program training aimed to present current practices, challenges and opportunities worldwide and to assess the way radiology is perceived in different countries.

### 2. Materials and methods

Members of the International Economics Committee of the ACR developed a survey in a focus group format. The members of the committee are senior level radiologists with 10–25 years of experience and interest in organized radiology as well as in international collaboration. The 31-question survey categorized 4 different categories related to residency in radiology including: economic issues, program size and length, resident's activities both during daytime and on call, academic aspects including syllabus and examinations and finally questions related to how is radiology perceived as a profession. Each member of the ACR International Economics Committee responded to the survey on behalf of their country. Additional nations were added and were contacted through the representatives of their respective national radiology societies. Survey elements were multiple choice (12 questions), limited to yes/no options (6 questions) and free-text questions (13 questions) (Appendix 1). The survey was administered online via SurveyMonkey (SurveyMonkey, San Mateo, California) (REF: SurveyMonkey URL). The survey was sent to participants by e-mail. Data was tabulated using the aforementioned thematic framework and was qualitatively analyzed.

### 3. Results

Responses were received from 17 countries (France, Netherlands, Israel, UK, Russia, USA, Japan, India, Germany, Canada, Turkey, Croatia, Serbia, Italy, Ireland, Hungary, Greece) representing North America, Asia and Europe.

### 4. Structure and education

Residency length varied between 2 and 5 years with the latter being the most common with 4–5 days a week devoted to training. Training may include 6–12 months of non-radiological clinical training (such as in Internal Medicine or Surgery) in Greece, Italy, Israel, Hungary and Japan while in Ireland, a pre-requisite of 2 years of prior clinical training in other specialties is required. The certificate of residency completion is provided by a local hospital [4/17 (23%)], University [6/17 (36%)], National Board [6/17 (36%)], and Ministry of Health [1/17 (66%)]. In countries such as Turkey and Greece certificates are provided locally as well as by the university.

Among the countries there was variability among the number of residency programs and residents per program ranging from 15 to 300 programs with a range of 1–700 residents in each program respectively. The largest number of programs was in India. Funding for the residency programs was by the government in [15/17 (88%)] countries, by private hospitals in [15/17 (88%)] countries or by imaging centers from the public sector in [8/17 (47%)] countries. In some countries such as Ireland and Croatia only government funding was available whereas in other countries such as Israel, Turkey and Greece a combination of funding sources was available. Annual salaries varied significantly and ranged from 8000 to 75,000 USD equivalent.

Education was provided by different professionals including: attending level radiologists in all countries, non-radiologists physicians in [5/17 (29%)] countries, physicists in [11/17 (64%)] countries and also by technologists in [3/17 (17%)] countries. Education included lectures and hot seat case studies in all countries. View box (PACS) training was used in [14/17 (82%)] countries. Eleven out of 17 countries (65%) used on-line teaching (Fig. 1). All nations used a structured syllabus. [15/17 (88%)] of countries use one that is prepared and approved by a national board or organization, and in [2/17 (12%)] it is prepared and approved by a local University.

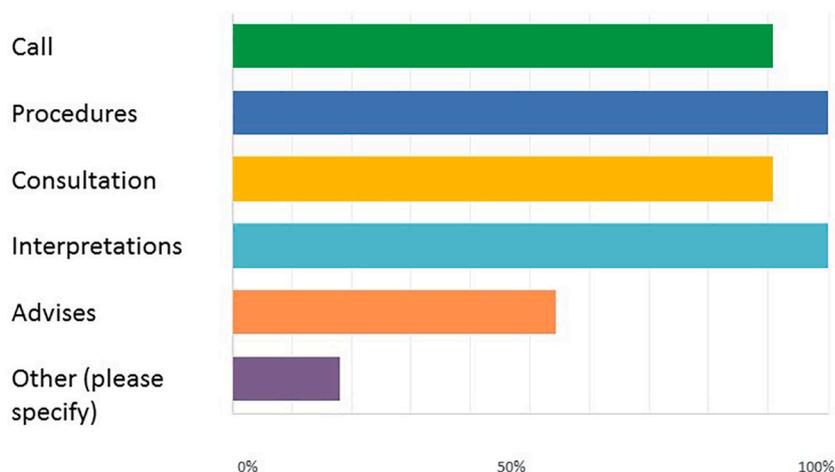


Fig. 1. Types of radiology education available to trainees. More than one possibility applies to each respondent country.

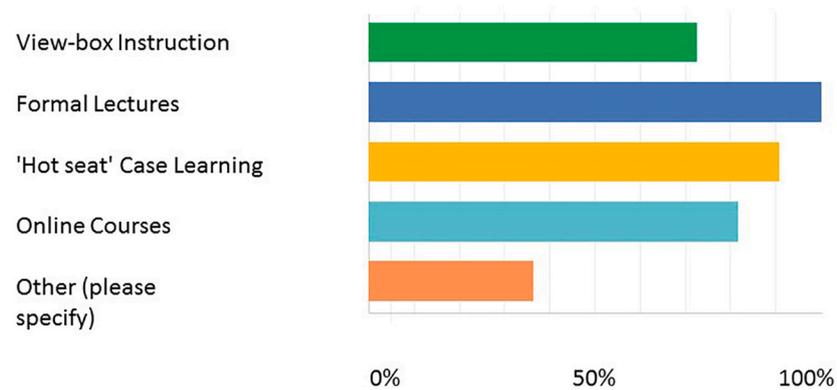


Fig. 2. Resident responsibilities during residency. More than one possibility applies to each respondent country.

Not all nations use the same list of domains to define what is required in radiology residency. In this survey those that are not required in residency syllabi include Nuclear medicine [6/17 (36%)], Obstetric US [1/17 (6%)], Vascular US [3/17 (18%)], and Interventional cardiology [15/17 (88%)].

Eleven out of 17 (65%) countries require a research project or manuscript submission.

Exams are an integral part of the residency training assessment and include oral [14/17 (82%)], written [14/17 (82%)] and practical testing [4/17 (23%)]. All nations require some form of testing during residency. There has been a recent change in France, which formerly did not use testing but recently adopted it. In [13/17 (76%)] of the nations, surveyed radiology boards supervise the examinations and in the rest this is done by regional bodies.

## 5. Resident responsibilities

Resident responsibilities included performing procedures and providing diagnostic interpretations in all countries. Initial report by a resident and signature by an attending was the most common approach with an independent report in only [4/17 (23%)] countries (Fig. 2).

In all countries taking call was an integral part of residency. Length of call varied between 5 and 26 h with the shortest one in Russia and the longest one in Israel. The number of monthly calls ranged from 2 to 6 per month. Supervision of call was by a junior resident supervised by senior resident [5/17 (29%)], junior resident supervised by on site attending [10/17 (59%)], junior resident supervised by attending from home [10/17 (59%)]. Residents start taking call anywhere from 6 months to 2 years after initiation of residency. Most calls are on site with four countries enabling taking call from home in up to 50% of calls.

## 6. The future after residency completion-perceptions of trainees

In [14/17 (82%)] countries, residents expect to get a job after training. In Canada and the Netherlands there is no shortage of radiologists and therefore the chances of finding a job position after residency is more difficult. In Ireland, there is expectation for further training mostly overseas. Fellowship training varies between 0 and 90% post basic residency training and is more common in North America than in Europe. In most European countries, no formal sub-specialty training is available. In [15/17 (88%)] countries. Radiology is regarded as an attractive profession and a score of 8.5 out of 10 for recommending the individual radiology training to a friend. The future of radiology is judged as growing in [12/17 (70%)] countries and stagnant in [5/17 (29%)] countries. Based on the survey the respondents stated that radiology will be more attractive mostly by having more job opportunities after training and more human interaction.

## 7. Discussion

Although there seems to be a notion that residency training varies significantly, this survey indicates that there are also major similarities among training programs worldwide with some differences locally. The educational goals in all countries are aimed at training an independent radiologist after a specific period of onsite supervision and education.

The differences between the countries are mainly with regards to funding and size of residency. India for instance has very large programs of up to 700 residents. Interestingly, funding is provided by the private sector in more than a third of the countries. This potentially may be related to an investment by private entrepreneurs with the intent of building an educated radiological force for the future.

Residents are paid for their work to varying degree. Radiology residents have a dual responsibility. They provide medical services for which they are paid and they are educated at the same time. The training facility gets resident work during daytime and off hours while providing an educational environment aimed at training the future generation.

The similarities between programs are related to structure and quality of training. The most common training approach is one on one interaction with an attending radiologist. This is further extended to a hot seat which simulates real life cases. Formal lectures are augmented by on-line resources in some countries. The impact of COVID-19 pandemic on education is an ongoing work in progress to be investigated in the future. The use of on-line resources may include peer reviewed as well as independent publications and with the educational value of the latter should be carefully evaluated when reviewed by accrediting agencies [3,4].

Syllabi are mostly provided by national boards. This harmonizes the way residents are educated and minimizes variations within the nation. Subspecialty topics that are taught vary to some degree and some nations consistently exclude nuclear medicine, vascular and/or obstetric US as well as cardiac intervention [5–8]. The remaining aspects of radiology are therefore covered in most syllabi. Turf battles do occur with radiology and other specialties. The differences brought out by this survey reflect the extent to which radiology has succeeded in keeping these fields in our profession in the reporting nations. For instance, only in one country (France) interventional cardiology is part of radiology training.

Some countries like France lacked a formal exam structure until recently. Currently all responding countries have a structured exam including written and oral parts. Although individual tracking of knowledge and competencies is important, resident examinations also play an important role in the learning process [9–12].

Taking call is an integral part of training. Its length varies from 5 h in Russia up to a maximum of 26 h as in Israel. Longer call may affect resident performance after long hours of work. Shorter call may affect the number of studies the residents are exposed to and may limit the overall aggregate time of clinical effort [12–14]. Residents are always

supervised by a higher-level radiologist either a more senior resident or an attending within the hospital or at home. This helps avoid serious mistakes and reduces the discrepancy rate between initial and final reports.

Based on the current survey most radiology residents believe they will find a paid position after training and give a score of 8.5 in recommending the profession. This is in contrast to the way the profession is being perceived by residents as stagnant in [5/17 (30%)], of countries. The contradicting responses may be related to the perceptual differences between the situation of the individual radiologist and the overall perspectives on the health of the professional radiology environment and the concomitant risk of burnout [15,16].

Limitations to the study may relate to the fact that most responding countries are members of the Organization for Economic Co-operation and Development (OECD) and therefore the variability between them may be small. The survey covered multiple continents and presents a wide range of national residency training cultures. This reduces the possibility of response bias. It included 17 countries ranging from small ones (e.g. Croatia and Serbia) to very populated countries (e.g. India). Our survey was constructed by 10 members of the ACR international economics committee. The analyzed data was from a total of 17 countries of which [7/17 (40%)], were from countries not represented in the committee. Another limitation is that a single individual representative for each country provided the responses. This may underestimate the real variability between programs. However, the responding radiologists have knowledge of the structure of residency programs in their countries and are involved with the national radiology societies mostly as current or past officers or in leading academic institutions. They were specifically asked to report on the state of their national systems rather than their local institutions. We deliberately chose to not address the impact of AI on residency and on the perception of our profession. This might be too early to assess with the relative paucity of real AI use in clinical practice. The survey also did not address specifically the impact of the COVID-19 pandemic and therefore the impact of on-line and remote teaching may be underscored [17].

In conclusion, the aims and means in which radiologists are trained worldwide have many similarities. The differences are in the structure of the residency programs and payments to individual residents. Most trainees will recommend radiology as a profession but stagnation and uncertainties need to be addressed by governing professional bodies to ensure the continued development of the next generation of radiologists.

## Appendix 1. The Survey Questions

1. What is the number of Radiology residency programs in your country?
2. What is the number of residents per program?
3. Funding is provided by:
  - a. Government
  - b. private hospitals
  - c. private imaging centers
  - d. public sector
4. What is the residency length?
5. Is clinical training included?
6. What is the salary range?
7. What are resident responsibilities:
  - a. Call
  - b. Procedures
  - c. Consultations
  - d. Interpretations
  - e. MDTM
8. How are reports generated:
  - a. Initial report by resident and signature by attending
  - b. Independent report followed by an attending after report reached the clinicians-

## 9. Supervision of call:

- a. Junior resident supervised by senior resident
  - b. Junior resident supervised by on site attending
  - c. Junior resident supervised by attending from home
10. When do residents start taking call?
  11. What percentage of call is taken on site?
  12. Are residents allowed to work outside the residency program?
  13. How many days are devoted to clinical radiology?
  14. Length of call
  15. Number of calls per month is:
  16. Types of education
    - a. View box
    - b. Lectures
    - c. Hot seat case studies
    - d. Online Who delivers training?
  17. Who provides education
    - a. Radiologists
    - b. Non radiologists physicians
    - c. Physicists
    - d. Technologists
  18. Is there a structured syllabus?
  19. Who prepares and approves the syllabus?
  20. Is research required?
  21. Who provides the certificate of residency completion?
    - a. Local hospital
    - b. University
    - c. National Board
    - d. MOH
  22. What percentage do a fellowship?
  23. Are there exams?
    - a. Oral
    - b. Written
  24. Who supervises the exams?
    - a. Regional
    - b. Board
  25. Are residents expecting to get a job after residency?
  26. Is there shortage of radiologist in your country?
  27. Fields not required in residency: (number of countries)
    - a. Nuclear medicine
    - b. Obstetric US
    - c. Vascular US
    - d. Interventional cardiology
  28. A radiologist regarded as an attractive profession
  29. Rate level that you would recommend your program to a friend on a score of 1–10
  30. How would you perceive the future of radiology in your country?
    - a. Growing
    - b. Stagnant
  31. What would make a career in Radiology more attractive?
    - a. Compensation during residency
    - b. Compensation after training
    - c. More job opportunities after training
    - d. More human interaction
    - e. Life style changes

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