Radiology Education and Clinical Service during the COVID-19 Pandemic – the Puerto Rico Medical Center Experience

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Residency training programs have faced the dual challenge of providing continuous and effective clinical services and graduate medical education during the Coronavirus Disease 2019 (COVID-19) pandemic. This article outlines the changes incorporated by the University of Puerto Rico School of Medicine Diagnostic Radiology Program during the COVID-19 pandemic, including incorporating a virtual approach for read-out sessions, didactic conferences and additional learning experiences for the radiology residents. By means of collaboration and unity in the noble goal of public service, the faculty and residents of the Diagnostic Radiology Program at UPR-SOM have shown resilience throughout the many challenges faced during the current COVID-19 pandemic. [*P R Health Sci J 2022;41(2):51-55*]

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The dual challenge faced by residency training programs during the Coronavirus Disease 2019 (COVID-19) pandemic has been providing continuous and effective clinical services and graduate medical education. In radiology, trainee education has been traditionally achieved by direct exposure to radiological studies with subsequent face-to-face read-out sessions between the resident and the attending, as well as through didactic conferences and self-learning. During the ongoing pandemic, innovative technology-driven didactic techniques have been incorporated by radiology residency programs throughout the United States (1-11) to achieve this goal. In this article, we present the clinical and didactic experience at the University of Puerto Rico School of Medicine (UPR-SOM) Diagnostic Radiology Program during the COVID-19 pandemic.

Diagnostic Radiology Program Background

The Diagnostic Radiology Program at the University of Puerto Rico School of Medicine began training radiologists in 1960 and has been continuously accredited by the Accreditation Council for Graduate Medical Education (ACGME) since 1972. The main teaching site is the Puerto Rico Medical Center, the island's only tertiary and quaternary care hospitals complex serving at least 3.2 million residents in Puerto Rico and the Lesser Antilles located in San Juan. The radiology department affiliated with the residency program is located at the Puerto Rico Medical Services Administration. Radiology services are offered to all institutions belonging to the Puerto Rico Medical Center (Table 1), with over 150,000 radiological studies performed annually, including radiographs, ultrasound, computed tomography, and magnetic resonance imaging.

Table 1. List of Puerto Rico Medical Center Institutions serviced by our Department.

Puerto Rico Medical Center Institutions
Medical Services Administration of Puerto Rico (Emergency Department, Outpatient Clinics and Operating Rooms)
Cardiovascular Center for Puerto Rico and the Caribbean Dr. Ramón M. Suárez Calderón
Industrial Hospital
Trauma Hospital
Oncologic Hospital Dr. Isaac González Martínez
University District Hospital
University Pediatric Hospital Dr. Antonio Ortiz

Diagnostic Radiology is an advanced 4-year specialty training program that requires a prerequisite clinical year of training. During the prerequisite year of training, the resident fulfills clinical duties as a Post Graduate Year 1 (PGY-1) resident. The first year of radiology training (R1) begins at the Post Graduate Year 2 (PGY-2) level. Currently, the Diagnostic Radiology residency program at the University of Puerto Rico trains a total of 17 residents (Table 2). No clinical fellowship programs are

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currently offered. Direct resident supervision and guidance are performed by over 35 attending radiologists, most of whom have further training in different radiology subspecialties (Table 3).

Table 2. Number of residents at the UPR-SOM Diagnostic Radiology Program by residency level.

Residency level	Number of residents
PGY-2	4
PGY-3	4
PGY-4	4
PGY-5	5

Each resident is assigned to a rotation that addresses a core practice domain per the ACGME program requirements (Table 4). Each rotation lasts for a period of 3 weeks. One or more residents may be assigned to a specific rotation at a given time. The typical workday schedule is from 7:30 AM to 5:00 PM. The call schedule covers the radiological studies performed at the Puerto Rico Medical Center. One upper-level resident (PGY-3, 4, or 5) and one lower-level resident (PGY-2) are assigned to week-day short calls from 5:00 PM to 7:00 PM and weekend day calls from 7:00 AM to 7:00 PM. One upper-level resident is assigned to the Emergency Radiology (Night Floater) shift from 7:00 PM to 7:00 AM from Sunday to Friday. The Saturday night shift (from 7:00 PM to 7:00 AM) is distributed equitably among the other upper-level residents.

Table 3. Number of attending radiologists affiliated with the UPR-SOM Diagnostic Radiology Program by subspecialty.

Radiology Subspecialty	Number of radiologists
Breast Imaging	4
Abdominal Imaging	6
Cardiothoracic Radiology	2
Musculoskeletal Radiology	3
Neuroradiology	2
Pediatric Radiology	4
Vascular and Interventional Radiology	3
Nuclear Medicine	6

Table 4. Clinical Rotations

Clinical Rotations
Neuroradiology
Cardiothoracic Radiology
Breast Imaging
Abdominal Radiology (Gastrointestinal and Genitourinary)
Emergency Radiology (Night Floater)
Nuclear Medicine
Pediatric Radiology
Ultrasound (Endocrine/Reproductive, Obstetric and Vascular)
Vascular and Interventional Radiology
Clinical and Translational Research

ACGME Core Competencies

The ACGME and the American Board of Medical Specialties (ABMS), which includes the American Board of Radiology (ABR), expect residents to obtain proficiency in six core competencies or domains. These core competencies or domains include patient care, medical knowledge, interpersonal and communication skills, professionalism, practice-based learning and improvement, and systems-based practice. We will discuss how the changes in the Diagnostic Radiology Program during the COVID-19 pandemic allowed continued resident development within these core competencies.

Changes in the Diagnostic Radiology Program during the COVID-19 Pandemic

The Diagnostic Radiology Department at the UPR-SOM has incorporated many protective measures based on recommendations by the Centers for Disease Control and Prevention (CDC) to minimize resident exposure to the 2019 novel coronavirus. At the beginning of the quarantine established by the Government of Puerto Rico (mid-March 2020), a two-team ("platooning") system (12) was employed to provide clinical care (patient care domain) while heeding the observance of protective measures to ensure a healthy workforce. An on-call shift schedule plan was initiated for on-site coverage of the radiological studies performed at the Puerto Rico Medical Center. One upper-level resident (PGY-3, 4, and 5) and one lower-level resident (PGY-2) were assigned to the day shifts. These were 12-hour shifts from 7:00 AM to 7:00 PM. As usual, one upper-level resident was assigned to the floater night shift from 7:00 PM to 7:00 AM. The use of surgical or N95 face masks is mandatory, even while dictating study reports. Workstation cleaning is performed before and after each work shift. The entry of consultants to the radiology reading rooms is limited, with case discussions and consultations managed via telephone or text messages. Also, the radiology residents communicate with the technologists and nurses via telephone in case of patient and imaging concerns. These changes continue the development of the interpersonal and communication skills core competency. Radiology residents designated to work remotely participated in synchronous didactics, interdepartmental conferences, asynchronous online educational modules, scholarly activities, and quality improvement projects. The combination of these on-site and off-site duties continued resident growth within the domain of medical knowledge, as well as demonstrating a commitment to carry out professional responsibilities (professionalism domain). Participation in quality improvement projects specifically progresses the domain of systems-based practice.

Easing of the restriction measures approximately two months after the start of the quarantine brought an increase in the number of radiological studies performed, including outpatient studies that were postponed at the beginning of the quarantine. The Diagnostic Radiology Program modified the on-site schedule accordingly for the residents into a

half-day work plan. PGY-5's were assigned for on-site coverage of the outpatient studies performed at the UPR-SOM Outpatient Imaging Center located at Reparto Metropolitano Shopping Center. The rest of the upper and lower-level residents were divided into two groups for coverage of the inpatient and outpatient studies at the Puerto Rico Medical Services Administration. One group was assigned the 7:00 AM to 12:00 PM shift and the other group was assigned the 12:00 PM to 5:00 PM shift. Each resident was assigned to a different subspecialty to focus on the interpretation of the corresponding radiological studies. A maximum of two residents is allowed per each reading room. One upper-level resident and one lower-level resident were assigned to a short call from 5:00 PM to 7:00 PM. Night float coverage continued as usual.

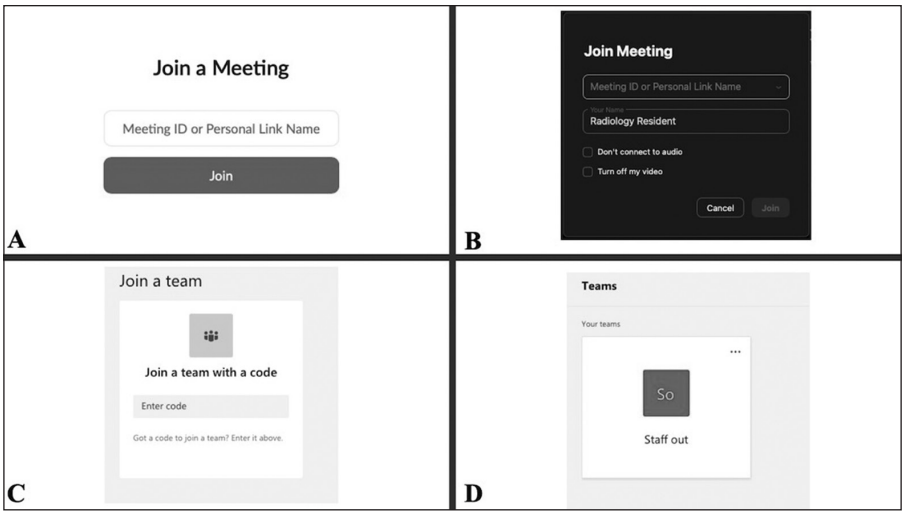

Figure 1. Joining the attending radiologist Zoom session through the web browser (A) or the application (B). Joining the attending radiologist team with provided code on Microsoft Teams (C). Example readout session team under "Your teams" (D).

With the further easing of the quarantine restriction measures that coincided with the beginning of the new 2020-2021 academic year, a full-day work schedule plan for the residents was restarted. Assignment to a different subspecialty rotation continued, with additional institutions becoming available to expand the didactic experiences, such as Breast Imaging. Special agreements have been reached with other UPR residency programs (for example, Family Medicine and Pediatrics) that allow their residents to participate in the read-out sessions, both presential and virtual (see below). Participation in the read-out sessions is complemented with additional assignments, including completion of online radiology modules. A limited number of fourth-year medical students (MS4) have been allowed to rotate in the Radiology Department abiding by social distancing measures.

Read-out Sessions: Presential, Virtual, and Hybrid

For the read-out sessions between the residents and the attending radiologist, the Department integrated presential and virtual approaches. Each imaging section within the Department integrated one of these approaches or both (hybrid approach). For the presential read-out sessions, COVID-19 protective measures are followed, including the use of face masks and physical distancing. Virtual read-out sessions are performed via Zoom Video Communications (13) and Microsoft Teams (14), which are video conferencing tools compliant with the Health Insurance Portability and Accountability Act (HIPAA). The virtual meeting credentials are shared exclusively between the attending radiologist, the participating residents, and medical students. For Zoom, the shared meeting ID is entered in the web browser or the application (Figure 1). Microsoft Teams allows the attending radiologist to build a read-out session team with the residents (Figure 2).

The attending radiologist screen shares the studies in the picture archiving and communicating systems (PACS), scrolling through all available images and highlighting encountered imaging findings with the mouse cursor. The resident may be given or request remote control during the case discussion to highlight imaging findings and make annotations on the screen,

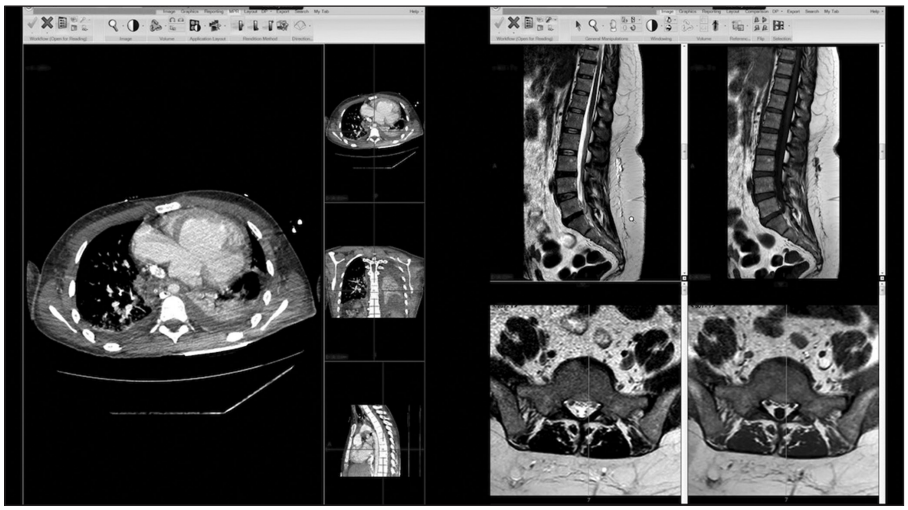

Figure 2. Example of the variety of cases seen during virtual read-out sessions.

allowing a dynamic interaction. The preliminary report can also be screen shared to facilitate the discussion and proofreading of the cases reviewed. These video conferencing tools allow the participants to supplement case discussions by screen sharing research articles and web pages.

The residents assigned to the Cardiothoracic Radiology, Neuroradiology, Night Floater, Musculoskeletal Radiology, and Pediatric Radiology rotations participate in both presential and virtual read-out sessions. The Cardiothoracic Radiology, Neuroradiology, and Pediatric Radiology rotations have provided learning opportunities to residents of other medical specialties via virtual read-out sessions. On some occasions, these residents join the presential read-out session between the radiology resident and the attending radiologist.

The resident assigned to the Abdominal Radiology rotation participates in presential read-out sessions. One resident from another medical specialty and one MS4 may also participate in these presential read-out sessions. Presential read-out sessions, case discussions, and image-guided procedures take place in the Breast Imaging and Vascular and Interventional Radiology rotations. The Ultrasound rotations include the performance of the diagnostic examination by the radiology resident under the direct supervision of the attending radiologists with presential case discussions and read-out sessions. Presential case discussions take place in the Nuclear Medicine rotation. Clinical and Translational Research rotation integrated a virtual approach. In summary, 5 rotations (50%) incorporated a presential approach, 4 rotations (40%) incorporated a hybrid approach, and 1 rotation (10%) incorporated a virtual approach.

Didactic Conferences and Additional Learning Experiences

Resident education also continues through didactic conferences scheduled via Zoom. As an example, weekly Neuroradiology virtual conferences include core curriculum lectures, case discussion lectures, tumor board conferences, and journal club sessions. The participation in the journal club sessions is an example of how the residents continued progression within the domain of practice-based learning and improvement by performing a critical assessment of the scientific literature. Participation from residents of other medical specialties (Neurology and Neurosurgery Departments) and medical students is encouraged. The Musculoskeletal Radiology rotation has scheduled virtual interdisciplinary conferences with the participation from the UPR-SOM Orthopedic Surgery and Physical Medicine and Rehabilitation Departments. Weekly Radiation and MRI physics virtual conferences are scheduled for radiology residents. Asynchronous physics class content is available through additional virtual platforms, including Google Classroom (15) and Blackboard Learn (16). WhatsApp Messenger (17) provides an additional learning tool for resident education. Unknown musculoskeletal and breast imaging case discussion is performed via encrypted WhatsApp group chats between the attending radiologists and the residents, in which no patient identifier information is shared to maintain confidentiality.

National and international imaging society meetings have also shifted their education curriculum to virtual platforms during the COVID-19 pandemic, providing supplementary valuable learning experiences to the radiology residents. During 2020, the radiology residents from the UPR-SOM participated in many imaging society meetings, including the American College of Radiology (ACR), Radiological Society of North America (RSNA), American Roentgen Ray Society (ARRS), American Society of Neuroradiology (ASNR), American Society of Head and Neck Radiology (ASHNR), and European Congress of Radiology (ECR). Specifically, the residents participated virtually in these meetings through oral presentations, electronic exhibits, and engaging with the educational sessions offered.

The COVID-19 pandemic also caused the postponement of the ABR Initial Certification Exams, including the Diagnostic Radiology (DR) Core Exam that is offered to the residents after completing 36 months of training. The ABR has determined to administer the DR Core Exam in a virtual format going forward. The four-week radiologic pathology course of the American Institute for Radiologic Pathology (AIRP) and the Duke Review course have continued available virtually as part of the residents' preparation for the DR Core Exam. Additional virtual webinar opportunities are available virtually for the residents, including the New York University (NYU) Langone Annual Head to Toe Imaging Conference.

Comparing Changes with Other Residency Programs

The changes implemented at the UPR-SOM Diagnostic Radiology Program assimilate those reported by an online survey that was answered by radiology residencies throughout North America (4) and those described in articles by specific programs such as the radiology residency program at the University of Southern California (6) and an academic breast imaging program at Massachusetts General Hospital (11). The online survey reported that 93% of the 86 responding radiology programs throughout North America had fewer residents on service. No change was reported in more than 80% of the programs regarding the number of residents on call and the duration of the resident call shifts. As detailed above, the UPR-SOM Diagnostic Radiology Program had fewer residents on service during the start of the COVID-19 pandemic without change to the number of residents on call or the duration of the call shifts.

Conclusions

The University of Puerto Rico School of Medicine Diagnostic Radiology Department has incorporated several strategic operational initiatives to ensure the delivery of clinical services and many innovative didactic techniques to provide residents with formative graduate medical education

during the COVID-19 pandemic. A virtual approach to read-out sessions and conferences has allowed continued graduate medical education with a significant reduction in the risk of virus exposure. By means of collaboration and unity in the noble goal of public service, the faculty and residents of the Diagnostic Radiology Program at UPR-SOM have shown resilience throughout the many challenges faced during the current COVID-19 pandemic.

Resumen

Los programas de entrenamiento para médicos residentes se han enfrentado al doble desafío de brindar de manera continua servicios clínicos efectivos y educación médica graduada durante la pandemia de la Enfermedad del Coronavirus 2019 (COVID-19 por sus siglas en inglés). Este artículo describe los cambios incorporados por el Programa de Radiología de Diagnóstico de la Escuela de Medicina de la Universidad de Puerto Rico durante la pandemia de COVID-19, incluyendo la incorporación de un enfoque virtual para las sesiones de lectura de los estudios radiológicos, conferencias didácticas y experiencias adicionales de aprendizaje para los residentes de radiología. Mediante la colaboración y la unidad con el objetivo noble del servicio público, la facultad y los residentes del Programa de Radiología de Diagnóstico de la Escuela de Medicina de la Universidad de Puerto Rico han demostrado resiliencia a lo largo de la actual pandemia de COVID-19.

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