Radiology Residency Program Management in the COVID Era – Strategy and Reality

Eric England, MD, Alisa Kanfi, MD, Carl Flink, MD, Achala Vagal, MD, MS, David Sarkany, MD, Maitray D. Patel, MD, James Milburn, MD, FACR, Seetharam Chadalavada, MD, MS, Sheryl Jordan, MD, RCC

INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) is a global pandemic whose impact thus far cannot be overstated. In response to this global pandemic, the Accreditation Council for Graduate Medical Education (ACGME) developed a new framework for its sponsoring Institutions; the ACGME's three stages are Stage 1 "Business as Usual", Stage 2 "Increased Clinical Demands" and Stage 3 "Pandemic Emergency Status" (1) (Table 1). Radiology residency programs throughout the United States may find themselves in any of these three, with each stage having distinct implication on resident education, clinical care, and research (2). The purpose of this manuscript is to highlight pandemic expertise, experiences, adaptations, and solutions, for resident training and education from a diverse group of radiology residency programs. We employ the ACGME COVID-19 pandemic stages as the manuscript framework.

STAGE 1 "BUSINESS AS USUAL"

Stage 1 is defined as having no significant disruption of patient care and educational activities. In this stage, outpatient imaging volumes should be maintained and robust enough to continue with typical resident rotation schedules. Educational activities should continue unabated although adoption of national and state social distancing

policies should be enforced. In this stage, all ACGME site visits, self-study activities, and ACGME surveys are suspended (1).

During Stage 1, emphasis should be placed on disaster preparedness for possible progression to pandemic Stages 2 and 3. If institutions can accommodate, efforts should be made to assure appropriate information technology (IT) infrastructure to support resident work from home with teleconference and teleradiology capabilities. The ability of departments to provide residents teleradiology capability varies widely, from fully diagnostic and integrated home radiology workstations, to limited abilities to review radiology information systems (RIS), picture archiving and communication system (PACS), and electronic medical records (EMR) on virtual desktops, laptops, tablets, and phones (typically not of diagnostic quality but may be functional) (3). Working with hospital system IT to ensure appropriate off-site virtual private network (VPN) access for residents is important in this stage given that in later stages IT personnel may be stretched thin with other health care system tasks.

The resident lecture curriculum should continue to emphasize established lecture series and radiology topics. However, expanded lecture topics should include topics pertaining to the COVID-19 pandemic and associated imaging findings. This stage is an ideal time to reinforce educational topics concerning appropriate personal protective equipment (PPE) and workplace safety. Furthermore, leadership training for residents may be included, as dealing with an ever-changing crisis has reinforced the need to further develop leadership skills (4).

In this stage, research activities can continue as routine, although new "normal" and "business as usual" definitions will change. As previously discussed in this stage, preparedness is paramount. It is important to set up necessary research infrastructures to permit a seamless transition of research activities to a virtual environment, if needed. This includes establishing remote access to research servers, setting up cloud–based image sharing, and analysis procedures.

TABLE 1. Three Stages of GME During the COVID-19 Pandemic	
Stage 1: Business as Usual	• No significant disruption of patient care and educational activities but are likely in the process of planning for increased clinical demands.
	• Activities suspended: site visits, self-study, ACGME Resident/Fellow surveys.
	• Telemedicine with appropriate level of supervision
Stage 2: Increased Clinical Demands Status	• Programs remain responsible for upholding ACGME requirements to ensure patient and resident/fellow safety and well-being.
	• Some trainees may shift to pandemic-related patient care duties and/or some educational activities may be suspended
	• Must ensure:
	1 Adequate resources and training in infection prevention
	2 Adequate supervision
	3 Work hour requirements
	4 Fellows functioning in Core specialty (with stipulations)
Stage 3: Pandemic Emergency Status Guidance	• Declaration lasts 30 days, but can be extended or terminated early
	• Must comply fully and ensure:
	1 Adequate resources and training in infection prevention
	2 Adequate supervision
	3 Work hour requirements
	4 Fellows functioning in Core specialty (with stipulations)
	• ALL other Common Program Requirements are suspended during the time of the declaration.

STAGE 2 "INCREASED CLINICAL DEMANDS"

Stage 2 ushers in increased but manageable clinical demands on hospital systems due to COVID-19. These increased clinical demands may see some residents and fellows shifting to patient care duties. However, most redeployed residents and fellows are likely to be from institutional residency programs whose prior experiences include critical care rotations (5). Paradoxically, due to the cancellation of elective procedures and exams, radiology volume and procedures may be significantly decreased in this stage.

In Stage 2, the need for social distancing to mitigate the spread of COVID-19 is paramount to maintain residents' health. Fortunately, decreased outpatient exams and procedures allow renewed flexibility in the on-site hospital workforce. Many residency programs adopt a shift work model, with a cohort of residents on home isolation specifically to serve as backup workforce

replacements should on-site team members require replacement due to sickness, quarantine or redeployment. Sickness in essence necessitates quarantine of a portion of the in-house residents (6). Distinguishing between home "isolation" and "quarantine" is crucial, because it identifies residents who will serve as a backup response team. Protecting residents at increased risk, notably those who are immunocompromised or pregnant, by assigning them to home isolation work shifts should be considered. Additional factors to consider are community infection rate, appropriate access to personal protective equipment (PPE), and degree of on-site patient exposure.

When assigned to home isolation, it is imperative residents remain engaged in the clinical, educational, and research missions of the department. These shifts require documentation and compliance with duty hour restrictions. Isolation radiology residents can perform clinical duties in a number of manners, even those with limited teleradiology capabilities. Suggested roles of

TABLE 2. Virtual Resident Clinical Duties Roles		
Resident Role	Primary Activities	ACGME Core Competency
Assuming the role of a reading room or call triage assistant	Provide logistical support to on-call team allowing in-house faculty and residents to be more efficient. Calls forwarded from resident on call reading room directly to an isolated resident's phone. Communication between on call resident and home isolation resident via text/chat through the EMR or directly to the cell of on-call resident.	○ Interpersonal and Communications Skills (ICS) core competencies (23,24).
Protocoling patient studies	Access to EMR, RIS, and PACS is required to protocol studies while on home isolation. Protocoling patient exams decompresses on-site faculty and resident protocolling responsibilities allowing more time for exam interpretation.	○ Medical knowledge core competencies (23,24)
Interpreting studies	Draft study reports to a common folder through a diagnostic quality (ideal) or non-diagnostic consumer quality model. Study then reviewed on a diagnostic quality workstation by faculty either working at home or in-house Essential for faculty to provide formative resident feedback through multiple collaborative tools including shared report screens, PACS messenger note, dictation system report comparison, phone conversation or follow-up email.	○ Medical knowledge core competencies (23,24)
Communicating with patients and families	Offsite residents may assist in the rescheduling or triaging of elective and nonurgent patient studies employing ACR and CDC guidelines.	○ Interpersonal and Communications Skills (ICS) core competencies (23,24).

engagement (all of which assist the resident in meeting ACGME Milestones) in clinical care include assuming the role of a reading room or "call triage" assistant, protocoling patient studies, interpreting studies, and communicating with patients and families (Table 2).

Radiology resident education will also be significantly affected in stage 2, albeit in different ways than other specialties' residencies. The ACGME describes suspension of some educational activities in Stage 2 due to residents shifting to more patient care duties associated with the pandemic (1). The reported drop in clinical volume ranging from 50% to 70% (7) means Radiology has unique needs *and* opportunities to focus on promoting a virtual landscape for dissemination of educational content.

Born of necessity, resident distance teaching sessions have emerged rapidly and vary in form, adapting traditional teaching techniques and employing new creative methods. The authors have used several innovative techniques including a virtual escape room, biweekly "reimagined" journal clubs, R1 precall simulation labs, R3 oral boards simulation labs, and institutional resident case studies/faculty teaching files (Table 3). In the virtual escape room, teams vie with one another to scavenge assigned reference articles for answers to detailed questions that unlock the next clue. At the journal club, a recent patient clinical presentation and case images frame the clinical question to be answered from the literature, complete with module learning objectives, outline, resident and fellow presenters, multilevel learners (residents, fellows, faculty, medical student participants) and, where applicable, radpath

or epidemiology segments. Both R1 simulation labs and R3 oral boards models cultivate virtual Socratic methodology as residents interpret and describe cases via remote PACS access.

In addition, multiple online resources have been curated or created for self-directed learning and/or curricular assignments. The Association of University Radiologists (AUR) has developed a Core Curriculum Lecture Series. Supported by the AUR R&E Strategic Alignment Grant, these lectures deliver high yield content by noted educators across many subspecialties (8). The Association of Program Directors in Radiology (APDR) offers a National Virtual Noon Conference via Zoom webinar at 12 PM EST every Tuesday and Thursday currently scheduled through July 2020 (9). A blended educational approach may work best, specifically permitting residency programs to utilize nationally available lectures to complement institutional lecture series, or even supplant lectures in the case of physician redeployment.

The APDR website provides links to resident education resources (10). Question banks are another resident-favored active learning tool (11). Despite many advantages, virtual conferences, and online learning pose practical challenges. Each PD needs to set clear guidelines on appropriate resident learner etiquette when engaging in virtual conferencing, specifically ensuring learners minimize distraction such as muting microphones, and avoiding multitasking during conference time. Video conferencing should be password protected, with conference links and passwords not easily accessed by

TABLE 3. Virtual Curriculum Best Practices (Activities and Resources for Distance Learning)

Conferences:	Remote Conferences	Many Available Platforms: • Microsoft Teams • WebEx • Zoom • GoToMeeting • Google Meet Should be password protected, especially if sensitive information is being shared
	Remote journal club	Possible through the available platforms listed above • Traditional model—with selected topic-based articles • Case based model—recent patient clinical presentation, related articles, rad-path correlates, and epidemiology data
	Online conferences provided by national societies	MANY, with a select few listed below: • AUR(8) • APDR(9, 10) • RSNA • ASPNR
	Online educational resources by individuals or organizations	• YouTube lectures by radiologists • Case of the Day through Instagram and Twitter posted by radiologists, radiology departments, and radiology societies
Innovative teaching techniques	Virtual escape room	• Residents split up into virtual teams • Case based question created by faculty • Residents used online articles and references to "unlock" the next clue
	R1 precall simulation labs	• Virtual R1 meetings with case-based "hot seat" format • Shared screen conferences, with the R1s annotating the findings
	R3 oral boards simulation laps	• Personal virtual conferences with each attending "examiner" where the resident will describe cases
	Teaching files/case files	• Departmental/institutional compilation of 100 mammo cases in PowerPoint for independent resident review (including normal) • Residents submit dictated report with the findings, reviewed by attendings • Useful for meeting residency mammo requirements • Similar concepts can be created for other sections (Nuclear medicine, Neuro, MSK)

Wellness:	Virtual huddle	• Frequent virtual/remote meetings with the PD/APD and residents
		• Useful in keeping residents up to date with the frequent changes
		• Also useful for checking-in on resident well-being
	Workout challenges	• Residents and faculty document 30 minutes of exercise either through selfie or health monitoring app/watch
		• For every participant, a donation was made to a charity of their choice
		• Could also be done in a team-based format, where the team with the most steps or minutes logged is deemed the winner
		• Many online resources for exercise: yoga, Pilates, HIIT, Bootcamp(22)
	Happy hour	• Virtual meeting with residents and PDs/APDs after hours
		• Faculty also had a virtual Happy Hour afterhours
	Game night	• Virtual meeting for games such as: Bingo, trivia, "House-party" app, scavenger hunts
	Mental Health Resources	• Institutional GME departments should have compiled list for local/hospital-based mental health resources and counselors
		• ACR: "Combating the COVID-19 Pandemic: A Collection of Well-Being Resources for Radiologists"(22)
		• Physician Support Line: https://www.physiciansupportline.com 1-888-409-0141 Free, confidential and staffed by volunteer psychiatrist. 8 am-12 am EST 7 days a week.
		• PeerRxMD A buddy system, or peer-to-peer support, during the COVID-19 crisis where two physicians check in with each other regularly: https://www.peerrxmed.com/
		• National Crisis Lines: 1-800-273-TALK or 1-800-SUICIDE

the public on social media; these safeguards avoid interruptions and privacy breaches. When properly structured, virtual conferencing has the potential to not only act as a substitute to in person conferences, but to engage learners creatively and significantly enhance their learning environment.

With increased community exposure to COVID-19 at Stage 2, almost all universities gave a directive to halt nonessential research for safety of study participants and research personnel. Only essential or critical research has been allowed to continue, for example, COVID-19-related research. Research groups are currently working from home and carrying out work remotely as much as possible. Similar to adaptations in online education, residencies can adapt to "virtual research" and encourage resident participation. Remote research includes EMR chart review data gathering, data analysis, literature review, or manuscript writing. Writing manuscripts and grants may prove overwhelming for residents; to offset, the remote working environment may be leverages to set up virtual writing groups and mentor faculty/resident teams. One author's institution observed a rise in the number of manuscript and abstract submissions in the pandemic time period and research PhDs and research associates offered residents virtual sessions on research methodology.

Finally, the pandemic has also shown us the importance of open research collaboration as we train residents for the post-COVID world highlighting tenets of open science collaboration and the open science framework (12).

STAGE 3 "PANDEMIC EMERGENCY STATUS"

Stage 3 is reflected in both the realities of hot spot residency programs and in the preparation planning by institutions and programs whose communities' curves were flattened. Authors' hot spot residencies "crossed a threshold beyond which the increase in volume and/or severity of illness creates an extraordinary circumstance where routine care education and delivery must be reconfigured to focus only on patient care" (1). Our authors reflect on their experiences from their training programs thusly:

> Despite extraordinary hard hits to the community and preparation to redeploy, the latter occurred in limited manner, most on resident volunteer basis but other residents faced mandatory redeployment with assurances of adequate PPE and training by clinical staff. Specific roles filled included redeployment to ventilated and nonventilated COVID floors in true intern roles, as well as to central venous access teams. It has been well-understood that radiology PDs must remain in close contact with the clinical services assuming direct supervision of redeployed residents to (a) ensure wellness and (b) monitor duty hours. The designation institutional office (DIO) supervised widespread redeployments.
> The toll was significant. Faculty development was needed as redeployment to COVID floors involved patient and family counseling. Residents developed COVID symptomatology. The need for emotional support was extraordinary.

Many radiology departments sustained significant decreases in radiology case volumes because of curtailed or cleared patient elective care appointments and the RRC specifically addressed education impact in a recent 2020 publication (13). The announcement included requirements for (a) resident proper training in use of PPE, (b) appropriate supervision of residents, (c) adherence to work hour requirements. Beyond that, however, is acknowledgment of depressed clinical volume impact on case log minima: "The COVID-19 pandemic will reduce the volume of imaging and the number of interventional procedures performed by the residents/fellows in those programs for the foreseeable future." What *must* be accomplished per program, however, is assurance that each graduate is competent to enter autonomous practice, adherence to case log minima, and adherence to breast imaging, nuclear medicine and early specialization in interventional radiology (ESIR) requirements. The first tenet is absolute; the latter lists may be qualified. Programs whose graduates cannot meet all case log minima requirements should "delineate for the Review Committee how it was affected by the pandemic in the Major Changes and Other Updates section of ADS." Senior residents impacted by COVID 19 may interpret already finalized mammograms in blinded fashion, postgraduate documentation of supervised sodium iodide I-131 administration cases is permitted and ESIR residents may enter independent IR residencies with fewer than 500 cases

logged. For example, at one author's institution, a standardized PACS file of 100 screening mammograms was built for residents to remotely interpret. Graded and proctored virtually by breast imaging faculty, this file meets graduation requirements.

The predominant area of active research during Stage 3 is COVID-related research. At one author's institution, an Innovation Task Force for COVID-19 Research was established. One example of collaborative sharing as a form of educational scholarship is RSNA's collated COVID-19 Resources 2020a shared resource of medical imaging for the diagnosis and imaging-based treatment of COVID-19 (14).

ALL STAGES: WELL-BEING

One of the greatest challenges for programs at this time is to maintain the well-being of residents in the face of uncertainty, stress, and anxiety. Illness, isolation, child care concerns, loss of educational opportunities, redeployment — all take their toll on well-being, and personal crisis may not be readily apparent to coworkers in this era of skeleton crews and social distance (15). The prior Severe Acute Respiratory Syndrome (SARS) outbreak yielded negative mental health impact on health care workers even years after the outbreak (16). Psychosocial support during the prior SARS outbreak from trusted pre-existing relationships was found to be far more effective than other means (17). A bond and sense of trust between the PDs and residents must be cultivated (18). Providing ample opportunities for easily-accessible communication between PDs and residents helps alleviate uncertainty and offers a sense of security to residents. For example, a short daily "virtual huddle" each morning allows all residents to hear updates, pose questions, and make suggestions; this empowers the trainees and is also beneficial to PDs/APDs to fully understand resident concerns.

From US hot spots:

> We have learned it is extremely important for the PD to keep in close contact with the entire residency and especially the chief residents during such a crisis and there must be an emphasis on resident preparedness to return to work. No vacation time has been lost. Expectations have been established that residents may be called on to do more routine work including future weekends to meet appointment surges postpeak.

Further, all faculty must be hypervigilant to investigate any suspicion of depression and stress among residents. Mental health and wellness resources provided by the institutional GME office or employee health should be reiterated and circulated to all residents. PDs must emphasize the need to be alert for, and to report, signs of depression (19).

Recent ACGME emphasis on the establishment of resident well-being programs has equipped programs with wellness tools and strategies (19−21). There are numerous suggestions to support a culture of wellness and positivity, examples being

virtual workout challenges, "happy hour" or "game night". The American College of Radiology recently released "Combating the COVID-19 Pandemic: A Collection of Well-Being Resources for Radiologists" (22), an excellent self-care and fitness array of podcasts, webinars, mindfulness, and fitness apps.

Childcare concerns for residents and faculty abound in this era. The COVID-19 crisis created the perfect storm scenario of essential workers, peak child-raising years, and mandated closure of schools and/or institution of homeschooling along with closure of childcare facilities. PDs must first consult GME resources for guidance on institutional and state resources to tackle this important problem. One author's institution offered an emergency childcare subsidy program for essential healthcare employees. This incorporated both health system emergency childcare subsidy program and state Department of Health and Human Services (DHHS) parent financial assistance for emergency childcare. Additionally, a PD may consider customization of work hours to skew toward evening and weekend work hours for residents with prohibitively difficult childcare issues (25).

CONCLUSION

Much as health care systems are adapting to the fluid demands of the COVID-19 pandemic, so must the PDs adapt to meet the changing needs of the residents during the different stages of the pandemic. It is important to prioritize safety and well-being of our residents and at the same time maintain the departmental educational mission.

FUNDING INFORMATION

DISCLOSURES

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