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Off-Site Radiology Workflow Changes Due to the Coronavirus Disease 2019 (COVID-19) Pandemic

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DESCRIPTION OF THE PROBLEM

Medical practices have been taken by surprise by the coronavirus disease 2019 (COVID-19) pandemic as they rush and react daily to changing patient needs, government policies, and provider protection. Diagnostic radiology, as a largely non-patient-facing specialty, is unique in that it can be practiced away from where the patient is diagnosed and treated and that this off-site reading has been part of standard radiology practice since at least the late 1990s [1]. The two main ways off-site reading is conducted is through at-home reading by radiologists who are members of the practice (internal teleradiology) or by contracting corporate teleradiology practices (external teleradiology).

Typically, the current use of off-site reading is mainly for overnight and call shifts [1,2]. Many practices continue to be hesitant to make off-site reading part of their normal daily workflow due to a perception of commoditization and limited interaction with clinical colleagues [1,2]. The COVID-19 pandemic has brought new challenges that are obligating radiology practices to take a second look at off-site reading as a potential way to decrease radiologist exposure to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

We hope this information will aid radiology practices not yet affected by

the COVID-19 pandemic to prepare sufficiently and to aid the practice of radiology for future similar types of disasters.

WHAT WE DID

We sent a survey to US radiology residency program directors for distribution to attending radiologists on March 26, 2020, and posted on the ACR Engage platform on March 31, 2020, with a single reminder sent after 1 week. We aimed to evaluate the proportion of practices that made a shift to off-site reading during the early phase of the COVID-19 pandemic, which factors were associated with this workflow change (Table 1), subjective assessment of the teleradiology experience (Table 2), and assessment of precautions taken to reduce infectious exposure (full survey provided in the [e-only supplement](#)). The response rate was 60% (174 of 290).

Frequencies and descriptive statistics were used to describe the sample demographics, including grouping practices by US Census-derived regions (West, Midwest, Northeast, South) [3,4]. We performed χ^2 analyses to compare independent groups on categorical outcomes. Nonparametric Mann-Whitney *U* tests were used to analyze nonnormal continuous outcomes. Medians and interquartile ranges were reported and

interpreted for the nonparametric tests. Statistical significance was assumed at an α value of .05, and all analyses were conducted using SPSS Version 26 (IBM Corp, Armonk, New York).

OUTCOMES

Our results represent a geographically diverse cross section of radiology practices (Table 3) with the majority (36) of the states and US regions represented. Before the COVID-19 pandemic, teleradiology was often used for call and overnight shifts; however, we observed an overall increase in the proportion of practices installing new home workstations (65.2%; 75 of 115) and switching normal daytime shifts to internal teleradiology (73.6%; 128 of 174) in a similar fashion across the different geographical regions [1]. This distribution demonstrated highest transitions to teleradiology in the North and lowest in the South and West. Although there was no correlation in teleradiology practice adoption with reported hospital cases, there is significant correlation with Centers for Disease Control and Prevention-reported statewide cases. Please note that statewide cases were collected daily [4]. This implies broad adoption of home workstations early in the pandemic. This broad adoption may have been influenced

Table 1. Pandemic-related teleradiology workflow changes

Variable	Increased at-Home Workstations, n (%)	Moved At-Work Shifts to At-Home, n (%)	Contracted Teleradiology Work, n (%)	Reading Room Not Staffed, n (%)
Region				
South	20 (52.6)	38 (66.7)	4 (7.0)	24 (42.1)
Northeast	22 (81.5)	35 (89.7)*	2 (5.1)	15 (38.5)
Midwest	21 (63.6)	39 (75.0)	2 (3.8)	24 (46.2)
West	9 (64.3)	14 (63.6)	1 (4.5)	6 (27.3)
Practice type				
Hospital-owned	43 (71.7)	62 (76.5)	6 (7.4)	32 (39.5)
Private practice	32 (58.2)	65 (71.4)	3 (3.3)	37 (41.1)
Hospital type				
Academic	40 (71.4)	56 (78.9)	5 (7.0)	25 (35.2)
Community	35 (59.3)	72 (70.6)	4 (3.9)	45 (44.6)
Practice size				
<5	3 (50.0)	9 (81.8)	1 (9.1)	8 (80.0)
6-10	6 (40.0)	17 (63.0)	3 (11.1)	11 (40.7)
11-40	30 (62.5)	54 (70.1)	1 (1.3)	25 (32.5)
40-60	22 (88.0)*	23 (67.7)	1 (3.3)	13 (43.3)
60+	14 (66.7)	25 (89.3)	3 (10.7)	13 (46.4)
Confirmed in-hospital COVID-19 cases				
0	3 (50.0)	9 (75.0)	2 (16.7)	4 (36.4)
<5	15 (60.0)	23 (60.5)	3 (7.9)	12 (31.6)
5-10	13 (56.5)	29 (72.5)	1 (2.5)	20 (50.0)
11-30	16 (66.7)	27 (77.1)	0 (0.0)	13 (37.1)
31-50	11 (84.6)	13 (81.3)	1 (6.3)	8 (50.0)
>51	16 (69.6)	25 (83.3)	2 (6.7)	12 (40.0)
Current state cases, median (interquartile range)	2,199.00 (4,592.00)	2,239.00 (4,280.00)*	1,012.00 (3,470.00)	2,477.50 (4,146.25)*

COVID-19 = coronavirus disease 2019.

* $P < .05$.

by government policies of promotion of social distancing and government regulations against nonessential cases, which were first enacted in the Northeast and more slowly in the South [5]. Although there was a higher number of home workstation installations at hospital-owned practices and academic centers, this is likely due to the 1.5 and 1.9 times more stations installed at private practices and community institutions pre-COVID-19, respectively, from the data collected. Increased installations

at groups with ≥ 11 radiologists may signal a manpower resource issue, with larger groups better able to move a larger percentage of their workforce home while keeping the minimum in the hospital to staff procedures and contrast reactions. However, regardless of practice size, all groups increased internal teleradiology.

Of note, there was no increased dependence on external teleradiology. Moreover, many practices have decreased external teleradiology dependence because of reports of

lower case volumes across the country from reduction of nonessential cases [6]. Interestingly, the seriousness of this pandemic transcended any other correlation, with a large minority of hospitals (40.2%; 70 of 174) allowing no in-house radiologist.

Although it is true that current pandemic internal teleradiology shifts cannot be completely compared with normal daily practice, it is prudent to assess perceived benefits or drawbacks to internal teleradiology for radiologists. This is particularly apropos given

Table 2. Teleradiology experience

Level	n (%)
Turnaround time	
Improved	21 (16.9)
No change	98 (79.0)
Worsened	5 (4.0)
Stress level	
Increased	5 (4.1)
No change	38 (31.1)
Decreased	79 (64.8)
Rapport	
Increased	1 (0.8)
No change	87 (71.3)
Decreased	34 (27.9)
Interruptions	
Increased	8 (6.4)
No change	37 (29.6)
Decreased	80 (64.0)
Continue internal teleradiology after pandemic	
Yes	66 (55.9)
No	52 (44.1)

that over half (55.9%; 66 of 118) of the respondents reported that they perceived enough benefit from their experience with internal teleradiology that they plan to continue a similar workflow after the pandemic subsides. There was a higher prevalence of respondents wanting to pursue internal teleradiology beyond the pandemic in the South (66.7%; 24 of 36) and West (61.5%; 8 of 13), than the Northeast (45.5%; 15 of 33).

We also found that more private practices (64.3%; 36 of 56) desired to continue a similar internal teleradiology workflow than hospital-owned practices (47.5%; 29 of 61) postpandemic. There was a significantly higher desire among community institutions (63.6%; 35 of 59) to continue internal teleradiology postpandemic compared with academic institutions (46.2%; 40 of 56). Conceivably, academic institutions require the physical presence of

Table 3. Radiology practice characteristics

Variable	Respondents
Region, n (%)	
South	58 (33.9)
Northeast	39 (22.8)
Midwest	52 (30.4)
West	22 (12.9)
Missing	3 (1.7)
Practice type, n (%)	
Hospital-owned	82 (47.4)
Private practice	91 (52.6)
Missing	1 (0.6)
Hospital type, n (%)	
Academic	72 (41.4)
Community	102 (58.6)
Practice size, n (%)	
<5	11 (6.3)
6-10	27 (15.5)
11-40	77 (44.3)
40-60	30 (17.2)
60+	29 (16.7)
Confirmed In-hospital COVID-19 cases, n (%)	
0	12 (7.0)
<5	38 (22.2)
5-10	40 (23.4)
11-30	35 (20.5)
31-50	16 (9.4)
>51	30 (17.5)
Missing	3 (1.7)
Current state cases, median (interquartile range)	2,199.00 (3,908.50)

COVID-19 = coronavirus disease 2019.

radiologists owing to more multidisciplinary activities and academic obligations such as research and teaching. There may be a persistent negative perception of teleradiology in academia, tying it to commoditization, purported for the past two decades by many influential academics [1,2,4]. These influencers may have significantly shifted the conversation

and sentiment, particularly in academic circles, toward a defensive position against teleradiology, which may still be pervasive today and may help explain the significant difference between academic and community institutions.

Overall respondents were pleased with their internal teleradiology experience, with a majority (64.8%; 79 of 122) reporting decreased stress levels, improved or no change in turnaround time (96%; 119 of 124), no change in rapport with other physicians (71.3%; 87 of 122), and decreased interruptions (64.0%; 80 of 125). It should be noted that a minority (28%; 34 of 122) did perceive less rapport with other physicians. This perception of decreased rapport was more prevalent in hospital-owned practices (27.6%; 21 of 76) and academic institutions (26.4%; 18 of 68) than in private practices (14%; 13 of 90) and community institutions (16%; 16 of 99). Although reasons for these differences are unknown, teleradiology is inherently practiced in isolation, and although technology has allowed for greater efficiency and ubiquitous use for remote image interpretation, policies and procedures using the same technology for greater clinician-clinician interaction over remote sessions are lacking. This lack of real-time, face-to-face interaction over a remote session may contribute to the perceived decrease in rapport among some respondents.

Of note, over 80% of respondents reported no standardized protocol to reduce infectious exposure. One concern among health care workers, including radiologists, is a perceived increased risk of contracting COVID-19 when in-house. From in-person consultations with clinicians and technologists, performing minor procedures, and simply walking the halls, radiologists may have a heightened concern for contracting COVID-19. An exposed radiology workforce

limits the integral role radiologists play during this pandemic in interpreting imaging studies and collaborating with other clinicians on the frontlines.

Limitations

Although small, our sample size of 174 respondents represented the diverse types of radiology practices across the country. This survey represented a snapshot of teleradiology practices in March 2020 in the early phase of the COVID-19 pandemic. We also recognize that internal teleradiology experiences during this time of a pandemic are not the same experientially as prepandemic practices.

In summary, our survey in the early COVID-19 pandemic period

found that the majority of radiology practices have leveraged internal teleradiology for normal workday shifts and found sufficient benefit to consider continuing internal teleradiology after the pandemic passes. These preliminary findings will require follow-up but suggest that the use of internal teleradiology may persist post-COVID-19.

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