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# Characteristics of COVID-19 Community Practice Declines in Noninvasive Diagnostic Imaging Professional Work

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## Abstract

**Purpose:** The operational and financial impact of the widespread coronavirus disease 2019 (COVID-19) curtailment of imaging services on radiology practices is unknown. We aimed to characterize recent COVID-19-related community practice noninvasive diagnostic imaging professional work declines.

**Methods:** Using imaging metadata from nine community radiology practices across the United States between January 2019 and May 2020, we mapped work relative value unit (wRVU)-weighted stand-alone noninvasive diagnostic imaging service codes to both modality and body region. Weekly 2020 versus 2019 wRVU changes were analyzed by modality, body region, and site of service. Practice share  $\chi^2$  testing was performed.

**Results:** Aggregate weekly wRVUs ranged from a high of 120,450 (February 2020) to a low of 55,188 (April 2020). During that –52% wRVU nadir, outpatient declines were greatest (–66%). All practices followed similar aggregate trends in the distribution of wRVUs between each 2020 versus 2019 week ( $P = .96-.98$ ). As a percentage of total all-practice wRVUs, declines in CT (20,046 of 63,992; 31%) and radiography and fluoroscopy (19,196; 30%) were greatest. By body region, declines in abdomen and pelvis (16,203; 25%) and breast (12,032; 19%) imaging were greatest. Mammography (–17%) and abdominal and pelvic CT (–14%) accounted for the largest shares of total all-practice wRVU reductions. Across modality-region groups, declines were far greatest for mammography (–92%).

**Conclusions:** Substantial COVID-19-related diagnostic imaging work declines were similar across community practices and disproportionately impacted mammography. Decline patterns could facilitate pandemic second wave planning. Overall implications for practice workflows, practice finances, patient access, and payment policy are manifold.

**Key Words:** COVID19, imaging utilization, work relative value unit

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## INTRODUCTION

Between January and March 2020, the coronavirus disease 2019 (COVID-19) pandemic quickly spread across all 50 US states [1]. Widespread public health initiatives to “flatten the curve” of this rapidly emerging global pandemic prioritized social distancing and activity restrictions. Associated recommendations that health care facilities defer nonurgent visits, tests, and procedures [2] led many imaging facilities to substantially curtail most of their nonurgent services [1,3].

Substantial (50%-70%) but anecdotal declines in nationwide imaging volumes were recently noted [3]. Subsequently, COVID-19-associated declines in imaging volumes were described for a single large academic-affiliated health system in New York, the state then hardest hit by COVID-19 [4], as well as a large university hospital in Northern California [5]. No community practice or geographically broader reports have yet emerged, however, nor have reports emerged that have considered the professional work relative value unit (wRVU) magnitude of these declines. Better knowledge about wRVU-weighted declines focusing on sites of service, as well as modalities and body regions, could inform ongoing radiologist and technologist manpower, clinical coverage, and financial planning, as well as Medicare payment methodology. Additionally, in light of predictions of an upcoming potentially disastrous “second wave” of COVID-19 [6], such information could prove actionable for radiology practice planning.

Using imaging examination metadata from nine community radiology practices across the United States, we aimed to characterize radiologist professional work implications of declines in noninvasive diagnostic imaging services by modalities, body parts, and sites of service.

## METHODS

Because this study involved no private identifying information, it did not constitute human subjects research and thus did not require institutional review board oversight.

We obtained imaging examination metadata from nine community radiology practices in predominantly urban areas representing all four US census regions for all professional services rendered between January 6, 2019, and May 3, 2020. As a condition of those groups sharing proprietary practice business information, complete patient and facility de-identification was required. Because all groups provided their information in different formats, heterogeneous practice data were first converted in a uniform manner to uniquely map each service descriptor to a unique Current Procedural Terminology (CPT) code.

In a manner similar to that previously described [7], each identifiable stand-alone noninvasive diagnostic

imaging CPT code was then mapped to both modality (CT, MR, nuclear medicine, ultrasound, radiography, or fluoroscopy inclusive of mammography) and body region (brain, head or neck, spine, cardiac, chest, abdomen or pelvis, extremity, breast) using the pre-established Neiman Imaging Types of Service (NITOS) classification system (<https://www.neimanhpi.org/neiman-imaging-types-of-service-nitos/>). To assign physician work effort to each service, each CPT code was additionally mapped to its Medicare-assigned wRVU. Because data spanned 2 calendar years, 2020 calendar year Medicare wRVU assignments were used throughout to ensure consistent weightings.

Changes in wRVUs between matched full 2020 versus 2019 weeks were assessed for each individual practice as well as for all practices in aggregate by modality, body region, and site of service (inpatient, outpatient, emergency department, undetermined).  $\chi^2$  Tests were performed on practice share distributions for each week in 2020 compared with its corresponding week in 2019.

Analyses were performed using SAS version 9.3 software (SAS Institute, Cary, North Carolina) and Excel 365 (Microsoft, Redmond, Washington).

## RESULTS

Geographic and weekly share characteristics of the wRVU contribution of each community radiology practice to the overall sample are outlined in Table 1. The nine practices represented all four census regions (Northeast, Midwest, South, and West) and were all predominantly urban based. At the individual practice level, calendar year 2019 noninvasive diagnostic imaging examination volumes ranged from a low of 506,258 to a high of 2,688,726 (mean 999,821  $\pm$  689,548 SD). Associated practice-level calendar year 2019 wRVUs ranged from a low of 324,039 to a high of 1,670,426 (mean 658,723  $\pm$  420,115 SD). Each practice's share of total weekly wRVUs was similar across all 69 weeks in the sample, with no statistical differences in the distribution of each practice's share of overall wRVUs between each 2020 week and its corresponding week in 2019 (*P* values range between .96 and .98). Across all nine practices over all 16 months, a total of 11,567,205 noninvasive diagnostic imaging services were rendered, corresponding to a total of 7,594,263 wRVUs.

Aggregate weekly wRVUs ranged from a high of 120,450 in week 7 of 2020 (ie, the week ending February 23, 2020) to a low of 55,188 in week 14 of 2020 (ie, the week ending April 12, 2020). During that volume nadir week, total aggregate wRVUs had declined 63,992 from the corresponding week 14 in 2019, reflecting an overall decrease of 52%, with declines across all sites of service: 29% (inpatient), 66% (outpatient), and 40% (emergency

**Table 1.** Geographic and weekly work relative value unit share characteristics of each community radiology practice to the overall sample

Practice	Census Region	Average (%)	Minimum (%)	Maximum (%)	2019 Week 14 (%)	2020 Week 14 (%)
A	Midwest	12	11	14	12	13
B	South	10	9	13	11	12
C	Northeast	7	5	8	6	5
D	South	6	0	6	6	5
E	South	13	11	19	13	14
F	West	6	2	7	6	5
G	Midwest	5	1	6	5	5
H	West	12	11	14	12	12
I	South	28	26	33	28	29

department; Fig. 1). All nine practices followed similar aggregate trends. Significant differences in volume changes between practices would change the share of each practice's output during that week in the overall sample, but we found no statistically significant differences in the distribution of each practice's share of overall wRVUs between 2020 week 14 versus 2019 week 14 ( $P = .98$ ).

Overall total wRVU changes and percentage wRVU changes across all practices during the week with the largest aggregate decline (week 14 of 2020) compared with the same week in 2019 for noninvasive diagnostic imaging by modality and body part are heatmap detailed in Figure 2. As a percentage of the total aggregate 63,992 wRVU decline, CT (20,046 of 63,992; 31%) and radiography and fluoroscopy inclusive of mammography (19,196; 30%) together accounted for more than half (61%) of that overall decline. By body region, abdomen and pelvis (16,203; 25%) and breast (12,032; 19%) imaging together accounted for nearly half (44%).

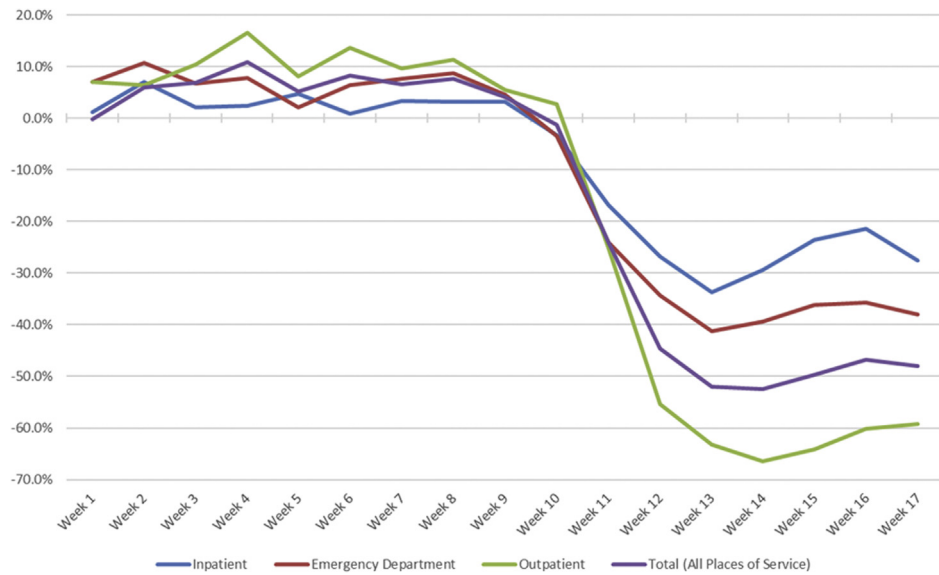
Overall total wRVU changes and percentage wRVU changes across all practices during the week with the largest aggregate decline (week 14) compared with the same week in 2019 for noninvasive diagnostic imaging for each individual NITOS modality-region group are further heatmap detailed in Figure 3. By NITOS group, mammography (11,080 of 63,992; -17%) and abdominal and pelvic CT (8,663; -14%), and abdominal and pelvic ultrasound (5,189; -8%) accounted for the largest shares of total all-practice wRVU reductions. Within individual NITOS modality-region groups with 100 or more aggregate wRVUs in 2019, wRVU declines were by far greatest for mammography (-92%) and cardiac CT (84%).

The share of aggregate weekly 2020 wRVUs by site of service are presented in Figure 4. Outpatient imaging comprised that largest share of imaging wRVUs from the beginning of 2020 up through week 10 (ie, the week ending March 15, 2020), fluctuating between 49% and 50% of total wRVUs. After week 10, the share of outpatient wRVUs declines reached a low of 34% of total wRVUs in week 14 before increasing to 38% in week 17 (ie, the week ending May 3, 2020). From week 10 to week 14, the share of inpatient imaging increased from 13% to 20% of all wRVUs, and the share of emergency department imaging increased from 31% to 40%.

## DISCUSSION

Using de-identified imaging examination metadata from a convenience sample of nine cooperating community practices across the United States, we mapped wRVU-weighted noninvasive diagnostic imaging service volumes to modalities and body regions using a pre-established categorization system (NITOS) and found consistent and dramatic COVID-19-related declines across practices, particularly in the outpatient setting. Together, declines in mammography, abdominal and pelvic CT, and abdominal and pelvic ultrasound accounted for over 40% of practice professional work reductions. With a greater than 90% relative work reduction, mammography services were most greatly impacted.

Our findings support widespread anecdotal as well as early published reports of massive declines in imaging volumes and revenue that have led to great concern across radiology practices. Substantial (50%-70%) but anecdotal



**Fig 1.** Percent change in weekly aggregate all-practice 2020 versus 2019 noninvasive diagnostic imaging service work relative value units by site of service.

declines in nationwide imaging volumes were noted recently by Cavallo and Forman [3]. Shortly thereafter, Naidich et al reported COVID-19-associated imaging volume declines as high as 58% for both services locations and modalities across a single large academic-affiliated health system in New York, a state which was then the US epicenter of the pandemic [4]. Even more recently, Madhuripan et al reported similar overall (54%) declines in radiology service volumes at a large academic hospital in Northern California, which they segmented by not only service location and modality but also radiology subspecialty [5]. Although our categorization approaches differed, their modality and subspecialty changes largely comported with our modality and body region changes, with both our groups demonstrating the most dramatic declines in mammography.

To date, no reports have emerged from nonacademic health systems or geographically more diverse regions. Our work, we believe, further fills the knowledge gap about the

impact of COVID-19 on radiology practices by specifically focusing on service declines in a wRVU-weighted manner and even more granularly characterizing those declines across not only modalities and sites of service but also across anatomic regions. With no end in sight to the current pandemic, such information could prove actionable for both radiologist workforce and practice financial planning, particularly if a predicted potentially disastrous second wave of COVID-19 [6] indeed materializes.

Although, as this manuscript is being prepared, radiology practice volumes seem to be increasing [5], the impact of incomplete restoration of baseline radiology practice work could be both consequential and manifold. Access to radiologist services in rural settings, already constrained in many locations [8], could be further jeopardized by practice and facility financial insolvency related to a sustained decline in revenues should our observations be generalizable outside of the urban setting. From a

	Brain	Head/Neck	Spine	Cardiac	Chest	Abdomen/Pelvis	Extremity	Breast	All Body Areas
wRVU	-6,863	-3,599	-6,967	-926	-6,988	-16,203	-6,648	-12,032	-63,992
% Change	-44%	-51%	-58%	-78%	-38%	-45%	-58%	-88%	-52%

	Computed Tomography	Magnetic Resonance	Nuclear Medicine	Ultrasound	Radiography & Fluoroscopy	All Modalities
wRVU	-20,046	-11,556	-972	-8,458	-19,196	-63,992
% Change	-40%	-57%	-70%	-55%	-69%	-52%

	wRVU decrease 1-33%
	wRVU decrease 34-66%
	wRVU decrease > 66%

**Fig 2.** Overall aggregate work relative value unit (wRVU) changes and percentage work relative value unit changes across all practices during the 2020 week with the largest aggregate decline (week 14) compared with the same week in 2019 for noninvasive diagnostic imaging by modality (top) and body part (bottom).



	Computed Tomography		Magnetic Resonance		Nuclear Medicine		Ultrasound		Radiography /Fluoroscopy		
	wRVU	% Change	wRVU	% Change	wRVU	% Change	wRVU	% Change	wRVU	% Change	
Brain	Inpatient	-296	-23%	-539	-29%	-4	-74%	-2	-3%	0	
	Outpatient	-515	-55%	-2,623	-61%	-23	-95%	6	32%	0	
	ED	-2,082	-39%	-296	-48%	0		-1	-100%	0	
	All	-3,099	-38%	-3,742	-52%	-27	-88%	4	5%	0	
Head & Neck	Inpatient	-221	-32%	-44	-27%	-4	-88%	-163	-50%	-42	-31%
	Outpatient	-869	-64%	-224	-60%	-75	-72%	-806	-75%	-169	-80%
	ED	-634	-32%	-68	-77%	0	0%	-31	-75%	-32	-60%
	All	-1,864	-43%	-342	-54%	-80	-72%	-1,058	-69%	-256	-60%
Spine	Inpatient	-71	-30%	-208	-31%	0		-2	-18%	-43	-54%
	Outpatient	-423	-68%	-3,054	-66%	0		-19	-85%	-739	-72%
	ED	-1,444	-45%	-280	-64%	0		0	0%	-273	-73%
	All	-2,040	-47%	-3,794	-63%	0		-21	-61%	-1,112	-71%
Cardiac	Inpatient	-7	-25%	-10	-50%	-75	-82%	0		0	
	Outpatient	-381	-82%	-32	-40%	-165	-76%	3		0	
	ED	-2	-100%	0	0%	-13	-100%	0		0	
	All	-580	-84%	-69	-54%	-280	-75%	3		0	
Chest	Inpatient	-297	-17%	-5	0%	-81	-65%	4	20%	-554	-30%
	Outpatient	-2,218	-53%	-57	-72%	-46	-75%	-10	-53%	-1,159	-57%
	ED	-581	-16%	0	0%	-64	-79%	0	-20%	-1,324	-43%
	All	-3,447	-33%	-60	-66%	-209	-72%	-8	-18%	-3,264	-44%
Abdomen & Pelvis	Inpatient	-690	-27%	-99	-25%	-47	-40%	-373	-34%	-123	-22%
	Outpatient	-3,286	-50%	-810	-48%	-222	-67%	-3,041	-58%	-631	-70%
	ED	-4,164	-38%	-22	-44%	-4	-100%	-1,522	-50%	-231	-44%
	All	-8,663	-40%	-993	-44%	-295	-62%	-5,189	-53%	-1,064	-50%
Extremity	Inpatient	-49	-24%	-168	-52%	-8	-73%	-265	-35%	-94	-38%
	Outpatient	-221	-61%	-2,212	-69%	-69	-79%	-564	-59%	-1,368	-67%
	ED	-56	-24%	-39	-64%	0	0%	-358	-56%	-811	-50%
	All	-353	-41%	-2,555	-67%	-82	-80%	-1,238	-50%	-2,420	-58%
Breast	Inpatient	0		0		0		-1	-31%	6	357%
	Outpatient	0		0		0		-837	-60%	-10,034	-91%
	ED	0		0		0		0	0%	0	
	All	0		0		0		-952	-62%	-11,080	-92%

<100 wRVUs in 2019
  wRVU decrease 1%-33%
  wRVU decrease 34%-66%
  wRVU decrease > 66%

Fig 3. Overall aggregate work relative value unit (wRVU) changes and percentage work relative value unit changes across all practices during the 2020 week with the largest aggregate decline (week 14) compared with the same week in 2019 for noninvasive diagnostic imaging for each Neiman Imaging Types of Service modality-region group by site of service. ED = emergency department.

workforce perspective, although the radiologist employment market has been particularly favorable in recent years [9], continued professional revenue declines could reverse that trend, making radiology a potentially less attractive specialty for medical students choosing residencies, or potentially precipitating a wave of early retirement among more senior radiologists who continue to practice [10]. More and more, capital investors are catalyzing the corporatization of the specialty [11] and radiology practices are rapidly consolidating [12]. How declining practice revenues will influence such trends is unknown (eg, discourage nonradiologist investors versus encourage small practices to protectively consolidate). And finally, disproportionate work declines in some subspecialty areas (eg, breast imaging) in times of this crisis—particularly if they prove sustained or recurrent—could increase demand for more multispecialty radiologists with broader skill sets [13] to help ensure robust radiology practice coverage.

From the perspective of ongoing policy initiatives by Medicare and other payers to reduce expenses, imaging payments have historically been predicated on imaging equipment usage assumptions [14]. Without a clear and definitive anticipated pandemic endpoint, ongoing declines in examination volumes, coupled with greater staff and extended room time demands (eg, extra cleaning, greater appointment spacing) should, we believe, prompt policymakers to reassess traditional methodological assumptions.

Our work has several limitations. First, given the emerging nature of our report, it is intentionally based on a convenience sample of radiology groups that agreed to expeditiously share proprietary practice data in a deidentified manner. Although there was consistency in our observations across practices, both over time and across modalities and body regions, our findings may not be as generalizable as those that will likely come in 1 to 2 or more years when

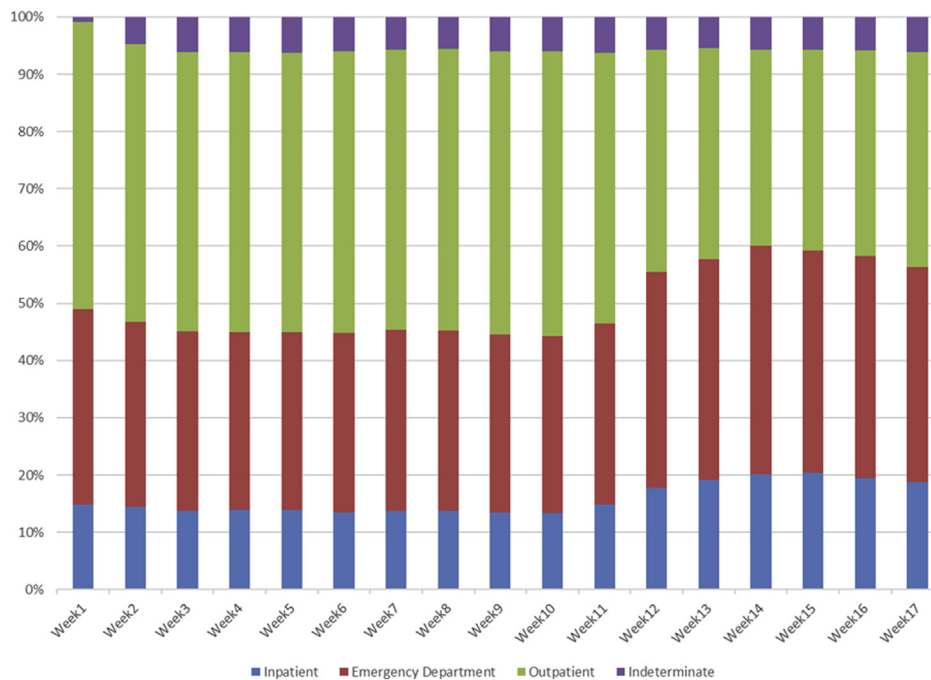


Fig 4. Share of aggregate weekly 2020 work relative value unit by site of service.

large payer claims data sets for 2020 become available. Second, our work focuses specifically on community radiology groups that are predominantly urban based. Although such practices represent the majority of radiology practices across the United States [15], the modality, body region, and site of service changes described herein may not apply more broadly to academic practices or rural practices whose case mixes are often quite different. And finally, given that no validated CPT-based classification systems exist to characterize interventional radiology procedures, we focused our analysis specifically on noninvasive diagnostic imaging services. More work would be necessary to quantify the impact of COVID-19 on interventional radiology professional services.

### TAKE-HOME POINTS

- In community radiology practices across the United States, the physician professional wRVU impact of COVID-19 has been substantial, with peak pandemic declines averaging 52%.
- By modality, CT and radiography and fluoroscopy (inclusive of mammography) together accounted for well more than half of total practice wRVU declines.
- By body region, abdomen or pelvis and breast imaging together accounted for nearly half of total practice wRVU declines.

- Across modality-region groups, declines were far greatest for mammography.
- The implications of COVID-related imaging declines on radiology practice finances and workflows, patient access, and payment policy are manifold.

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