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TeleResidents: Exploring the use of Resident Home Workstations During the COVID Pandemic

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Rationale and Objectives: Since the beginning of the COVID-19 pandemic, numerous strategies have been proposed to allow for continued resident education while following social distancing guidelines. Diagnostic radiology is largely electronic work, allowing for relatively easy transition to telehealth. Our institution deployed home workstations to interested upper level radiology residents and fellows in order to maintain high volume workload and education, while complying with CDC social distancing and quarantine guidelines.

Materials and Methods: We deployed 28 home workstations with integrated PACS, electronic health record, and reporting system, supporting workflow that matched our on-site processes and allowing residents to work from home while on diagnostic rotations. Two months into the pilot, surveys were sent to trainees and faculty to assess satisfaction related to education, productivity, and wellness. A retrospective study count was performed for a sample of residents in order to assess productivity.

Results: Residents perceived their remote productivity as unchanged or better than at the hospital, while faculty were more likely to perceive it as decreased, however, objective results showed no difference. Education was largely considered worse or unchanged with very few regarding it as improved. Those utilizing shared-screen signout platforms rated education better than those utilizing voice/telephone communications only. Trainees expressed improvement in wellness and quality of life.

Conclusion: Home workstations for trainees represent a feasible solution for implementing social distancing or even quarantine while maintaining operational productivity. There is the added benefit of scheduling flexibility, option to overcome space constraints, and improved quality of life.

Key Words: tele radiology; COVID-19; wellness; resident; education.

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BACKGROUND

The COVID19 pandemic has significantly impacted life as we know it, including radiology departmental operations and resident education nationwide. Multiple strategies attempting to mitigate the impact on residents have been proposed and described over the past year, such as virtual curriculums, web based conferences and learning modules, online teaching files, and simulated faculty readout sessions (1). Many residency programs have also established social distancing measures to reduce viral transmission by utilizing remote workstations within the hospital and performing report sign-out via teleconferencing (2). However, this strategy is largely limited by availability of isolated work space

and computers. This also fails to account for the impact of quarantine when mandated, which may require even asymptomatic and healthy residents who may have been exposed to the virus, out of the reading room for up to 14 days, significantly impacting education, clinical productivity, and reducing scheduling flexibility within the residency and fellowship programs.

Since the beginning of the pandemic, there has been a nationwide shift across multiple industries encouraging remote work in order to diminish disease transmission, while maintaining productivity (3,4). Diagnostic radiology is a unique specialty in healthcare as a majority of the work is digitized and many physicians have the capability of teleworking if enabled from a technical perspective. Given the persistently high infection rate, new viral strain, and limited speed of vaccine distribution (at the time), COVID-19 continues to wreak havoc on trainee education and wellness (5,6). Near the close of 2020, our radiology department decided to launch a home workstation pilot among interested upper level radiology residents and fellows, providing them with the equipment required to interpret images from home. In

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this paper we will describe the strategy implemented by our large academic radiology department in order to maintain a high volume workload and resident education, all while complying with social distancing and safety guidelines.

MATERIALS/METHODS

Our radiology program consists of 41 residents; 11 PGY 2 (R1), 9 PGY 3 (R2), 10 PGY 4 (R3), and 11 PGY 5 (R4). We have an additional 19 PGY 6 fellow trainees. The administration elected to offer remote work opportunities to PGY 4–6 trainees due to greater experience and increased comfort with interpretation autonomy. Within this cohort, multiple subspecialty divisions opted out of workstations for their fellow trainees due to on-site call and procedural responsibilities. Several PGY 5 (R4) trainees also declined workstations, preferring to work at the hospital. For those interested, our institution purchased 28 home workstations consisting of a PC tower, three 24" monitors for viewing images and administrative work, keyboard, mouse, PowerMic (Nuance, Burlington, MA), webcam, Wi-Fi antenna and additional connecting cables and adaptors. The total cost per workstation was \$2,126 (USD). The IT department pre-installed our usual integrated electronic health record, PACS, and reporting systems, as well as virtual private network (VPN) software (BIG-IP Edge, F5, Seattle, WA), before distribution amongst post-graduate year 4 through 6 trainees (PGY 4–6), including 10 of 10 third-year radiology residents (R3), 5 of 11 fourth-year radiology residents (R4), and 11 of 11 eligible subspecialty fellows. Trainees completed home-setup independently with a short instruction document provided by the department. The chief residents collaborated with individual division chiefs to determine which rotations would be amenable to remote work. It was decided that thoracic and abdominal CT/MRI, noninvasive cardiovascular imaging, neuroradiology, and musculoskeletal imaging could be interpreted remotely, while procedural services including ultrasound, fluoroscopy, breast imaging, and nuclear medicine required attendance in the hospital. While a resident was assigned to one of the aforementioned rotations, they interpreted and reported clinical studies from home during the normal working hours, similar to when working in-house.

Our department utilized several options for conducting remote synchronous signout with trainees working from home. Some sessions were performed over the telephone, while others utilized one of several screen sharing options including Skype Business (Microsoft, Seattle, WA), WebEx (Cisco, Milpitas, CA), and native session sharing within the PACS (Vue PACS, formerly Carestream Health in Rochester, NY; acquired by Philips Healthcare Information Solutions in Andover, MA). All three screen sharing options allow for real-time screen sharing, scrolling images, and identification of findings on both the sharing and receiver's end. The platform used for case sign-out was chosen according to faculty preference.

Approximately 2 months into the home workstation pilot we conducted an online survey (Appendix 1A and 1B) of radiology trainees and faculty to gauge ease of use, perceived productivity, and overall satisfaction. Links to the survey were distributed by email to clinical faculty in divisions that supported remote reading ($n = 32$) and all trainees ($n = 28$) who received a workstation. Relevant clinical faculty were those in divisions that participated in the read from home program for trainees.

Objective data on trainee productivity was retrospectively collected and evaluated by comparing the number of studies interpreted by remote trainees versus their counterparts who were working on-site. To avoid confounding factors such as difference in years of training, interpretation speed, and variable day to day case volume, we evaluated the number of studies (including MR, CT, US and radiographs) interpreted by musculoskeletal fellows (PGY6) who were working both remotely and on-site over a period of 2 months. We also used one of the PGY4 residents who completed one half of their noninvasive cardiovascular imaging rotation (CT and MR angiograms chest, abdomen, pelvis, and extremities) before receiving a workstation and half of it after, serving as their own internal control. We ran a PACS search of all studies approved by a given trainee on days they were working on-site and days they were working remotely. The daily average value of cases interpreted by the trainees working from home were compared to that of their colleagues working on-site.

RESULTS

The survey was sent to 28 trainees with a response rate of 89% ($n = 25$) and all 32 eligible faculty with a response rate of 50% ($n = 16$). The primary faculty subspecialties responding to the survey included abdominal ($n = 5$), musculoskeletal ($n = 3$), thoracic ($n = 3$), pediatrics ($n = 2$) neuroradiology ($n = 2$), and noninvasive cardiovascular imaging ($n = 1$).

The majority ($n = 23$, 92%) of the resident and fellow participants found installation and setup easy and most ($n = 18$, 72%) did not report a noticeable or impactful difference in exam loading time between home and the hospital. In our experience, the major factors impacting load times at home were related to the VPN used to remotely connect to the hospital system. Home internet speed was less impactful given the prevalence of high speed internet connections.

Platforms for remote sign-out varied by preference, however, Skype was the most frequently used ($n = 11$, 69%) followed by telephone alone ($n = 2$, 13%). Faculty perceived teaching and education to be worse (63%, $n = 10$) or unchanged (38%, $n = 6$), with no one rating it better than in-person. The faculty utilizing communication without video function were more likely to rate education as worse compared to in person (Fig 1). Similarly, residents found teaching to be worse (40%, $n = 10$) or unchanged (56%, $n = 14$) (Fig 2). Perception of sign-out length was split with 50% ($n = 8$) of faculty reporting more time spent on remote sign

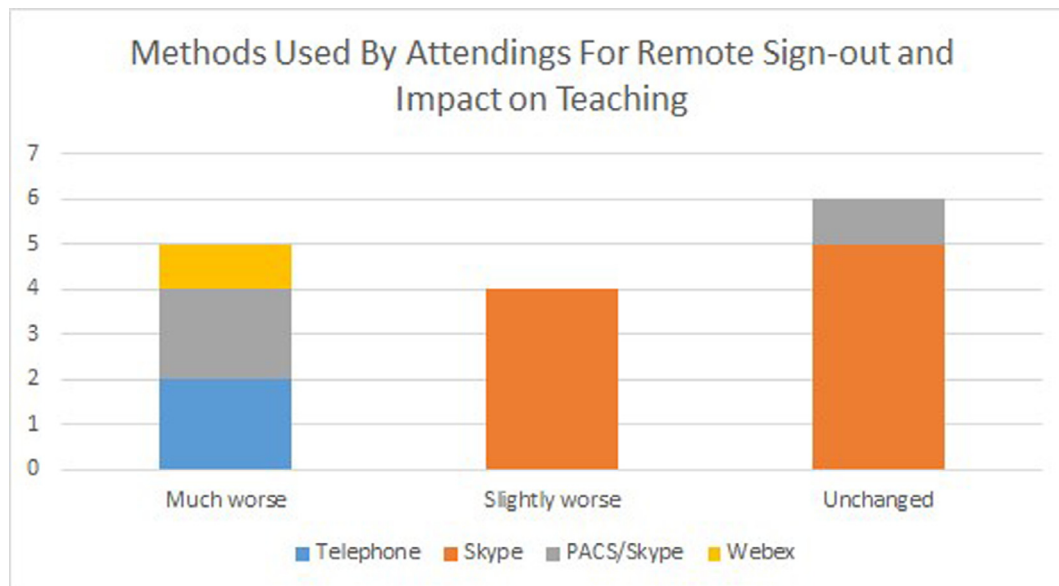


Figure 1. The method of choice used by attendings to perform remote sign-out with residents grouped by how they felt remote sign-out impacted teaching quality. PACS/Skype represents attendings who used a combination of PACS screen sharing and Skype. All faculty using only telephone for sign-out felt remote sign out resulted in a significant decrease in education quality. Skype screen sharing results in the least impact on education. (Color version of figure is available online.)

out, the remainder reporting shorter or unchanged sign-out duration (Fig 3).

When asked about the number of studies read, residents felt they read the same, or more (92%, n = 23) than when at the hospital. Contrarily, a majority of faculty were under the impression that residents at home were reading slightly less (43%, n = 7) or much less (31%, n = 5) (Fig 4). Residents did

not experience significant additional difficulty reporting critical findings or getting in touch with referring providers (Fig 5).

When asked for free text answers regarding the pros and cons of the home stations, the time saved commuting was a common theme mentioned in 62% of comments (13/21 comments). While there was very little negative feedback

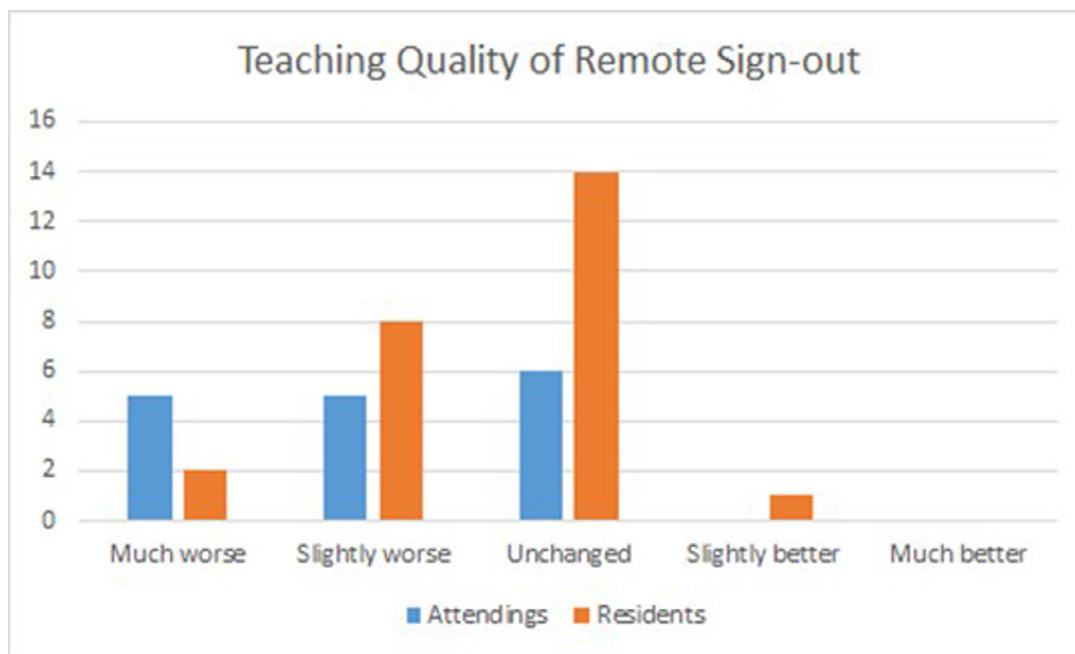


Figure 2. Graph of collected responses from residents and attendings when asked to rate the quality of remote sign-out using home workstations as compared to traditional in-person sign-out. The Y axis represents the number of received responses. Note: one attending responded to the survey however had not signed out with a resident/fellow remotely; they rated the educational impact as slightly worse. (Color version of figure is available online.)

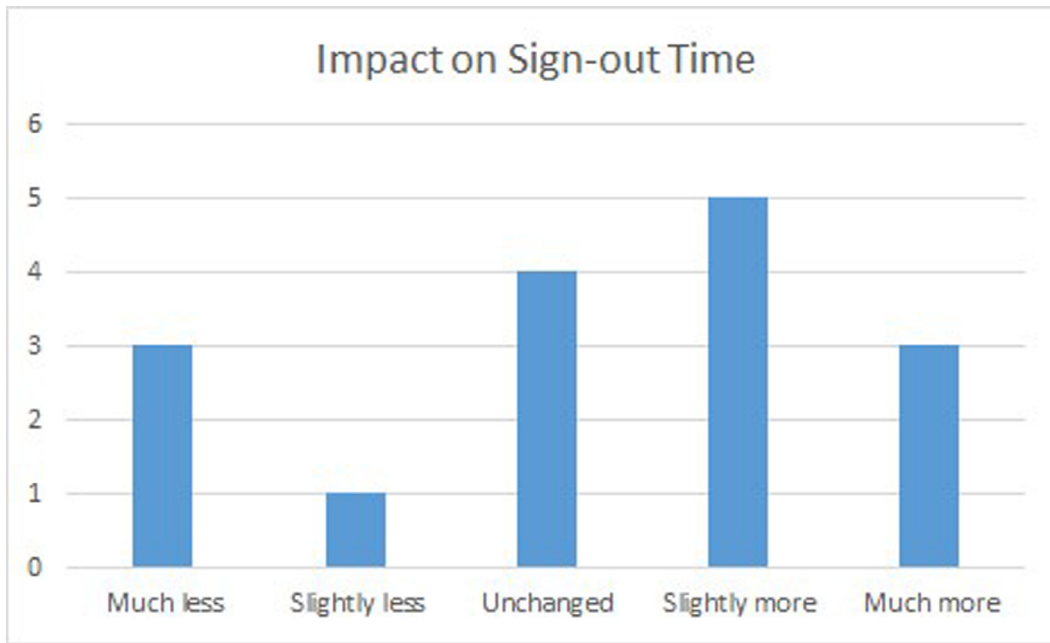


Figure 3. Response from attendings when asked how remote sign-out affects readout time. Of note, all attendings who rated educational quality as “much worse” with remote sign-out also responded indicating much more time spent on remote sign-outs. (Color version of figure is available online.)

from residents and fellows, some comments included the missed interaction with colleagues and difficulties with their personal, home internet connections.

When comparing the number of studies interpreted by trainees working remotely and on-site, we found no significant difference in the daily average. Over a 2 month period, the number of studies read per shift by remote PGY6 trainees was approximately 43 compared to 46 by the on-site trainees ($p = 0.616$). Our PGY3

trainee averaged 9.9 noninvasive vascular imaging studies per day working both remote and on-site.

DISCUSSION

Education

There was some perception that education was worse during remote signout as compared to in person, although this

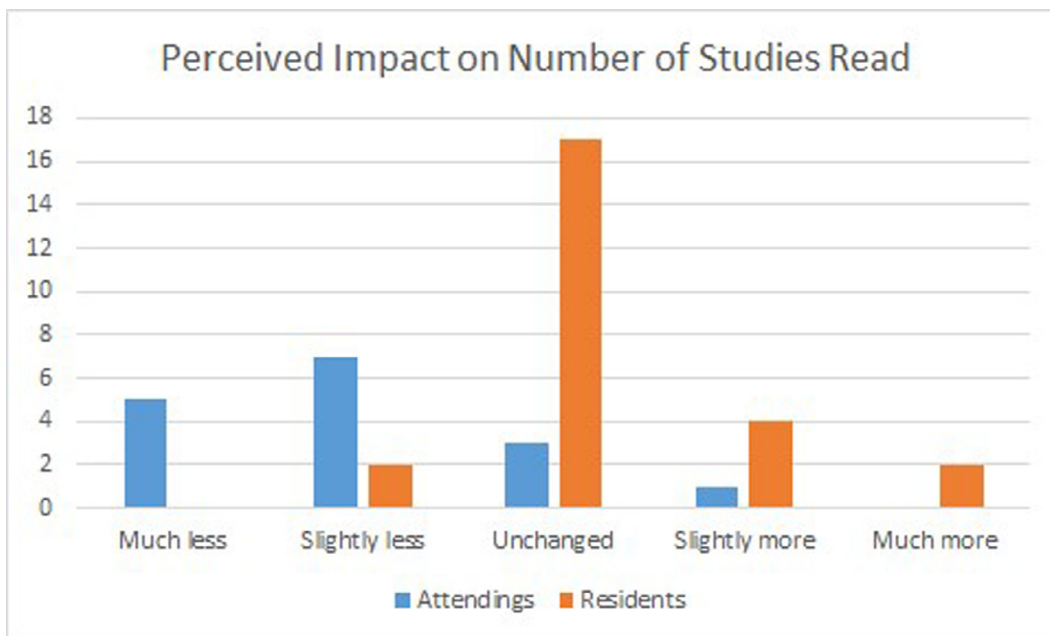


Figure 4. Subjective perception of studies read using home workstations as compared to a traditional workday in the hospital. Attendings tended to perceive residents/fellows as reading less studies while residents and fellows perceived unchanged to increased performance. (Color version of figure is available online.)

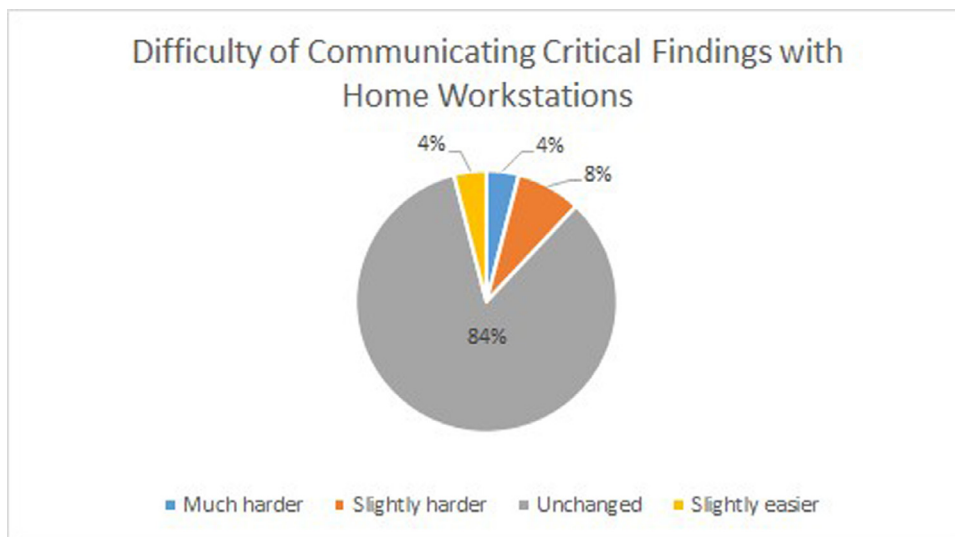


Figure 5. Response from residents and fellows when asked to rate how difficult it is to communicate critical findings to providers when working with a home workstation. Although the vast majority felt it unchanged, experience with use of Vocera, internal paging systems, and knowledge of direct phone number extensions for in-hospital communication may have impacted responses. Of note, there were no responses for “much easier.”

sentiment was stronger amongst faculty than residents and fellows, and furthermore, appears at least partially related to the communications platform utilized. The use of screen sharing during readout sessions allowed for sharing of PowerPoint presentations, journal articles and figures, and other educational materials more closely mimicking in-person signout. Attending comfort level with the various programs likely impacted their view on education quality during remote sign-outs.

Faculty were also under the impression that less questions were being asked by trainees. A proposed explanation for this is that the remote working opportunity was only offered to senior trainees, who are likely asking less questions in general when reviewing straightforward cases.

While there were some educational drawbacks during clinical sign-out sessions, trainees reported the home stations useful for educational and scholarly activity outside of report interpretations. Approximately 75% of trainees used the computers for studying, made feasible by VPN access to teaching resources typically only available at the hospital. It also allowed for work to be done in preparation for multidisciplinary clinics and conferences from home, rather than remaining at work after hours.

Workflow, Productivity and Accountability

The primary discrepancy between faculty and trainee surveys was the perceived productivity, with the two groups being at essentially opposite ends of the spectrum. Residents may overestimate their ability to cope with distractions at home and underestimate the inevitably slower loading times of exams, however, our data objectively suggests there was no impactful difference in the number of studies read remotely versus in person. We postulate that the faculty may have had

a negative misconception of productivity due to residents staffing exams with multiple different faculty members throughout the day, and thus each individual attending only reading a few studies by a single resident. Alternatively, the faculty’s perception of resident volume may have been skewed by the lack of immediate presence and in-person interaction.

Wellness/Quality of Life

One of the underlying themes amongst resident approval of the program was the time saved commuting. It was nearly unanimous that time and money saved driving allowed for more time spent enjoying life outside of work, including studying, exercising, sleeping, and being present for family/pets, improving overall quality of life. Residents also reported feeling safer at home, enjoying work without wearing a mask or the fear of viral exposure. The positive effects of less time on the road came at the expense of daily face-to-face interaction with colleagues and attendings. Some of the collegiality gained during daily coffee breaks or short conversations in the hall were missed.

Moving Forward

Given concern over new variants, we believe that the home workstation program may continue to have a place in radiology training. The flexibility of remote working allows easier scheduling for programs that are heavily resident or fellow driven, and minimizes unexpected disruptions to education. Home stations allow for continued operations through extreme weather conditions, which may otherwise keep people off the roads. It also allows for trainees to continue working through other medical conditions not requiring use of

sick leave, for example; unexpected injuries limiting mobility, vehicular problems, or short-term childcare disruptions. With the recent announcement of ABR reevaluation of parental leave to adhere to American Board of Medical Specialties (ABMS) mandate (7), standardized weeks of parental leave have to be granted without extending graduation, while meeting the minimum ABR certification requirement. Remotely working from home may allow flexibility for trainees to continue to work after their parental leave weeks ends and continue to be present for their child with less impact on their progress in residency.

Limitations

Our strategy of utilizing home workstations during the pandemic to preserve resident education and patient care has its limitations. Implementing home workstations is a costly endeavor requiring a certain level of monetary (\$2,126 per workstation) and personnel (IT) resources not feasible for all programs. The response rate from faculty was incomplete as responses were not mandatory, and not all faculty had the opportunity to work with residents remotely, contributing to a small sample size. This may have led to increased bias either in favor of or against home workstations, as it is more likely that those with strong feelings responded to the survey questions.

CONCLUSION

For institutions with the financial resources, offering a remote option for senior radiology residents and fellows represents a feasible solution for implementing social distancing and personal safety measures during the pandemic, while maintaining operational productivity. These benefits can be applied to other scenarios where residents and fellows are unable to

work in-house, including inclement weather. It contributes to improved quality of life and provides scheduling flexibility among residents and fellows needing to adjust for unexpected life events. This may come at an arguable cost of quality of education, however, further objective studies are needed to confirm.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.acra.2021.11.001.