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Network Radiology: Future of Imaging Practice in the Post COVID-19 Era

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The healthcare climate has been rapidly changing over the last several years, and the change is accelerated by the COVID-19 (SARS-CoV-2) pandemic. Radiology practices from around the world are struggling to adapt to the demands of these changes. While the specific challenges for radiology practices vary by geographic location and social factors, some of the common themes include growing patient volumes as we recover from the pandemic, increasing cost of care, dropping reimbursements, challenges in radiologist recruiting, and rising expectations of referrers and patients.

The major stakeholders of radiology practices include the radiologists, referrers, patients, non-physician radiology staff (such as technologists), and the hospital/health system, and each has certain expectations from the radiology practice. The biggest patient priorities include easy access to imaging services close to their home, short wait-times, high-quality reports that are personalized, complete, accurate and standardized, short report turnaround times, and ultimately, equitable, high-quality patient care. The referrer expectations include availability of a wide array of radiology services, expert subspecialty reads regardless of imaging location, high-quality reports, clear expression of findings in the radiology report, and easy access to a radiologist for consults. Non-physician radiology staff typically prefer to work fixed hours, at a location

that minimizes the commute time, with easy access to a radiologist if any patient-related questions arise. Some of the institutional priorities include expansion to increase the patient population the hospital/healthcare system serves, and to meet the resultant rising demands, provision of high-quality, personalized care, while minimizing the costs, and maintaining efficient use of resources. The institutions are also facing increasing economic pressures and must adapt to the evolving healthcare landscape, to which they often respond by expanding their network or acquiring and consolidating smaller practices. The common themes that emerge from these stakeholders include provision of subspecialty radiology services at remote care sites, high-quality standardized reports, short turnaround times, efficient optimized staffing, and open communication with various stakeholders. The radiologists must adapt to these demands while meeting their own needs of professional growth and fulfillment, robust information technology infrastructure and efficient workflows, reasonable work hours, and better work-life balance.

The COVID-19 pandemic further complicated the situation by forcing the radiologists out of the reading rooms. However, it also provided an opportunity by pushing the radiology practices to create resources to support remote work, build virtual teaching models, and refine hybrid readout practices for radiology trainees when the attending radiologist and trainee are at different locations. Several radiology practices created smaller, remote spaces for the radiologists to work while maintaining social distance. These locations include reading rooms, radiologist offices, remote locations and even home workstations. Some of these capabilities existed even before the COVID-19 pandemic; however, now they have become more widespread and acceptable. These systems, where radiologists from the same group work from different sites

using shared resources, such as common picture archiving and communication system (PACS), dictation and result communication software, and electronic health record (EHR) create a miniature form of network radiology.

This concept could be expanded to a large hospital/ healthcare system such as ours, which includes two large academic medical centers (Brigham and Women's Hospital and Massachusetts General Hospital) and a cancer institute (Dana-Farber Cancer Institute) in the metropolitan Boston area, several community hospitals in the suburbs, and multiple smaller remote sites. The conventional radiology care model for such systems consisted of a separate radiology practice at each of these sites, including larger subspecialized academic radiology departments at the academic medical centers, small community groups at the community hospitals, and smaller or solo practices at the rural clinics. Unfortunately, this model cannot meet the patient and referrer demands of high-quality subspecialized reads at all locations. Small practices also suffer challenges with overnight reads and backup coverage to meet fluctuating demands or radiologist absence. However, if such a large hospital/health system could create shared resources (EHR, PACS, and dictation and result communication software) for all the sites belonging to their system (including the academic centers, community hospitals and remote sites) that would establish a larger radiology network spanning several geographic locations. In such a system, patients could be scanned at any location, all the imaging studies could be pooled in a central data warehouse, and the radiologists from various locations could access these studies on shared PACS. Since all these radiologists now form a large single network, they would have the unique ability to distribute the cases based on radiologist availability and expertise.

There are several advantages of this type of network radiology. This system is scalable and can be applied to healthcare systems of varying sizes, it is also key to meeting the demands of various stakeholders. A system such as this would help provide subspecialty reads, especially for complex studies, even for the patients scanned at remote locations, using two possible approaches. One, general radiologists could bolster their reports by obtaining a second opinion on challenging cases from more experienced subspecialty radiologists. Alternatively, pooling of cases in a common PACS opens the possibility for radiologists, even at the remote sites, to develop subspecialty expertise by reading more studies in their chosen area of interest. Either

approach would potentially improve the report quality at the remote sites and provide learning opportunity for the radiologists at remote locations. Radiologists could also read studies within their area of expertise from different locations, including from home or a site closer to home, thus allowing a better work-life balance. The distribution of cases could be adjusted in real time depending on radiologist availability. For example, if there is radiologist shortage or excess studies at one site, the others from different locations could help absorb the extra volume. This provides dynamic and more equitable division of labor among different radiologists.

Network radiology is also more amenable to efficient workflows and quality improvement initiatives because all the new initiatives can be easily expanded to all the network sites without each site having to create their own workflows. A harmonized approach adds more consistency and a standardization to imaging services such as scanning protocols and report templates [1-3], while efficient workflows can add capacity and shorten report turnaround times. Patients are the primary beneficiaries of the network radiology practice because even patients in remote locations benefit from the subspecialty expertise of the academic medical center, leading to more equitable care. The hospital/healthcare system benefits from more efficient resource allocation and by providing better, patient-centric care. There are also several educational opportunities whereby creation of a common set of educational tools, such as virtual lectures and online teaching resources [4], benefit all the radiologists across the network. Traditionally, radiologists at remote locations could not benefit from the expertise and education available at the academic medical centers.

There are also several challenges in creating a radiology network across a large healthcare system. The primary challenge is the cost and effort needed to create shared resources such as EHR and PACS. These systems are complex and very expensive. In our network, creation of these resources required a significant financial commitment from the institute, several years of planning and execution, and efforts from numerous individuals and teams. It also required a change of practice for many sites as they adapted to the new systems. However, once these shared resources were created, many (such as EHR) were applicable to areas outside the radiology, and overall, there was a significant and long-term improvement in the radiology services. Another challenge of network radiology

is limited interpersonal interactions between radiologists at various sites. However, we leveraged electronic forms of communication including video conferencing and screen sharing to aid in the education of radiology trainees, create shared online educational resources, and to improve communication with the referrers and technologists.

In summary, healthcare systems continue to evolve, and radiology practices must adapt to remain viable and to meet the demands of various stakeholders. In an era where many hospital/health systems are growing and consolidating, network radiology is the future of our specialty. It allows easy, equitable access to imaging services for the patients, and allows the radiologists to provide high quality, subspecialized care even in remote locations, with the added potential to improve efficiency as well as work-life balance for the radiologists.

Availability of Data and Material
Data sharing does not apply to this article as no datasets were generated or analyzed during the current study.

Conflicts of Interest
The authors have no potential conflicts of interest to disclose.

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