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Operational Radiology Recovery in Academic Radiology Departments After the COVID-19 Pandemic: Moving Toward Normalcy

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Abstract

This article presents a current snapshot in time, describing how radiology departments around the country are planning recovery from the baseline of the coronavirus disease 2019 pandemic, with a focus on different domains of recovery such as managing appointment availability, patient safety and workflow changes, and operational data and analytics. An e-mail survey was sent through the Society of Chairs of Academic Radiology Departments list server to 114 academic radiology departments. On the basis of data reported by the 38 survey respondents, best practices and shared experience are described for three key areas: (1) planning for recovery, (2) creating a new normal, and (3) measuring and forecasting. Radiology practices should be aware of the common approaches and preparations academic radiology departments have taken to reopening imaging in the post-coronavirus disease 2019 world. This should all be done when maintaining a safe and patient-centric environment and preparing to minimize the impact of future outbreaks or pandemics.

Key Words: Coronavirus, COVID, SARS-CoV-2, pandemic, recovery, analytics, practice management, process engineering

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INTRODUCTION

On January 20, 2020, the first case of coronavirus disease 2019 (COVID-19) affecting a patient within the United States was reported, and by the beginning of April, 33 states had issued statewide stay-at-home orders [1]. As the virus spread across the country, health systems scrambled to keep up with demand for critical care patients, as they anticipated widespread surges in COVID-19-related volume. Many health care services, such as screening studies and non-time-sensitive or elective surgical procedures, were

put on hold for patient and employee safety, also accommodating an anticipated large-scale surge in patients with COVID-19 that may or may not have been realized depending on regional epidemiology and incidence.

After these dramatic drops in volume as a result of the COVID-19 pandemic and stay-at-home mandates, radiology departments are safely and effectively reinitiating activities and recovering from the workflow and volume impacts of the COVID-19 pandemic. In most areas, government-mandated lockdowns have kept most people at home and banned most non-time-sensitive diagnostic imaging and procedures. In locations hit hard during the early stages of the COVID-19 pandemic, such as New York and Michigan, resources were redeployed to address the surge of critical care patients, and many ambulatory sites closed during stay-at-home mandates. Imaging volumes therefore decreased. At the same time, shortages of personal protective equipment and other coronavirus-related safety concerns affected daily imaging workflow and operations, leading to further reduction of service availability.

The challenge facing radiology in revitalizing our workflow is transitioning from an unprecedented multiweek decline in services to a new normal, without any relevant

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Dr Norbash is a scientific adviser for GE, Siemens, Penumbra, Stryker, and IBM and is a cofounder of and stockholder in Boston Imaging Core Laboratories. All other authors state that they have no conflict of interest related to the material discussed in this article. Drs Siegal, Wessman, Zadorozny, Palazzolo, Montana, Rawson, Norbash, and Brown are employees.

historical data or roadmap available for how to proceed. Significant numbers of imaging studies were deferred, rescheduled, or cancelled during the shutdown. These now must be rescheduled within an evolving framework of complex regulatory and safety requirements, and competing with existing scheduled examinations. Imaging workflow must adapt to new spacing, testing, and cleaning expectations, and these changes must be consistent and clearly communicated to patients, referring physicians, administrators, health systems, and staff members. Patients are hesitant to leave their homes and even more resistant to return to hospital settings where they could potentially contract COVID-19 [2,3]. A recent resurgence of cases in the South and Southwest reinforces very real concerns around a “second wave” of cases.

Although COVID-19’s impact differs on the basis of such factors as disease burden, geography, state and local government regulation, population density, socioeconomic status, race, and many other population health factors, we intend to share a snapshot of recovery approaches that is applicable to the broad cross-section of radiology departments. As part of our efforts to identify resources for academic departments to guide them through the recovery, we informally surveyed academic radiology departments and their recovery plans. Although not sufficiently rigorous, this information provides a real-time estimate of responses to a major system stressor. These will be further illustrated and supplemented with in-depth examples from several academic radiology departments.

SOCIETY OF CHAIRS OF ACADEMIC RADIOLOGY DEPARTMENTS SURVEY

To better understand the landscape of COVID-19 effects on academic radiology departments and how these departments were planning recovery to a new post-acute coronavirus state, an e-mail survey was conducted through the Society of Chairs of Academic Radiology Departments (SCARD) list server, which consists of nearly all US academic radiology department chairs. The survey consisted of 14 questions, with a mix of subjective and objective response options (Appendix 1). The survey was sent to 114 recipients. Thirty-eight responses were received (33% response rate) (Table 1).

THE ACUTE EFFECT AND RESPONSE

The survey data indicate large drops in volume, suggesting that recovery may be challenging, particularly for those areas hit hard by the virus. Of the survey respondents, one-third reported reductions in radiology volume of more than 65%, with one hospital in New York experiencing an 80% decrease in total radiology volume. More than 60% of

respondents closed outpatient imaging facilities to meet state and hospital requirements. One-quarter of the departments surveyed furloughed or laid off up to 20% of their nonphysician staff members as a result of imaging volume decreases. Even in comparatively less affected areas, 17 respondents reported 50% to 60% decreases, and only 7 respondents had decreases of less than 40% in volume (Fig. 1).

Henry Ford Health System is located in Detroit, one of the epicenters of the national coronavirus outbreak. When the virus began to spread rapidly, plans were quickly put in place to defer non-time-sensitive imaging studies to mobilize system capacity for the anticipated surge in patients with COVID-19. All scheduled radiologic studies were reviewed by a triage team composed of our departmental process engineers, a faculty radiologist, and a rotating team of four resident radiologists in an effort to triage on the basis of time sensitivity and urgency of need. Appointments deemed non-time-sensitive were designated, with communication taking place by either an examination scheduler and/or a customer service staff member. Communication took place with the ordering provider and patient, and examinations were postponed with an intent to reschedule when safe to do so. Processes were put in place to mark these deferred cases in the electronic medical record and radiology information system for easy retrieval and categorical designation, so they could be tracked, identified, and therefore followed up in the future. The intent was to contact these patients and reschedule their appointments once conditions permitted. Approximately 12,505 scheduled studies were deferred over 9 weeks as a result of applying this process. An even larger number of orders (approximately 65,000 studies) that had yet to be scheduled were also deferred using the same approach and justification.

Beth Israel Deaconess Medical Center in Boston used a different triage process for rescheduling. Lists of scheduled outpatients were reviewed by the requesting service and triage for whether the examination should be done as scheduled or could be rescheduled. Rather than flagging the examinations in the electronic health record, a management report was created to check for subsequent radiologic imaging for any ambulatory radiology patient that was rescheduled.

PLANNING FOR RECOVERY

As volumes dropped significantly and only time-sensitive examinations were performed during the height of the coronavirus pandemic, departmental focus began to shift toward recovery planning [4]. The new large backlog of orders posed challenges in rescheduling and prioritization, compounded by unclear timelines and guidelines for safe

Table 1. List of the 38 academic radiology departments that responded to the Society of Chairs of Academic Radiology Departments survey

Academic Hospital	Location
NYU Langone	New York, NY
Spectrum Health Grand Rapids/MSU	Grand Rapids, MI
Maine Medical Center	Portland, ME
University of New Mexico	Albuquerque, NM
University of Pittsburgh Medical Center	Pittsburgh, PA
University Medical Center – LSU Radiology	New Orleans, LA
Beth Israel Deaconess Medical Center	Boston, MA
SUNY Upstate Medical University	Syracuse, NY
University of Illinois	Chicago, IL
University of Alabama at Birmingham	Birmingham AL
RI Hospital/Brown	Providence, RI
SSM Health St. Louis University Hospital	St. Louis, MO
University of Cincinnati	Cincinnati, OH
Baystate Medical Center	Springfield, MA
University of Nebraska Medical Center	Omaha, NE
Froedtert & Medical College of Wisconsin	Milwaukee, WI
Saint Luke's KC UMKC	Kansas City, MO
Oklahoma University	Oklahoma City, OK
University of Vermont	Burlington, VT
University of Missouri	Columbia, MO
Mayo Clinic Florida	Jacksonville, FL
University of Texas McGovern Medical School	Houston, TX
University of Iowa	Iowa City, IA
University Hospitals Cleveland Medical Center/CWRU	Cleveland, OH
University of Minnesota	Minneapolis, MN
University of Rochester	Rochester, NY
Emory University/Emory Healthcare	Atlanta, GA

(continued)

Table 1. Continued

Academic Hospital	Location
Einstein Health	Philadelphia, PA
Montefiore	New York, NY
Indiana University	Indianapolis, IN
University of Chicago	Chicago, IL
University of California San Francisco	San Francisco, CA
Duke University	Durham, NC
University of California San Diego	San Diego, CA
Beaumont	Royal Oak, MI

reopening of facilities. Large numbers of examinations had been placed on hold, and additional new orders initiated during the pandemic period were also similarly deferred unless they were considered time sensitive. Many institutions realized their need to review and prioritize these orders to safely and efficiently bring these patients back for care, initiating approaches to do so.

Of the survey respondents, 71% prioritized orders according to their time sensitivity. Seventy-four percent of survey respondents used the ordering provider to help determine time sensitivity. Fifty-five percent used a radiology review process to determine triage prioritization; 52% looked at specific clinical indications, 29% broke down orders by modality, 25% prioritized by order date, and 19% performed manual reviews by a technologist or other radiology staff members.

At Henry Ford Health System, a total of just over 76,000 orders were in various imaging queues, with approximately 12,000 scheduled examinations postponed during the coronavirus pandemic (Fig. 2). To address the backlog of orders in queues waiting to be scheduled, radiology department process engineers coordinated a systemwide effort to review all orders and follow up with ordering providers, where applicable, to determine if the study was still needed, realizing that this effort would diminish the backlog queue by a certain number of unnecessary studies. Orders were also reviewed to see if they had already been completed within the institution or elsewhere, and all such duplicate orders were removed by reviewing Epic Care Everywhere (Epic, Verona, Wisconsin) records.

Understanding and prioritizing orders enabled us to better match supply and demand, and allows us to consider our capacity and to set expectations for schedules and resources as we progressed toward imaging volume recovery.

APPROXIMATE % DECREASE IN RADIOLOGY OUTPATIENT VOLUME
DURING COVID-19 PANDEMIC

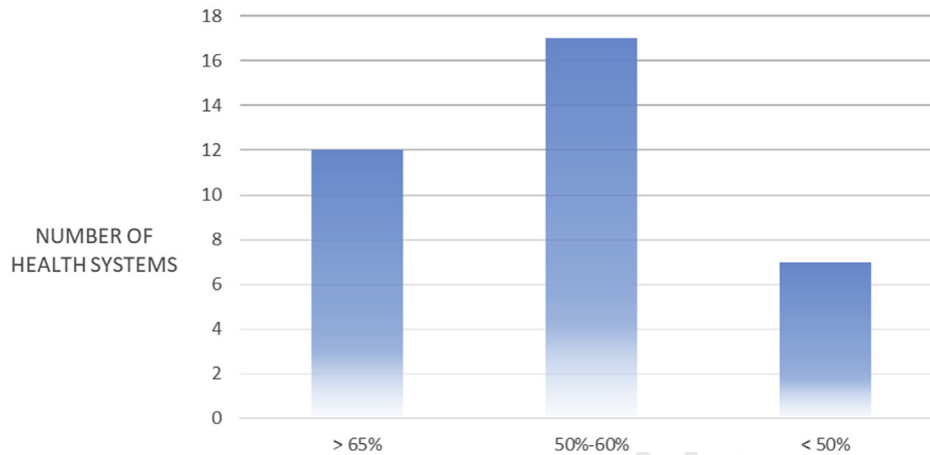


Fig 1. Approximate decrease in radiology outpatient volume during the coronavirus disease 2019 pandemic.

This process was dynamic and evolved rapidly. Having a team of dedicated radiology process engineers enabled us set up a course to efficiently address patient needs, scheduling requirements, and other logistics, and respond appropriately to changes in government, hospital, or other regulatory guidance.

CREATING A NEW NORMAL

As health systems prioritized the examinations needing to be scheduled, they were faced with ensuring that patients and

employees felt safe and informed. State law and regulations now mandated a new 6-foot physical distance between each person. This increased physical distance now led to a related space capacity constraint and needed to be taken into consideration and each department also attempted to accommodate increased patient volumes from a markedly increased backlog. Waiting rooms, patient flow, and safety measures had to be adjusted to accommodate the new increased physical distancing and more time-consuming cleaning protocol guidelines [5]. As health systems assessed

Henry Ford Health System Radiology Postponed Exams During COVID-19

Total: 12,505

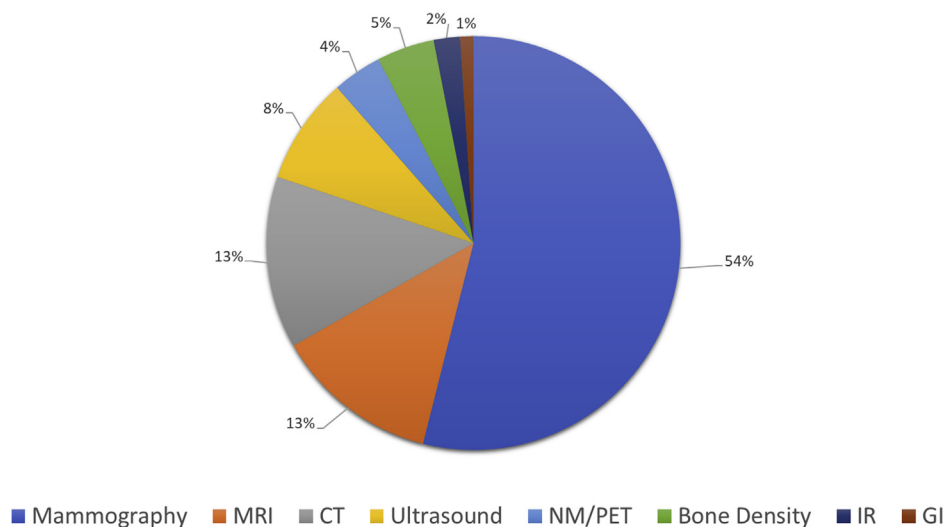


Fig 2. Modality breakdown of scheduled examinations postponed at Henry Ford Health System. Mammography composed the majority of delayed examinations, followed by MRI, CT, and ultrasound. Radiographic examinations are not shown, as they do not require scheduled time slots.

and implemented these changes, they also had to take into consideration patient-directed communications to ensure that these changes were understood and well received.

Of the survey respondents, 84% had ramp-up plans that included reviewing orders, prioritizing patients, using a site checklist for social distancing, and securing infection control sign-off. Additionally, 100% of respondents updated their waiting rooms to accommodate for the new increased social distancing expectations, 84% found the need to increase the space between appointments in order to spread out patients on the schedule, 68% spaced out appointments to allow increased equipment sanitization, and 55% focused all outpatient flow to nonhospital locations. One respondent commented that the health system was now requiring masks for all those entering the facility, and another commented that the health system was implementing curbside registration and a “text-when-ready” process to keep patients out of common waiting rooms to the extent possible.

Part of creating the new normal involved testing for COVID-19 in selected instances and screening patients for symptoms before arrival for any imaging examination or procedure. Potentially aerosolizing procedures needed special considerations and a high degree of attention to ensure proper testing was completed before services, thereby also facilitating scheduled availability of higher level personal protective equipment as necessary for aerosolizing procedures in COVID-19-positive patients when such procedures are absolutely essential. Eighty-seven percent of respondents tested patients’ temperatures upon arrival to the facility, 58% implemented telephone screening questionnaires before the appointment, and 84% implemented mandatory COVID-19 testing for patients undergoing potentially aerosolizing procedures. No respondents had as of the survey implemented universal COVID-19 testing processes for all radiology appointments. One respondent commented that there was mandatory COVID-19 testing for all interventional radiology procedures, and the health system had also created a curtain-like physical barrier attached to the ultrasound units to improve safety for sonographers.

Of the survey respondents 74% used remote reading, 35% implemented site-of-assignment changes, 29% implemented additional shifts, and 19% altered protocols to accommodate for the new normal. Forty-two percent of respondents added extended hours on the weekend, 39% added new evening late hours, and 23% added new early morning hours. Some health systems commented that although they had planned on extended hours, they had not yet had to initiate extended hours because of near normal and otherwise manageable examination volume levels.

At Henry Ford Health System, as the volume of patients returning to the system increased, it was determined that extended hours and extra shifts would be needed to

accommodate for the post-COVID-19 surge. Early morning, evening, and weekend hours were added, with additional technologist and radiologist support to accommodate.

MEASURING AND FORECASTING

Moving into the new normal, there was a need to align service ramp-up with potential significant increases in examinations needing to be completed once past the peak of the pandemic [3]. Without historical precedents or other roadmaps available to determine a realistic recovery timeline, planning even simple milestones was challenging to substantiate [6]. Of the survey respondents, all health systems reported plans to recover to 50% of their pre-COVID-19 volumes by July 2020, with 75% of the respondents indicating that they have surpassed 50% as of May 2020. Of the same group, respondents expect to be at 75% of their pre-COVID-19 volumes by September 2020 at the latest. When asked the same question with regard to nearing 100% of their pre-COVID-19 volumes, the survey respondents diverged, with 63% indicating that 100% of their pre-COVID-19 volumes would be reached or surpassed at some point in 2020, 19% of respondents expecting this to occur in 2021, and 5% expecting this in 2022.

Of the survey respondents, 39% used some method of forecasting tools to aid recovery planning. Excel data tables and homegrown systems were widely used. Four systems hired external consultants to assist in planning, recovery, and implementation. When asked to identify the metrics used to support recovery planning, 94% selected the number of examinations completed, 74% tracked schedule utilization, and 68% tracked number of examinations scheduled. Thirty-nine percent of respondents tracked number of orders received, 23% monitored worked hours per unit of service, and 3% monitored cost per unit of service. Fourteen percent selected “other” and reported interest in the number of no-shows, third next available appointment, income/expense ratio, backlog, and charges against baseline.

Henry Ford Health System process engineers use Excel and Power BI (Microsoft, Redmond, Washington), in addition to an in-house analytics system. This analyzes data from the radiology information system (GE Centricity; GE Healthcare, Little Chalfont, United Kingdom) and the electronic medical record (Epic) and allows near real-time tracking of the number of incoming orders compared with the number of daily scheduled examinations. While monitoring the number of examinations scheduled on a daily basis, the department also tracks schedule utilization to monitor available open appointments against interval holds placed for social distancing, equipment cleaning, and other

safety measures. Similar, Beth Israel Deaconess used similar software and approaches to model recovery volumes and finances. The process engineering team uses these data to better understand key measures informing a constructive and appropriately reactive plan of action. This approach combines a robust management control system with adjustments intended to maximize strategic value. The dashboards track current against projected future needs and dynamically inform key decisions. These metrics have continued to be the source of truth as the pandemic is navigated.

LESSONS LEARNED

We describe the range of responses academic radiology departments have taken to reopening of imaging in the post-COVID-19 world at the same time maintaining a safe and patient-centric environment. In Shakespeare's play *The Tempest*, Antonio says "what's past is prologue," implying that what has occurred in the past will predict future events. The statement "what's past is prologue" is what everyone remembers. However, the full quotation is actually "Whereof what's past is prologue; what to come is yours and my discharge." Taken this way, the past is written, the stage is set, but the future remains ours to define, subject to the choices we decide to make [7].

The timing and impact of COVID-19 cases have varied greatly by geography. Most facilities significantly reduced patient visits, non-time-sensitive surgical procedures, and imaging studies to maximize capacity for anticipated COVID-19 surging. The SCARD survey responses show how locally relevant can inform resolution and recovery status and can also help determine appropriate speed for individual department recovery efforts. Several themes are seen across SCARD institutions responding to our survey.

Telemedicine has rapidly expanded during the pandemic. Many respondents reported gratitude for remote reading capabilities inasmuch as they could protect their radiology workforce and the increased capacity remote reading affords despite technical and logistical hurdles encountered in rapidly deploying remote reading systems.

Ramp-up plans across institutions included similar safety features, including temperature screening and altered waiting room workflow. Most institutions also monitored completed examinations as the key metric to help predict recovery and reported May 2020 and September 2020 as the times when 50% and 70% of pre-COVID-19 volumes would be reached. Departments differed in their approaches to adding capacity, such as extending hours and spacing out appointment times.

Most likely, the changes we have experienced with the COVID-19 pandemic will be here to stay. Although remote

teaching capability varied, some were able to use teleconferencing technology to teach residents and perform "virtual read-outs." One respondent felt that the role of the radiologist will continue to change and will have to expand from simply addressing examination lists. Above all, communication, flexibility, and adaptability are key. Patients will return when they are ready, not necessarily when health care facilities are ready.

The COVID-19 pandemic led to significant decreases in imaging volume and procedures in radiology departments. We have begun to recover from the first volley. We know what next steps to take and what data to monitor. What we do not know is what comes next. Nevertheless, as we prepare to ramp up, we must not forget the past and carefully understand ways to minimize the impact should this occur again.

TAKE-HOME POINTS

- Planning how to absorb cases deferred during COVID-19-related shutdowns and compete with existing scheduled examinations is a major challenge. Radiology departments have instituted a variety of metrics and strategies to monitor scheduling and completion of this examination backlog, with the actual completed examination rate the most commonly used metric.
- As pandemic "hotspots" continue to shift geographically, radiology departments should pay close attention to locally relevant data and trends around new infections. This can be used to inform the status of recovery and any new actions to be taken. Where possible, analytic tools should be used and informed by real-time data. These can be used to help guide the pace of individual department recovery efforts.
- Most institutions generally expect May 2020 and September 2020 to be the times when 50% and 70% of pre-COVID-19 volumes will be reached. Anticipated time to recover near 100% volume is variable, with a majority predicting that this will occur sometime in 2020 but 19% expecting that it will not occur until 2021 and 5% not until 2022.
- As radiology departments ramp back up, it is important to also look at ways to minimize the impact should this occur again. Workflow changes such as altering waiting rooms, temperature screening, and schedule adjustments can improve patient and workforce safety in both the short and long terms. Memories are short, so the more we can prepare now, the less we will have to rediscover during the next pandemic.

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ADDITIONAL RESOURCES

634 Additional resources can be found online at: <https://doi.org/10.1016/j.jacr.2020.07.004>.

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