Radiology Resumption of Clinical Services

Canadian Association of Radiologists
L'Association canadienne des radiologistes

Chair
Bill Anderson (AB)

Taskforce members
Jean Seely (ON, CSBI), Gilles Soulez (Qc), Ania Kielar (ON), Sheldon Wiebe (SK), Emil Lee (BC), Dan Petrie (NS), Scott Harris (NL), Mark Given (CAMRT), Amol Mujoomdar (CAIR), Darren Ferguson (NB), Lucia Carpineta (Pediatrics), Carole Dennie (CSTR), Tanya Chawla (Ultrasound), Melanie McQuaid (PEI), Heidi Schmidt (ON), Pierre Bourgoin (Qc), Daniel Lindsay (MB), Peter Froese (AB, AHS), Thorarin Bjarnason (COMP), Lisa Pyke (CADTH), Jill Sutherland (CADTH), Christa Bergquist (CADTH), Mitchell Rowe (Health Canada), Susan Clarke (Sonography Canada), François Lamoureux (CANM), Marc Venturi, Nick Neuheimer, and Micheline Turnau (CAR)

Executive summary

We are currently experiencing a pandemic-driven postponement of diagnostic imaging. In response, to the eventual easing of restrictions, the CAR Board of Directors moved to create a **Radiology Re-entry Taskforce** (April 18, 2020). The Taskforce includes: Radiologists, Medical Radiation Technologists (MRTs), Medical Physicists, Sonographers, Nuclear Medicine specialists as well as provincial data leads and federal agencies such as CADTH and Health Canada.

The people and organizations (listed above) donated their expertise during a demanding time – we thank them for their thoughtful contributions under extraordinarily short time constraints.

This document should be consulted as principles and general guidelines. It is not intended to be prescriptive.

This paper was written to provide radiology services guidance – once provincial authorities have approved resumption of service – on ramping-up, and using appropriate precautions ensuring patient and healthcare professional safety.

Key Points

- **Regional variation:** Responses to ramping up (and potentially down) of radiology services across Canada will vary depending on severity and lifecycle of the pandemic in each region.
- **Capacity variation:** Radiology service capacity will vary; turnaround-times may increase due to increased equipment cleaning protocols and use of personal protective equipment.
- **Triaging patients:** Guided by the work that the CAR has done with the Wait Time Alliance, patients on wait lists may be assessed using P1 (higher) to P4 (lower) priority measures.
- **Patient Anxiety & Apprehension:** Wait times and anxiety are compounded due to the pandemic's postponement of exams and uncertainty regarding resumption of normal service.
- **Cancer Screening:** The postponement of regular cancer screenings (mammography, colorectal, etc.) means the risk of having missed cancer in thousands of patients over the last six weeks.
- **Ethical decisions:** Difficult decisions will need to be made in balancing postponement of cancer screening versus public health priorities.

Governance and communication in managing the radiology re-entry to service

- **Patients:** The medical imaging community cares about patients. During this stressful time, it is more important than ever to focus on communication with patients.
- **Connecting with COVID-19 (C-19) Management:** Radiology may benefit by appointing a main contact for the hospital's COVID-19 taskforce, including regular check-ins.
- **Referring specialists:** Communication with referring specialists is key to managing the ramp-up intake.
- **Human resources:** It is important to consider burnout of radiology human resources when adding additional capacity, especially in areas that have already been on C-19 frontlines.

Abbreviations

C-19: Coronavirus Disease of 2019 (COVID-19)

CADTH: Canadian Agency for Drugs and Technology in Health

CAIR: Canadian Association of Interventional Radiologist

CAMRT: Canadian Association of Medical Radiation Technologists

CANM: Canadian Association of Nuclear Medicine

CAR: Canadian Association of Radiologists

COMP: Canadian Organization of Medical Physicists

CSBI: Canadian Society of Breast Imaging

CSTR: Canadian Society of Thoracic Radiology

FIFO: First-In-First-Out

HCP: Healthcare Professional

IHF: Independent Health Facility

PM: Preventative Maintenance

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2

US: Ultrasound

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1.0 Introduction – COVID-19: The Most Important Health Crisis of the Century

COVID-19 has emerged as perhaps the single most important health crisis of the last 100 years. As of May 4, 2020, it has infected 3,665,403 individuals, caused 252,944 deaths, and affected 215 countries and territories around the world. In Canada, 60,772 people are confirmed to have been infected with 3,854 deaths (1).

While Canada has taken strong action toward preventing further spread of novel coronavirus SARS–CoV-2, there is concern that other medical issues will be negatively impacted by the focus on COVID-19. In the transition to the "new normal' after the acute phase of the COVID-19 pandemic, institutions will face dual challenges of maintaining operations during stay-at-home safety orders and planning for a future that will not resemble our past "normal." Further, the lifecycle of a pandemic is complex, and all services must be prepared to alter services levels in response to increasing and decreasing infection rates. There will likely be fear of hospitals that poses obstacles to cancer screening and other non-emergent imaging studies. A significant backlog of postponed and rescheduled imaging studies will create a demand that taxes capacities of personnel and scanner time.

Public health response to the pandemic resulted in a 50-70% drop in radiology services March-April 2020

According to surveys administered by the CAR and CAMRT, from March 11-April 30, overall radiology service output dropped between 50-70% and mammography dropped by over 90%, creating enormous wait lists for imaging services, including cancer screening. It is public knowledge that wait-times for medical imaging in Canada are a serious issue which need addressing. As such we implore everyone in the medical imaging community to take the time to keep detailed records during this unprecedented time. Over the coming weeks, the data over wait-times and delays to care will be analysed in numerous papers. Accordingly, this present paper provides guidance to facilitate the ramp-up process by imaging departments, once the local provincial governments have given the go-ahead to get up and running in a safe and productive manner.

Overview

This paper contains sections on safety for patients and professionals, capacity, human resources and stress, communications, modality recommendations (CT, MRI, mammography and ultrasound), nuclear medicine, medical physics, and some sub-specialties: interventional radiology (IR), pediatrics, and breast imaging. Not all the sub-specialties in radiology were included due to time and resource constraints. However, the supply management, human resource and safety protocol principles are meant to be used as guides across other areas of radiology.

The appendices include a printable one-page summary of operational measures for imaging services as well as cleaning protocols, the modality and sub-specialty specific guidelines, and priority levels.

Regional Variations

Health care in the provinces and territories are opening-up at different times, given diverse COVID-19 situations across Canada. Resumption of services should only be deployed after local health authorities have confirmed it is safe to do so. Radiology will need to coordinate with local health pandemic planning and health care departments (i.e. surgery, ambulatory, anesthesia, and intensive care units).

2.0 Imaging Professionals' Safety and Stress

The safety of imaging professionals is fundamental to ensuring patients receive safe, quality care during medical imaging exams. Personal protective equipment (PPE) is imperative to enable health care professionals to be on the job and minimize risk to patients, professionals, and Canadian families. As healthcare professionals, it is difficult to eliminate risk; yet risk can be managed and minimized. The availability of PPE has been a major concern highlighted in numerous surveys, papers and in the media (2,3). As frontline health care professionals, it is assumed medical imaging professionals will have access to the required PPE as outlined in **Appendix A**. It is also recommended to widely test all healthcare professionals who exhibit any SARS-CoV-2 symptoms (4). Encouraging teams to take their time and follow local procedures will be key to ensuring safety for professionals, their families, and patients.

Shanafelt et al. (2020) listed the eight primary sources of anxiety among health care professionals. Recognizing the sources of anxiety allows health care leaders and organizations to develop targeted approaches to address these concerns and provide specific support. A comprehensive (yet condensed) list of actions to address these sources of anxiety was also outlined by Shanafelt et al.'s (2020) paper. We have adapted the contents into a table in **Appendix B** specifically for medical imaging professionals. We hope that you will share any lessons you learn and take care of your fellow professionals.

We cannot stress enough the importance of communicating with empathy during this stressful time. ECRI has posted the recording of a webinar on their site which encompasses the importance of communicating with empathy (**https://www.ecri.org/events/having-empathetic-communication-during-covid-19**).

Table 1: 8 sources of anxiety among health care professionals [5]

1. Access to appropriate PPE
2. Being exposed to COVID-19 at work and taking the infection home to family
3. Not having rapid access to testing if they develop COVID-19 symptoms and concomitant fear of propagating the infection at work
4. Uncertainty that their organization will support/take care of their personal and family needs if they develop an infection
5. Access to childcare during increased work hours and school closures
6. Support for other personal and family needs as work hours and demands increase
7. Being able to provide competent medical care if deployed to a new area
8. Lack of access to up-to-date information

2.1. PPE and Infection Control

PPE consisting of surgical masks, eye protection, gloves, gowns, and meticulous hand hygiene provides effective protection from COVID-19 (6). It is imperative to understand, PPE is only effective if properly utilized (7,8) and all medical imaging professionals should receive specific training regarding safety protocols (9). Implementing various physical distancing measures within medical imaging units is the best way to avoid being exposed to COVID-19 (2). It is especially important with vulnerable populations, including older adults, people with underlying medical conditions (e.g., heart disease, hypertension, diabetes, chronic respiratory diseases, cancer) and people at risk due to a compromised immune system from a medical condition or treatment (e.g., chemotherapy). In addition, vulnerable groups also include homeless or underhoused people and individuals from a gradient of socioeconomic groups that might struggle to cope financially, mentally, or physically with the crisis (10). This should be considered when scheduling and imaging vulnerable or higher risk patients.

Large portions of the population have been infected with COVID-19 and are asymptomatic (11); there is no evidence to suggest that limiting imaging to asymptomatic patients will reduce the spread of infection. It has been suggested that intermittent distancing will be required into 2022 unless critical care capacity is increased, or a treatment or vaccine becomes available (12). Imaging departments and practices will need to increase their communication with the broader health care community for the foreseeable future to respond appropriately to the pandemic.

Recommendations on key PPE and infection control measures for medical imaging have been outlined in **Appendix A**. There are also various resources available in **Appendix D** to support the effective use of PPE and infection control measures.

2.2. Leadership

An April 23rd editorial by Robert Chun Chen, MD published in European Radiology outlined the importance of leadership during this pandemic (13). Chen et al. (2020) describe their early move in summoning a small radiology task force and noted that a dedicated communications effort is crucial to managing any sort of public-health crisis. Members of

their task force included not only radiologists but also technologists, nurses, and administrative staff. Among its duties were reviewing operational capacity daily and serving as a contact point for the hospital's broader COVID-19 task force.

Table 2: Five ways radiology will need to modify practices [13]

1. Set up a small radiology task force, consisting of key members of the division, inclusive of radiologists, radiographers, nurses, and administrative staff
2. Triage, categorize and segregate patients of varying risks
3. Ensuring adequate human resources to deal with the crisis
4. For suspected or confirmed COVID-19 patients, minimize unnecessary imaging, reducing the potential spread of pathogen to other patients and staff
5. Continue to advocate for workplace and social responsibility

There is a great deal of information on leadership during stressful times. The American Psychological Association summed up the important points: manage stress, share information with empathy and optimism, use credibility to build trust, be honest and transparent, provide regular communications, provide a forum for feedback, and be a role model (14).

This pandemic will force many radiology departments and IHFs to re-evaluate many of their practices, policies, and operating procedures. Academic radiology departments can not only lead but teach the next generation of radiologist how to effectively manage this and other changes. Prabhaker et al. (2020) listed all the actions they have taken to ensure their academic radiology department is safe and productive. Rather than list all their recommendations, we strongly recommend radiology leaders read this paper and, just as Prabhakar et al. (2020) have done, share what they have learned with their colleagues.

3.0 Patient Safety and Communication

Patients are currently and may continue to be reluctant to come in for their imaging appointments. Consequently, both urgent and elective outpatient and screening participation may be reduced. Instances of patients missing appointments, not seeking medical treatment, and becoming clinically worse due to fear of COVID-19 have been reported in China (15). After SARS, patients who recovered were observed to have PTSD (16,17).

There is little published evidence regarding strategies to reassure patients and allay fears especially in terms of imaging. We can assume that the anxieties that health care workers face (see above) are very similar for patients. We are proposing the following in terms of reassuring patients.

Key points:

- Make no assumptions – Screen all patients for potential exposure to SARS-CoV-2. This protects staff and provides confidence to the patients.
- Work with your booking department (if you have one) to ensure patients are receiving the correct information about safety and precautions being taken, including PPE – Guidance to the imaging department and how to contact the department (phone, email).
- If you are in contact with patients, listen to them – Listening will ease their anxiety and allow you and your team to respond appropriately.
- Communicate with empathy and patience – Circumstances may be exceptionally difficult for some patients. They may need extra support and guidance. Plan for adequate time to communicate with patients to help ensure appropriate responses that meet patient needs and align with operational requirements.

Important discussion points with patients – use as applicable

- Enquire whether there have been any changes to the patient's health that you need to know about (i.e., any new SARS-CoV2-risk factors).
- Convey clear instructions on how patients and/or caregivers can contact and find the imaging department (clear, explicit geographic directions such as which door to enter help to mitigate confusion and improve patient confidence).
- Give clear and explicit instructions on how to reach radiology if patients have any follow-up questions or need additional guidance.
- Tell patients, "You will be asked to wear PPE and it will be provided to you, along with instructions on how to wear it properly."
- Let patients know that waiting rooms have been organized to ensure safe distance between patients.
- Reassure the patient that their appointment is scheduled during a time when only low risk patients are present, as applicable.
- Stress the importance of showing up on time for appointments—not early or late—so as to ensure appropriate social distancing.
- Explain that staff at the clinic/hospital will be wearing PPE and may look unusual; there is no need for concern. It is mandatory for all staff during this time.

To further mitigate risk to vulnerable populations, another consideration would be to dedicate specific entrances and traffic patterns for immunocompromised patients, including patients undergoing chemotherapy, who are returning to hospitals and treatment centers for clinic appointments and imaging studies (15).

3.1 Vulnerable Populations

Vulnerable populations are more at risk of getting an infection and developing severe complications due to their health, social and economic circumstances (18). Vulnerable populations may include social or geographic isolation, like in remote and isolated communities. As an example, the 2009 H1N1 pandemic found that Canada's Indigenous (First Nations, Inuit, and Métis) populations living in geographically remote areas were disproportionately affected by the crisis (19–21).

All organizations play an important role in helping to mitigate risk to vulnerable populations and it is vital to ensure mitigation strategies are feasible, accepted, and culturally appropriate. Health Canada has provided a resource with information on supporting vulnerable populations during COVID-19 outbreaks (18).

The medical imaging community has a part to play in ensuring that there is access to care and that people feel comfortable accessing care. The communication strategies listed above are appropriate for everyone. With imaging being a central component of healthcare, the strategies used to alleviate anxiety in radiology will help in other aspects of care. The one additional recommendation we can make, beyond the section above, is to enhance or create communications with vulnerable populations before the pandemic reaches their community (20–22).

3.2 "No Shows"

There is a justifiable concern of patients not attending their scheduled appointment due to the potential risks of contracting COVID-19. We have presented some important aspects of communication to ease anxiety and reduce "no shows." In discussions with radiology leaders, four additional elements of a patient's journey were indicative of their likelihood of attending their diagnostic imaging appointment.

1. Did they make their own appointment with their Family Physician (FP)?
    a. If they have not, consider contacting their FP to ensure that imaging is necessary.
2. Did they attend the appointment with their FP?
    a. Again, contact the FP to ensure the imaging request is necessary.
3. Did they request a referral to diagnostic imaging?
    a. If the request was of their own volition, they are more likely to show up for the appointment.
4. Did they follow-up with their FP's referral for imaging?
    a. Again, their desire for imaging would lead us to believe they are more likely to show up for their appointment.

4.0 Safely Returning to Capacity

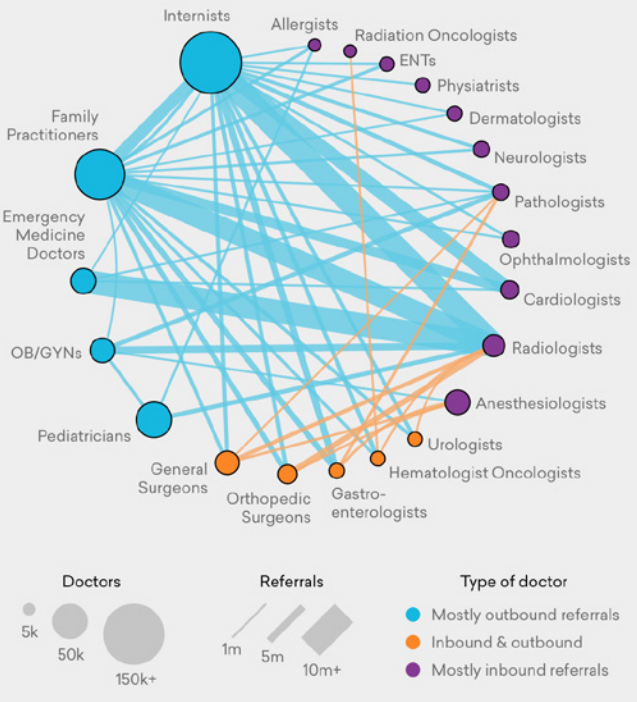
There will be a transition period where the additional safety precautions reduce the volume of imaging allowed to take place. From there, and as restrictions ease, we may return to more "normal" operations. For the time being, it is important to take the appropriate precautions to ensure information around capacity and safety can be communicated not only with all stakeholders in medical imaging, but also with clinicians who request imaging (hint: that's everyone – Fig 1). The following section outlines some general recommendations to take while re-starting/increasing services, including managing departments and prioritizing patients. These are recommendations and should not be seen to overrule local guidance and context.

There are numerous guides (peer-reviewed, blogs, grey literature, posts, and general helpful advice) around best practices and tips aimed at increasing patient throughput in imaging departments. The most pertinent recommendations have been summarized in **Appendix A** as a printable one-page document for reference.

Fig 1

How doctors work together

Top 50 most common doctor referrals based on patient volume, as documented in health insurance claims



Within this text, we have only repeated the information contained in **Appendix A** when there are additional complexities and factors to consider.

Further, we have a curated list of links to safe cleaning procedures for medical imaging equipment in **Appendix C**.

4.1 Risk Reduction

Reducing exposure in the imaging environment, particularly CT and MRI, to positive or suspected SARS-CoV-2 patients decreases the need for downtime for cleaning. A common recommendation is to dedicate a CT suite to positive and suspected SARS-CoV-2 patients (23,24). However, few locations in Canada have the capacity to dedicate a CT suite and we acknowledge that fact.

We recommend using mobile X-ray systems as much as possible to reduce potential exposure to imaging suites (25). Engage your local radiation safety expert (X-ray radiation safety officer, x-ray medical physicist, etc.) if using systems outside of their regular use or setting up temporary x-ray rooms. The Radiation Safety expert can ensure that the system is being operated according to regulatory requirements.

4.2 Quality Control/Quality Assurance

Many medical imaging systems have continued to be operational during the larger shut-down of services; although, some systems may have been idle. For medical imaging equipment that has been out of use for more than 14 days, you must review the manufacturers' recommendations for start-up of the system and immediately begin with routine quality assurance/quality control (QA/QC) on a regular basis (daily, weekly, monthly, etc.). If there is a failure of a routine QA/QC test or any indication that diagnostic performance is sub-optimal, consult your local medical physicist or manufacturer before examining patients.

Consider your imaging system's preventative maintenance (PM) cycle, ensure the PM is up to date, and performed prior to any QC, and before any patient procedures are performed.

Less frequent QA/QC (annual or semi-annual tests, physics testing, etc.) might have been postponed by accreditation/regulatory agencies in response to the COVID crisis. As imaging activities increase, it is imperative that normal QA/QC procedures are

resumed. Annual and semi-annual QA/QC accounts for less than 1% of patient throughput and little difference on department efficiency. In many jurisdictions, during normal imaging operations, QA/QC tests are done during the day, scheduled during patient slots. Often the same people doing the QA/QC are also involved in radiation safety initiatives and need to be available during regular working hours for consults. It would be reasonable during current operations for QA/QC to be performed outside of regular hours during this transition phase, with the caveat that this kind of operational practice is not sustainable over the long term. Resumption of previous QA/QC schedules should commence within 3 months of the resumption of non-emergent imaging exams.

4.3 Prioritizing Patients

The Canadian Association of Radiologists, Canadian Association of Interventional Radiologists, Canadian Society of Breast Imaging, and Canadian Society of Thoracic Radiology and Sonography Canada have published guidelines for performing procedures on patients with suspected or confirmed SARS-CoV-2 (26–29). These guidelines were created to safely care for SARS-CoV-2 positive patients while minimizing the risk to non-SARS-CoV-2 patients and healthcare professionals.

As we transition from the current pandemic state of operations towards an increase in the number of imaging and interventional procedures performed, there will be significant pressures to address the needs of patients who have been deferred. Re-prioritizing (triaging) of patients and procedures will be an option as we increase imaging related activities and define a new normal operating state. For difficult decisions regarding prioritizing patients beyond our recommendations, we suggest checking with your local jurisdiction for an ethical framework to support decision making. If a local framework is unavailable, we recommend the following framework from the BC Ministry of Health (**https://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/covid-19/duty_to_care_during_covid_march_28_2020.pdf**). This document serves as a guide for radiologists, interventional radiologists (as necessary), administration, and leaders, including department chiefs, to help prioritize patients. A multidisciplinary team is required to ensure that all factors are considered. Specialities such as nuclear medicine potentially face supply shortages and are recommended to institute multidisciplinary priority setting committees in advance of any issues (30).

All patients should be advised that any change in symptomatology should be communicated with their referring clinician in case a change in their priority rating is required.

4.3.1 CT/MRI

Imaging procedures should be immediately performed to treat urgent conditions, such as acute cardiovascular disease, stroke, or bleeding, and patients with trauma (31). The CAR recommends a five-point priority classification system for MRI and CT imaging with priority definitions and maximum benchmark time interval targets as shared in **Appendix F** (32).

If re-prioritizing of patients is a chosen path, ensure appropriate representation from a multidisciplinary team to guarantee that all factors are being considered. Radiologists can ensure that alternative forms of imaging or alternative protocols are considered on an individual patient basis.

At the department or facility level, it may also be necessary to ensure that outstanding requisitions/examinations, particularly elective, non-urgent low priority exams (P4s), have not been performed elsewhere in the interim. This step can be accomplished by reviewing provincial or regional EMR or PACS where there is no central booking system. In addition, some patients in Canada may choose to go to a private clinic, in which case it may not be possible to determine recent imaging. Any postponed examination should be evaluated to ensure it has not already been done. If such information is not available on PACS or EMR, the referring physician should be contacted to verify whether the examination is indeed still required.

Another option for increased throughput is to shorten MRI protocols as much as feasible. This will need to be done at the local level due to variations in systems and protocols.

4.3.2 Interventional Radiology

Procedures must be triaged based on procedural type and clinical indication. The resultant categories are P1 (emergent), P2 (urgent), P3 (semi-elective) and P4 (elective) procedures, based on a combination of resources available in the literature (33–35). A comprehensive list of categorized procedures is contained in **Appendix I**.

Although the list in **Appendix I** is comprehensive, some procedures may not be listed; in such cases, the clinical indications and urgency can be determined following a multidisciplinary discussion, and appropriately prioritized. Also, clinical urgency may dictate a procedure be prioritized in an individual patient, outside of these parameters. As mentioned earlier, this list represents a guide, and allows for urgent indications.

4.3.3 Breast

The Canadian Society of Breast Imaging (CSBI) along with the CAR in response to the current situation have created a prioritization table, utilizing the P1-P4 classification system, specifically for breast imaging available in **Appendix G**. Included are relative risk percentage of specific categories being diagnosed as cancers.

4.3.4 Nuclear Medicine

Nuclear Medicine (NM) does not have portable systems and as such must take extra precautions with the pre-screening of patients before arrival, including at the point of scheduling. This screening could affect the prioritization of patients and will need to be managed according to local requirements.

Other considerations when scheduling/prioritizing is the availability of radiopharmaceuticals. Radiopharmaceutical suppliers are producing at regular capacity; however, distribution has become the rate limiting step in the access of isotopes (36). Increased communication with suppliers and carriers (Air Canada) is recommended to ensure continuity of supply and service.

Further, the Canadian Agency for Drugs and Technology in Health (CADTH), with input from the Medical Isotopes and Imaging Modalities Advisory Committee (MIIMAC), has developed a practical tool that helps medical imaging professionals to prioritize the use of technetium-99m (99mTc)-based imaging procedures in the event of a disruption in the supply of the isotope (**https://www.cadth.ca/SMART-Tool**).

4.3.5 Ultrasound

As part of the guidance for the booking of ultrasound appointments, the triaging schema implemented by the wait time alliance is in widespread use across much of Canada (37) and there is also a more detailed breakdown of specific indications as they pertain to ultrasound available in **Appendix H**. Over the next few weeks and months, hospitals, clinics, and independent health facilities (IHFs) will be aiming to address the needs of the outpatient, emergent, and oncological patient population who have had their existing appointments either deferred or delayed as a result of the COVID pandemic.

Here are some guiding principles pertinent to the practice of ultrasound:

1. The backlog of patients is likely going to impact current targets for the P categories. Wherever possible, the current guidelines should be adhered to; however, if backlog/volume makes this a challenge, we suggest:
   a. P1 within 24 hours (i.e., as is)
   b. P2 within 14 days
   c. P3 within 6 weeks

4.3.6 Pediatric

Pediatric patients have generally been less frequently and less severely affected by COVID-19. As a result, pediatric sites have not seen the sharp rise in hospitalizations and ICU admissions seen by our adult counterparts.

Through only a slight reduction of bookings, concentrating on P1-P2-P3 and target-date patients, and attrition by no-shows, outpatient volumes are also decreased, though not as severely as in adult centers. The anticipated backlog should therefore be less pronounced. Among P3 and target date categories, priority should be given to oncology cases within each category.

There is also greater reliance on non-radiation techniques in pediatrics, which means that US and MRI are favoured over CT whenever possible. As a result of the greater reliance on MRI, however, and the intrinsic need for sedation, especially in the 0-5 years age group, medical imaging professionals are also heavily reliant on availability of anesthesia or sedationist services.

Due to the limited availability of anesthesia/sedation teams being able to provide local services, including recovery and/or ICU afterward if needed (patients with co-morbidities), all attempts should be made to avoid cancelling exams booked under anesthesia and "no-shows" on days when anesthesia services are

available. Please see the communication section of this document for additional guidance on preventing "no-shows." If ICU beds are not available, patients who are otherwise relatively well could be scheduled instead on those days, to avoid a massive backlog of exams requiring sedation post-COVID.

These bookings under sedation should also concentrate on P1-P2-P3 and target-date patients accompanied by the standard of First-In-First-Out (FIFO) in pediatrics. See **Appendix J** for a more detailed outline of P1-P4 patient categorization for pediatric patients.

4.4 Know your capacity- Turnaround Times

Your local context will determine your new medical imaging capacity. Additional cleaning protocols, time to prepare patients, and – most importantly – the availability of staff will be contributing factors. Below are a few considerations as you begin to transition from pandemic operations to a new normal.

Air Exchange

One the largest factors in determining capacity for your imaging suites is to know what the turnaround times (TAT) of the suite will be. Those TATs will be highly variable and dependent on your given population's potential to carry SARS-CoV-2, how individual patients present, the risk of infection applied to subsequent patients, and even your own risk tolerance. Until additional information on ensuring a "safe" imaging suite is widely available, we have provided a brief reference table assuming the average size of a CT suite.

This example is intended for local or jurisdictional planning. We recommend you contact your facility services to better understand airflow within your medical imaging suites so that your calculations are accurate. The important values to know are the volume of the room and how much air flows into that room per hour. Based on ventilation guidelines, the number of air exchanges in a CT suite is likely to be between 6 and 12 Air Changes per Hour (ACH)(38). Your ACH will likely be the rate limiting step in turning around any imaging suite. ACH should also be considered for waiting rooms.

Another factor to consider is that many devices such as ventilators, continuous positive air pressure (CPAP), and Bilevel positive Air pressure (BiPAP) devices can aerosolize COVID-19 particulates for up to three hours (39). Patients using negative pressure devices and other closed loop systems will result in less contamination of the room and allow for a faster TAT. Additional precautions can be taken such as adding High-Efficiency Particle Air (HEPA) filters to any device that would aerosolize COVID-19 particulates (39).

The values in Table 2 are an example of how to determine the various TAT for different patients. The times in Table 2 are based on recommendations by the American Society of Anesthesiologists and the CDC to achieve a 99% reduction in airborne particulates (40). A 99% reduction in aerosolized COVID-19 is achieved in a room with 6 ACH in 46 minutes. Accepting a 90% reduction reduces the air exchange time to 23 minutes. To see further information or to calculate the specific TAT for your imaging suites, see **Appendix E**.

Table 2: Example of the various TAT times for a typical CT suite assuming 6 Air Exchanges per Hour (ACH) to achieve a 99% reduction in air particulates

Patient	Scan Time (Minutes)	Time to 99% particulate reduction – 6 ACH (Minutes)	Cleaning Time (Minutes)	Total Turnaround Time (TAT) (Minutes)
Non-COVID 'r/o bleed'	5	N/A	10	15
Suspected COVID CT chest	5	46	10	61
COVID + on Ventilator	5	180	10	195
COVID + CT Chest with NPD*	5	15	10	30
COVID + CT Chest with NPD* and 1min cleaning solution	5	15	1	21

*NPD = Negative Pressure Device

Reducing Turn Around Time – Additional precautions

Beyond air exchange, other precautions/practices can be observed to improve imaging throughput.

- Use portable X-ray systems as much as possible with suspected SARS-CoV-2 cases to ensure imaging suites do not succumb to lengthy downtime.
- Increase room air flow with portable negative pressure devices; note that this is not always possible as these systems must usually be vented outside.
- Proceed with patient scans in the order that results in a) the least risk to patients and, b) the least risk to healthcare professionals
  - Scan confirmed cases back to back with healthcare professionals wearing fitted full face respirators
  - Group patients in at risk and not at-risk cohorts

Recommendations around patients wearing of PPE are considered later in the report and should not affect room TAT. Other considerations, such as which personnel will clean the rooms, and their availability will be subject to local jurisdictions.

4.5 How you reorganize imaging departments

Given the evolving situation, it is important to remain flexible and responsive when considering how to reorganize imaging departments. New protocols may need to be developed and work processes will need to be reviewed and refined. There have been many recent articles published about radiology department preparedness during COVID-19 (23,24,41–43) Because of varying infection control policies (both provincially and regionally), steps for radiology preparedness for COVID-19 will vary between institutions and clinics.

We have created a list of key operational measures to consider when ramping up medical imaging services in **Appendix A**. We encourage medical imaging sites to review their policies and procedures to confirm their current preparedness activities.

Please note, it is important to follow facility specific policies and procedures when available.

4.5.1 Physical space adaptations

Other aspects to consider are the physical limitations of the imaging department or IHF. With a focus on ramping up radiology services, there may be a need to modify aspects of your space, including layout, waiting room size, and available equipment, to determine your new capacity.

Below are some physical space adaptations to consider:

- Divide departments into contaminated areas, suspected contaminated areas, transition areas, and clean areas to accommodate the categories of patients (43).
- Ensure there is a dedicated entrance area, passage, and waiting room for patients with suspected COVID-19 (44).
- If a dedicated facility or equipment scanner cannot be assigned (e.g. highly specialized equipment that is not duplicated, such as that used in nuclear imaging), suspected or confirmed patients should be scanned at the end of the work day, not only to minimize cross contamination, but also to factor in time required for cleaning the room (41,42).
- Adjacent imaging rooms' access should be blocked off or restricted to reduce cross-infection between patients (42).
- Use standardized protocols for decontaminating imaging rooms after caring for suspected or confirmed COVID-19 patients (23).
- Decrease foot traffic in radiology reading rooms by encouraging remote consultations by video and telephone rather than in-person (23,45).
- Improve the capability for remote interpretations from home or other sites(24,45).

4.6 Coordinate with other departments

Enhancing communication with other departments such as surgery, intensive care, and anesthesia will ensure that patient prioritization is aligned at your local facility. This will include day, medical or ambulatory services specifically for interventional procedures.

5.0 Managing the Research Enterprise

The COVID-19 pandemic led to a shutdown of most research activities in imaging (46). Only Level 1 research status, critical research activities approved on campus are allowed in most research centres. These activities are predominantly limited either to a) COVID-19-related research or b) medical research that, if discontinued, would endanger the lives of participating human subjects. The top priority is the safety of patients and research staff.

- When feasible, urgent standard-of-care clinical research imaging examinations should be migrated from research centres to hospitals. If continued in research centres, hospital policies for COVID-19 protection of staff and patients should be implemented.
- For non-critical research projects, activities should be performed remotely and focus on data analysis, grant and paper writing, and preparation of standardized operating procedures to prepare for post-COVID research activities.
- Remote access to patient data should be compliant with *The Personal Information Protection and Electronic Documents Act* (PIPEDA) and/or the provincial equivalents
- Weekly research meetings and implementation of strategies to support research staff and student are strongly encouraged.

The impact of this pandemic shutdown is likely to be very detrimental to research units in imaging (46). There is a significant risk of loss of highly qualified personnel. Whenever possible, staff who are not engaged in ongoing/critical projects should be reassigned to clinical departments. An impact on student and research fellow graduation is also anticipated and may prejudice future recruitment. The operating budget of research units will be in jeopardy if this partial shutdown is prolonged. We can anticipate budget reductions in research funding, as clinical backlog will take higher priority. A collaborative approach to maximizing the technical and human resources of both clinical and research units is one way of attaining a favourable outcome for all.

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7.0 Appendices

Appendix A: Summary of operational safety measures for imaging services

Operational Measures for Imaging Services

Pre-screening of patients	Patients pre-screened for any symptoms of COVID-19 at the time of scheduling
	Patients screened again immediately before their imaging visit
	Any patient with recent travel history or even mild symptoms should be rescheduled to 2 weeks later once symptoms have resolved
Staff – Physical Distancing	Specified workstations 2 m apart
	Virtual meetings
	Remote reporting or teleradiology (e.g. work from home) requiring secure and reliable connectivity. Be prepared to change staff assignment if any develop symptoms
	E-consultations
	Intra-team physical distancing to avoid travel between different clinics or sites is a recommended approach for health care workers
	Consider staggered shift hours and alternating weekly schedules to on-site alternating with off-site coverage
Patients – Physical Distancing	Staggered appointment times
	Seating in waiting rooms arranged for 2 m distancing between patients (Seats marked off as appropriate) Or "just in time appointments" such as waiting in car and receiving a text when ready for the patient.
	Physical barrier (Plexiglas) between receptionist and patients
	Restricted patient entry
	Remove non-essential items e.g. pamphlets, toys and magazines
PPE/ Infection control	All staff wear PPE – surgical mask, eye visor, gown if physical distancing not possible
	Patients all have masks (if local jurisdiction does not supply, patients may be asked to bring their own mask to their appointment)
	Monitor consumption rate of PPE
	Make use of portable equipment
	If possible, setup dedicated imaging area(s) for suspected or positive COVID-19 cases
Cleaning	Additional time allowances for increased cleaning measures within the site (scan room, waiting room, etc.) and more robust regular cleaning for common areas and patient areas
	Radiologists' and technologists' workstations wiped down with disinfectant before and after each use
	Portable equipment covered with single-use disposable plastic sheets and wiped down meticulously according to a set protocol for disinfection
	Standard cleaning of X-Ray, mammography, CT, and MRI equipment in between all patients (soap and water or low-level or intermediate-level disinfectant, such as iodophor germicidal detergent solution, ethyl alcohol, or isopropyl alcohol according to vendor specifications)
	For COVID positive or suspected patients, "Terminal cleaning" requiring both thorough cleaning and disinfection for environmental decontamination
Communication	**Patients**: Change appointment confirmation style with telephone call and apply screening questions for COVID-19. Provide script for addressing patients' concerns about risk of infection.
	Healthcare Providers: Provide mental health support for colleagues, messages of encouragement and support. Use frequent short meetings to communicate COVID-19 protocols with limited agendas through virtual conferences.
	Communications with system managers (Hospital Boards, Provincial Health Authorities): Radiology should appoint a contact for the hospital's COVID-19 task force. Suggest a checklist for cleaning and safety protocols for patients and staff with regular check-ins
	Communication with other specialists: Communication with referring specialists is key to managing the ramp-up in-take

Appendix B: How to address anxiety

Requests from Health Care Professionals to their Organizations During SARS-CoV-2 Pandemic (5)

Request	Principal Desire	Concerns	Key Components of Response
Hear me	Listen to and act on health care professionals' expert perspective and frontline experience and understand and address their concerns to the extent that organizations and leaders are able.	Uncertainty whether leaders recognize the most pressing concerns of frontline health care professionals and whether local physician expertise regarding infection control, critical care, emergency medicine, and mental health is being appropriately harnessed to develop organization-specific responses.	Create an array of input and feedback channels (e.g., listening groups, email suggestion box, town halls, leadership visits to hospital units) and make certain that the voice of health care professionals is part of the decision-making process. Some radiologist are in more isolated locations or working from home; leverage the technology at your disposal to communicate with the broader medical imaging team and peers in other departments.
Protect me	Reduce the risk of health care professionals acquiring the infection and/or being a portal of transmission to family members.	Concerns about access to appropriate personal protective equipment, taking home infection to family members, and not having rapid access to testing through occupational health if needed.	Provide adequate PPE, rapid access to occupational health with efficient evaluation and testing if symptoms warrant, information and resources to avoid taking the infection home to family members, and accommodation to health care professionals at high risk because of age or health conditions.
Prepare me	Provide the training and support that allows provision of high-quality care to patients.	Concerns about not being able to provide competent care if deployed to a new area and about rapidly changing information/ communication challenges.	Provide rapid training to support a basic, critical base and appropriate backup and access to experts. Provide clear and unambiguous communication acknowledging that everyone is experiencing novel challenges and decisions, everyone needs to rely on each other in this time, individuals should ask for help when they need it, no one needs to make difficult decision alone, and we are all in this together.
Support me	Provide support that acknowledges human limitations in a time of extreme work hours, uncertainty, and intense exposure to critically ill patients.	Need for support for personal and family needs as work hours and demands increase and school and daycare closures occur.	Provide support for physical needs, including access to healthy meals and hydration while working, lodging for individuals on rapid-cycle shifts who do not live in close proximity to the hospital, transportation assistance for sleep-deprived workers, and assistance with other tasks. Provide support for childcare needs. Provide support for emotional and psychological needs for all, including mental first aid deployed via webinars and delivered directly to each unit (topics may include dealing with anxiety and insomnia, practicing self-care, supporting each other, and support for moral distress), and provide individual support for those with greater distress.
Care for me	Provide holistic support for the individual and their family should they need to be quarantined.	Uncertainty that the organization will support/take care of personal or family needs if the health care professional develops infection.	Provide lodging support for individuals living apart from their family, support for tangible needs (eg, food childcare), check-ins and emotional support, and reassurance for their position and other needs if quarantine is necessary.

Appendix C: Cleaning Links

Ultrasound

Quick guide on COVID-19 projections – Ultrasound Transducers, Equipment, and Gel

https://aium.s3.amazonaws.com/covid19/Covid19_Quick_Guide_UTEG.pdf

ISUOG Safety Committee Position Statement: safe performance of obstetric and gynecological scans and equipment cleaning in the context of COVID-19

http://www.efsumb.org/blog/wp-content/uploads/2020/03/ISUOG-Safety-Committee-statement-COVID19.pdf

Computed Tomography

Failure to Routinely Clean CT Scanner or Fixed Radiology Equipment Surfaces between Patients Could Intensify Community Spread of COVID-19 [ECRI Exclusive Hazard Report

https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-Alert_CT_Cleaning.pdf

Magnetic Resonance Imaging

ACR Guidance on COVID-19 and MR Use

https://www.acr.org/Clinical-Resources/Radiology-Safety/MR-Safety/COVID-19-and-MR-Use

Appendix D: PPE and Infection Control Links

PPE Burn Rate Calculator (CDC, April 7, 2020)

https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/burn-calculator.html

Priority Setting of Personal Protective Equipment (Ontario Health, March 25, 2020)

https://www.wrh.on.ca/uploads/Coronavirus/Ethics_Table_Policy_Brief_3_PPE_Within_Health_Care_Institutions_Community_Support_Services.pdf

Ethical Framework for the Allocation of Personal Protective Equipment (during COVID-19) (Health Ethics Alliance, March 9, 2020)

http://jcb.utoronto.ca/news/documents/Ethical-Framework-for-the-Allocation-of-Personal-Protective-Equipment-2020.pdf

PPE Supply Equivalents (ECRI, April 10, 2020)

https://covid.cadth.ca/infection-control/personal-protective-equipment-ppe-supply-equivalents-ecri/

Recommendations for PPE Conservation: Restrict, Reduce, Re-Use (Institute for Health Care Improvement-Canada, March 24, 2020)

http://www.ihi.org/communities/blogs/covid-pandemic-conserving-personal-protective-equipment

CADTH RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS Hand Washing for Health Care Workers to Reduce the Transmission of Infection: Clinical Effectiveness and Guidelines (CADTH, March 3, 2020)

https://www.cadth.ca/hand-washing-patients-clinical-effectiveness-and-guidelines

Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings (CDC, April 13, 2020)

https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html

IPAC Recommendations for Use of Personal Protective Equipment for Care of Individuals with Suspect or Confirmed COVID-19 (Public Health Ontario, May 3, 2020)

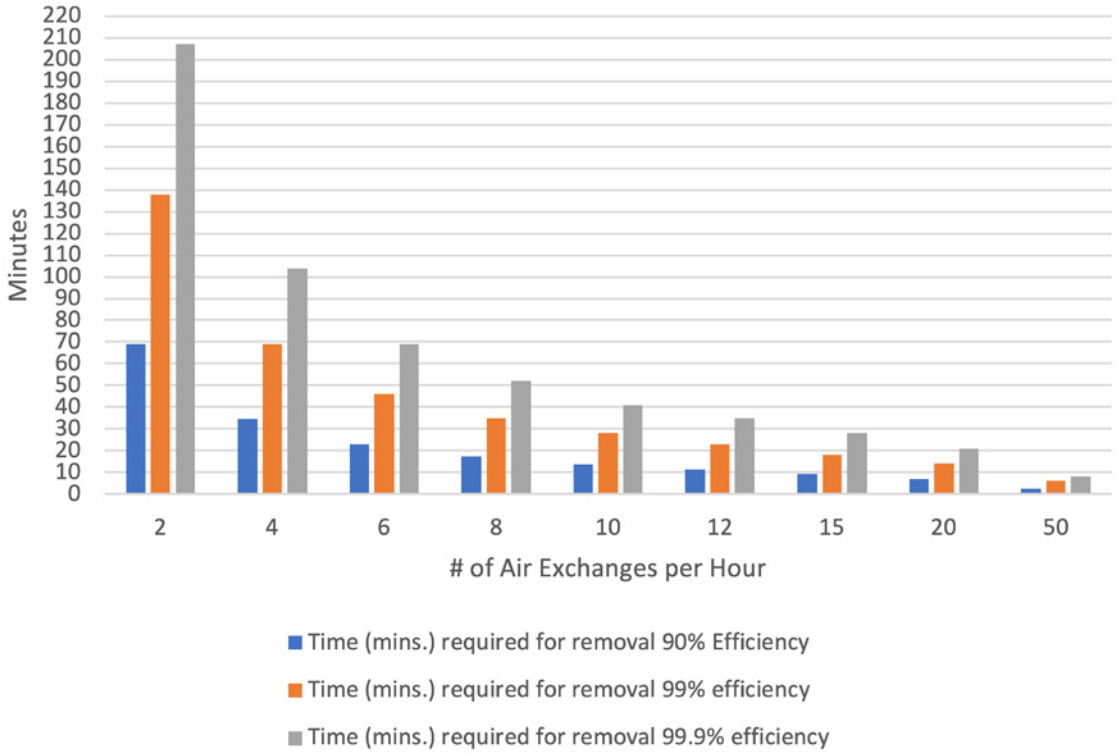
https://www.publichealthontario.ca/-/media/documents/ncov/updated-ipac-measures-covid-19.pdf?la=en

Appendix E: Turn Around Time: Determining your imaging suite turnaround times

The formula to determine the air changes per hour and the time to reduce airborne particles to a desired percentage is given below. This formula assumes the airflow in the room is even and there are no dead air spaces. We recommend the CDC and American College of Anesthesiology guidelines targeting a 99% reduction (39,40).

$$ACH(air changes/hour) = Q(air\ flow\ rate\ in\ ft^3/hour)/V(room\ volume\ in\ ft^3)$$

$$Time = -ln(1 - \%particles\ removed/100)/ACH\ X\ 60$$



Appendix F: CT and MRI Prioritization (32)

CAR Pan-Canadian MRI and CT Wait Time Benchmarks

Priority Category Definitions	Maximum Time Interval Target
Priority 1 (P1) Emergent: an examination necessary to diagnose and/or treat disease or injury that is immediately threatening to life or limb.	**P1:** Same day – maximum 24 hours* * For emergent/life-threatening conditions, some patients require imaging in even less than an hour and these decisions are based on the clinical team's judgment.
Priority 2 (P2) Urgent: an examination necessary to diagnose and/or treat disease or injury and/or alter treatment plan that is not immediately threatening to life or limb. Based on provided clinical information, no negative outcome related to delay in treatment is expected for the patient if the examination is completed within the benchmark period.	**P2:** maximum 7 calendar days** ** There is a spectrum of "urgency" within the urgent category. In most instances, the exam should be completed as soon as possible after the referral is received. However, in some cases (depending on medical need as determined by the clinical team's judgment), while the need is still urgent, a maximum wait time of seven days may be medically acceptable.
Priority 3 (P3) Semi-urgent: an examination necessary to diagnose and/or treat disease or injury and/or alter treatment plan, where provided clinical information requires that the examination be performed sooner than the P4 benchmark period.	**P3:** maximum 30 calendar days
Priority 4 (P4) Non-urgent: an examination necessary to diagnose and/or treat disease or injury, where, based on provided clinical information, no negative long-term medical outcome related to delay in treatment is expected for the patient if the examination is completed within the benchmark period.	**P4:** maximum 60 calendar days
Specified Procedure Date The MRI or CT Scan appointment date requested by the ordering physician for the purpose of disease surveillance.	It is recommended to track performance against specified dates, as poor performance in P1-P4 categories may alter performance in this category, creating a serious concern in patient care for which strategies should be developed.

Appendix G: CAR – CSBI Breast Imaging Wait Time Benchmarks

Priority Category Definitions	Breast imaging specific indications	Maximum Time Interval Target*
Priority P1 **Emergent:** an examination necessary to diagnose and/or treat disease or injury that is immediately threatening to life or limb.	• Rare in breast imaging • Septic patient with severe breast abscess for urgent drainage • Post-operative complication • Breast gangrene (Fournier's disease) for sonographic assessment	P1: same day-maximum 24 hours
Priority P2 **Urgent:** an examination necessary to diagnose and/or treat disease or injury that is not immediately threatening to life or limb. Based on provided clinical information, no negative outcome related to delay in treatment is expected for the patients if the examination is completed within the benchmark period.	• Majority of pre-operative needle localizations appointments • Clinical suspicion of inflammatory breast carcinoma for needle biopsy/pathology diagnosis • Breast abscess for diagnosis and treatment • Diagnostic MRI for breast problem • Preoperative MRI assessment of a breast cancer for staging – pre-chemo assessment – post-chemo to see if response to treatment/guide management • Pregnant woman with symptoms of breast cancer • Breast biopsy of BI-RADS 5 (>95% chance of malignancy)	P2: maximum 7 calendar days
Priority P3 **Semi-urgent:** an examination necessary to diagnose and/or treat disease or injury and/or alter treatment plan, where provided clinical information requires that the examination be performed sooner than the P4 benchmark period.	• Breast biopsy (risk of malignancy): BI-RADS 4A (<2%) BI-RADS 4B (> 10%) BI-RADS 4C (>50%) • Diagnostic work-up of a new breast problem: breast or axillary lump or thickening, nipple discharge(clear/bloody, unilateral, one duct, spontaneous), skin or nipple retraction or dimpling, breast pain -diagnostic work-up of a screen-detected abnormality e.g. Calcifications, asymmetry, mass, architectural distortion or other finding (BI-RADS 0) • Assessment of clinical suspicion of peri-implant (BIA-ALCL) breast collections with MRI or US or both • Male with new breast mass • Follow-up of a BI-RADS 3 lesion (2% risk of malignancy) (past due date** • Follow-up of a previous benign biopsy (past due date**) • Symptomatic cyst for drainage (BI-RADS 2)	P3: maximum 30 calendar days
Priority 4 **Non-urgent:** an examination necessary to diagnose and/or treat disease or injury and/or alter treatment plan, where based on provided clinical information, no negative long-term medical outcome related to delay in treatment is expected for the patient if the examination is completed within the benchmark period.	• MRI and mammography/tomosynthesis screening of high-risk individuals for breast cancer (lifetime risk for breast cancer >20-25%) (past due date from prior screening**) • Annual mammography surveillance post breast cancer** • Mammography screening for average risk women for breast cancer (past due date from prior screening**) • Supplemental screening with US or MRI for intermediate risk women for breast cancer (lifetime risk 15-20-25%) (past due date from prior screening**) • Assessment of breast implant integrity with MRI or US or both • Mammography screening for high risk male for breast cancer	P4: maximum of 60 calendar days

* from date of receipt of requisition

**If the follow-up date is due "X" (specified date as determined by previous breast imaging examination, including 3, 6, 12 or 24 months prior), the date booked should not exceed due date "X" plus benchmark days.

Appendix H: Ultrasound Prioritization Guideline Summary (BC Guidelines.ca)

(https://www2.gov.bc.ca/assets/gov/health/practitioner-pro/bc-guidelines/ultrasound-summary.pdf)

For notes and alternative tests, refer to BC Guidelines: Ultrasound Prioritization Guideline

General Overview					
	Priority Level 1	**Priority Level 2**	**Priority Level 3**	**Priority Level 4**	**Priority Level 5**
	Immediate to 24 hours	Max 7 calendar days	Max 20 calendar days	Max 60 calendar days	Specified time
Abdomen and Pelvis	• Acute abdominal pain (e.g., appendicitis, cholecystitis) • Acute post-transplant assessment • Splenic rupture • Septic renal colic/focal pyelonephritis • Acute painful hernia, (obstruction, strangulation, or ischemia suspected) • Intra-abdominal abscess • Painful jaundice • Testicular torsion/ Epididymitis • Testicular rupture • Priapism	• Acute painful hernia, (obstruction, strangulation, or ischemia not suspected) • Painless jaundice • Pancreatitis, complications • Painless hematuria • Renal colic • Acute renal failure • New testicular mass • New painless abdominal or pelvic mass	• Acute painless hernia/ chronic hernia (if diagnosis in doubt) • Extra-testicular mass • Cholelithiasis • New pulsatile abdominal mass • Renal stone burden	• Chronic abdominal pain/ bloating • Abnormal liver function tests/Known chronic liver disease • Pre-transplant work-up • Scrotal or pelvic ultrasound as part of workup for varicocele embolization/ uterine artery embolization • Peyronie's disease	• Known abdominal aortic aneurysm/Endovascular abdominal aortic aneurysm repair follow-up
Obstetrics and Gynecological	• Ectopic pregnancy • Threatened abortion • Embryonic/fetal demise • Placental abruption • Vasa/vena previa • Pre-term labour to determine cervical length • Acute pelvic pain of suspected gynecological cause (e.g., query ruptured cyst, pelvic inflammatory disease, ovarian torsion)	• Medical abortion • Polyhydramnios • Oligohydramnios • Follow-up of oligohydramnios (unless otherwise specified) • Intrauterine growth restriction • Post-dates fluid assessment • Intrauterine device localization with pain	• Post-menopausal bleeding • Follow up possible fetal abnormality from routine detail scan • High risk pregnancy • Pelvic mass • Intrauterine device localization without symptoms	• Dysfunctional uterine bleeding e.g., fibroids, adenomyosis • Follow-up placental location • Adnexal cyst follow-up (unless otherwise specified) • Fetal detail exam (unless otherwise specified)	
Muscuskeletal/ Extremity	• Deep vein thrombosis • Septic arthritis/toxic synovitis • Abscess	• Acute tendon tears	• New palpable neck/thyroid mass • New palpable extremity mass • Acute rotator cuff tear	•Synovitis/arthropathy follow-up • Tendinopathy, chronic shoulder pain, non-operative rotator cuff tear • Bursitis • Chronic palpable mass • Multi nodular goiter • Carpal tunnel syndrome or other neuropathy • Baker's cyst	• Follow-up soft tissue mass
Pediatrics	• Pyloric stenosis • Intussusception • Clinically suspicious intra-abdominal /pelvic mass	• Increasing head circumference (hydrocephalus) • Biliary atresia as the cause of neonatal jaundice	• Follow-up antenatal hydronephrosis		Developmental dysplasia of the hip (may be P2/P3; within 4–6 weeks of birth) • Spine ultrasound (prior to 5 months of age) • Urinary tract infection • Chronic liver disease • Renal anomaly
General	• Abscess	• Cancer staging or metastatic workup • New suspicious palpable mass			
Vascular		• Carotid ultrasound with acute stroke/transient ischemic attack symptoms		• Carotid doppler screening	• Follow-up of prior carotid surgery or stenting

Appendix I: Interventional Radiology Prioritization Guidelines

P1 procedures (emergent, within 24 hours):

- Trauma/acute hemorrhage/vascular pseudoaneurysm embolization
- Stroke intervention
- Endovascular intervention/thrombolysis for acute ischemia
- **TIPS/BRTO** for acute bleeding
- PE thrombolysis
- Intravascular foreign body retrieval
- **EVAR/TEVAR** for ruptured or symptomatic **AAA** or for dissection with rupture or malperfusion
- Abscess drainage/biliary drainage/nephrostomy for septic shock
- Any other procedure that fulfills the same criteria

P2 procedures (urgent, within 7-10 days):

- Chest tube insertion/abscess drainage/biliary drainage/nephrostomy insertion in stable patients
- AV fistula/graft thrombolysis
- IVC filter insertion
- Dialysis catheter insertion
- Endovascular management of critical limb ischemia
- Endovascular management of acute **DVT**
- Endovascular management of high-risk aortic aneurysm
- Transplant organ biopsy
- Inpatient enteral or venous access
- Thoracentesis/paracentesis
- Any other procedure that fulfills the same criteria

P3 procedures (semi-elective, within 30 days, more urgent depending on the patient):

- Gastrostomy/gastrojejunostomy feeding tube insertion
- Needle biopsy
- Advanced interventional oncology procedures (ablation, **TACE/TAE/TARE**)
- Portal vein embolization
- Tunnelled pleural/peritoneal catheters
- Endovascular management of AV fistula/graft dysfunction
- Endovascular management of chronic peripheral/visceral ischemia (non-claudicant)
- Vertebroplasty/kyphoplasty
- Venous access procedures for oncology
- Any other procedure that fulfills the same criteria

P4 procedures (elective, can be done after 30 days)

- Endovascular management of peripheral/visceral vascular malformations
- Endovascular management of chronic peripheral ischemia (claudicant)
- Endovascular management of vascular aneurysm
- Embolization of scrotal varicocele/pelvic congestion syndrome
- TIPS for refractory ascites
- Uterine fibroid/prostate artery embolization
- IVC filter removal
- Venous sampling
- Drainage tube change (nephrostomy, biliary, abscess, cecostomy, etc.)
- Small renal mass ablation (**T1a**)
- Tunnelled central venous line/portacath removal
- Any other procedure that fulfills the same criteria

TIPS: Transjugular intrahepatic portosystemic Shunt

BRTO: Ballon-occluded retrograde transvenous obliteration

PE: Pulmonary embolism

DVT: Deep Vein Thrombosis

EVAR: Endovascular repair of aortic conditions

TEVAR: Thoracic endovascular repair of Aorta

AAA: Abdominal Aortic aneurysm

AV: Arteriovenous

IVC: Inferior Vena Cava

TAE: Trans arterial embolization

TACE: Trans arterial chemoembolization

TARE: Trans arterial radioembolization

Appendix J: Pediatric Radiology Prioritization – P1 to P5

Guidelines for triaging imaging requests in pediatric imaging, applies across modalities:

P1 – (Emergent): an examination necessary to diagnose and/or treat disease or injury that is immediately threatening to life or limb. Such an examination will need to be done either stat or not later than the day of the request.

- Any condition in which failure to diagnose and initiate treatment immediately would result in serious morbidity/mortality, including trauma, pulmonary embolus, gastrointestinal bleeds, and acute surgical conditions (e.g. torsion, volvulus)
- All truly emergent cases should still be getting done during COVID and will continue to go first. Ongoing demand with no expected backlogs.

P2 – (Urgent): an examination necessary to diagnose and/or treat disease or injury and/or alter treatment plan rapidly for a condition that is not immediately threatening. Based on provided clinical information, no negative outcome related to delay in treatment is expected for the patient if the examination is completed within a short time frame. Maximum 7 calendar days.

- Any condition in which failure to diagnose/treat rapidly would result in significant deterioration/ deficit, including oncology (acute presentation), infection.
- Most acute care imaging across all modalities, virtually all inpatients, and most x-rays will fall in this category.
- These cases should also still be getting done during COVID and will continue to go second. Ongoing demand with little to no expected backlogs.

P3 – (Semi-urgent): an examination necessary to diagnose and/or treat disease or injury and/or alter treatment plan, where provided clinical information requires that the examination is indicated to investigate symptoms of potential importance. Maximum 30 calendar days.

- Any condition in which failure to diagnose/treat would result in moderate deterioration/deficit
- Most evolving known oncologic cases and fetal/ obstetric imaging (and related screening) will fall in this category.
- Should include investigation of any potentially serious condition, and follow-ups of known possibly progressing disease.
- Among the patients to be rescheduled, these should be the third to go (first rescheduled appointments), with appointments given according to "first-in, first-out" principle (person on waiting list longest should go first).
- If functioning at >50% capacity throughout COVID, should have relatively small backlog, if any, at time of ramp up.

P4 – (Non-urgent – Short term): An examination indicated for long-range management or for prevention. Maximum 30-90 calendar days

- Follow up of known conditions which require long range management with frequent re-evaluation, such as preop re-evaluation, restaging.
- Includes conditions where delaying the exam could result in greater setup required for investigation later (e.g. US spine at 3 months vs MRI spine under anesthesia at 6+ months for work-up of "sacral dimple").
- Among the patients to be rescheduled, these should be the fourth to go (second rescheduled appointments, with appointments given, again according to "first-in, first-out" principle. Moderate backlog expected.

P5 – (Non-urgent – Routine): an examination necessary to diagnose and/or treat disease or injury, where, based on provided clinical information, no negative long-term medical outcome related to delay in treatment is expected for the patient if the examination is completed within the benchmark period.

- Any condition in which failure to diagnose/treat would result in minimal deterioration/deficit.
- Includes follow-up of chronic or stable conditions, and routine assessment/screening for non-evolving conditions (e.g. malformations).
- Among the patients to be rescheduled, these should be the last to go, with appointments given, again according to "first-in, first-out" principle.
- Largest backlog expected.

PX – Target date: Timed follow-up exam or specified procedure date recommended by radiologist and/or clinician.

- Any condition requiring specific follow-up date. Most scheduled follow up of known stable oncologic conditions will fall in this category. In pediatrics, may also include scheduled regular routine screening for tumor-predisposing condition (e.g. Beckwith Wiedemann).
- These patients will often fall between categories P3 and P4, and it may be necessary to "subdivide" into PX-3 and PX-4. In as much as it is possible to still respect the requested target date, these patients should continue to be combined with their respective subdivision (with P3 for PX-3, and with P4 for PX-4), to make sure they are not at risk of sequelae from disease evolution.
- Priority given to follow up of known oncology cases.

Canadian Association of Radiologists
L'Association canadienne des radiologistes

600 – 294 Albert Street
Ottawa, Ontario K1P 6E6
Tel.: 613 860-3111
Fax: 613 860-3112
www.car.ca