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Tailored breast imaging during the first wave and preparedness for the second wave of COVID-19 pandemic<!--<ForCover>Shimpi T, Kulkarni S, Bukhanov K, Fleming R, Scaranelo A, Ghai S, Au F, Beresford M, Dua H, Grant A, Freitas V, Tailored breast imaging during the first wave and preparedness for the second wave of COVID-19 pandemic, *European Journal of Radiology Open*, doi: 10.1016/j.ejro.2020.100265</ForCover>-->

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**Tailored Breast Imaging during the first wave and preparedness for the second wave of
COVID-19 Pandemic.**

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Conflicts of Interest:

All authors have no conflicts of interest to disclose.

Highlights:

1. Avoiding transmission of COVID-19 pandemic while providing essential breast cancer care is critical.
2. Tailored recommendations and algorithms have been developed promptly at the breast imaging department to face the COVID-19 pandemic outbreak.
3. The dynamics of the operational measures developed in the imaging departments may need to be updated, given the uncertain course and duration of the COVID-19 pandemic and the anticipation of the second wave of the pandemic. As we continue to move forward, discussions are underway on the best way to resume regular patient care.

Abstract:

The pandemic caused by the new Coronavirus has changed the way patient care is provided worldwide. This review focuses on the description of the operational measures implemented in a breast imaging department in accordance with existing recommendations for the treatment of breast cancer during the COVID-19 pandemic to make optimal use of finite resources without interruption of essential imaging services for breast cancer patients. It will also apply during a second-wave of the pandemic, which, according to experts, is inevitable and requires us to be better prepared.

Key words: COVID 19, Coronavirus, Guidelines, Practical Guidelines, Breast Imaging, Infection Prevention.

INTRODUCTION:

The coronavirus outbreak that emerged in Wuhan, China, in late December was caused by a novel Coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV2), and within a time frame of just a few months, it evolved into a pandemic. As of May 29, 2020, the coronavirus disease 2019 (COVID-19) pandemic has resulted in 5,701,337 confirmed cases and 357688 deaths worldwide, including 87,902 cases and 6799 deaths in Canada [1]

This novel coronavirus shares phylogenetic similarity with the severe acute respiratory syndrome (SARS) caused by severe acute respiratory syndrome coronavirus 1 (SARS-CoV-1) and Middle East respiratory syndrome coronavirus 1 (MERS-CoV-1) [2]. Many secondary transmission of SARS-CoV-1 and MERS CoV-1 occurred in the hospital setting, which has also proven true for COVID-19. Of the first 4,672 COVID-19 cases in China, 1716 were health care workers (HCW), of which 14.8% confirmed as severe or critical, and five deaths were observed [3]. After that, these numbers affecting HCW kept escalating, as reported in different parts of the world, for instance, in Ontario, they made up one in ten of the total COVID-19 cases in Ontario as of April 2, 2020 [4], by April 9, 2020, around a total of 9,282 U.S. of HCW were confirmed COVID-19 according to CDC [5], and by April 17, 2020, around 17, 000 were affected by this viral infection in Italy [6].

World Health Organization (WHO) affirms that in some countries, one in ten HCW is expected to be infected with coronavirus [7]. Two mammography technologists reportedly died of COVID-19 in March 2020, the first two medical personnel death recorded in the state of Georgia due to the disease [8].

As per the international council of Nurses (ICN), Geneva, as of May 6, 2020, at least 90,000 health care workers were estimated to be infected, and more than 260 nurses have died after contracting the fatal viral infection [9]. From the lessons learned by the entire medical community from the past, new policies and guidelines are continually emerging across various medical specialties to reduce unnecessary exposure and minimize the risk to health care providers.

Breast imaging specialty is at high risk for acquiring or transmitting infections, as it involves close patient contact while providing patient care, performing screening, diagnostic and interventional breast procedures [10]. Nevertheless, it is well-known that breast cancer is the number one cancer affecting the women in North America, Canada as well other continents [11-13], and it is a potentially life-threatening disease when left untreated. Hence, continuity of breast imaging service is of paramount importance.

We aimed to describe the operational measures implemented in our breast imaging department, which serves multiple academic tertiary care centers during the COVID-19 pandemic to limit the transmission and make optimal use of the finite resources without the interruption of essential imaging services to the breast cancer patients. We also discuss the challenges expected and radiological preparedness to face an anticipated second-wave of the pandemic.

BACKGROUND:

Shortly after World Health Organization (WHO) declared COVID-19 as a pandemic on March 11, 2020, [14], before the guidance documents for breast cancer care during COVID-19 pandemic from the scientific societies were made available, an internal task force was created at our institution. The timeline with exact details of the same depicted in Table 1. It included breast radiologists with an administrative leadership role in each of the tertiary care centers that are part of the Joint Department of Medical Imaging of Sinai Health System, University Health Network, Women's College Hospital, affiliated to University of Toronto. The goal of the task force was to develop priority categories for the breast imaging tests, organize the rescheduling of low risk/not essential breast imaging tests and prioritize urgent and suspicious for cancer cases after weighing the risks and benefits of screening and other breast imaging tests compared to the risks of contracting COVID 19.

Thereafter, a streamlined approach to systematically identify and summarize emerging evidence was conducted [15]. The literature search consisted of a Medline search (included "pandemic", combined with "coronavirus" or "COVID 19", and "guidelines" in the title) in April 2020, which retrieved 284 studies. Out of 284 studies retrieved, none addressed clinical guidelines in breast cancer care during the COVID-19 pandemic. Simultaneously, the reviews of the available scientific societies' recommendations for breast cancer care during the COVID-19 pandemic were carried out, including the guidance document produced by Ontario Health (Cancer Care Ontario) (OH-CCO) [16], endorsed by the Canadian Society of Breast Imaging (CSBI) and Canadian Association of Radiology (CAR) [17], as well as the document provided by American College of Radiology (ACR) [18], The American College of Surgeons (ACS) [19], and Society of breast imaging (SBI) [20].

OH-CCO [16] recommendations endorsed by other local organizations (CSBI and CAR) [17] and by the ACS [19] states that treatment and triage of breast cancer patients during COVID-19 pandemic must follow Priority Categories (Table 1). The ACR and SBI [18,20] do not explicitly follow specific priority categories but support rescheduling all nonurgent outpatient visits, such as screening mammography and other non-emergent or elective radiologic and radiologically guided exams and procedures.

IMPLEMENTED OPERATIONAL CHANGES

In alignment with the emerging priority categories provided by the scientific societies [16-20], and acknowledging the fact that breast imaging department plays a "front line role" in delivering multidisciplinary breast cancer care, the operational changes that were carried out at Joint Department of Medical Imaging, Breast Division, are entailed below.

Priority Category A patients are defined as those considered critical, in need of services/treatment even in the event of a pandemic because their situation is either unstable, results in unbearable suffering or is immediately life-threatening. In breast imaging context, these patients include emergency patients with acute onset of infectious symptoms, suspected breast abscess imperative for diagnosis and drainage as well as patients in whom a delay in surgery would result in either an immediate threat to life or would significantly alter the patient's prognosis.

Category B patients are defined as those who require services/treatment in the cancer centers, hospitals or primary care settings, but whose situation is deemed non-critical (no unbearable

suffering, the patient is stable, and the condition is not immediately life-threatening). These patients are those with breast symptoms or imaging-detected lesions classified as BI-RADS 4 or 5 in accordance with Breast Imaging Reporting and Data System (BI-RADS) lexicon [21].

For patients in the categories A and B, the decision was made to continue providing support for diagnostic imaging studies and image-guided interventions (percutaneous biopsies and pre-operative localizations) on a case by case basis at the earliest available appointment.

Due to possible cancellation or delay of elective surgeries, all patients who underwent biopsy procedures had metallic breast markers placed at the end of the biopsy, unless the index mass was associated with calcifications [22]. If no elective surgery was performed at the time of diagnosis, the patients were then referred to oncology for initiation of endocrine or neoadjuvant therapy with surgery scheduled once operating rooms became available.

For primarily healthy category C patients, whose condition is deemed as non-life threatening, in which the service can be delayed without an anticipated change in outcome, identified as patients for screening studies (including mammography for average-risk and mammography and MRI for high-risk population), diagnostic post-cancer annual surveillance, call back patients with abnormal screening result deemed to be likely benign upon review of the screening study and follow up lesions classified as BIRADS 3 as per Breast Imaging Reporting and Data System (BI-RADS) lexicon [21]. Their previous imaging was reviewed by Staff Radiologist, and a decision was made to defer their appointment to a future date, either when pandemic has resolved or when it is felt safe to perform them as per hospital guidelines.

Effective patient communication and assurance that patients would be called back and kept informed of the new dates of their appointments were done and considered vitally important to reduce patient anxiety caused by the delay of their imaging assessment.

The evolution of COVID related events pertinent to breast imaging and breast cancer is summarized in Table 2, and Figures 1 and 2 summarize the implemented imaging workflows for categories A, B, and category C.

MEASURES TO MINIMIZE RISK OF INFECTION TRANSMISSION

In order to limit propagation of disease, patients in categories A and B who needed assessment in the breast imaging department, on the day of their scheduled appointment, were pre-screened at the hospital entrance for any suspicious symptoms (fever, cough, myalgia, fatigue, diarrhea and shortness of breath) and positive travel history and were accepted in the breast imaging department only after passing this initial screening [23].

However, if the patient did not clear screening at the hospital entrance, they were redirected to the COVID assessment center for testing and the breast imaging appointment deferred to a later date after a negative test result.

Personal protective equipment:

Personal protective equipment including gloves, medical/ surgical face masks, goggles, face shields, and gowns, as well as items for specific procedures filtering facepiece respirators (i.e., N95 masks or equivalent), have been identified amongst the most critical measures effective for protection of health care workers from COVID-19 infection [24].

During the earlier phase of the pandemic, the institutional recommendations for the use of personal protective equipment (PPE) and its availability were still evolving. However, the departmental task force had early recognized the higher risk of transmission in breast imaging departments given the fact that recommended physical distancing of 20-30 cm is impossible to be maintained while performing mammography and ultrasound examinations as well as breast interventional procedures. Hence, following CSBI and CAR recommendations [17] to allow protection from respiratory droplets and saliva, which are known mechanisms of transmission for COVID-19 [24-25], the radiology technologists, imaging reception clerical staff, trainees, and staff radiologists were all encouraged to wear disposable surgical face masks during interaction with patients. Nevertheless, because breast imaging departments do not deal with aerosol-generating procedures, N 95 masks were not recommended.

In due time, the institutional policy of mandatory masking of patients and staff members was instituted (Table 2). However, this mainly implied a consistent supply of PPE resources following the practices already in place in our department as per the operational changes implemented by the task force in mid-March 2020.

As a general guideline, patients must use disposable face masks during their stay in the breast imaging department or are allowed to use their own masks, as homemade face masks have been shown to reduce exposure to respiratory infections among the general population [26]. For the health care workers, disposable surgical facemasks are donned before entering the patient area and adequately discarded after exiting the patient's care area. Hand hygiene with a sanitizer with

70% alcohol performed after discarding the facemask. Also, gloves are worn whenever patient contact is anticipated upon entry into the patient scanning room and discarded when leaving, followed by immediate hand hygiene.

The technologist and the radiologist follow the mandatory use of gowns before entering the procedure room, and these are discarded in a dedicated container before leaving the procedure suite. Cloth gowns are laundered after each use. After each patient evaluated in the ultrasound/mammography room, the technologist carefully disinfects the equipment and ultrasound probe used before making the room available to the next patient.

PPE supply and demand: Concerns and Planning for the second wave of the pandemic:

Though the supply was adequate in our province and set up through the initial phase of this first wave of the COVID pandemic, it is to be noted that there has been a global shortage of PPE stocks and hence rational and prudent use of PPE is of utmost importance in case of a second wave of the pandemic.

The availability of the PPE to all frontline staff has always remained the priority for every hospital. Guidance on PPE usage in Ontario province as per the IPAC Recommendations for the use of Personal Protective Equipment and WHO guidelines for the rational use of personal protective equipment for coronavirus disease (COVID-19) [27, 28].

Resource availability is essential in maintaining the practices as this could directly impact the ability to provide uninterrupted breast imaging service. As a result, PPE's prioritization and

rational use is an important factor to consider if there is the second wave that negatively impacts the availability of PPE stock [29]. Backup plans should be timely devised before the anticipated second wave arrives, based on the caseload's dynamics in the given practice.

Amongst the ancillary measures taken for minimizing the risk of transmission, the following steps were taken:

Reinforcement of departmental protocols:

- Minimize the number of staff per site, including the number of radiologists: To avoid disruption in manpower, if any cross-transmission occurs, staff segregation was implemented throughout all the sites with minimum Radiology staff at each site.
- Minimal interhospital movement of radiology staff.
- Back up staff in reserve to provide help when required/ shortage.

Reinforcement of Infection control steps:

- Regular daily briefing of the staff on the availability of supplies /resources, including surgical masks, PPE, and hand sanitizers, as well as monitoring the stock of PPE.
- Reinforcing the importance of optimally implementing the disinfection tools wherever and whenever needed to maintain the quality and standards set for hygiene and cleanliness at the workplace as a part of protection from COVID-19 [30].

Patient factors:

- Strictly maintaining the rule of physical distancing between patients all the time with a safe distance of 2 meters.
- Modification to the patient waiting rooms/ hallways and changing rooms to minimize patient interaction. For example, the chairs/ seats for patients in the waiting area are spaced out at a safe

distance, the changing room to be used one by one, the changing room keys given to the patient are disinfected after each use before giving it to the next patient, and at the front desk, the patients are asked to stand in a circle drawn, mindfully keeping a safe distance of 2 meters from the health care staff.

- Removing material of everyday public use such as magazines, common closet keys, etc.

ADDITIONAL IMPLEMENTED MEASURES

Through these challenging times, taking good care of the mental health of staff as well as patients are of paramount importance. Hence, abundant health resources have been facilitated by the hospitals and are available for access to the health care staff to keep their stress and anxiety to a minimum, including, but not limited to mental health counseling, online support and learning tools, online fitness classes, and mental health courses, teleconsulting for health care workers, etc.

The educational activities, essential meetings, and interdepartmental multidisciplinary rounds were conducted remotely via various online portals, for instance, Zoom Inc, Microsoft teams, Blackboard, etc.

CONCLUSION:

Avoiding or minimizing transmission and providing essential breast imaging services during the COVID 19 pandemic is critical. So far, the operational measures reviewed here have proven to be effective to limit transmission and efficiently run breast imaging services at our department over the last three months, as there have been no patient-related infection encountered in any of the staff across all sites (including medical, paramedical and clerical

staff), and, hence, can be used as a basic operational framework to build upon for other breast imaging departments. We remain aligned with evolving institutional guidelines and additional updates may be necessary, given the uncertain course and duration of the COVID 19 Pandemic as well as with the projection of anticipation of the second wave in different parts of the world. There are challenges expected along the course, including PPE supplies, and these need to be timely dealt with appropriate planning in anticipation of shortages. As we continue to move through this phase, the discussions around thoughtful return to caring for patients is underway. The impact of increased screening interval, particularly in high-risk women, is likely to be significant, and we hope further to evaluate this indirect effect of the COVID-19 pandemic.

Declaration of Interest

There are no financial disclosures from any author.

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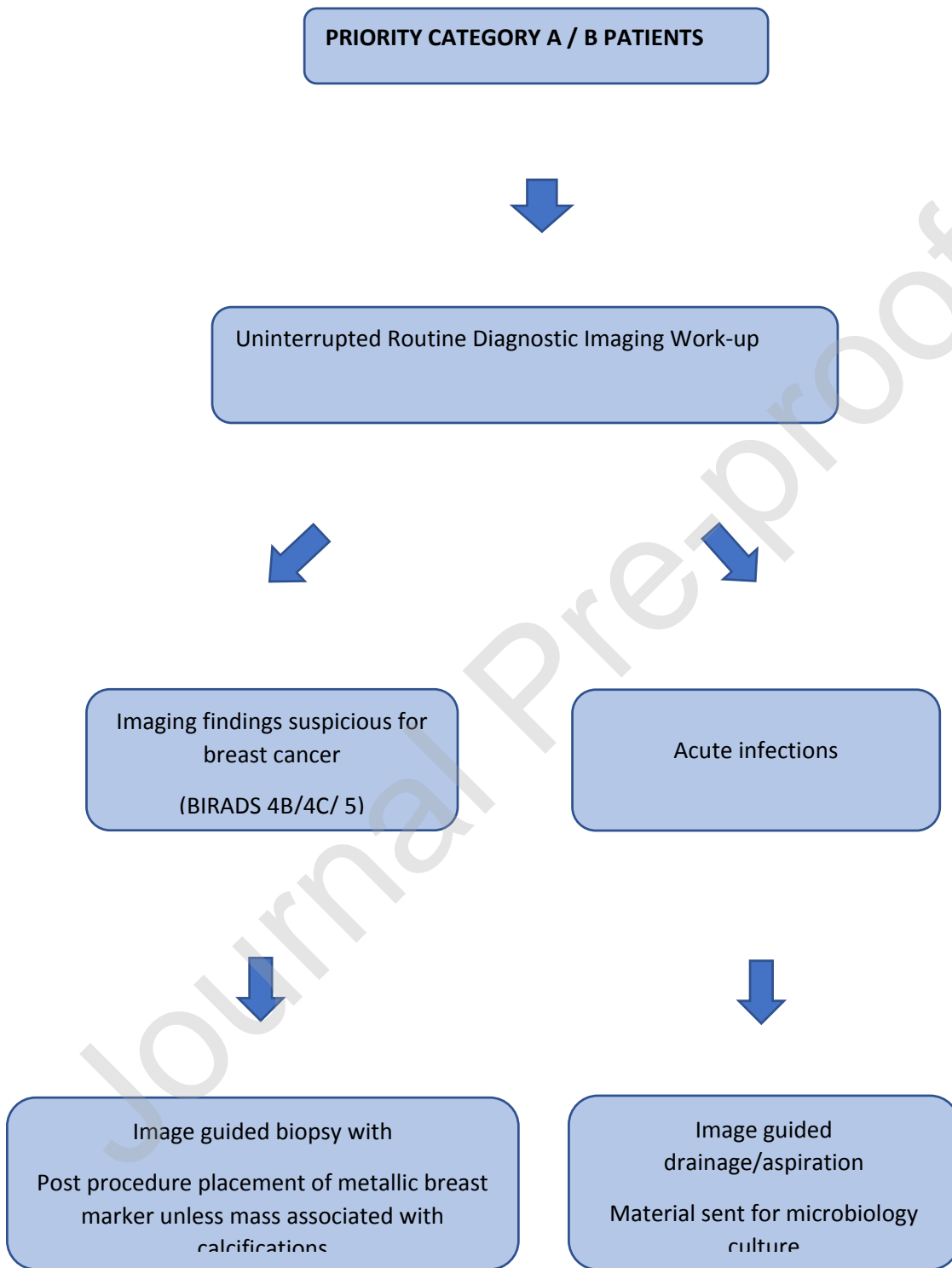
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Figure 1: Imaging algorithm for priority category A and B



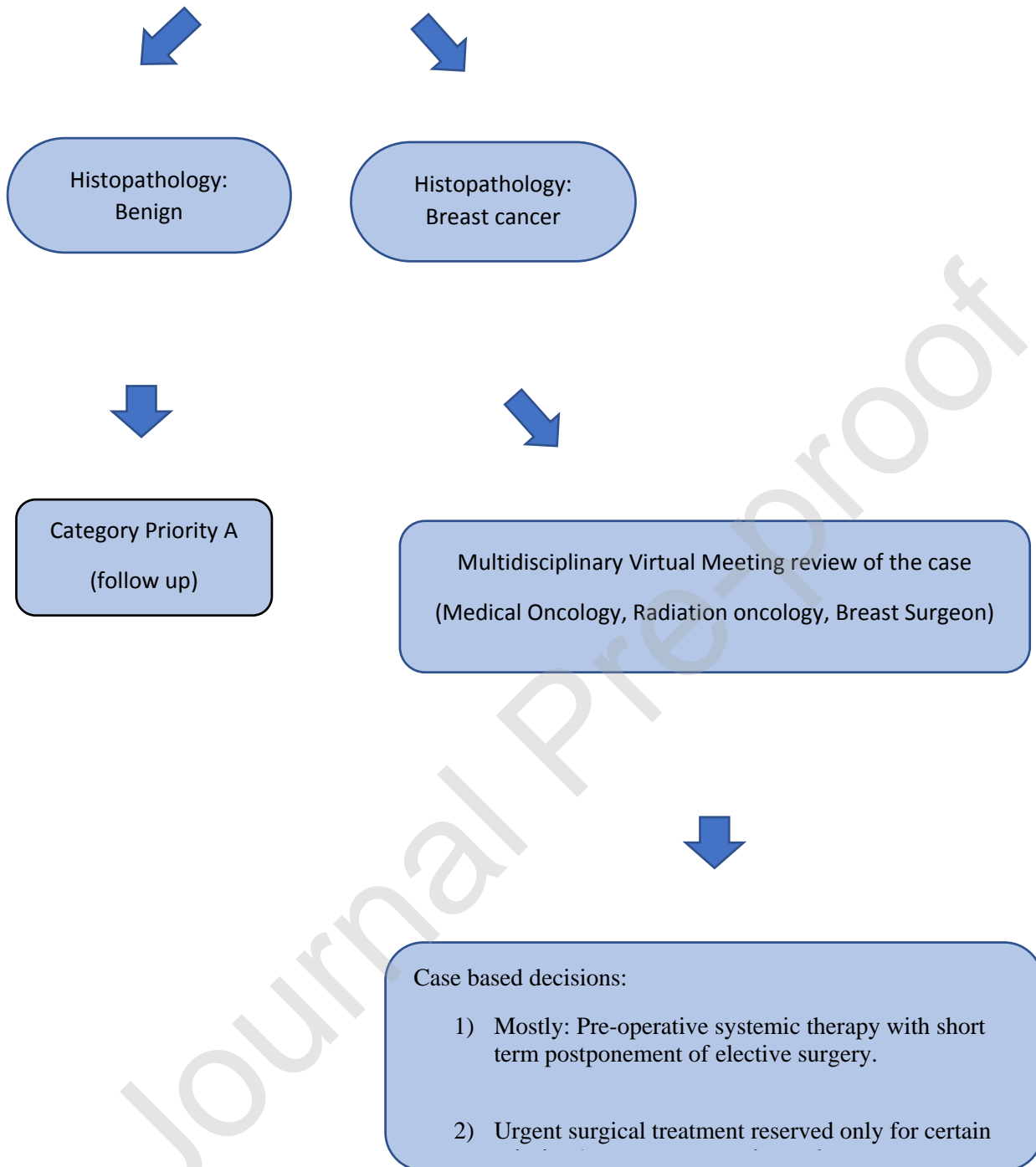


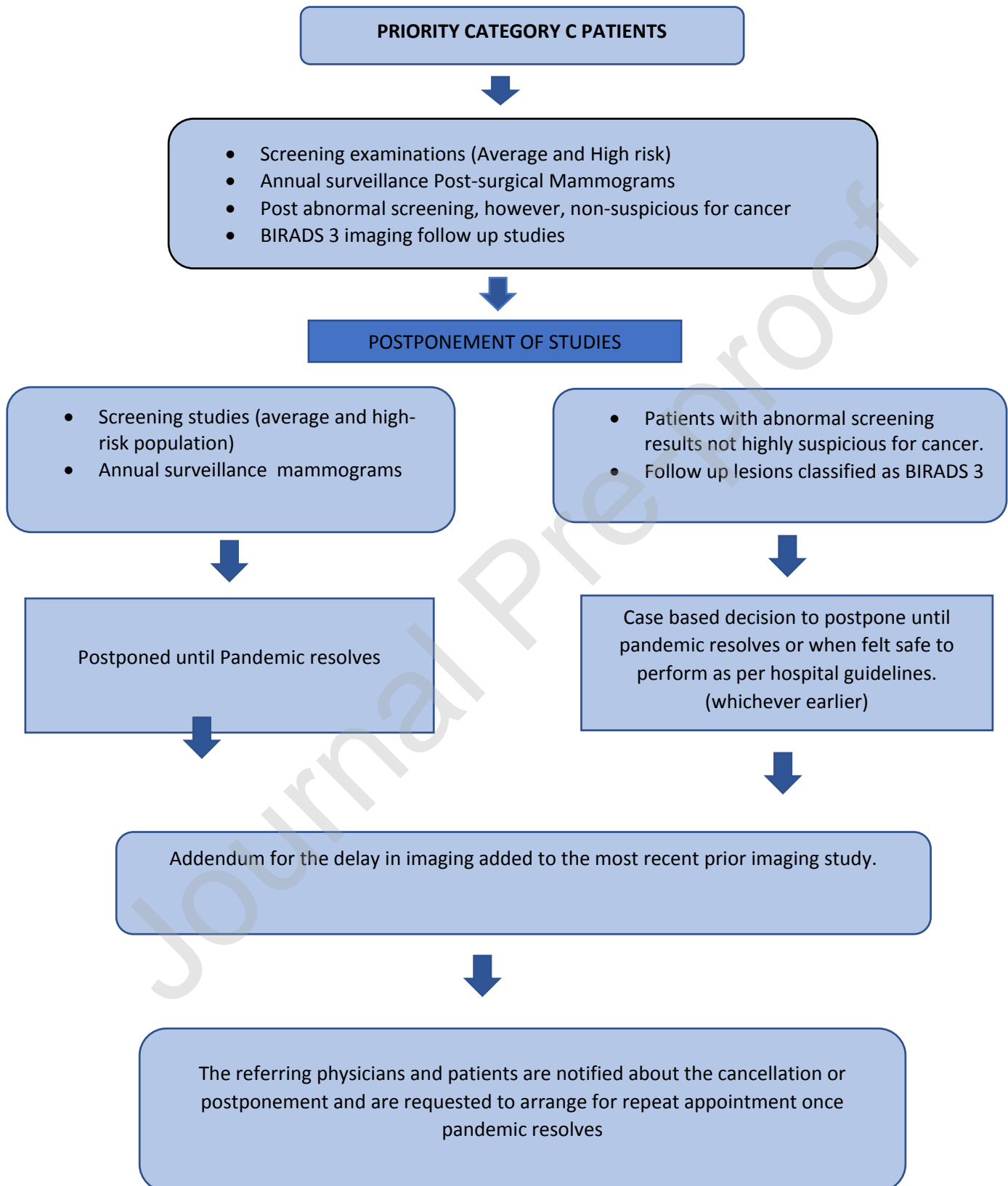
Figure 2: Imaging algorithm for priority category C

Table 1: Priority category definition by CCO-OH (16)

Priority Category	Description
Category A	Patients who are deemed critical and require services/treatment even in the event of a pandemic because their situation is unstable, has unbearable suffering and/or immediately life threatening.
Category B	Patients who require services/treatment in the cancer centres, hospitals or primary care settings but whose situation is deemed non-critical (no unbearable suffering, patient is stable and condition is not immediately life threatening).
Category C	Patients who are generally healthy, whose condition is deemed as non-life threatening where the service can be delayed without anticipated change in outcome. In the advent of the pandemic, these services can be discontinued for the duration of the pandemic.

Table 2: Timeline of evolution of COVID related events pertinent to breast imaging and breast cancer

Dates	Important events
Dec 31, 2019	WHO informed of cases of pneumonia of unknown etiology in Wuhan City, China.
January 11, 2020	Reported first death due to illness caused by Coronavirus
January 27, 2020	First confirmed case of Coronavirus reported in Canada
January 30, 2020	WHO Declared Public health emergency of international concern
March 10, 2020	OH CCO pandemic planning guidance documents for cancer care published
March 11, 2020	WHO declares COVID-19 a Pandemic
March 12, 2020	A task force involving the breast radiologists and administrative leaders in our institution developed operational guidelines for breast imaging during COVID-19 pandemic.
March 15, 2020	Operational modifications implemented at author's institutional centers for "TAILORED BREAST IMAGING DURING PANDEMIC"
March 29, 2020	International guidelines for cancer care during pandemic become available worldwide.
April 2, 2020	A reassurance of correct operational measures was performed after reviewing the available web-based guidelines by the task force in our institution

DECEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				



MARCH

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4



APRIL

S	M	T	W	T	F	S
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2