Original Research

A COVID-19 Referral Center's Cardiac Catheterization Laboratory Response to the Pandemic: A Stakeholder Analysis

Published online: 25 November 2025
https://doi.org/10.69944/pjc.cc61871594
https://pjc.philheart.org
ISSN: 0115-1029
e-ISSN: 2815-2123
Volume 53 Issue 2

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DISCLOSURE: None

Abstract

INTRODUCTION: The sudden designation as a COVID-19 Referral Center at the beginning of the pandemic brought about immense change to the Cardiac Catheterization Laboratory (CCL) services of a National Referral Center for tertiary care. As a proactive strategy to determine actions that can be undertaken should an unforeseen event ever happen again, this study was done to explore the impact of COVID-19 to the institution's CCL caseload, and to review the challenges, innovations and adjustments made by the CCL to become pandemic-capable and crisis-ready.

METHODS: A qualitative cross-sectional study was conducted, with the first phase describing the CCL census starting from the baseline pre-COVID year of 2019 to the pandemic years of 2020-2022, and the second phase involving Key Informant Interviews (KII) and Focus Group Discussion (FGD) with the hospital and CCL healthcare staff.

RESULTS: The study revealed a large reduction in the urgent, elective and overall number of cases of the CCL in the first year, but has seen a steady increase in subsequent years. Surges of COVID variants were also seen to affect the CCL caseload. The following were noted to be the key elements in the CCL's transformation to become COVID-19 capable: (a) changes in operations and patient selection, (b) appropriate use of PPE, (c) strict adherence to an infection control protocol, and (d) staffing modifications to reduce infectivity and protect staff availability.

CONCLUSION:The preparation of the hospital's CCL to become a pandemic capable laboratory has been difficult and faced many challenges. However, the innovations and adjustments done through efforts and ingenuity of the CCL healthcare team allowed continuous delivery of the highest level of care to patients in spite of the changing pandemic landscape. These changes were duly documented as a basis for response to possible future global and/or national healthcare crises.

KEYWORDS: COVID-19 pandemic; cardiac catheterization laboratory; national Covid-19 referral center; pandemic-capable; crisis-ready

INTRODUCTION

At the beginning of 2020, the highly infectious severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) causing the coronavirus disease 2019 (COVID-19) swept through countries, leading to major morbidity and mortality, and tremendous strain in the world's healthcare systems.1

In the Philippines, the disease was first identified on January 30, 2020 in a 38-year-old woman admitted at the San Lazaro Hospital in Manila.2 By March 7, 2020, the Department of Health confirmed its first local transmission.3 With the rapid spread of illness across the country, the Philippines was declared under a state of calamity by March 17, 2020. On March 30, 2020, the University of the Philippines-Philippine General Hospital (UP-PGH) became a COVID-19

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Referral Center.4 Expectedly, this also led to sudden changes to the institution's health care delivery system including the highly specialized and historically non-infectious areas of the hospital, such as the Cardiac Catheterization Laboratory (CCL).

Since September 1998, UP-PGH's CCL has provided high-quality, state-of-the-art, and patient-centered diagnostic and interventional cardiology services. It has even extended its operations to include electrophysiology, radiology, neuro-radiology, thoracocardiovascular surgery, gastroenterology and hepatobiliary services in the past years.5

However, at the beginning of the pandemic, there was a noted significant decrease in CCL caseloads worldwide, which was seen to be caused by fear of the disease and infection, and abrupt changes in the hospital system.6-10 As a response to this worrisome occurrence, the American College of Cardiology (ACC) Interventional Council in conjunction with the Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (SCAI ELM) produced a consensus to equip the CCLs in continuing services at this tumultuous time, which included recommendations on the use of screening evaluation upon admission and catheterization laboratory activation, the alternative use of systemic fibrinolytic therapy, appropriate use of personal protective equipment (PPE) and sanitation, the necessity of intubation and the formation of a staffing algorithm appropriate for the pandemic.11 Locally, the Philippine Society of Cardiovascular Catheterization and Intervention also released a statement of recommendations pertaining to patient selection (specifically ST-Elevation Myocardial Infarct [STEMI], non-ST-Elevation Myocardial Infarct [non-STEMI] and elective patient), the use of thrombolysis, intubation and cardiopulmonary resuscitation (CPR) in the CCL.12 Our institution's CCL as well as different CCLs worldwide were quick to adapt to these guiding principles in order to continue services and provide proper care to patients, while minimizing exposure to the disease and maximizing staff availability and hospital resources.

This study was done with the general objective of reviewing impact of the disease, and the challenges, innovations and changes instituted by the CCL of a COVID-19 referral center during the COVID-19 pandemic. Specific objectives include: (1) Exploring COVID-19 pandemic impact on CCL census of cardiac procedures, particularly on Primary Percutaneous Coronary Intervention (PPCI) for STEMI patients and elective procedures, (2) Exploring changes in the CCL operations, procedure workflow and case selection, (3) Describing establishment of infection control protocol in the CCL, (4) Describing personnel management and contingency planning, and (5) Identifying possible solutions on best CCL practices during the pandemic.

METHODOLOGY

A qualitative study was conducted using a cross-sectional descriptive design with the first phase describing and comparing the CCL census starting from baseline pre-COVID year of 2019 to the COVID years of 2020-2022, followed by the second phase involving key informant interviews (KII) and focus group discussions (FGD). These FGDs and KIIs were organized as semi-structured interviews with the objective of creating an open and engaged conversation with interviewees in order to discover personal perspectives, and gain a depth of context and understanding of the changes and adjustments made by the CCL staff and hospital that may not be easily proffered in quantitative surveys.

For the KII, we identified the following key informants for the interviews, who were established leaders and policymakers of the hospital and the CCL specifically, and were the most knowledgeable on the processes done from 2020-2022, namely:

1. Cardiac Catheterization Laboratory (CCL) Head
2. CCL Manager (Head Nurse)
3. Hospital Infection Control Unit (HICU head)
4. Interventional Cardiology Chief Fellow
5. Deputy Director for Nursing

The FGDs were conducted with a total of 36 participants: (a) Fifteen physicians, which included Interventional Cardiology (IC) consultants, IC fellows, anesthesiology consultants, anesthesiology fellows, as well as General Cardiology consultants and fellows who regularly referred patients needing catheterization but were not assigned to the CCL, (b) Nine nurses, (c) Eight radiology technicians, and (d) Six support staff (institutional workers and nursing aides) who were assigned to the CCL.

The aforementioned semi-structured format of the KIIs and FGDs used a general interview guide adapted from Toral, et. al., which composed the following open-ended questions:4

For the KIIs:

1. What steps did you or your committee make to prepare the CCL in accommodating COVID patients? What were the changes to the pre-COVID procedure workflow and case selection? Did you come across any issues? How did you solve such issues?
2. During the actual operations, how did the CCL implement the pandemic infection control protocol (use of PPE, social distancing, disinfection)?
3. Were there any changes to personnel management? What were the contingency plans at this time?
4. What lessons, both best practices and miscalculated moves, did you gain in the planning and execution of COVID-19 plans in the CCL?
5. How do you think this preparation and execution of the COVID-19 plan will help the CCL in the coming years?

For the FGDs:

1. What were the changes to the pre-COVID procedure workflow and case selection? Did you come across any issues? How did you solve such issues?

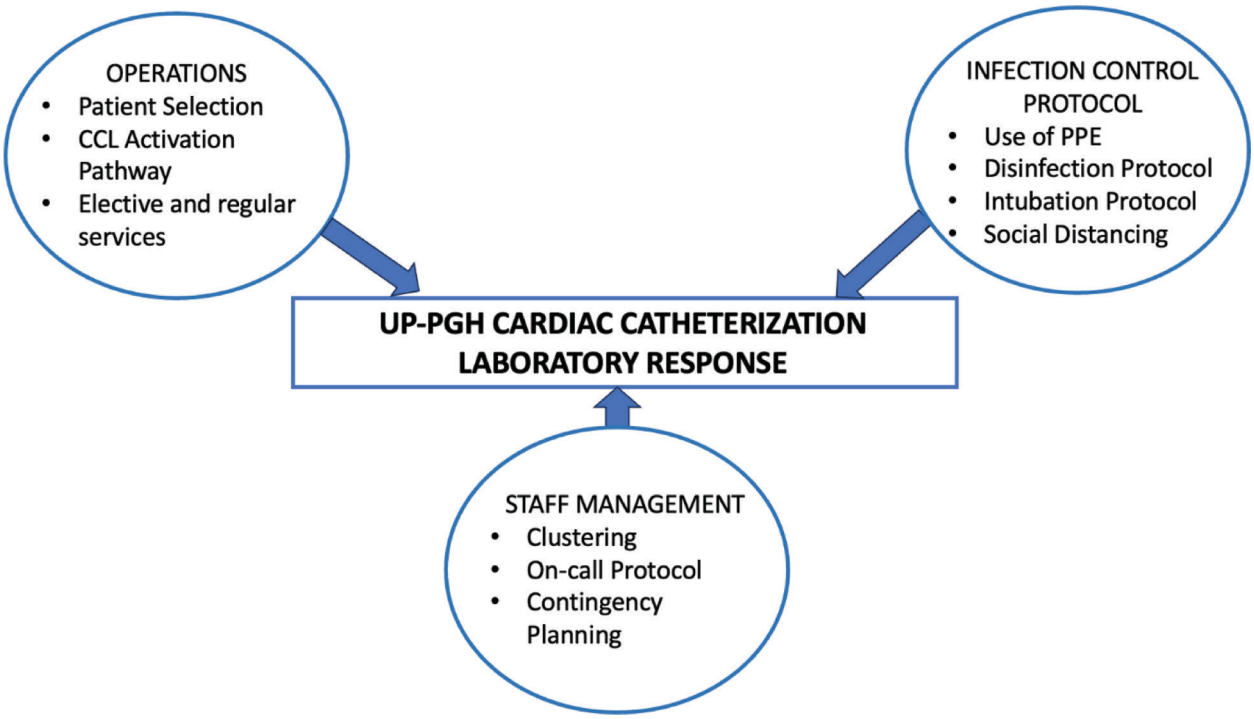
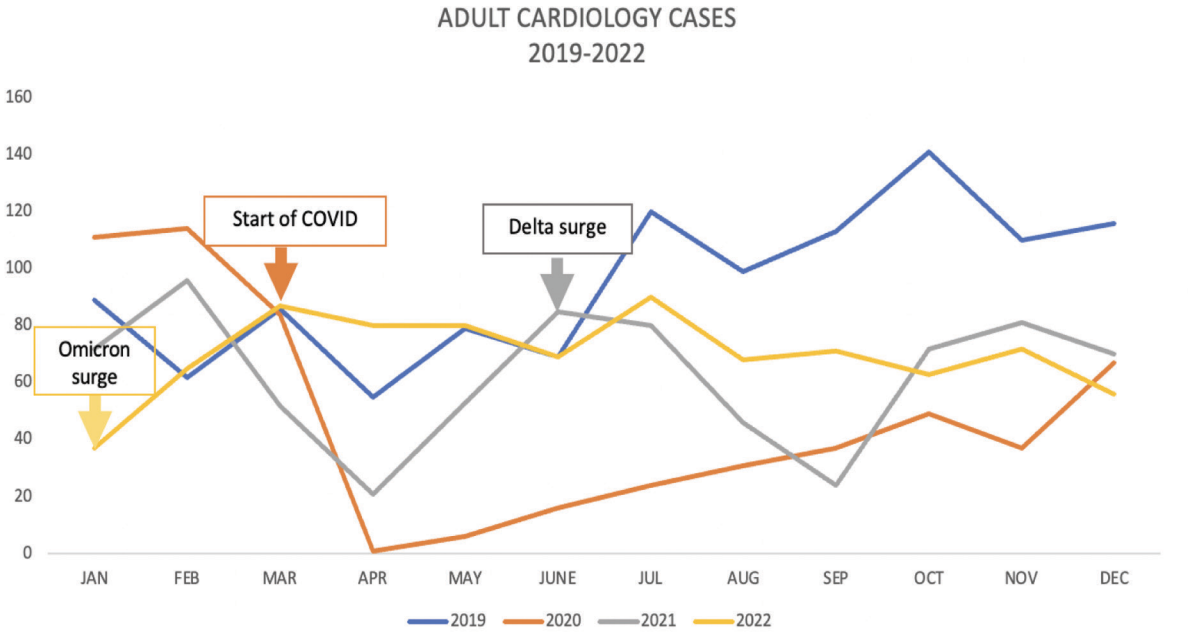
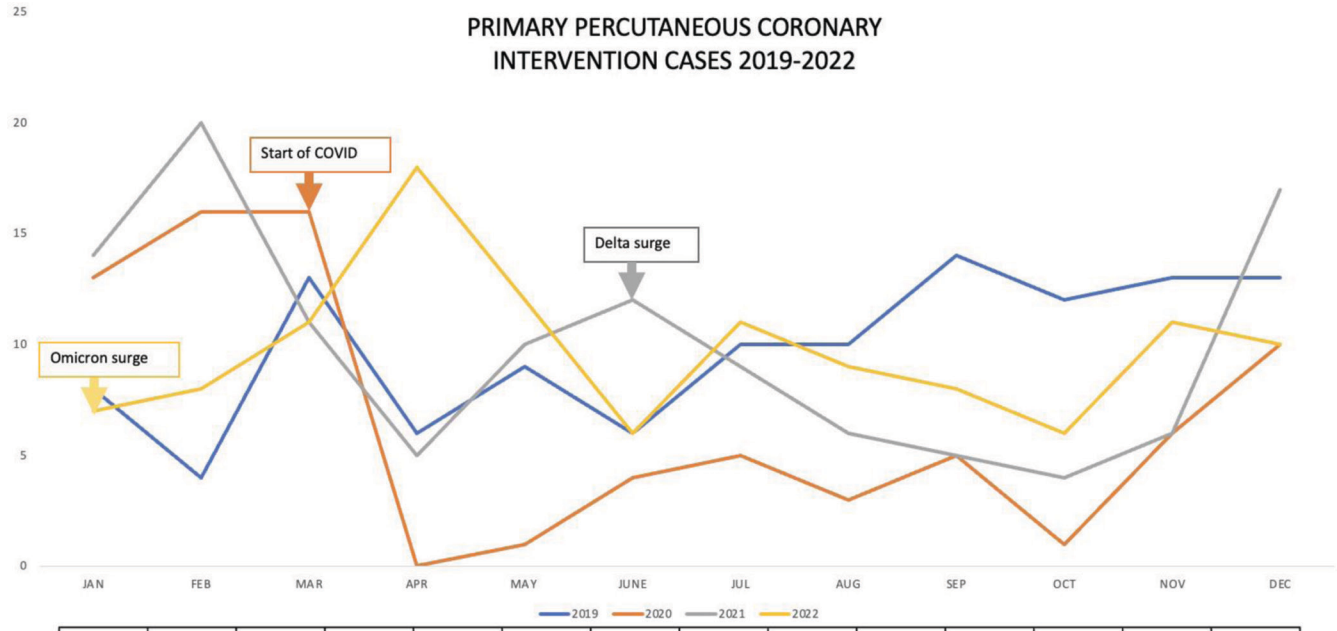


Figure 1. Conceptual Framework of the Cardiac Catheterization Laboratory Response to the COVID-19 Pandemic.



	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2019	89	62	86	55	79	69	120	99	113	141	110	116	1139
2020	111	114	84	1	6	16	24	31	37	49	37	67	577
2021	72	96	52	21	53	85	80	46	24	72	81	70	752
2022	37	65	87	80	80	69	90	68	71	63	72	56	838

Figure 2. Overall Census of Adult Cardiology Cases Done at the CCL in 2019-2022.



	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2019	8	4	13	6	9	6	10	10	14	12	13	13	118
2020	13	16	16	0	1	4	5	3	5	1	6	10	80
2021	14	20	11	5	10	12	9	6	5	4	6	17	119
2022	7	8	11	18	12	6	11	9	8	6	11	10	117

Figure 3. Primary Percutaneous Coronary Intervention Cases Done at the CCL in 2019-2022.

2. What was your experience in the execution of the pandemic protocol (use of PPE, social distancing, disinfection) in the CCL?
3. What was your experience in the changes in staff scheduling or personnel management at this time?
4. What would you recommend to further aid or guide the response of the CCL in pandemics or other emergencies like this?
5. How do you think this preparation and execution of the COVID-19 plan will help the CCL in the coming years?

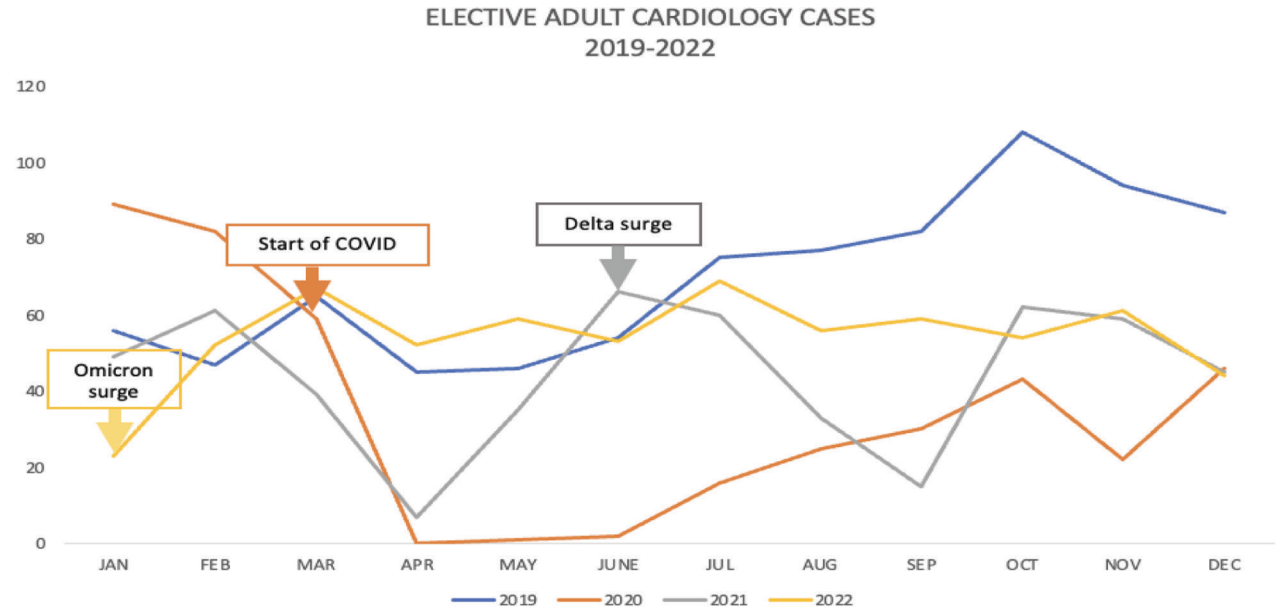
Data was collected using qualitative methods. For the first phase of the study, the CCL census was based on data from the official CCL logbook of cases from the baseline pre-COVID year of 2019 to the pandemic years of 2020-2022. The data collected from the second phase of the study through the KIIs and FGDs were sorted into groups based on the conceptual framework of the CCLs response to the COVID-19 pandemic, which include the following sections: (a) Operations - CCL activation pathway, patient selection protocol, and elective and regular services, (b) Infection Control Protocol - Use of PPE, disinfection protocol, intubation protocol and social distancing, and (c) Staff management - clustering, on-call protocol and contingency planning. Meeting minutes, memos and all other official records and communications pertaining to the topic were gathered and examined.

RESULTS

The CCL census for 2019 to 2022 were reviewed and analyzed for the first phase of the study. The overall census of adult cardiology cases (Figure 2) that included emergency and elective cases was noted to be at 1139 in 2019. There was note of a steep decline in the monthly census from March to April 2020, as this was the beginning of the COVID pandemic in the Philippines and the time when our institution was officially announced as a COVID-19 referral center. The total number of cases in 2020 only totaled 577 - there was approximately a 49% decrease in cases from the previous year. The trend of cases slowly increased in the following months into 2021, but was again noted to have a steady decline with a surge of the Delta variant, beginning June 2021 up to September 2021. Though there was a brief increase in the number of patients at the end of 2021, the Omicron variant surge at the beginning of 2022 again brought down cases into half. Since then, however, there has been a steady increase in the overall yearly census up to December 2022.13

The number of STEMI patients undergoing urgent PPCI (Figure 3) followed a similar pattern to the overall census - an abrupt decrease at the start of the pandemic on April 2020, and a decline in cases during the Delta variant surge in the middle of 2021 and the Omicron variant surge at the beginning of 2022. The over-all number of PPCI cases decreased by 32% from 2019 to 2020. However, in 2021 and 2022, the caseload was almost equal in number as in the pre-COVID days.13

In April-June 2020, there was a sharp decrease in elective cases as the CCL adjusted to the pandemic. Overall, there was a 56% fall in the total number of elective cases in 2020 as compared to 2019. Also, during the Delta and Omicron



	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2019	56	47	65	45	46	54	75	77	82	108	94	87	836
2020	89	82	59	0	1	2	16	25	30	43	22	46	415
2021	49	61	39	7	35	66	60	33	15	62	59	45	531
2022	23	52	67	52	59	53	69	56	59	54	61	44	649

Figure 4. Elective Adult Cardiology Cases Done at the CCL in 2019-2022.

surges, the number of elective cases was intentionally reduced to prioritize urgent cases, decrease possibility of transmission among patients and staff, and to avoid overwhelming the CCL. After the latest surge, however, there has been a steady increase in the total number of elective cases up to the end of 2022.

The second phase of the study through the KII and FGDs was able to explore and document the challenges, adjustments and innovations done per section of the previously described conceptual framework of the CCL's preparation to become capable in handling both COVID and non-COVID patients needing catheterization.

A. OPERATIONS AND PATIENT SELECTION

Challenges

At the onset of the pandemic, there was inadequate knowledge on the disease's transmission, severity and treatment options. (1) The balance between staff exposure and patient benefit had to be weighed carefully, especially for urgent cases such as STEMI patients that were also COVID suspects or positive. Elective procedures were temporarily placed on hold to maximize hospital bed availability and reduce patient exposure within the hospital. Nonetheless, timely and appropriate treatment was still of import, hence a *Cardiac Catheterization Laboratory Activation Pathway (CCL-AP)* was created and implemented on April 2020 for the evaluation of patients in need for cardiac catheterization at the CCL (Figure 5).

Adjustment and Innovations

The CCL-AP began with identification and evaluation of the patient at the emergency room (ER)/point of entry, wherein, the level of urgency was identified. Urgent cases included patients in hemodynamic instability or cardiogenic shock, with recurrent or ongoing chest pain refractory to medical treatment, with life-threatening arrhythmia or cardiac arrest, or with mechanical complications of myocardial infarction, acute heart failure, or recurrent dynamic ST-T wave changes.14 If deemed urgent, the COVID-19 status was then determined via nasopharyngeal swabbing for Reverse-Transcription Polymerase Chain Reaction (RT-PCR) of the virus. If the patient tested negative, the procedure was done with the team using level 3 PPE, the use of which will be discussed more in detail in a separate section. If the patient tested positive or was a COVID-suspect with pending results but needed urgent catheterization, the CCL was activated with the team donning level 4 PPE. During these early months, the option of Optimal Medical Therapy (OMT) was given for these COVID-19 positive patients instead of catheterization until infection was resolved or if their current status changed. Additionally, systemic thrombolysis was offered as a primary therapy instead of catheterization for appropriate STEMI patients without contraindications.

But by October 2020 (Figure 6), the following significant changes were instituted to the CCL-AP: (a) OMT and systemic thrombolysis were removed as primary options for COVID-positive patients needing urgent catheterization in our PCI-capable hospital, (b) The CCL began to utilize the universal precaution protocol instead of level 3 PPE for COVID-19

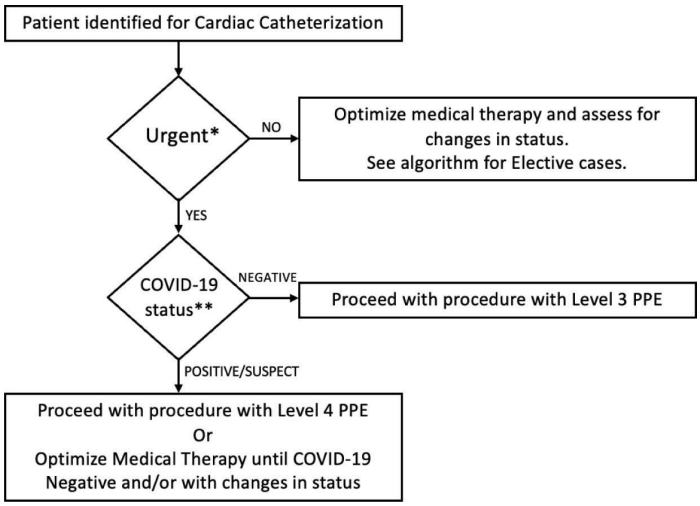


Figure 5. Algorithm for patient selection for urgent activation of cardiac catheterization and intervention (April 2020)
*Urgent cases: a. patient in hemodynamic instability or cardiogenic shock, b. recurrent or ongoing chest pain refractory to medical treatment, c. with life-threatening arrhythmia or cardiac arrest, d. With mechanical complications of myocardial infarction, e. acute heart failure, or f. recurrent dynamic ST-T wave changes.
** COVID-19 nasopharyngeal RT-PCR result: positive, negative or suspect with pending swab result

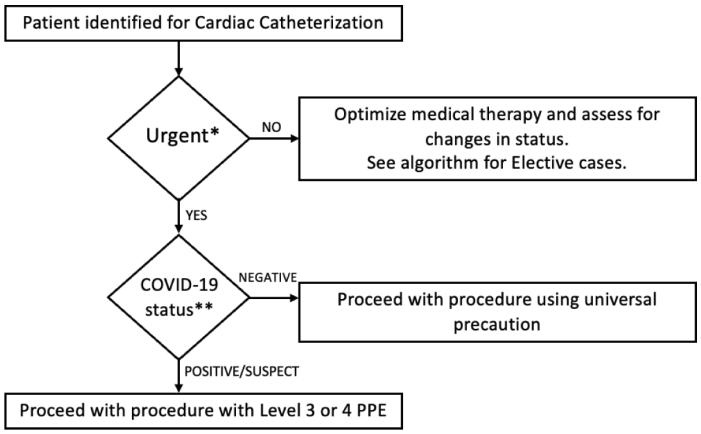


Figure 6. Algorithm for patient selection for urgent activation of cardiac catheterization and intervention (October 2020)
*Urgent cases: a. patient in hemodynamic instability or cardiogenic shock, b. recurrent or ongoing chest pain refractory to medical treatment, c. with life-threatening arrhythmia or cardiac arrest, d. With mechanical complications of myocardial infarction, e. acute heart failure, or f. recurrent dynamic ST-T wave changes.
** COVID-19 nasopharyngeal RT-PCR result: positive, negative or suspect with pending swab result

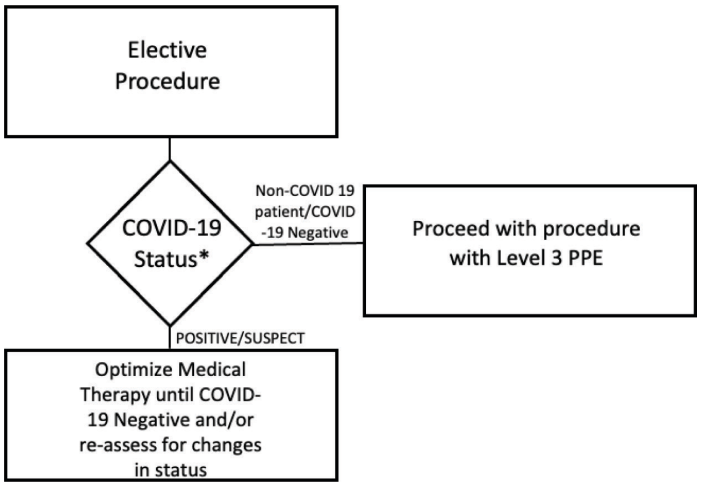


Figure 7. Algorithm for patient selection for elective cardiac catheterization and intervention (April 2020)
*COVID-19 nasopharyngeal RT-PCR test result: positive, negative or suspect with pending swab result

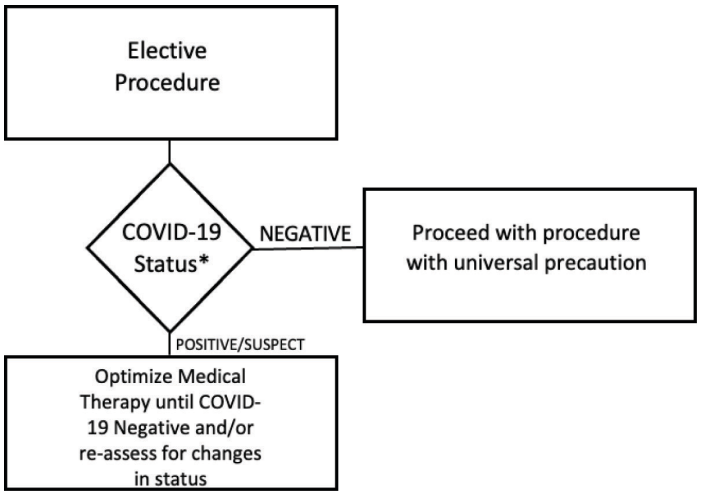


Figure 8. Algorithm for patient selection for elective cardiac catheterization and intervention procedures (October 2020)
*COVID-19 nasopharyngeal RT-PCR test result: positive, negative or suspect with pending swab result

negative patients, which only involved the use of at least a face mask and an optional face shield, and (c) The staff was given the option to use level 3 or 4 PPE for CCL activation of COVID-positive patients.

For elective procedures, another pathway was also created in April 2020 with the plan of resuming this service as the CCL adjusted to the pandemic (Figure 7). For elective patients who tested negative, he/she may proceed with the procedure with the staff donning level 3 PPE. However, if he/she tested positive or was highly suspected to be infectious, OMT was done first, with the procedure rescheduled. The patient was still continuously assessed for changes in status. This pathway was also updated in October 2020 (Figure 8) by allowing COVID-negative patients to proceed with the procedure with staff now utilizing the universal precaution protocol. However, elective procedures were still deferred for patients who tested positive for COVID.

B. HEALTH CARE PROVIDER PPE

Challenges

Arguably, the most critical factor in taking precaution against infection is the use of PPE. Through effective use of PPE, there is a reduction in the likelihood of the medical team to become infected, and at the same time, it also minimizes exposure to the other patients that the team is caring for. Hence, the CCL adapted the recommendations of the hospital's HICU guidelines, with additions specific to the CCL, taking into consideration the other equipment used during a catheterization procedure.15

Adjustments and Innovations

From the beginning, PPE use was already recommended while doing a procedure with a COVID-19 positive or suspect patient.15 The CCL staff underwent lectures and training on the proper doffing and donning of PPE. A level 3 PPE included the use of a hair cap, goggles/face/eye shield, shoe covers, N95 mask/elastomeric mask, gloves, non-sterile surgical gown and a scrub suit. A level 4 PPE replaced the use of the non-sterile surgical gown with a coverall, and the additional use of double gloves. Though the staff were trained, donning and doffing PPE at the cath lab were still done with a safety officer to monitor proper execution, the steps of which are as follows:

A. Donning: 1) Wearing of designated lead gown and thyroid shield. 2) Hand washing/hand hygiene with alcohol (HH). 3) Using of shoe cover followed by HH. 4) Wearing of inner gloves, then HH. 5) Wearing of non-sterile surgical gown/ coverall, then HH. 6) Wearing of N95/elastomeric mask, then HH. 7) Wearing of goggles/face or eye shield, then HH. 8) Wearing of hair cap, then HH, and finally 9. putting on the outer gloves (for level 4). Once the procedure begins, the staff wears a sterile surgical gown and a pair of sterile gloves.

B. Doffing: 1) Removal of the sterile surgical gown and sterile gloves. 2) HH then removal of shoe cover, to be followed again by HH. 3) Removal of outer gloves followed by HH. 4) Removal of face/eye shield, then HH. 5) Removal of coverall/ gown, then HH. 6) Removal of head cap, then exchange of inner gloves to new pair of nonsterile gloves. 7) Then removal of the N95 mask to be replaced with a new surgical mask or the elastomeric mask may be kept on, and as the last step, 8. removal of the gloves and a final HH.

C. DISINFECTION PROTOCOL

Challenges

Another aspect considered was the environmental persistence of the virus and the use of disinfection to prevent its further transmission and confer additional protection to the CCL team. A disinfection protocol was put in place in the CCL.

Innovations and Adjustments

After each procedure of the COVID-suspect or -positive patients, deep cleaning and disinfection were done in the CCL with hospital cleaning materials (bleach, alcohol, soap and antiviral wipes), especially the exposed surfaces of the CCL room. UV-light based disinfection after the procedure was also utilized. The staff members who were assigned to cleaning and disinfection used level 3 or 4 PPE. Appropriate disposal of materials used was also done following the HICU protocol.15

D. INTUBATION PROTOCOL

Challenges

The possibility of exposure to the CCL team was increased due to the aerosolization of respiratory secretions during intubation and suctioning, thus, an intubation protocol following

Table 1. Donning and Doffing of Personal Protective Equipment at the CCL.

DONNING	Wearing of designated lead gown and thyroid shield
	Hand washing/Hand hygiene (HH)
	Using of shoe cover followed by HH
	Wearing of inner gloves, then HH
	Wearing of surgical gown/ coverall, then HH
	Wearing of N-95/elastomeric mask, then HH
	Wearing of goggles/face or eye shield, then HH
	Wearing of hair cap, then HH
	Putting on outer gloves (level 4)
	Wearing of sterile gown and gloves
DOFFING	Removal of sterile gown and gloves, then HH
	Removal of shoe cover, followed by HH
	Removal of outer gloves, then HH
	Removal of face/eye/shield, then HH
	Removal of coverall/gown, then HH
	Removal of head cap, then glove exchange
	Removal of N-95 mask or elastomeric mask stays on
	Removal of gloves and a final HH

the concept of an airway team as advised by the HICU was followed.15

Innovations and Adjustments

For the performance of endotracheal intubation, the anesthesia service in proper PPE was designated as the airway team inside the CCL. To prevent unnecessary exposure, any staff who was not required for the intubation procedure was asked to leave the immediate vicinity. Due to the closed-circuit ventilation that is used to regulate the ventilation of patients who are already intubated, there is less transmission risk to the team. Hence, early intubation before transfer was also advised if the patient was already in respiratory distress or unstable. Ideally, the lab should have been able to convert to a negative pressure room temporarily to offer optimal protection, but it was not available in our institution.

E. SOCIAL DISTANCING

Challenges

Another principle emphasized was the maintenance of social distancing at the CCL during the procedure. By avoiding close proximity and decreasing the number of staff inside the procedure room, contact was minimized and transmission reduced. The number of staff members in the CCL was regulated through the formation of a core team, with specific roles for each member.

Innovations and Adjustments

A core team consisted of one attending physician, one senior interventional cardiology fellow, one junior interventional cardiology fellow, one general cardiology rotator, one circulating nurse, one radiologic technologist and one anesthesia consultant or fellow. Another scrub nurse and radiologic technologist stayed outside of the CCL to act as safety officers and monitor and assist as needed. A nursing attendant or utility worker was also available to maintain environmental control measures before and after the procedure, UV light-based disinfection and appropriate disposal of materials post-procedure. In addition, a single procedure room was designated for use by positive or suspected patients for safe containment of the virus and disinfection after.

F. PERSONNEL MANAGEMENT AND CONTINGENCY PLANNING

Challenges

An alternative staffing model was put in place to minimize the staff's exposure given that the hospital had limited staffing resources (both physician and support staff) to attend to cardiac emergencies such as STEMI. A clustered team approach was initially used, but was continuously adjusted to the staffing needs of the CCL and hospital.

Innovations and Adjustments

From April to June 2020, separate clustered teams were formed to minimize contact and exposure of the staff to each other. Three teams were formed: A-C, wherein the Interventional Cardiologists, Interventional Cardiology Research Fellows, Cardiology fellow rotators, nurses, radiation technologists and utility workers/nursing attendants came in on a 1-week on and 2 weeks off basis. The team members assumed daytime as well as weeknight and on-call coverage, 24 hours a day and 7 days a week (24/7). Though exhausting, this ensured the CCL stayed functional. However, also at this time, the interventional cardiology fellows were assigned to different wards to augment the hospital workforce. Nurses were also reassigned to the COVID medical wards due to shortage in the nursing service. But in July 2020, the CCL duty schedule was back to the *regular* pre-covid rotation (daily procedures, regular on-call and off-status) to accommodate more patients as the hospital adjusted to the new normal, though individual nurses were still pulled out at regular intervals to man the COVID medical wards up until December 2021.

DISCUSSION

As the COVID-19 pandemic swept across the world, it forced hospitals and medical systems to respond quickly to an unprecedented crisis. Our institution was not exempted, as well as its CCL. This study reviewed the impact of the disease as well as the changes, adjustments and innovations done to transform the CCL to become capable of providing service to both COVID and non-COVID patients.

The analysis of the 2019-2022 CCL census showed that the reduction in CCL procedures was considerable, with note of a 49% decrease in the total number of adult cardiology cases in 2020 as compared to 2019. STEMI patients who underwent PPCI decreased by 32% in the first year, but were quick to revert back to pre-COVID numbers in the next two years. Fifty-four percent of elective cases were initially deferred to prioritize urgent cases but a slow, steady climb in caseload was eventually seen in 2021-2022. In addition, particular patterns were noted during the surges of different COVID variants; we observed the steady drop of caseload during the Delta surge then recovery, as compared to the sudden drop and recovery during the Omicron surge.

One positive outcome that came about from the decrease in cases at particular times is that it has allowed the CCL time to adjust to the pandemic and its surges - granting it the ability to maintain the precarious balance of prioritizing safety of the staff, maximizing hospital resources, while providing appropriate treatment to patients. The formation of the CCL Activation pathway provided the opportunity to thoroughly assess patients in need for catheterization. From the entry point of admission, the patients were continuously monitored. Decision-making was individualized, while taking into account the risk for exposure versus risk for delay in diagnosis and therapy. Urgent cases were prioritized, while some electives were deferred to preserve hospital resources such as beds and PPE, and minimize transmission. The modifications of the CCL Activation pathway have also been reflections of the adjustment of the hospital to the pandemic landscape in the country, as eventually the criteria

for catheterization became less stringent and more elective cases were accommodated.

With regards to the adherence to the PPE use in the CCL, it allowed the team to provide direct care to the COVID-suspect or -positive patients with reduced risk for transmission. However, PPE use required much equipment such as N-95 masks and gowns that needed to be specially bought and were in such high demand, but low in stock. Hence care was given in using the equipment, with waste kept to a minimum. Focus was also done on the donning and doffing of the PPE in order to maximize protection while ensuring adequate comfort. Training and education on PPE use were emphasized to all members of the team as the duration of the illness was uncertain. The mitigation of the disease's spread and maintenance of good health of the healthcare team remained to be the priority all throughout the pandemic.

As for the disinfection protocol, the health care staff became more aware of the important role of deep cleaning and disinfection of the CCL. With this awareness came the effort to limit waste and place materials in proper disposal areas, and to only utilize the assigned room or materials during the procedure to minimize the area of exposure.

The intubation protocol also allowed the CCL team to review the appropriateness of intubation for patients brought into the CCL. The airway team was given the opportunity to do intubation at a controlled environment, wherein contact was less and transmission was reduced. It also drove the medical team managing the patient at the point of admission/entry at the hospital to properly and fully assess the patient and decide on intubation prior to transfer to the CCL, avoiding unnecessary exposure to the catheterization team handling the patient.

Another adjustment to the pandemic was the directive on social distancing as it whittled the CCL staff to a core team when treating a COVID-suspect or -positive patient. It allowed the staff to specify roles and responsibilities clearly and streamline procedures such that all members of the team were able to contribute to the management of the patient. Also by isolating the procedure to be done in a single room, the CCL was able to prepare the lab and allocate materials in a single area to avoid unnecessary exposure and waste.

The adaptation of the clustered team approach allowed adequate isolation and an added layer of protection for the hospital staff, especially at the beginning, while still maintaining a functioning CCL at the hospital. However, the concomitant assignment of the specialized healthcare team to different wards as support to the hospital workforce which led to further adjustment to schedules conflicted with this clustered team approach, but this fortunately ended after a year. The gradual adjustment to the pandemic as well as the decrease in COVID numbers have led the staff to return to the CCL full time and in full capacity.

CONCLUSION

The impact of the COVID-19 pandemic to the health care system and CCL has been immense. The caseload of the CCL was significantly reduced for both urgent and elective cases, but has steadily increased in recent years. The preparation of the CCL to become pandemic-capable and crisis-ready has been difficult and faced many challenges. However, the innovations and adjustments done through the efforts and ingenuity of the CCL healthcare team allowed continuous delivery of the highest level of care to patients in spite of the changing pandemic landscape. These changes were carefully and thoroughly documented as a basis for response to possible future global and/or national healthcare crises.

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