ORIGINAL ARTICLE

RADIOLOGICAL ASSISTANCE IN MANAGING WORKFLOW IN MEDICAL AND SURGICAL INDICATIONS AT SHIFA INTERNATIONAL HOSPITAL IN COVID-19 PANDEMIC

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Background: Novel Corona Virus took the world by storm under the name of COVID-19, metamorphosing the whole health care structure and alienating what we the medical community considered normalcy. The sudden unexpected need for social distancing resulted in dire dependency on imaging for expert diagnosis and management. The purpose of the present study is to describe in-depth strategies that were taken by radiology department at our hospital as a part of a coordinated hospital system-wide response in managing workflow of patients presenting to our hospital for various medical and surgical semi-urgent/urgent indications requiring hospital admission. This article may assist and provide guidance for preparation and management for other radiology departments in the early stages or in dire need of providing services in a secure environment, especially in low-income countries such as ours, while maintaining the quality of radiological reports, dealing with increased workloads. It was a descriptive qualitative study, conducted at Shifa international hospital, Radiology Department, from 28 March to 5 June 2020. **Methods:** After approval from IRB, a descriptive qualitative study was carried out, which included all patients regardless of age or gender who underwent radiological imaging including CT and radiograph chest, at our department from 28 March to 5 June, 2020. **Results:** Overall, on a yearly basis, the number of CT scans decreased 30% (total), 53.4% (OPD), and 0.61% (IPD), respectively, in 2020 when compared with figures in 2019. However, no. of HRCTs performed were significantly increased compared to 2019, in same months 568 (0.09%), compared to 2020 where a majority of total CTs performed were HRCTs for COVID alone. **Conclusion:** The radiology department plays a central role in streamlining the patient inflow admitted for surgical or medical indications and thus needs to be prepared for patient surges and increased volumes, with large influxes of patients to the emergency department that will require diagnostic imaging and interventional services.

Keywords: Radiology; Workflow; COVID-19

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INTRODUCTION

Novel coronavirus was officially declared a pandemic by the World Health Organization on 11 March 2020.[1] By 26 February 2020 virus was confirmed to have reached Pakistan. As of 4 June 2020, there have been 85264 confirmed cases with recovery no. of 30,128 and 1770 deaths.[2] Amidst rising coronavirus disease 2019, there was a need for an objective approach to identify patients in need of hospital admission rapidly. The authors' hospital is a 500 bedded general medical centre. As a quick response to the outbreak of novel coronavirus, 135 beds were dedicated for positive COVID 19 patients, which included medical, surgical ICUs, high dependency units (HDUs) and a general ward. Eighteen beds were allocated for patients who were suspected but awaited PCR results. Under Hospital Leadership Committee, in collaboration with the infection control department, the hospital underwent infrastructure and workflow modifications to prepare for the outbreak. It was of utmost importance to acclimate our practices and be prepared to assess a vast number of patients. Since radiology is central within the healthcare diagnostic and delivery environments, we need to be ready for patient surges and increased volumes, with expected large influxes of patients to the emergency department that will require diagnostic and interventional procedures[3]. We, as radiologists, can help clinicians at the battlefront identify patients who do not require hospitalization and can be managed at home conservatively and thus secure the active hospital care and beds for the critical patients[4]. Role and aptness of chest radiographs (CXR) and computed tomography (CT) for the screening, diagnosis and

management of patients with suspected or known COVID-19 infection is paramount in current scenario.[3,5] Promoting to this appeal are short supply and availability of viral testing kits to date, apprehension for sensitivity of tests, and the time delay in test results, which takes between 6 hours up to 3 days.[6] Our study describes the key role of radiology in streamlining the patient inflow at our hospital admitted for surgical or medical indications. Also, we describe organizational measures that can be taken within radiology departments in order to handle the incursion of patients while expertly subsisting to manage other emergency and high priority cases, especially when the second wave of this deadly pandemic is expected.

MATERIAL AND METHODS

After approval from the institutional review board, a descriptive qualitative study was carried out in our department of Diagnostic Radiology, which all patients regardless of age or gender who underwent radiological imaging, including CT and radiograph chest, at our department from 28 March to 5 June 2020 were included in our study. During the same dates in 2019, data was collected of patients who underwent CT and radiograph chest imaging from our hospital's Radiology information system(RIS). Percentage analysis was used for the interpretation of primary data.

RESULTS

Neither staff working in radiology, including doctors and nursing aides nor patients with confirmed COVID-19 disease, have developed hospital-acquired infections. However, 3 of our patient transporters became positive at the start of June and had to be quarantined.

A total of 4095 CTs (Figure-1), including emergency cases, were performed between 28 March and 5 June 2020. In-patient CT scans were 2582 (63%), out of which 1571 (60%) scans had been performed from emergency department. Rest of scans, shown as OPD cases on our database, majority of those had been performed on sub emergency and cannot be delayed indications. CT performed for the purpose of diagnosis and management of COVID cases alone were 1978 (76%) and CT chest with contrast including CT pulmonary angiographies being 70 (0.02%).

During the same period of 2019 (Figure-1), 5847 CTs, out of which 2598 (44%) scans were of admitted patients and 1020 (39%) scans had been performed through ER department. The number of out-patient scans also dropped dramatically in 2020. On a yearly basis, the number of CT scans decreased 30% (total), 53.4% (OPD), and 0.61 % (IPD), respectively in 2020 when compared with figures in 2019. However, no of HRCTs performed were significantly increased compared to 2019, in same months 568 (0.09%), as compared to 2020 where the majority of total CTs performed were HRCTs for COVID alone.

Similarly, there were a total of 15860 radiographs performed, out of which 9307(58%) were in-patient and 2609(28%) came through ER.

In the same period, a total no. of 7550 radiographs were performed; out of which in-patient radiographs reported were 6106(80.8%) while through emergency 1757 (28%) radiographs were reported out of which 1157 (65%) were CXRs.

No. of radiographs in the year 2020 decreased 52.3 %(total), 34.4 %(OPD), and 78% (IPD) from 2019 in same dates.

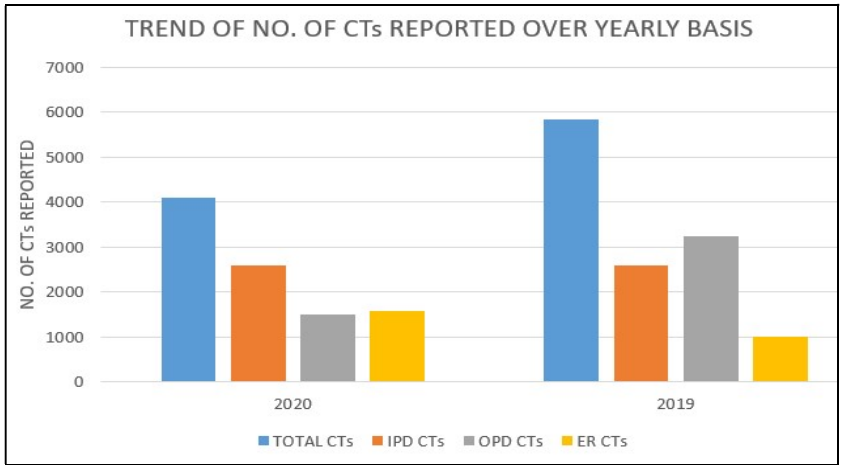

Figure-1: Graphical representation of no. of CTs reported from 28 March 2020 to 05 June 2020 vs exact dates in 2019

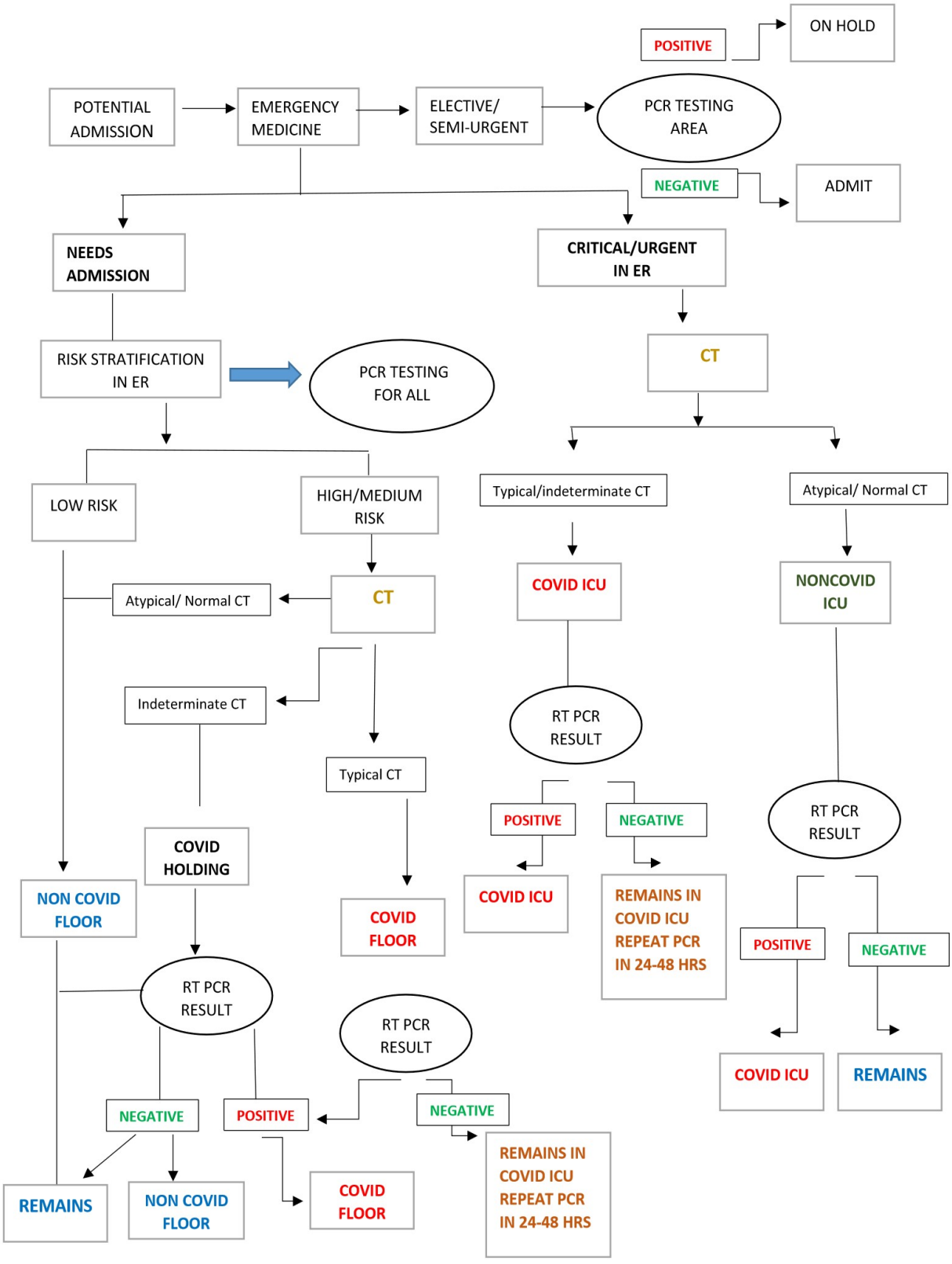

Figure-2: Proposed workflow plan for medical indications

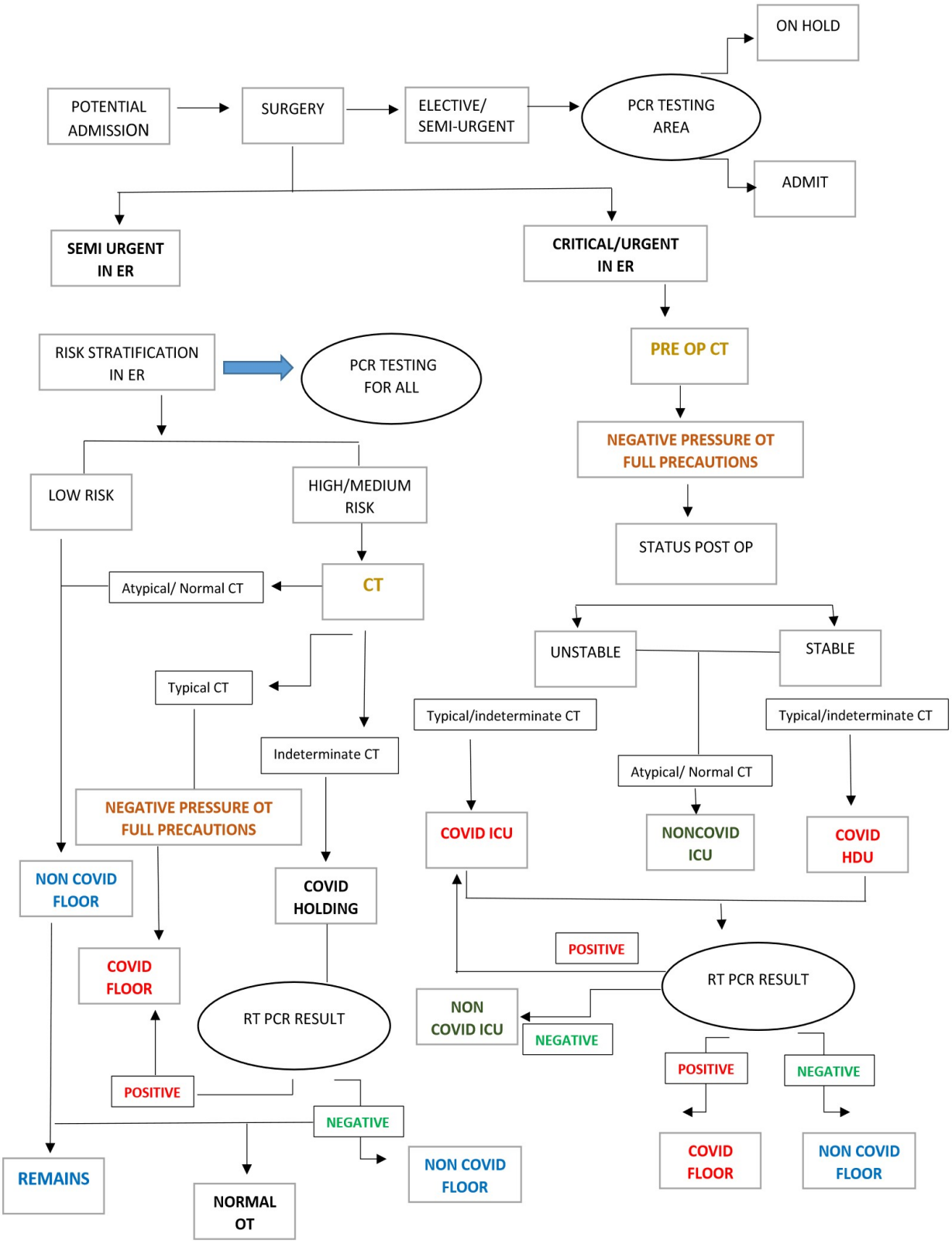

Figure-3: Proposed workflow plan for surgical indications.

DISCUSSION

In the wake of COVID 19 being declared a pandemic, we were not prepared for its implications. However, with the first couple of suspected patients, our hospital rapidly developed a workflow system to aid in diagnosing and managing patients presenting to the emergency department. Out-patient departments were closed, and ER department was extended. Patients were graded according to symptoms and then sent to ER triage, a negative pressure isolation room. Due to initial non-availability of testing kits at our hospital, tests had to be sent to an outside government facility and took three days for confirmation of results and later, the time delay in test results which took almost 6 hours, CT chest was decided to be used as first investigation especially in suspected or probable cases.[4,5] This was a phase of pure radiological dependency on deciding the fate of suspected patients, especially those who required hospital admission. A special low dose HRCT code (kVp: 100-120, mAs: 20, slice thickness: 1–2 mm) was generated by the name of CT-COVID.[6] It was used for all the patients having COVID 19 pneumonia symptoms, presenting to ER department. Later this code was also used for the patients who required hospital admission for either medical or surgical indications without having symptoms. This code was also used as complimentary scan in patients who required CT imaging for other reasons than diagnosis of COVID 19 pneumonia. Out of 3 CT scanners, 1 CT scanner with purposely in-built negative-pressure airborne infection-isolation room situated just next to ER department was dedicated for COVID HRCTs. Patients were directed through an alternate corridor that bypasses main corridor with heavy foot traffic and the usual patient contact. For scans coming through ER, STAT reporting time of 30 minutes was decided. CT technician would perform the scan and inform the resident rotating in CT that particular day or on-call resident during off duty hours. After reviewing the scan with a consultant, the resident would classify it as typical, indeterminate, atypical or negative according to RSNA guidelines[7] and inform the primary physician if the case turned out to be typical or indeterminate, reinforcing the need for confirmation with PCR testing. A critical alert was also raised in such cases with a disclaimer that this report has critical findings that may affect patient outcome, seen as a red tab on our radiology database (RIS), highlighting its importance. Only then the patient would be moved out of the CT suite and back to ER. Afterwards, deep cleaning and sterilization of CT suite would be carried with room locked for 1 hour. This allowed the normal functioning of the rest of the pre-existent pressurized departmental scanners. Also, due to government restriction and lockdown, the usual load of CTs through OPD referrals and non-urgent causes was decreased; hence, it was possible to entertain a large number of CT scans from the emergency department and follow proper sterilization protocol as well at the same time.

Our department developed standard operating procedures (SOPs) in the initial phase with structural changes to accommodate portable CXRs and ultrasound along with CT imaging facility and safe patient transfer.[8] These included systems for clinicians to raise a red alert for high-risk COVID-19 patients, training of radiological staff, reinforcing the need for disinfection, sterilization of contaminated areas, and pre-notification of cleaning teams.[9] In the next phase, strictness upon restrictions and controls were upgraded meticulously in our department, and regular hospital service was reduced to a minimal level to guarantee maximum interception of cross-transmission.[10] Currently, we are resuming non-urgent care services simultaneously, dealing with the pandemic's peak in our country. During this period, our priority has been patients coming through the emergency department and requiring in-patient admission[10]. Mobile portable imaging units were preferably used to reduce patient transportation, which required less surface area for cleaning and sterilization, also limiting staff at risk.

By mid-April when we had a relatively better grasp of the dynamics of novel coronavirus. Due to the discouragement of CT to be used as screening tool[3,4] and our dedicated COVID CT scanner malfunctioning, we slightly altered our strategy and introduced a portable radiograph chest as a new screening tool. It was cheap with less risk of cross-infection due to dedicated portable radiograph machines which were also easier to clean and sterilize. The same time limit of 30 minutes was applied to chest radiographs, especially those coming through the ER department and STAT reporting was done on an urgent basis by the radiologist during duty hours and on-call residents after Radiologist consultation and review during on-call hours. Pediatric population was also screened through chest radiography since CT is not recommended[11]. Regardless of difficulties faced due to improper patient positioning, AP technique and exposure factors, we successfully identified typical and negative patients. However, in patients with atypical appearance, pulmonary edema or cardiac causes, it was difficult to exclude or confirm COVID pneumonia. Hence in atypical cases, patients having multiple co-morbids especially oncological disease and those who required emergency interventional or surgical procedures were evaluated through CT. Later

due to the high no. of false-negative results and availability of rapid testing PCR, screening through chest radiography was discontinued.

After introducing RT PCR in our hospital, a screening triage system was introduced, which included PCR testing, HRCT chest, and clinical assessment for risk stratification for the patients present to the emergency department (Figures-2 and 3). In this phase, CT was used as a part of the screening process, changing dependency to assistance.[3,5,6,12] In urgent or semi-urgent conditions requiring immediate hospitalization for either medical or surgical indications, CT was the preferred modality while waiting for RT PCR results taken for all patients requiring admission regardless of clinical suspicion of COVID.[6,13] Patients requiring urgent surgical intervention with typical or indeterminate CTs were shifted to operation theatres (OT) having negative pressure facility with full precautions and afterwards into intensive care units or high dependency units on dedicated COVID floors.[14–16] Patients with other semi-urgent non-intervention requiring surgical indications having typical findings on CT were straightaway shifted to COVID floors. However, those patients who had indeterminate CT findings were kept in a COVID holding area until RT PCR characterized their COVID status. If it came out to be positive they were shifted to COVID UNIT, and in cases of negative PCR, these patients were moved to the required regular floor. At the same time, low-risk patients with atypical or normal CT findings were admitted to standard beds. Once the RT PCR results were in, again scrutiny was done, and patients were shifted to respective floors.

Tan BP *et al.* [17] and Wen Z *et al.* [18] describe similar use of chest radiography with CT scan as the only time saving analytical and methodical tool which was used to deal with large patient influx with rapid radiological reporting, further aiding the process of patient diagnosis and management.

Mendel J[19] recommends using portal chest radiography for low income having medium to poor socioeconomic conditions as a cost-effective method.

Zhu HD *et al.* [20] describe the modifications at their interventional radiology department divided into 3 phases in which they adapted according to the need of each phase. During the early stage in preparation for the COVID pandemic, they underwent mainly infrastructure alterations while allowing elective cases. During the next phase in which the no. of positive cases had peaked in their region, they put up strict restrictions only catering to emergency cases and sub-emergencies in which delaying treatment would seriously impact patient outcomes, similar to the policy goal which our department has been following. In the last phase, with the decrease in no. of newly infected cases, they have been trying to resume the normal radiological services.

CT scan combined with conventional chest radiography is a definite problem-solving tool that acts as a frontline warrior to combat the sly SARS-Coronavirus's unpredictability, assisting vanguard clinicians in rapid triage and identification of critical patients. We recommend that these imaging modalities be used in conjunction with rapid to the point radiological reporting according to terminologies used in guidelines to accentuate patient protection and solidify our defences in the battle against novel coronavirus.

CONCLUSION

A multilayered defence system is needed to prevent possibly disastrous nosocomial spread of transmission of infection. Health care services can quickly collapse under a combination of large patient influx and compromised infected staff. Extreme caution and commitment to following set protocols is vital for the safety of our patients and families. The radiology department is indispensable for survival in the face of this unprecedented challenge playing an essential role in the risk stratification and screening process, saving time and energy better spent on the care of critical patients. Since the second wave of this deadly virus is expected, this pathway implemented in our hospital can help streamline the workflow of patients needing admission and prevent further spread of infection in hospital staff and patients.

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AUTHORS' CONTRIBUTION

LM, SG, and AIR contributed to the conception and design of the study. SBZ, MSW and SA contributed to data collection. LM, SG and SBZ contributed to the analysis and interpretation of the data and the manuscript's drafting and critical revision. All the authors have read and approved the final version of the manuscript.

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