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RESEARCH ARTICLE

SYSTEM STUDY OF BEST PRACTICES IN A COVID HOSPITAL

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Abstract

The declaration of COVID-19 as a pandemic disease by WHO has led to drastic changes in the healthcare environment within a short span. These changes were also dynamic requesting an efficient leadership skill to adopt and implement the changes demanded. This system study was carried out in a Cardio-Thoracic tertiary care hospital treating COVID patients, to identify the problem faced during various phases and their good practices along with their adherence to the National & International guidelines. It is a descriptive observational study carried in the hospital along with document study and interview of the staff involved in COVID management. This study concludes that an effective leadership with structured organogram in a healthcare setup during a disaster like COVID-19 pandemic could drastically improve the healthcare management both clinically and administratively, provided the resources are optimally used and the workforce strictly adhering to the hospital policies and guidelines.

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Introduction:-

After 100 years of the dreadful Spanish flu pandemic, the world is battling again another flu pandemic – the SARS-CoV2. WHO declared this outbreak as Pandemic on 11 Mar 2020, which originated in Wuhan, China. It has now spread to more than 140 countries and has crossed 1.5 crores confirmed cases including 6,28,903 deaths worldwide⁽¹⁾. The typical symptoms of COVID-19 disease are fever, sore throat, fatigue, cough or dyspnoea coupled with recent exposure. Though various studies and clinical trials claim their cure to the disease, none could promise till date to control the disease as compared to classical public preventive health measures.

The first case of COVID-19 reported in India on 30th Jan 2020 in Kerala followed by first death in Karnataka on 12th Mar 2020⁽²⁾⁽³⁾. This rapid spread has reached 12,87,945 confirmed cases including 30,601 deaths as on 24th Jul 2020⁽⁴⁾. However, the rate of spread of infection is lower compared to other countries due to various measures taken by the Government and Healthcare Organisations⁽²⁾. Initial and consequent lockdown measures provided the healthcare system to prepare for the battle as well as to control the rapid spread of the disease.

Envisaging the situation, the Cardio-Thoracic tertiary care hospital took swift actions to convert itself to a COVID hospital within a short period. While facing multiple teething issues, especially during the initial lockdown, the hospital became ready to accept 400 COVID patients including those requiring critical care since 28 Mar 2020.

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Aim:

To study the best practices at a COVID hospital in Western Maharashtra

Objectives:-**The Objectives of the study are:**

1. To study the structure, process and outcome of a COVID hospital
2. To study the problems faced and good practices followed in the COVID hospital

Methodology:-**Study Design:**

Observational & Descriptive study

Period of Study:

The study was carried out for a period of one week (06 Jul 2020- 12 Jul 2020)

Study Instruments:

1. Direct Observations were carried out for physical structure and process in the COVID hospital
2. Study of documents was carried out for outcome measures in COVID hospital
3. Interview of staff was carried out for the problems faced and its management at various phases
4. Study of National & International guidelines applicable to COVID hospitals

Observations:-**Structure:****Physical structure:**

Envisaging the existing COVID situation, the Super-speciality hospital converted its existing wards into Isolation wards and acute surgical ward into Isolation ICU & High dependent unit (HDU), which had existing Medical gas pipeline system (MGPS). 400 bedded COVID hospital was established within a short period without affecting its primary role in treating Cardio-Thoracic patients. Filter OPD clinic was established in an open parking area near the gate to screen the patients visiting for cardio-respiratory illness. The admission of COVID cases was streamlined centrally from the referral centres.

Wayfinding and signage are very important environmental communication to the patients, which were adequately placed from the entrance till the COVID reception. Separate entry and exit were provided for patient and staff. Zoning of the hospital was done deliberately to have a functional barrier between COVID & Non-COVID area. The briefing of the route to ambulance drivers was done in advance along with the route chart (Figure-i).

This interconnected multistoried building along with the 120% circulation space provided the advantage to establish the COVID hospital. Six wards located in the 3rd and 4th floor were converted to Isolation wards (Figure-ii). Beds were laid out in Nightingale pattern (Figure-iii) with more than 1.5 m distance between two adjacent beds to avoid the spread of air droplets. Each Isolation ward has a maximum capacity of 40 beds with PASA classification (Primary, Auxiliary, Sanitary & Ancillary area). Window screens, blinds and unwanted tables were removed to reduce the fomites in the wards. Doffing area was also created in each ward where partial doffing was being done after the duty.

ICU and HDU were established on the 2nd floor with 20 and 30 beds respectively (Figure-iv). Triage and Central Donning area were also created on the same floor by converting the other wards.

Each ward is equipped with the required medical and non-medical equipment (Table-1). The ICU & HDU also had equipped adequately with the equipment (Table-2). In addition to 22 ventilators, 9 ventilators for the COVID hospital were donated by Non-Government Organisations (NGO).

Manpower planning was carried deliberately and additional manpower was sought from the nearby teaching hospital. Teams were made with 8-hour shift and not more than a week duty for any healthcare staff. Staff members of the team for ICU/ HDU and wards are shown in Table-3 & 4. Additional staffs were also planned considering the

requirement for an increase in workload. Apart from these, each floor has a dedicated floor-in-charge and housekeeper for co-ordination & sanitation purposes respectively.

Transportation:

Lifts:

This well-planned hospital had an adequate number of lifts which provided the advantage of separate lifts for patients, staffs, dietary and linen & laundry services. These lifts were decontaminated with 1% hypochlorite solution spray periodically and after every admission of new patients.

Ambulances:

Earmarked separate ambulances were used for COVID services and disinfected with 1% hypochlorite solution spray after each use.

Dietary cart:

Separate food trolleys were provided to each floor which was also decontaminated before sending from the ward and at the cookhouse.

Laundry vehicle:

Infected linen & laundry are carried from ward/ICU, after disinfection by soaking in 1% hypochlorite solution for a minimum of 45 minutes, through the separate lift to the ground floor by two earmarked persons with full PPE. They were carried separately by closed laundry vehicle till mechanical laundry and the same staff loads it to the laundry machine. The washable scrub suit used by the staff was also carried by the same vehicle to laundry.

Process:

Screening:

Filter OPD clinics were established to screen the patients for COVID-19 attending the speciality hospitals and sending them to Flu clinic. These patient's history and symptoms were elucidated for COVID and investigation were carried out for the suspected cases at the Pathology department. If the suspected patients' report were negative, they were quarantined for 14 days at 100 bedded quarantine facility which was established at the Teaching hospital. COVID-19 positive patients were referred to this COVID hospital centrally and transported through dedicated ambulances coordinated by COVID Nodal officers for further treatment.

Quarantine:

Quarantine policy has been made into the following categories with the guidelines of Govt & Institutional management policies.

- (i) 14 days of institutional quarantine for staff & other workers.
- (ii) 7 days home quarantine after three days of symptom-free hospital stay for staff dependents and civilians

Regular quarantine of healthcare workers (HCW) after performing duty in COVID-19 areas was not warranted until specified in special circumstances like exposure/breach of PPE or symptoms suggestive of COVID-19.

Transfer-in / Admission:

Only COVID-19 positive patients were admitted in COVID hospital through referrals by Nodal officers. Nursing & Ambulance Assistant (AA) reaches the reception area in full PPE, once the intimation of patient arrival is made. The ambulatory patients were guided to the Triage area and critically ill patients to ICU through the patient lift. Patient history recording, vitals monitoring and treatment plan were carried out in the Triage area before sending them to wards. Female patients were accompanied by a female attendant during the examination.

Ward Management:

Stable COVID-19 positive patients were admitted in Isolation wards. Temperature and pulse oximetry oxygen levels were checked for each patient every 4th hourly with constant monitoring. Treating clinicians assess the status of each patient daily for further treatment and disposal. Treatments for co-morbid conditions were also continued simultaneously. Soiled linen & laundry were pre-treated with 1% hypochlorite solution at least for 45 minutes before sending it to Mechanical laundry. Food to patients was distributed in their beds to avoid congestion & clustering at the pantry. Dietary carts were surface cleaned with 1% hypochlorite solution before sending it back to the cookhouse. Close monitoring of drug indent and dispense was also carried in Isolation wards.

ICU/HDU Management:

Patients were admitted directly or transferred-in when they are unstable & critical. Depending on the requirement of Ventilator support the patients were placed in ICU or HDU, where the earlier provides ventilator support. Intensivist and Postgraduate residents were constantly available for medical support to critically ill patients. Full PPE were provided to all the staff involved in treating patients. The main challenges faced by staff in ICU / HDU was working in full PPE for 8 hours under the physiological challenges like heat exhaustion, reduced visual field, auditory acuity and tactile inputs.

Discharge:

This COVID hospital follows the Ministry of Health & Family Welfare (MoHFW) guidelines for discharge after treatment of COVID-19 patients⁽⁵⁾.

Personal Protective Equipment (PPE):

PPE are protective gears designed to safeguard the health of workers by minimising the exposure to a biological agent. The basic components of the PPE kit are facemask, gloves, overall gown, shoe cover, facial shield and surgical caps. The COVID hospital with the help of WHO⁽⁶⁾ & AIIMS⁽⁷⁾ guidelines for rational use of PPE, formulated its own list of PPE components for various staff for additional safety (Table-5). Partial doffing was carried at ward and ICU/ HDU i.e. removal of highly contaminated PPE components like outer gloves, shoe cover, face shield, outer face mask, gown, disposable cap following hand hygiene with alcohol-based disinfectant at each step which were deliberately monitored with the help of a trained person. Along with donning & doffing area, separate bathing areas were also provided with clean towel and soap for mandatory bathing before leaving the Red - COVID zone. The temperature of all staffs was monitored before and after their duty hours.

Bio-Medical Waste (BMW) Management:

Guidelines of Central and State Pollution Control Board on BMW management⁽⁸⁾ were followed by the COVID hospital for handling, treatment and disposal of BMW generated during treatment/diagnosis/quarantine of COVID-19 patients. These wastes were collected in double-layered yellow bags at wards & ICU/HDU, centrally collected at each floor, supervised by the floor in-charge and handed over to Common Biomedical Waste Treatment & Disposal Facility (CBWTF) agency. The staffs involved in handling these wastes were provided with full PPE kits. The trolley used were disinfected with 1% hypochlorite solution spray after unloading and before sending them to the wards & ICU/ HDU.

Infection Control:

National guidelines⁽⁹⁾ were followed for Infection control practices in the COVID hospital. Housekeeping staff in full PPE were provided with 1% hypochlorite solution to carry out environmental cleaning. Floor mopping and surface cleaning of high touch areas were done continuously every 4th hourly. As precautionary measures curtains, blinds and table cloth were removed to reduce the fomites. Toilets were also cleaned with hypochlorite solutions. Soiled linens were soaked in 1% hypochlorite solution for at least 45 minutes before sending to laundry. Instruments and equipment were disinfected with an alcohol-based solution after and before use on each patient.

Linen & Laundry:

A separate laundry machine was being used for COVID infected linen & scrub suits. These pre-treated soiled clothes were carried in a closed laundry vehicle by staff in full PPE and loaded in the laundry machine. These laundries were washed, dried and pressed in batches and send back to isolation wards & ICU/HDU. Scrub suits which are part of PPE, after washing was sent for autoclave sterilisation and later to Central PPE section for the issue.

Dietary:

The pre-treated dietary cart disinfected at ward were again surface cleaned with 1% hypochlorite solution and kept in open for 30 minutes. Based on the demand from each ward, these dietary carts were loaded and sent to various floors through the dietary lift.

Prophylaxis:

All the staff involved in COVID management were provided with Hydroxychloroquine (HCQ) prophylaxis as per the ICMR guidelines⁽¹⁰⁾ and a separate register was maintained for its continuation and follow up.

Dead body disposal:

Standard Operating Procedures(SOP) were formulated with the help of guidelines of MoHFW⁽¹¹⁾ and ICMR⁽¹²⁾. The corpses were packed in leak-proof double-layered bodypack. All the orifices, puncture holes and wounds were disinfected with 1% hypochlorite solutions and plugged with impermeable material. The pack was again disinfected with hypochlorite solution and wrapped in a plastic sheet to avoid any leak. The corpses were temporarily held in mortuary till it was handed over to the authorised health representative of Regional Civil Authority for cremation/burial. As per the guidelines, the corpse is handed over to regional civil authority in presence of next of kin (NOK) and police. The ashes after the cremation were handed over to NOK for religious rites, as it doesn't pose any health risk. Death audit format was duly filled by treating physician.

Outcome:

1. The Statistics of the COVID hospital were compared with the Regional and National data (Table-6). The case fatality rate (CFR) of this COVID hospital was slightly higher compared with both State CFR and National CFR. The Recovery rate of COVID patients in this COVID hospital was better than both State & National Recovery rate.
2. The admission, discharge and death pattern since admission is shown in Figure-v. This shows the initial lockdown period had good control over the spread of infection, but the same increased when the lockdown diluted.
3. The graph of category wise admission is shown in Figure-vi.
4. The COVID-19 death data reflects that most of the death cases belong to elderly adult & old age group with other co-morbid conditions.
5. The average length of stay (ALOS) for discharged patients was calculated and found to be approximately 10.4 days.
6. The staff infection rate of this COVID hospital was found nil due to strict compliance of the guidelines.

Problems faced:-

Few problems were faced during initial setup like power failure due to heavy load by the Ventilators, Staff reluctance to work inside wards & ICU especially the housekeepers, delayed procurement of equipment & drugs due to initial lockdown, etc.

Best Practices Observed:-**Leadership:**

The need and timely decision to convert this super-speciality hospital into COVID hospital were achieved by the experienced Top-level Leadership. Once the hospital was decided to establish a 400 bed COVID hospital, the Institutional Head addressed all the stakeholders, involved in COVID management. He kept constantly motivating the staff and providing authority to act in critical situations.

Organogram:

The existing organogram in this hospital with few shuffling added the road towards the success in battling the pandemic. This clear channel of communication and job specifications of each individual helped the COVID managing staff function smoothly.

Flexibility of Plans:

Depending on the volume of admission of patients the hospital also had a step-up plan to open up more wards and deploy staff as per the facility being opened up. This flexibility of plans prevented exposure of staff until the need arises as well as conserves PPE kits.

Zoning of the Hospital:

Along with COVID management, the hospital also carried out its primary role in treating cardio-respiratory cases. There was a functional barrier created to avoid crossing over of traffic. Zoning of the hospital was carried out to restrict the traffic into Red - COVID area, Yellow - possible cross over of COVID cases and Green - Non-COVID area. Based on these zoning the healthcare workers were advised to wear protective N95/triple layer surgical mask and gloves.

Training of Staff:

Training of staff was carried out in batches for postgraduate residents, nurses, nursing & ambulance assistants, housekeeping staff and administrative support staff. The training was conducted centrally on specific topics like COVID-19, prevention, PPE usage and sanitation.

Support from NGOs & Philanthropists:

Nine (09) Transport Ventilators were donated by Gurudwara Sahib and Rotary Club to this COVID hospital as a good gesture to fight against COVID-19. Also, small quantities of masks & PPE kits were also provided in the initial days of lockdown.

Hydroxychloroquine Prophylaxis:

HCQ prophylaxis was given to all healthcare staff as per ICMR guidelines and the same was recorded in the register for continuation & follow-up.

Triage Area:

Examination of COVID patients in the Triage Area before admitting in the ward/HDU/ICU provides additional information for the treatment plan. Simultaneously information about COVID, Do's & Don'ts for COVID in the ward were also briefed in advance.

Full PPE kits

To Healthcare workers: As a safety measure, all the staff including housekeeping staff were provided full PPE kits to fight against COVID. To ensure safety, 90GSM over gown/ coverall which was spill-proof, breathable and single-use were procured and issued to healthcare staff.

Reuse policy of Goggles:

Industrial goggles were procured in bulk which was large enough to prevent eye contamination from contaminated spill. These goggles also prevented the entry of body sweat by their snug fit. These silicon goggles were reused after double disinfection by keeping overnight in 1% hypochlorite solution and cleaning with an alcohol-based solution.

Extended use of N95 mask

In Yellow zone: The COVID hospital follows the AIIMS policy of extended use of N95 mask for healthcare staff working in the yellow zone. Five N95 masks were given in different numbered envelopes which were to be used in cycles. A fresh set of N95 masks were issued every month.

Scrub suit & Triple gloves system:

In addition to MOHFW advisory on PPE, the hospital provides scrub suit & extra gloves to safeguard healthcare staff against COVID. These scrub suits were also autoclaved before issuing to the staff ensuring sterility.

Diet advise & refreshment system:

Based on the experiences, high protein – low fluid diet was advised for the staff who were engaged in ICU/HDU/Ward. This advice aided the staff to work for 8 hours continuously without any discomfort. All workers were provided refreshments after their duty shift at the doffing/ donning centre.

Coordination & Supervision

Of all COVID activities: Nodal officers of the COVID hospital and referral hospitals along with the COVID Help cell coordinated all the activities related to COVID management from transportation, admission till discharge. Floor in-charges were detailed for smooth coordination and supervision of all the activities of wards& ICU/HDU. Coordination with District Commissioner's office/ PMC and CMO was also maintained as part of the aid to civil authorities.

Conclusion:-

This study concludes that an effective leadership with structured organogram in healthcare setup, during a disaster like COVID-19 pandemic, could drastically improve the healthcare management both clinically and administratively, provided the resources were optimally used and the workforce strictly adhering to the hospital policies and guidelines.

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Nil

Conflicts of Interest:-
None declared

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Figures & Tables:

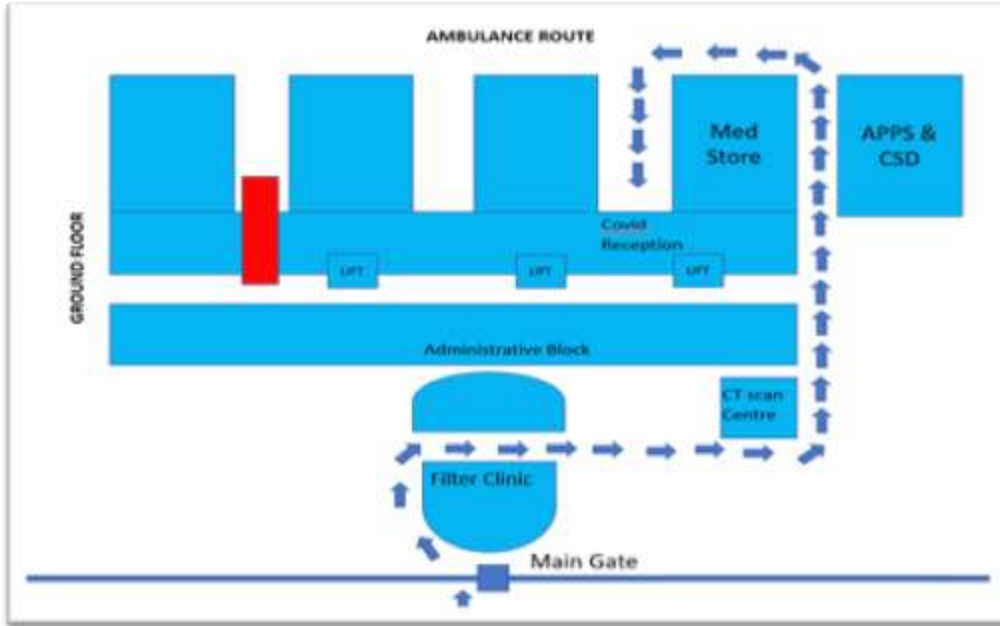


Figure-i:- Ambulance Route Chart.

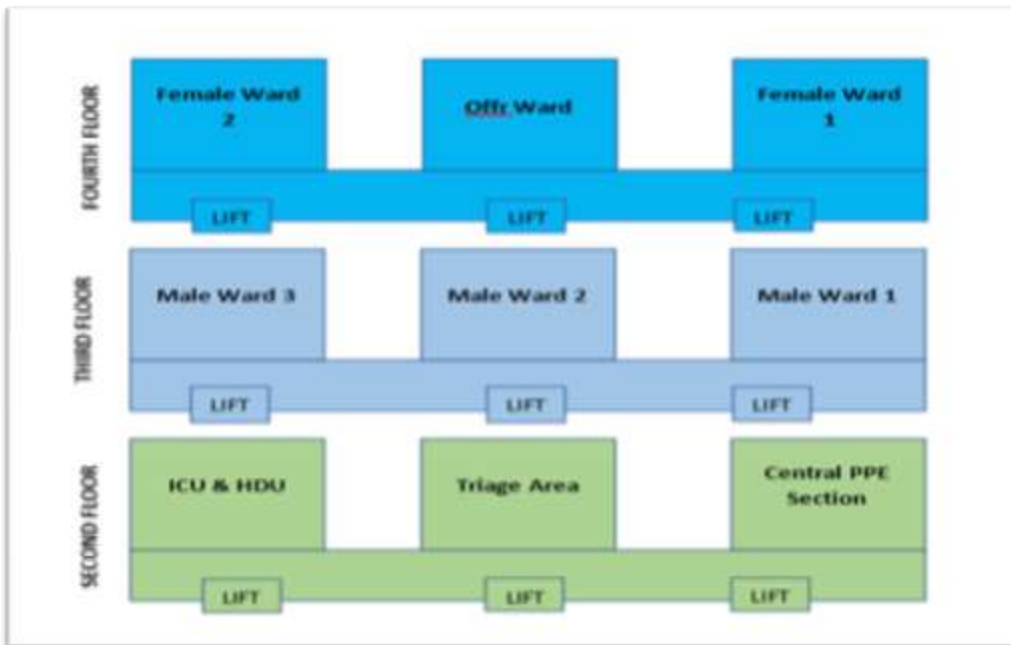


Figure-ii:- Layout of Ward & ICU/HDU.

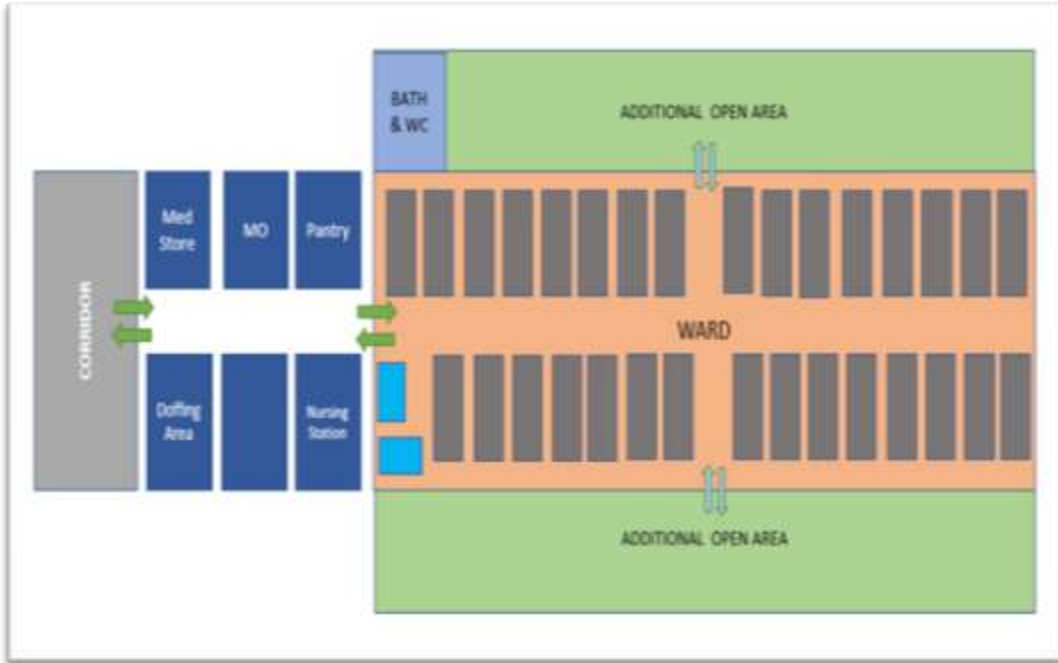


Figure-iii:- Layout of Ward.

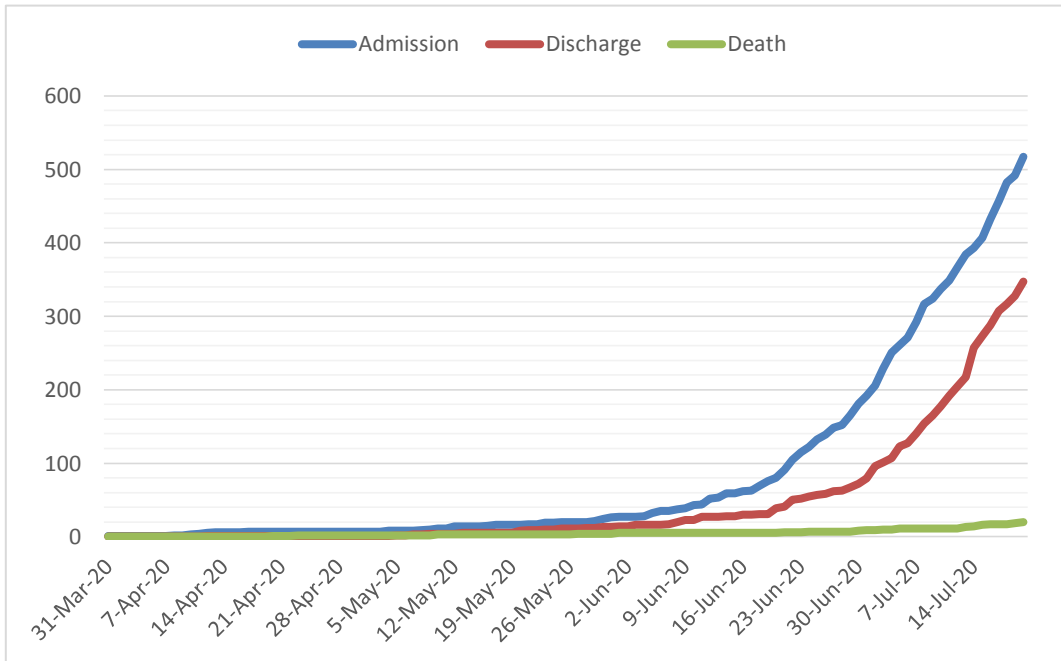


Figure-iv:- Layout of ICU & HDU.

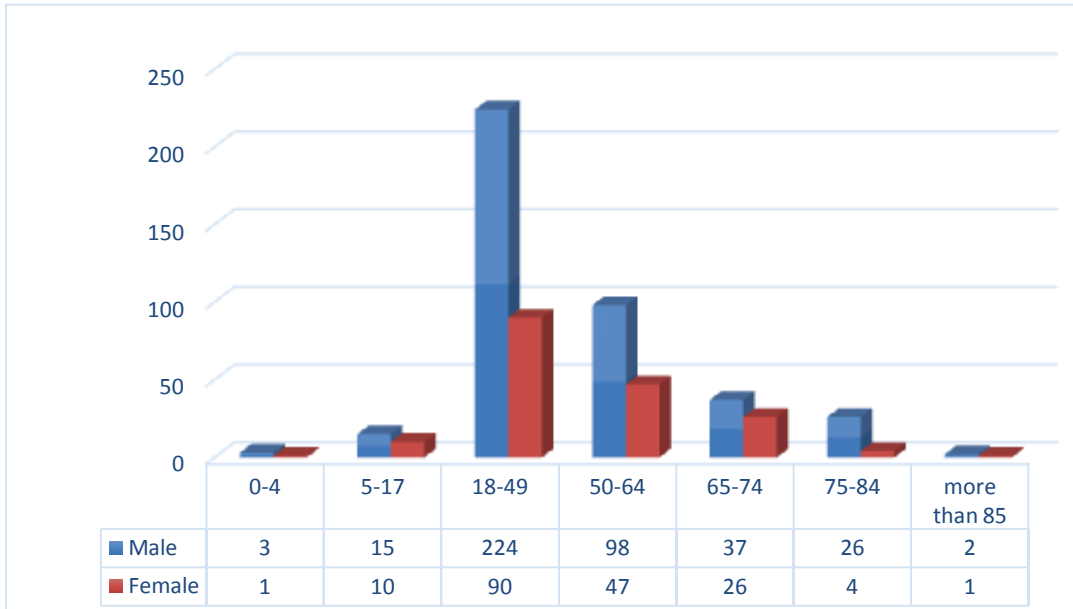


Figure-v:- COVID-19 - Admission, Discharge & Death pattern.

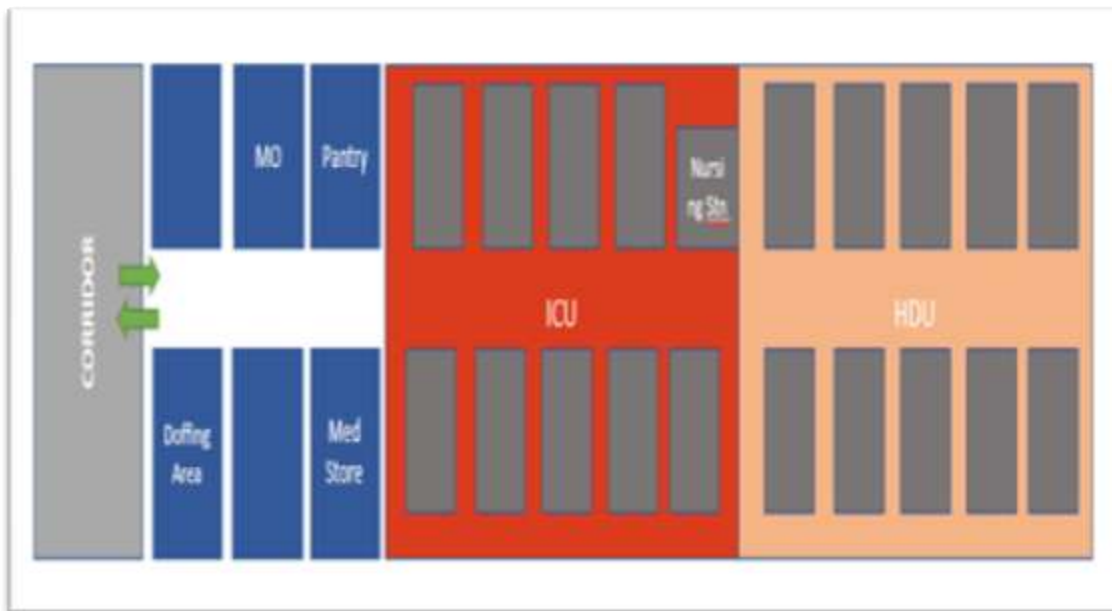


Figure-vi:- Admission pattern of COVID-19.

Table-1:- List of equipment in Wards.

Sr No	Equipment
a)	Oxygen Cylinder & Oxygen concentrator
b)	Pulse Oximeter
c)	NIBP
d)	Multipara monitor
e)	Crash cart with Defibrillator
f)	ECG
g)	Labelled medicines
j)	Virus Transport Media (VTM)

k)	Telephone
l)	Water dispenser
m)	Food trolley & Laundry cart – one for each floor
n)	Oxygen Cylinder & Oxygen concentrator
o)	Pulse Oximeter
p)	NIBP
q)	Multipara monitor
r)	Crash cart with Defibrillator
s)	ECG
t)	Labelled medicines

Table-2:- List of equipment in ICU/HDU (Additional).

Sr No	Equipment
a)	20 ventilators
b)	09 transport ventilators
c)	Portable ECG
d)	Portable USG
e)	Intensive care medicines

Table-3:- Staffing of ICU/HDU.

Sr No	Category	No's per shift
a)	Intensivist / Anaesthesiologist	01
b)	Physician	01
c)	Resident Anaesthesiology	01
d)	Resident Medicine	01
e)	Nursing Officer	3 (01 for 06 patients)
f)	Nursing Assistant (NA)	3 (01 for 06 patients)
g)	Ambulance Assistant (AA)	3 (01 for 12 patients)
h)	House Keeping	01
Total		(7-14) (min-max)

Table-4:- Staffing of Wards.

Sr No	Category	No's per shift
a)	Medical Officer	01
b)	Nursing Officer	01
c)	Nursing Assistant (NA)	01
d)	Ambulance Assistant (AA)	01
Total		04

Table-5:- Components of PPE Kit for Various Staff

Components of PPE	Isolation ICU Staff	Isolation Ward staff	Floor managing staff	Housekeeping/ BMW handling staff
1. Scrub suit (Cloth)	+	+	+	+
2. Caps – 2 (Cloth and Disposable)	+	+	+	+
3. Mask (Cloth/Disposable)	+	+	+	+
4. N-95 mask	+	+	+	+
5. Facial hood/ Shield	+	+ / - (only during sample collection)	-	+
6. Gloves (Double)	+	+	+	+ (+ Industrial gloves)
7. Gown	+	+	+	+
8. Shoe cover	+	+	-	-
9. Goggles	+	+	+	+
10. Boots	-	-	-	+ (Shoe cover if boot is NA)

Table-6:- Statistics of COVID-19& its comparison as on 25 July 2020.

Sr No	Rate	COVID Hospital (Study)	PMC & PCMC Area	Maharashtra	India
1.	Total number of confirmed cases	613	39,125	3,66,368	13,83,779
2.	Total number of active case	189	21,601	1,45,481	4,66,618
3.	Total number of recovered cases	397	16,427	2,07,194	8,84,654
4.	Total number of deaths	24	1,097	13,389	32,087
5.	Case fatality rate of COVID-19	3.91%	2.8%	3.65%	2.31%
6.	Recovery Rate of COVID-19	64.76%	41.98%	56.55%	63.93%
7.	Mortality Rate of COVID-19	-	16.54 per 1,00,000 population	10.96 per 1,00,000 population	2.32 per 1,00,000 population

*PMC – Pune Municipal Corporation, PCMC – Pimpri Chinchwad Municipal Corporation

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