

SETTING UP COVID-19 INTENSIVE CARE UNIT IN A RESOURCE COMPROMISED SETUP

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ABSTRACT

Corona virus is a new disease. Its contagiousness, course of disease and treatment are unfolding with time. Health care systems all across the world have evolved to cope up with this crisis. Pakistan reported its first case on 26th February. Since then, with the increasing influx of patients³ our health care system has been greatly impacted. Significant numbers of patients require Intensive care services⁴. Therefore, development of dedicated Intensive care units amid compromised resources has been our priority. Infrastructure development and modification, training of staff, Infection Prevention and Control (IPC) measures and staff well being are the main challenges faced. However, with meticulous planning and judicious use of limited resources our establishment has successfully developed Intensive care units that not only provide efficient patient care but also prioritizes on safety of its health care workers.

Keywords: Intensive care units, Infection control measures, Infrastructure, Resource limitations, Training of staff.

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INTRODUCTION

COVID-19 pandemic is a novel disease. Its spread, course of action, and treatment are all indefinite-under research across the globe. It has directly impacted health care systems and professionals, especially in a resource compromised country like Pakistan. In the struggle to cope up, targeted strategic planning and judicious use of limited resources is of utmost importance.

To accomplish this uphill task; our top priorities include optimizing patient care and keeping our frontline health care professionals safe. In dearth of local and international guidelines our establishment has paved its way, keeping in mind the ground realities and limitations. Pakistan reported its first two cases on February 26th 2020^{1,2} and since then, number of patients has increased drastically³. As a consequence more patients require hospitalization and intensive care services⁴. On account of high level of contagiousness of this disease 5 - infrastructure, human resource, electro medical equipment, medical supplies and all other logistic aspects required modification from conventional. Table-I

shows the main challenges faced.

Planning and preparation for the anticipated patient load was started in the month of March, keeping in view the above mentioned challenges.

From 13th April 2020, a completely dedicated COVID-19 intensive care unit started functioning at our hospital. Since then our services have evolved to cater for the escalating influx of patients requiring intensive care services.

Resource Limitations and Measures to Overcome them

Infrastructure; Designation of an isolation Intensive Care Unit (ICU) ward, geographically separated from other clinical areas, allows for concentration and segregation of equipment and staff, contributing to more effective containment⁶.

Our accident and emergency building was dedicatedly marked for COVID-19 cases. Three units (one existing and two newly raised) with a capacity of 10 beds each were marked COVID-19 intensive care units. One additional 10 bedded unit was marked as probable COVID-19 unit which constitutes cases in suspected COVID-19 category.

It is divided into three zones (fig-1): Red zone - highly infectious, Green zone - connecting

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Received: 23 Jul 2020; revised received: 11 Aug 2020; accepted: 18 Aug 2020

areas to infectious zone, constituting pathways, donning area and Yellow zone is non infectious, completely isolated from red zone.

Just before the entrance is a donning area, where all sterilized and disposable Personal Protective Equipment (PPE) is provided. This is the non-infectious, green zone - nothing comes out of ICU via this entrance. Inside (red zone) is a nursing station directly visualizing and monitoring the 08 bed bays placed at more that two meters apart. In addition there are two Isolation rooms, two retiring rooms for staff, drug preparation room and storage room. Outlet of ICU is bounded by doffing area. It is highly infectious red zone, where all disposables are discarded in specific labeled containers. While non disposables in containers, filled with 1% hypochlorite solution for disinfection.

Yellow area comprises of another nursing station involved in providing supplies, coordination with other departments and hospital patient record keeping. Conference room, counseling room and waiting area are also a part of yellow zone.

As a part of triaging, those patients with typical symptoms and radio-imaging but with initial negative PCR testing, and requiring ICU care are admitted at Probable COVID-19 ICU. It is a 10 bedded Unit located in the same building. They are later shifted to COVID-19 ICU's if found to have COVID-19 PCR positive after appropriate workup.

Electro Medical Equipment

Each ICU bed is equipped with full monitoring of six vital parameters and a mechanical ventilator. Inside ICU we have dedicated two ultrasound machines, portable X-ray machine, 2D Echo, Arterial Blood Gas analysis machine, laryngoscopes, transport ventilator, emergency cart for defibrillator and bronchoscope as a part of difficult airway trolley. Electro medical department remains in close liaison with us round the clock for any kind of equipment trouble shooting. In order to fulfill the requirements, equipment

has been borrowed from our sister units such as Cardiology and Liver Transplant Unit.

Human Resource

Comprises of those working inside red zone and the extra support staff. Initially 12 hourly rotation plan for each ICU was devised, however after a lot of deliberation and guidance by the Chinese medical delegation now six hourly

Table-I: Challenges encountered.

Resource Limitations	Trained Health Care Workers
	Medical and Electro Medical Supplies
	Personal Protective Equipment/ N95 Masks
Training	Infrastructure - expansion in dedicated Intensive Care Units.
	Infection Prevention and Control Training Critical Care Training
Infection Control Measures	Heating Ventilation and Air Conditioning System Surface Disinfection Staff Discipline - Preventing Intra Hospital spread Sterilization of Personal Protective Equipment
Patient transport system	Transport team COVID-19 specific Ambulances Designated pathways/Elevators
Staff wellbeing	Psychological Support Limited working hours Consultant supervision Monetary and Career incentives

rotation for each team comprising of doctors, nursing officers, nursing assistant and sanitary workers runs around the clock, which we found more workable and humane. Table-II shows human resource requirement for each 10 bedded ICU during COVID-19 pandemic.

They are supervised by consultants and resident critical care medicine, going inside as and when required to minimize exposure. To fulfill the deficiency of trained intensive care staff, cooperation from sister units has been paramount.

Extra Support Staff

To smoothly run the show inside COVID-19 units we needed staff to ensure supplies inside the unit. Our team included a logistic officer-coordinating with other departments and involved in all kinds of planning and trouble shootings - a linchpin of our ICU. Four assistants involved in sterilization and provision of PPE 24/7 and any sort of help needed inside at any time. Also lab courier, ward boy and computer assistant play their essential roles in facile running of this department.

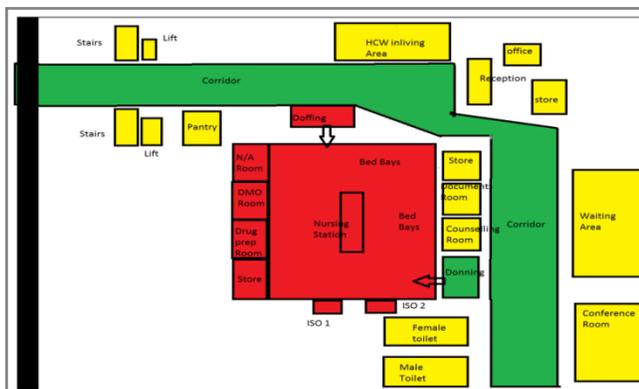


Figure-1: Organization of Intensive COVID-19 (red zone - highly infectious, green zone - connecting areas to infectious zone, constituting pathways and donning area, Yellow zone - non infectious, completely isolated from red zone).

gloves and face shield and safety goggles. COVID-19 pandemic has caused shortages and a hike in prices of PPE, which is an essential component of battle against this disease⁷. To manage this sudden increase in demand, certain strategies have been adopted. N-95 mask is issued to each health care worker at start of the working week. They are reused for approximately five to six times until visibly soiled or damaged. Decontamination of masks using Ultraviolet germicidal irradiation (UVGI) and Vaporous hydrogen peroxide (VHP) is done on self responsibility basis⁸.

Ultra Violet (UV) irradiation machine was borrowed from dental unit while VHP facility is available at operation theaters of this hospital.

PPE - hazmet suits are sterilized with 1% hypochlorite solution for disinfection and reused⁹. Due to shortage of face shields; initially they were prepared in house by Health Care Workers (HCW's).

This approach has helped us as none of our staff was infected while being on rotation.

Infection Control Measures

HVAC System

To avoid in hospital spread of infection while creating dedicated COVID-19 ICU ward,

Table-II: Human Resource requirement for each 10 bedded intensive care unit during COVID-19 Pandemic.

Consultants	Critical Care Medicine Fellows	Resident Medicine/ Anesthesia	House Officers	Nursing Officers	Nursing Assistants	Sanitary Workers	Helpers
24 hours Shift - For Every Six Hourly Shift							
02	02	02	01	03	05	01	01
Total Requirement Per 24 hour							
02	02	08	04	12	20	04	04

Personal Protective Equipment

Protection and safety of our staff was our top most priority as this was a precious resource, we wanted to conserve them for the future uphill task and moreover replacements were not readily available. So we adopted very stringent SOPs for PPE. Our complete set of PPE comprised of hazmet suit, gowns, shoe covers, head cover,

special modification has been done to separate the Heating Ventilation and Air Conditioning (HVAC) system of red zones from the green and yellow ones. Air flow of ICU's has been redirected from rest of the hospital. Moreover updated High Efficiency Particulate Air (HEPA) filters have been installed to meet requirements of very fine filtration.

Surface Disinfection

Strict SOP’s of hand hygiene, minimum touch technique, use of alcohol based hand sanitizers are practiced. Compliance with regard to six hourly cleaning of nursing station and bed bays using standard alcohol and hypochlorite disinfectants is observed⁹.

Staff Discipline - Preventing Intra Hospital Spread

To minimize exposure six hourly shift of HCW’s works around the clock. It is mandatory practice to properly doff, with buddy and spotter system before leaving ICU premises. Doffing and donning awareness posters have been displayed for guidance shown in fig-2 & 3.

Anything that comes out of the ICU e.g laboratory samples or equipment for trouble shooting are properly packed in talc sheet and sprayed with 1% hypochlorite solution for disinfection.

Designated medical teams working at intensive care units do not practice at other departments to prevent departmental cross infection. Teams working in ICUs comprise of limited number of staff members, just adequate enough, minimizing exposure. Departmental meetings and instructional guidelines are conducted via video conferencing.

In hospital boarding facility is availed during work week by all staff, followed by one week quarantine. Respiratory swab for COVID-19 PCR test is conducted every fifth day of quarantine. Those who are asymptomatic and PCR negative are put on the rota for next week while others are treated accordingly. This strategy has helped us in limiting the spread of infection out of ICU.

Transport of Patients

Patients require transport for emergency procedures or radio imaging (Ct scan/MRI etc). A designated transport team, properly donned in full PPE is involved for smooth transfer of patients. They take the patient from doffing area after necessary handover from the ICU team. Department receiving the patient are pre informed for necessary arrangements. Transport

plan is pre documented and conveyed to the receiving team as well.

For ventilated patients, two transport ventilators are available. All patients are covered in a talc tent, while non ventilated are required to wear face mask. All tubing and equipments are sprayed with alcohol/0.5% hypochlorite sprays. Dedicated pathways, lifts and ambulance are



Figure-2: Education poster - donning personal protective equipment (PPE).



Figure-3: Education poster- doffing of personal protective equipment (PPE).

used to prevent intra hospital spread of infection. All transporters are required to practice full IPC measures.

Training of Staff

In collaboration with the Chinese delegation, several workshops and simulation trainings have been conducted. Considering novelty of this disease, emphasis was laid on following aspects:

- Infection prevention and control

- WHO guidelines for COVID-19 management
- Donning and Doffing of PPE
- Ventilator Handling and Trouble Shooting
- CPR and Defibrillation
- Transport of COVID-19 patients
- CPR of COVID-19 patients
- Prone position ventilation
- Prone position CPR
- Staff well being

Health-care workers not only have to work harder and longer hours, they often do so in a context where the knowledge and understanding of the novel pathogen is still sub optimal. The regular donning and doffing of full PPE add to physical fatigue and psychological stress¹⁰. Considering this as a priority, consultants are available for any sort of support and encouragement of our frontline staff. This is via online platforms and daily meetings. This has helped to harmonize efforts for a coordinated response. Limiting working hours and one week break post work week has been a key component in limiting anxiety and physical stress. Monetary and Career incentives are also under pipeline.

Telecritical Care

To support clear and timely communication with frontline staff members, online platforms and video teleconferencing with Pan-tilt-zoom cameras make an integral part of our working. One such session is depicted. Amid insufficient intensivists, this allows remote monitoring and extension of Intensivist expertise. Limited exposure and consultant guidance are also its key advantages.

Multidisciplinary Approach

In these challenging times, collaboration between several departments has played a cardinal

role. Sharing of expertise and sound judgment is a regular feature to optimize patient care and smooth running of this department.

CONCLUSION

Critical care department has played a key role in tackling this crisis. Challenges encountered by the health sector during this pandemic are unprecedented. However, only meticulous planning which prioritizes patient care and safety of HCW's has allowed us to set up a cost effective and well organized intensive care unit.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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