Perspective

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Adaptive transformation of the Teaching Hospital Peradeniya, Sri Lanka into a Tertiary COVID-19 Treatment Centre; Steep learning curve in a limited resource setting.

Thilakarathne A & Ramachandran A

Teaching Hospital, Peradeniya, Sri Lanka

Correspondence:

Arjuna Thilakarathne
Director
Teaching Hospital, Peradeniya, Sri Lanka
Email: arjunatilak@yahoo.com

INTRODUCTION

An outbreak of pneumonia of unknown origin was reported from the Wuhan province of China in December 2019. Subsequently, the pneumonic illness was found to be caused by a novel coronavirus (CoV) resembling the severe acute respiratory syndrome (SARS). The World Health Organization (WHO) named the virus and disease as SARS-CoV-2 and (COVID-19) respectively. Further, the disease was declared as a pandemic by the WHO on 11 March 2020. Simultaneously, the healthcare facilities (including critical care units) have to be up-scaled to handle the severely ill COVID-19 patients in countries where the pandemic had a strong impact on the healthcare systems including Sri Lanka.

In Sri Lanka, the first case of COVID-19 was reported in late January 2020, who was a Chinese national and the first local case was identified in the second week of March, 2020. Since then, the Government of Sri Lanka introduced various sequential measures to improve social distancing such as closure of schools and education institutes, introducing work from home model to reduce the public gathering, introducing travel bans to international arrivals, and more drastically, imposed island wide curfew or severe travel

restrictions expecting to minimize the burden of the disease to the Sri Lankan health system and the entire community. Meanwhile, identifying various healthcare centers in different parts of the country as isolation and treatment centers for COVID-19 became a key component to address this challenge.

The Teaching Hospital Peradeniya is a leading innovative tertiary-care teaching hospital in the Kandy district in the Central Province of Sri Lanka. In the wake of the COVID-19 crisis, the Teaching Hospital, Peradeniya was compelled to improvise to create the best possible facility using available resources within the limited period. However, the implementation was a daunting task and required pragmatic solutions. In general, setting up a new facility involves three main components: management of human and physical resources and optimizing clinical management. Herein, this article describes the experiences and barriers in uplifting and transforming a general healthcare facility to a dedicated infectious disease setup in the wake of the COVID-19 pandemic in a limited resource country like Sri Lanka.

The Teaching Hospital, Peradeniya (THP) is one of the largest COVID caring institutions in the Central Province, Sri Lanka with more than seven hundred COVID patients being treated at a given moment

which included 5-bed dedicated COVID ICU, 25-bed HDU, 60-bed COVID ward for critically ill, 50-bed intermediate ward for critically ill, 40-bed COVID maternity ward, 65-bed Divisional Hospital as a step down facility for mild to moderate patients, 400-bed and 75-bed intermediate care centers (ICC) with 75-bed ICC for the health staff.

The Teaching Hospital Peradeniya has eighty dedicated medical specialist consultants and almost three hundred medical officers with more than two thousand hospital staff who are extremely using their limits to mitigate the COVID 19 Pandemic in Sri Lanka. This institution is training nearly 1500 medical students from the University of Peradeniya.

This article describes how the transformation process of the Teaching Hospital, Peradeniya into a tertiary COVID Treatment Centre was successfully accomplished without compromising the existing medical services and quality of care, thus optimizing the COVID management strategies by internal resource modification and uplifting the treatment facilities by enhancing the capacities of workforce and improving physical and digital technological services.

The trail of the adaptation process

The development of COVID-19 Steering Committee (CSC) was the key factor which primarily decided the success in the future.

The increased influx of COVID-19 patients along the first wave in Sri Lanka demanded the need for strategic management of the infectious disease. The pandemic outbreak in the country itself brought immediate concerns to the hospital management committee. It was emphasized at the very initial stage, that the timely deliverance of COVID care is mandatory without interfering the deliverance of other patient care services and the quality of care rendered by the hospital. It was acknowledged from the beginning that the tertiary healthcare institution may need to be transformed into a tertiary COVID treatment centre manned by the health personnel from the Ministry of Health. The success of any large endeavor of this magnitude is due to the planning and the constitution of a core and cohesive team. The

institution established a dedicated COVID cell or COVID Steering Committee (CSC) to plan, organize, implement, monitor and evaluate activities and outcomes. The COVID cell is the hub of all the activities in the institution and led by the Director of the Hospital and the other persons with decision making and implementing capacities (Deputy Directors, Consultants, Senior Medical Officers, Department heads etc.) in a way of shared care approach. The COVID cell members had similar responsibilities and were selected to be represented by all the relevant departments in the institution such as Medicine, Pediatrics, Emergency & Critical care, Anesthesia, Infectious diseases, Public Health, Planning, Forensic Medicine, Nursing and Other categories.

The CSC was empowered to constitute the core team for the planning and implementation of the process of restructuring the hospital to facilitate COVID-19 treatment. The inputs were received from peers, colleagues from other hospitals and from the experts of the relevant fields.

The CSC meetings were conducted in the conference room of the hospital continuously at a planned schedule and it was consisted with less than fifteen key stakeholders. Other stakeholders were invited through zoom cloud meeting facility. The social distancing was strictly carried out with optimum precautions taken to avoid transmission among the members. The vital decisions were made carefully after thorough discussion among the members and the implementations were carefully audited and the shortfalls were corrected in each sitting.

During the first wave of COVID-19 pandemic, the expectation was to maintain all the services without compromising the patient care, though the second and third waves lead the institution to decide on taking some strict decisions to limit some of the routine activities such as elective surgeries and clinics in order to minimize utilization of critical resources like oxygen, PPE and manpower. At the same time, surplus of COVID-19 cases in the country warranted to uplift the COVID patient care within the institutions and decision was made to expand the resources and enhance the work force in order to meet the requirements. The policy was to keep all the services in action until the need

arises for compromise and thus all the units were kept in optimal function with the available workforce.

Development of COVID triage and care pathways were important in early patient identification, isolation, risk assessment and optimal management. The Outpatient Department (OPD) and the Accident & Emergency unit (A&E) were the first contact points in the hospital with COVID positive patients. Thus, with the dedication of the A&E and OPD staff we initially established a triage area which was color-coded according to the risk of contamination. Strict safety procedures were implemented to ensure the smooth functioning of the institution. Considering the epidemiological and clinical risk, an assessment was conducted, and the patients were categorized and directed to relevant zones for further management. All COVID-19 suspected patients were referred to separate "Fever Counter" for consultation.

Separate area adjacent to the A& E was allocated for the patients who were acutely ill and presenting with the history of contact or symptoms suggestive of COVID 19 infection. This facility, which comprised of two HDU emergency beds with all the necessary infrastructure, helped to establish COVID emergency assessment and treatment without affecting the other casualties. The logistics needs were listed and moved from the other units initially and thus it enabled the emergency treatment at the first contact point.

The care pathway and guidelines were drafted and concluded in CSC after careful evaluation and implemented with extreme precautions. All the guidelines, protocols and flow charts of care pathway were distributed and exhibited by way of posters and leaflets.

Contingency Plan

In the first wave of the COVID outbreak, all the secondary and tertiary care institutions were instructed to establish dedicated COVID isolation and intermediate care ward in each facility. CSC decided to develop corporate plan in stages to combat the pandemic.

Plan A was the initial proposal to establish a separate unit (ward 17) to isolate and treat the COVID positive patients and suspects which would minimize the spread of the virus among the non-COVID patients. Plan B was to be implemented if the number of cases increased with time, in which case another ward (ward 18) adjacent to the existing unit was to be identified and to be converted as COVID isolation ward. Plan C was to identify another ward (preferably ward 21 or 12) for extra COVID care.

At first, the ward 17, the Toxicology ward, was converted into "COVID Isolation and Intermediate Care Centre" with a bed capacity of 35, which is now functioning as "COVID Treatment Center A" and with an HDU bed capacity of 28. Gradually over the year, the Plan B was implemented as we had large numbers of patients referred from many primary and secondary healthcare institutions in the Kandy District, mainly due to the success of COVID patient care with less complications and considerably higher cure rate among complicated patients in our units. At this stage of plan B, the ward 18 was converted into a 40-bed COVID treatment unit and a dedicated team of Consultant Physicians with Resident House Officers (RHOs) who have completed their internship were incorporated into the COVID management team. With the dedicated service provided by all the category of the staff, the unit was established with minimal available resources and gradually the infrastructure was developed and the logistics were moved from the less used units without compromising the outcome of those particular units (Figure1).

When the number of COVID patients who are being admitted with more severe symptoms and needed close monitoring, the CSC decided to expand the COVID treatment units and establish another ward (Plan C) for staging the COVID patients. The ward 12 was identified and immediately transformed into an "Intermediary COVID unit" with the prompt bed capacity expansion with added infrastructure and technological advancement including the successful development of central monitoring system and video surveillance of the wards with telecommunication to avoid the contamination (Figure 2). Currently this ward has a 50-bed strength with 12 HDU beds.

Figure 1: Development of COVID treatment units at TH Peradeniya with glass and polythene partitions

Figure 2: Central monitoring systems at COVID treatment units at TH Peradeniya

Figure 3: COVID Intensive Care Unit

The number of maternal losses in the second wave in the country was brought to the concern of the CSC and it was decided to establish a separate unit (Ward 3) for pregnant mothers for symptomatic treatment by collaborative efforts of the Gynaecology and Obstetrics staff and the medical team. Thus, it led to a very productive outcome in the management of COVID positive pregnant mothers and the newborns.

With the establishment of the Point-of-care (POC) PCR at the laboratory, Teaching Hospital, Peradeniya, the shortfall of waiting for the results of PCR test were largely minimized and the results were obtained within two hours of PCR. Thus, it helped largely in diagnosing the COVID patients

early and taking necessary precautions to isolate the COVID patients from the rest of the OPD admissions, which in turn largely contributed to overall outcome in the COVID management.

With the worsening scenario of the third wave of the COVID-19 pandemic and the identification of different mutated strains of the virus, the patients appeared to be more oxygen dependent and deteriorated in a short time requiring ventilatory support and ICU care within a few hours of admission. Thus, the development of COVID ICU and the transformation of COVID treatment units into COVID HDU with more oxygen ports and the supply of cPAP and Ventilatory supports were

highlighted in the upcoming CSC meetings. That led to the urgent need for dedicated COVID ICU and HDU with adequate infrastructure which became a challenge to the CSC of Teaching Hospital, Peradeniya.

The successful transformation of hospital main ICU into a dedicated COVID ICU with the bed capacity of ten was a critical point in COVID management at the institution. The CSC decided to convert the main ICU into COVID-19 dedicated ICU with the advanced development of negative air pressure system which would greatly minimize the contamination of the staff from patients undergoing emergency treatment in the closed unit. With the development of COVID ICU of 10-bed capacity, it was recognized that the staff training in critical management was inevitable. Therefore, the Anesthesia Department was requested to arrange urgent training for medical officers on critical ICU management within a short time. Currently the COVID ICU is providing optimal care for those who need ICU management with success (Figure 3).

Resource management

Resource management is the process of identification, assessment, redistribution, monitoring and evaluation of all available resources in the institution such as infrastructure, human resources, facilities, drugs, supplies and equipment including surgical and medical consumables. This in turn will be reflected in the efficient planning and execution.

The need for work force training in all categories of staff were identified as a critical factor which could assist in enhancing the capacity of the COVID treatment units. So, it was decided to establish a number of education groups consisting of consultants and subject specific specialists such as clinical microbiologist and physicians to train the staff of the hospital at the work place as work on trainings with enhanced precautions. This was successfully carried out in an efficient manner that improved the outcome by many-fold. The leaflets, educational materials and small voice messages were developed including educational videos on the subject and were delivered to the individual staff via electronic media platforms to uplift the knowledge on the disease process and

precautionary measures. Available IT facilities were used optimally to reach the participants which added to the success of the training programme.

In the first wave, the need for reserved work force was instantly recognized at the CSC, therefore the decisions were made to spare a group of workers, while the rest were in optimal function. Thus, one third of the workforce was off roster at any given moment (reserved workforce strategy). Following completion of the Covishield vaccination programme for the staff, reserved workforce strategy was abandoned.

The protection of the hospital staff from the exposure was highlighted and it was ensured by necessary precautional education and logistics management. Patient-staff interaction points were carefully evaluated and infrastructure developed to minimize the risk exposure, by using the transparent polythene and glass screens, CCTV cameras, and video surveillances. It was decided to produce hospital made protective aprons, face masks to the staff which aided in reducing the unnecessary wastage of PPEs.

We developed two Intermediate COVID Care Centres (ICC), which are medical complexes established to quarantine COVID-19 PCR positive individuals referred to or diagnosed at THP, who are medically stable or asymptomatic (Figure 4). The main objective of ICC is to facilitate successful isolation and management of asymptomatic individuals. This will largely prevent the spread during the active period of disease. The ICC Panideniya comprised of 400 beds under the medical supervision of the Teaching Hospital, Peradeniya. ICC Giragama was a staff quarantine centre (Table 1).

Table 1: Statistics for Intermediate Care Caentre, Panideniya (Nov 2020 – Jun 2021)

Total number of Admission	5239
Female	4808
Male (< 16 years)	431
Patients with Comorbidities	726
Number of Patients with Symptomatic	3248
Number of Patients with Asymptomatic	1991
Number of Death	Nil

The intermediate COVID hospital at Base Hospital, Kadugannawa was developed with an aim to treat all asymptomatic patients with co-morbidities or mild symptomatic persons under the surveillance of direct medical care. This may be utilized for treating moderate to severe symptomatic cases if and when need arises, to minimize the facilities at THP getting overcrowded unnecessarily. The COVID units at BH Kadugannawa are dedicated exclusively for the treatment of COVID patients, without deranging the existing medical services from the institute for non-COVID patients.

The third wave of COVID-19 demonstrated exaggerated numbers of cases, increased oxygen dependents, severe COVID pneumonias and more deaths. This worsening situation has warranted health authorities to strengthen the critical care health facilities including ICU & HDU to overcome the existing challenges. Development of THP as a tertiary COVID treatment unit was a rapid, daunting task amidst periods of National lockdowns, where most supply chains were not continuing as usual.

Tertiary COVID Treatment Hospitals are the health institutions that are dedicated to treat severe, critical COVID patients. These hospitals are generally tertiary care centers, where immediate

critical care facilities are already available. In this pandemic situation, the CSC decided to postpone the elective surgeries and some routine activities in order to safeguard available limited resources. Further the CSC decided to improve ICU and HDU facilities to cater the existing needs. COVID suspects or COVID confirmed patients with other emergencies like trauma, acute abdomen, obstetric emergencies were managed with full transmission-based precautions and infection control practices in consultation with the COVID steering committee in the hospital.

The institution now comprised of COVID ICU of 8 beds and three COVID treatment wards with 25 HDU beds. The infrastructure of these units are currently being evaluated by the CSC with careful clinical and administrative partnership and the facilities are being uplifted, from the supplies from the Ministry of Health, as well as through sources gathered from the donors, well-wishers, old student associations (OBAs) of schools and institutional donors such as NGOs and INGOs. The institution will be looking into further developing these facilities with minimal cost expenses and optimal use of the logistics being gathered and donated.

Figure 4: Intermediate Care Centre, Panideniya affiliated to TH Peradeniya

Overcoming the barriers

“Fear” is the main fallback of mankind since the ancient times. The main factor that dragged the development of COVID tertiary healthcare facility was the fear and the uncertainty of the disease at the very first stage of COVID 19 pandemic.

Education is the key factor in any successful development and therefore the primary aim was to educate all the categories of healthcare staff, by all available means. This was a key factor that led to the success of this institution. One main focus of the CSC was to ensure the safety of the staff, and

the development of infrastructure focusing mainly on the safety of the staff, as well as non-COVID patients being treated at the hospital.

All the necessary precautions were taken with consensus of the CSC in order to protect the staff of OPD to ICU. The infrastructure was designed in such a way that there will be minimum mixing of suspected patients and the staff at each level. Therefore, the patient receiving and treating areas were carefully designed to be away from staff entrances in each of the units with minimal exposure risks. Polycarbonate sheets with wooden or metal frames were developed at a low cost, which served as an optimized barrier in between staff and patients. Video surveillance and locally manufactured central monitoring systems by the Faculty of Engineering of the University of Peradeniya with optimal use of IT facility rendered the success so far.

A Personal protective equipment (PPE) sub committee was formed comprising the Deputy Director, the microbiologist and the physicians, and the usage of PPE was monitored throughout in order to ensure the optimal usage.

Resources were gathered from all possible sources including twin use ICU beds, CPAPs, oxygen concentrators, NRBM masks, wall oxygen flow meters, multi-parameter monitors and other consumables via direct and indirect social service individuals and donors. Available logistics were managed in such a manner that enabled us to provide better COVID care at the institution comparatively. Shortcomings were brought to the immediate concern of the relevant departments and it was sorted out without any delay.

Waste management was monitored and ensured careful disinfection of wastage from the COVID wards before disposal using external contactors.

The expectations from the working force were carefully brought to the concern of the administrators and fair decisions were made after careful discussions in the CSC. Vaccination of the health care staff was done by the Public Health Department and the immediate family members were given opportunity to reach the hospital staff for their concern which was a considerable relief of the working individuals of any category in the institution. A Medical Board comprising three clinical specialists evaluated all medical concerns

of staff force to reach medically and ethically sound decisions.

CONCLUSION

In conclusion, Teaching Hospital Peradeniya has been successfully adapted for COVID treatment, by developing ICC, ward, HDU and ICU facilities, with optimal development of infrastructure and human resources in a limited resource setting, by rapidly responding to the need of the hour. All success of this revolutionary adaptation for the COVID-19 pandemic are attributed to the dedicated shared leadership model of the institution and the commendable team work of each pillars of the hospital.

List of Abbreviations

COVID	Corona Virus Infectious Disease
CSC	Covid Steering Committee
HDU	Highly Dependency Unit
ICC	Intermediate COVID Care Centers
ICU	Intensive Care Unit
PPE	Personal Protective Equipment
THP	Teaching Hospital, Peradeniya

Author declaration

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