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Preparedness of Hospitals Post COVID-19 Era

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Abstract

COVID-19 is an unprecedented global crisis, but epidemics have increased in both frequency and reach due to globalisation, greater connectivity, and denser cities. The pace at which healthcare systems were able to respond and the transformation scale are incredible achievements. But they also serve to highlight how ill-equipped the world was for a pandemic of this kind. COVID-19 has shone a spotlight on systems and processes that had been fine-tuned over many decades, revealing flaws and vulnerabilities that we had overlooked, as well as glaring blind spots in our forecasting.

During the outbreak of the current COVID-19 pandemic, there were several problems faced by healthcare providers worldwide. A few of these were the shortage of spaces to handle the patient surge, availability of advanced equipment, overburdened doctors and paramedical staff, quality of services, and awareness about disease prevention.

It is believed that the world may have to live with such viruses indefinitely. There is a need for shifting, changing, and altering the design and construction of hospitals to tackle such pandemics. Future hospitals should have more flexibility and adaptability to handle pandemics and other outlier events that enable rapid preparedness of staff, facilities, and processes to manage an unprecedented influx of patients.

In this article, we are trying to answer some of the biggest questions faced by experts: ”what shall be the design of future healthcare institutions which are capable enough to handle such pandemics? What lessons can be learnt for the future design of hospitals, as well as other healthcare buildings? Do we need to adapt and refurbish preparing for a second, third or fourth wave of infections? What will the long-term impact be on building typologies and layouts, strategic planning and investment?”

We discuss the following major issues and suggest themes that could affect the design of such institutions and clinical services delivered by them.

1. Changes in the layout and facilities of the hospital.
2. Modification and adoption of improved working systems.
3. Temporary conversion of space in the hospital.

Following issues should be addressed and solutions must be implemented:

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Changes in the layout and facilities of the hospital

1. Infection control: The presence of vulnerable immunocompromised patients increases the risk of nosocomial infections and makes it necessary for hospitals to maintain high hygiene standards. Effective infection prevention and control require providing a clean and germ-free environment using techniques such as zoning of different hospital areas, ultraviolet and chemical disinfection, defined protocol and unidirectional flow of men and material, segregation of infectious and non-infectious patients, promotion of hand hygiene, availability of sanitation, automatic body thermal scanner, and temperature monitoring stations across the hospital, allocated spaces for Personal Protective Equipment (PPE) and tools (disposable apron, gloves, adequate disposal bins and facilities), reduction in the number of horizontal surfaces, providing barriers and vestibules.
2. Isolation Units: Isolating patients with suspected or known infectious diseases can reduce the risk of transmission. Single rooms should be en-suite, with a toilet and hand-wash sink as a minimum requirement, with no possible access to shared facilities. Some older hospital buildings may not have en-suite facilities but must have a minimum of a hand-wash basin in the room. Multiple bed indoor wards shall be divided into cubi-

cles, and each cubicle shall not have more than a prescribed bed limit with adequate inter bed space and ventilation. Moreover, the following contact precautions must be practised with isolated patients: PPE, hand hygiene before and after removal of PPE, and leaving the single room/environment.

3. Hybrid design of the building: It is necessary to have proper Heating, Ventilation, and Air Conditioning (HVAC) system in hospitals for maintaining comfortable temperature and humidity. The design must allow an adequate supply of external natural air, exhaustive level of filtration through various types and levels of filters (for example HEPA filters), flexibility and movability in the air conditioning system to allow cross ventilation and air return, humidifiers and dehumidifiers in place to maintain adequate humidity levels as per the weather conditions. Wider corridors and staircases with double glazed glass will allow sunlight to enter the building, facilitating natural temperature control.
4. Redesigning various hospital departments: The switch to ”pandemic mode” involves the reconfiguration of hospital entrances and layouts to separate infected and non-infected patients and the associated flow of staff, equipment, and consumables. The following recommendations can facilitate greater flexibility in both spaces and systems.

- Entrance lobbies shall be designed to reduce the number of people landing in the lobby by adopting technologies like online registration through portal and kiosk, automated/contactless doors, automatic body thermal scanner, hand sanitisation, ultraviolet baggage disinfection, personal protection dispensing spaces, and safeguarding staff with adequate partitions.
- Waiting lobbies shall have provision for physical separation between people using glass/plastic shields, appropriate queuing, planned sub waiting lobbies, minimum interaction with others, seating in smaller clusters, allowing waiting outside or entry at a pre-allocated time.
- ● Out Patient Departments (OPD) shall be designed to maintain social distancing and avoid direct contact with the patient using partitions, touch-free and wireless medical devices for clinical purposes, virtual (audio/video) consultations, routine disinfection/sanitisation/pressurising of OPD, mobile health tools and smartphone/tablet applications for diagnostic and monitoring purposes.
- Emergency department shall have a separate entrance with vestibule (or other means), sanitiser, personal protection tools and gadgets, hand wash/sanitisation stations. Also, entry to other departments shall be restricted from emergency using authorised doors/barriers. The medical officer cabin shall be air-tightened and under recommended pressure. It is important to ensure separate triage points where infected people are separated from others to reduce infection likelihood. A Green Zone could be assigned as a clean zone where it is reasonably certain that nobody is infected, a Blue Zone is where Covid-infected patients are sent, and an Amber Zone is where the state of the patient is unknown.
- In Patient Departments (IPD) shall ensure proper zoning for infectious and non-infectious patients in wards, Intensive Care Units, and High Dependency Units. This can be done using glass/plastic barriers, restricting movement into different zones, and creating isolation units. Open nurse stations must be equipped with partitions.
- Separate operating rooms for infectious patients with separate pre and postoperative areas and scrub rooms are recommended; however, some utility rooms such as the central sterile services department can be shared among both.
- Diagnostic labs shall have separate sample rooms for infectious and non-infectious patients with a separate set of instruments and disposables. Barriers can be installed at the sample collection counter.
- Staff and administrative workplaces must be taken care of to prevent intra-hospital transmission of infectious diseases. Some of the measures are but are not limited to: separate entrance to the hospital and adequate changing rooms with facilities, thermal scanning, sanitisation, personal protection tools and gadgets, additional storage spaces and stores, administrative departments may be moved at other places or promote work-from-home, and well-ventilated staff spaces with reasonable size, limited capacity and separation of workstations.
- Using antimicrobial finishes and materials that are easy-to-sanitise or germ-resistant, nonporous, and nonreactive when exposed to disinfectants in the building materials can control the spread of infection. Moreover, the use of antibacterial materials like copper-based products, antibacterial wall paints, flooring and prefabricated furniture made with easy-to-clean and sanitise synthetic materials, touch-free and sensor control technology such as sliding doors or swing doors shall be preferred.

Modification and adoption of improved working systems and standard operating procedures which are in consensus with the new or modified design of the healthcare facility

The Following General Recommendations Shall Be Adopted To Ensure the Safety of Healthcare Workers:

- To avoid cross-infection and ensure staff safety, segregate health workers involved in treating infected and

suspected patients from the staff treating non-infected patients.
- Staff attending infectious patients shall be minimum in number to reduce staff exposure.
- Each worker shall work only for one primary institute.
- Staff shall be provided with personal protective equipment, tools, and gadgets.
- All healthcare workers must undergo temperature monitoring daily.
- Staff shall undergo weekly antibody test.
- Shift timing shall be staggered for healthcare workers or they shall work on a rotation basis.
- Shaff shall undergo adequate training, teaching, and departmental meetings.
- Timely communication shall be established with all healthcare workers.
- Hand hygiene shall be mandatory for staff, multiple times a day.
- Sanitisation of hospitals must be carried out as per guidelines.
- Clearly defined protocol, systems, procedures and policies for cleaning and sterilisation/ sanitation shall be implemented.

The Following Changes At the Hospital Entrance Shall Be Implemented To Reduce Nosocomial Infection:

- Patients shall be screened for infectious diseases at the entrance using temperature monitoring or other techniques, followed by sending them to triage points.
- Protection tools (such as PPE and visors) and gadget dispensers shall be made available at the entrance.
- Clutter shall be minimised at the entrance, corridors, and waiting lobbies to make more open spaces.
- Using inquiry counters and help desk services shall be discouraged. Patients and visitors shall be encouraged to use the online help desk to submit their query using an online form and video guidance shall be provided.
- Crowd detection tools shall be used to avoid a cluster of people in one place.
- Social distancing measures shall be strictly taken care of and be followed. For this, waiting in the entrance halls shall be discouraged and smaller waiting lobbies spread across the hospital shall be planned. Also, token system or telemedicine practices shall be encouraged to reduce entrance patient footfall.
- The number of visitors or patient's attendants shall be minimised in the OPD and IPD.
- Adequate and appropriate signage shall be used in the hospital to guide the patients and visitor. This help to control unnecessary wandering in other hospital areas.

The Following Changes In the Hospital Out Patient Department Shall Be Implemented To Reduce Nosocomial Infection:

- Consultation shall be pre-registered and scheduled using an online system. In this system, patients shall receive a token number (appointment number) with consultation time. Entry inside the hospital shall not be permitted before the mentioned time. This will help to reduce to the number of patients/visitors inside a hospital at a single time.
- The OPD consultation room shall be regularly sterilised and disinfected as per protocol.
- Doctors shall be provided with necessary personal protective equipment, tools, and gadgets and shall be encouraged to use them with attending a patient. Also, doctors shall restrain from establishing close contact with the patient using various techniques such as wireless diagnostic tools, acrylic partitions, etc.
- Where possible, telemedicine practices such as remote (audio-video) consultation, e-prescription, and e-reporting shall be adopted. This allows the patient to receive a diagnosis and medicine within the comfort of his/her home and avoids unnecessary exposure of staff to infected patients.

The Following Changes In the Hospital In Patient Department and Isolation Zone Shall Be Implemented To Reduce Nosocomial Infection:

- The zoning concept shall be adopted and strictly followed. This will help avoid any cross-infection amongst patients and staff by ensuring dedicated equipment and staff in each zone.
- The number of visitors shall be restricted throughout the patient's hospitalisation. Patients shall be provided with facilities like hospital owned smartphone/laptop, wifi, or other internet connection to talk to the family via video calls.
- A two-way audio-video nurse call system shall be installed to avoid face to face patient/visitor interaction with the nurses.

The Following Changes In the Hospital Emergency Department Shall Be Implemented To Reduce Nosocomial Infection:

- A separate entrance shall be provided for suspected/infected patients to ensure they are not mixed with other patients/visitors/staff. If a common passage is used, it shall either be closed or strictly guarded at all times.

- All patients/visitors shall undergo a questionnaire survey and thermal scanning before they are allowed into the hospital premises.
- Waiting in the emergency spaces shall be discouraged. Instead, smaller waiting lobbies shall be designed at various places in the hospital to avoid crowding in a single place.
- Patients, staff, and visitors in the emergency department shall strictly adhere to the personal protection norms such as hand washing, sanitisation, face covering, and social distancing.

Temporary conversion of spaces into treatment units, emergency suits, ICUs, and isolation units to handle the patient surge

As long as a building is built to the required standard and specification, it could be used for a number of things. In many places, the immediate response to this crisis was to provide surge capacity by converting large buildings such as stadiums or conference centres, or constructing new field hospitals from scratch. For the future, this strategy will shift to providing extra capacity within hospitals themselves.

If hospitals require less outpatient space, layouts could be reconfigured to increase diagnostic and treatment space. With more bed space, discrete areas could be created for Covid patients, which would help in infection control and allow the rest of the hospital to carry on normally. Other services like medical gas pipe system, kitchen, laundry, general and pharmacy stores and toilets have to be added to these facilities to make them comprehensive for accommodating the patients.

The Following Points Shall Be Taken Care of While Designing Various Hospital Spaces So That They Can Be Converted Into Additional Clinical Service Area When Needed:

- Opt for wall finishes that require less time to fix and are easy to clean and sanitise.
- Opt for flooring that requires less time to fix and is easy to clean and sanitise.
- Exposed wiring with PVC conduit shall be provided to install electrical points and appliances when needed.
- A quick central line with couplers shall be provided to supply medical gases when the need arises.
- Foldable or rented beds and other furniture shall be used, which can be easily arranged or moved from one space to the other in a hospital.
- Quickly fixable and economical temporary inter bed partitions shall be used to separate spaces and lay mode beds in a room/hall.
- Temporary arrangements from the existing HVAC system or using any other technology shall be planned.
- Wireless nurse call systems shall be used for easy transport and installation across spaces.

While social distancing measures have reduced the transmission of COVID-19 in the community, nosocomial transmission continues to put vulnerable populations at risk of severe illness and death. As hospital services return to a new normal, prevention of nosocomial transmission remains vitally important, particularly since this may coincide with a new wave of COVID-19 related admissions or other future pandemics. This article demonstrates how minor changes in hospital design could affect the design and delivery of elective clinical services for patients with and without COVID-19. This will require innovative changes that look to the future, with unsubstantiated dogma being challenged and replaced with expert-led and, where possible, evidence-based approaches.

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