EXPERIENCE EXCHANGE

Long-term hospital management in the presence of COVID-19: A practical perspective

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Received: May 24, 2020 **Accepted:** June 1, 2020 **Online Published:** June 18, 2020
DOI: 10.5430/jha.v9n3p18 **URL:** https://doi.org/10.5430/jha.v9n3p18

ABSTRACT

In December 2019, a novel pneumonia caused by a previously unknown pathogen emerged in Wuhan, China. Whereas, thus far, the large majority of people infected by SARS-CoV-2 develop mild inconsequential respiratory symptoms, a minority of mostly fragile, immunecompromised, often aged individuals with chronic medical conditions, develop a severe form of acute respiratory distress syndrome (ARDS) and shock leading to death. Thanks to the early implementation of a social distancing strategy, some regions have seen only a moderate but significant increase in the number of SARS-CoV-2 infection. Although, a significant increase in severe and critical COVID-19 patients was noted, requiring significant investment in dedicated personnel and allocation of specific hospitalization and intensive care unit (ICU) infrastructure and resources, but the medical systems' functioning was not completely disrupted. As the development of a readily available vaccine against the new coronavirus is expected to take about 1.5 - 2 years, most hospitals will have to address the problems and challenges of caring for regular patients, some of them high-risk patients for SARS-CoV-2 infection, while caring in parallel for a low to moderate number of COVID-19 infected patients. This report presents an outline for a plan of action of a hospital system to deal with such an eventuality. We review the key changes that must be implemented in hospital management and activity to prevent disruption of key services due to the COVID-19 outbreak and the maintenance of high quality of care to all patients while ensuring the highest standards of staff and patient safety.

Key Words: COVID-19, SARS-CoV-2, Hospital management, Supply chain, Infrastructure, Strategic management

1. INTRODUCTION

In December 2019, a novel pneumonia caused by a previously unknown pathogen emerged in Wuhan, China. The pathogen was identified as a novel coronavirus, severe acute respiratory syndrome related coronavirus 2 (SARS-CoV-2) and the disease COVID-19.[1] Currently, there is no specific treatment against the new virus. SARS-CoV-2 has a lower-case fatality rate than either the severe acute respiratory syndrome related coronavirus (SARS-CoV) or Middle East respiratory syndrome–related coronavirus (MERS-CoV).[1] However, the SARS-CoV-2 virus poses a major public health threat to civilization. Whereas, thus far, the large majority of people infected by SARS-CoV-2 develop mild inconsequential respiratory symptoms, a minority of mostly fragile, immune-compromised, often aged individuals with chronic medical conditions, develop a severe form of acute respiratory distress syndrome (ARDS) and shock leading to death.[2,3] In some major urban areas, SARS-CoV-2 infection, because of its high rate of infectivity, has been directly related to the collapse of hospital infrastructure due to the sudden increase in the number of patients requiring medical attention and intensive care services. Other areas,

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partly thanks to the early implementation of a social distancing strategy, have seen a moderate but significant increase in the number of SARS-CoV-2 infection. Here too, a significant increase in severe and critical COVID-19 patients was noted, requiring significant investment in dedicated personnel and allocation of specific hospitalization and intensive care unit (ICU) infrastructure and resources, but the medical systems' functioning was not completely disrupted.

Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, recently said that a a COVID-19 vaccine could take 12 to 18 months to develop, test and approve for public use. But new vaccines typically take years to earn approval. Hence, the development of a readily available vaccine against the new coronavirus may take about 1.5-2 years at best.[1,4] Hence, most hospitals will have to address the problems and challenges of caring for regular patients, some of them high-risk patients for SARS-CoV-2 infection, while caring in parallel for a low to moderate number of COVID-19 infected patients. This report presents an outline for a plan of action of a hospital system to deal with such an eventuality.

2. Importance of knowing the prevalence of COVID-19 in your surrounding community

Because of the high infectivity of SARS-CoV-2, the virus can spread rapidly in a community and affect many of its members. Some SARS-CoV-2 infected individuals, although highly infective, will remain completely asymptomatic.[5] We have learned that continuous surveillance testing, identifying pockets of outbreak, is not only important for the early containment of the outbreak but also provides us with an early sign of a possible influx of patients within 2-14 days. Figure 1, a snapshot from our COVID-19 management dashboard, depicting patient's influx to our facility from the admission of the first patient (March 11, 2020) till May 1, 2020 and the distribution between patients requiring regular department versus ICU setting (see Figure 1). It is important to re-emphasize that some of these patients will require important ICU and other hospital resources. The median duration of hospitalization for severely affected COVID-19 patients in the literature and at our institution is more than 2 weeks.[6] Also depicted in figure 1 is the long tail of patients requiring ICU settings while the outbreak has receded, depicting the complicated ICU picture presented by these patients (see Figure 1).

3. Hospital infrastructure re-organization

It is important to realize that the coronavirus outbreak will disrupt previously well-established hospital management practices for an undetermined period. Hence, management must implement critical changes.

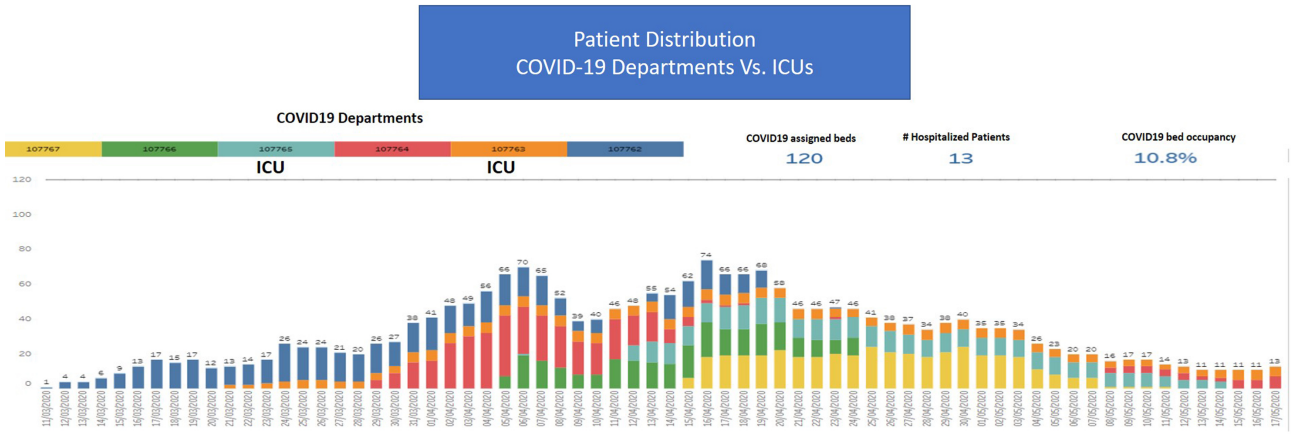

Figure 1. Patent's influx and distribution between regular department and ICU

3.1 Changing hospital infrastructure allocation

As other medical institutions worldwide, we have seen during the peak of the outbreak a 30% decrease in emergency room (ER) admissions and a 70% decrease in outpatient clinic referrals.[7] These findings imply that for the short-term patients neglect their acute and chronic health problems. This can be sustained, without major impact on society, for a short time. For the medium and long-term of the COVID-19 outbreak, hospital management and health care practitioners must reassure patients that a visit to the ER or to see their physician in the hospital or clinic is safe. Hence, the implementation of a strict separation of departments (if possible in

separate buildings), equipment and other resources between the coronavirus side and the regular side of the hospital is critical.

Of high importance is the pre- or on-admission identification of patients that come from endemic areas of coronavirus outbreak in the different hospital clinics and departments. These patients must be separated from patients presenting from low risk areas. Patients from endemic areas should undergo pre-placement triage, in the emergency room or in a preadmission clinic. Based on the real-time reverse transcription polymerase chain reaction (RTPCR) test for the qualitative detection of nucleic acid for SARS-CoV-2 in upper and lower respiratory specimens, patient carriers of the SARS-CoV-2 virus with active or asymptomatic disease must be separated from other patients.

As others, we have significantly extended our telemedicine services. Use of these technologies, in conjunction with some of the most advanced wearable sensors for continuous monitoring, can reduce the need for a personal meeting with a caregiver but cannot replace it entirely. Hence, hospitals must put in place a revised system that enables a safe patient - caregiver interaction. Patients invited to day-care units and clinics are invited using a scheduling system that aims to minimize the gathering of numerous patients in waiting areas, thereby maintaining social distancing. Clinics with a heavy patient load must be reallocated or rescheduled to reduce patient-to-patient interaction to a minimum. All patients must wear masks in public areas. Patients scheduled for elective surgery, procedures, births or day-care clinics should be considered for screening in advance for SARS-CoV-2 infection using RT-PCR 24-48 hours prior to admission. They should also complete a pre- or on-admission questionnaire regarding the presence of signs and symptoms of SARS-CoV-2 infection and exposure to such a patient during the previous 14 days. If any of these questions or tests point to the possibility of SARSCoV-2 infection or exposure, the elective procedure must be postponed. If an emergency procedure is required in a non-confirmed COVID-19 patient, a quick RT-PCR test should be ordered, possibly with an IgG antibody survey if available. If waiting for the results may put the patient at any risk, the procedure should be carried out in an especially dedicated negative pressure room with all personnel using adequate COVID-19 Personal Protective Equipment (PPE).

Realizing that COVID-19 is here to stay for an undetermined period, we have opted to put in place a duplicate infrastructure to treat patients with active or asymptomatic COVID-19, in order to separate those with a positive RT-PCR for SARS-CoV-2, from other non COVID-19 patients. For example, we have created a separate infrastructure to care for COVID-19 patients in the ER, as well as in internal medicine, pediatrics, delivery rooms, operating rooms and intensive care (some departments in a separate building). However, in special circumstances, due to a major concern for patient safety, will a procedure of patients with confirmed SARS-CoV-2 infection take place in a regular hospital area and as soon as possible, when medically permitted, will the patient return to the COVID-19 dedicated confinement departments. These specially designated departments have been designed to separate between the patients and the outside world, with separate air-conditioning systems and control rooms to allow for maximum interaction with patients through communication and telemedicine systems, thereby minimizing medical personnel exposure. Nevertheless, patients from endemic areas for COVID-19 outbreak or with symptoms compatible with COVID-19 although admitted to regular departments will be placed in full isolation until infection with SARS-CoV-2 is ruled out.

Staff, especially those caring for the sickest and immune compromised patients, should be instructed to undergo routine surveillance RT-PCR testing, to rule-out SARS-CoV-2 infection.

Efforts should also be focused on staff living in areas of endemic or higher prevalence of SARSCoV-2 infection within the general population.

The information presented above must be actively brought to the attention of the general public and explained to them using electronic, written and social media. This, in order to provide a level of comfort for patients to feel safe to come to the hospital.

3.2 A temporary hold on lean supply chain practices

COVID-19 has created critical shortages in key equipment and products used in hospitals. Some examples are the shortage of mechanical ventilators and monitors, PPE, certain drugs, most recently anesthesia drugs.[8] However, disruption in the supply chain was also noticeable in other areas, such as laboratory equipment and reagents, critical to establish a RT-PCR testing service for the diagnosis of SARS-CoV-2, sanitation products and food. This was, in part, caused by the disruption or halt in supply chains due to COVID-19. For this reason, early in the outbreak, we implemented a procedure in which we ensured an internally maintained 3- month supply of key medical and non-medical products. Contrary to previous policy, we engage in long term contracts with suppliers to ensure a specifically designated stock of critical products. However, we opted to use a selection of products and not a single product, contrary to previous

policy, to safeguard a continued supply in a scenario of a shortage or disruption in the supply chain of one supplier. Finally, to allow agility and fast decision making we have cut the red tape and have concentrated decision making for all purchasing tasks in the hands of the medical, purchasing and financing heads of the system. Further, we have implemented twice daily strategic/ tactical management meetings to anticipate possible shortages and rectify or prevent them if at all possible.

3.3 Strategic/tactical management meetings

We learned that even a moderate increase in the number of COVID-19 patients requiring hospitalization, is accompanied by a moderate increase in the severe and critical patients (see Figure 1). These patients require significant investment in dedicated personnel and allocation of intensive care unit (ICU) and other infrastructure resources in order to prevent the disruption of all other hospital-wide activities. Based on our previous experience from long- term disruptive events, at the onset of the crisis, we have put in place twice-daily strategic/tactical management meetings, including weekends and holidays, via teleconferencing or in a large conference room with 2 meters' distance between each participant. All participants must wear masks at all times. These meeting were scaled down as the outbreak subsided.

Present at the meeting are representatives of all key stakeholders contributing to hospital activity during the coronavirus crisis: hospital medical and nursing management; heads of the internal medicine division, infectious disease and infection control; infrastructure and services, supply, pharmacy and hospital emergency services coordinators. Ad-hock participants are invited, based on specific issues, as are the head of the anesthesiology and critical care division, ER, medical engineering and security.

The meeting has a structured list of key topics that are addressed in an organized manner:

Epidemiology and prevalence of the disease

A. The changing COVID-19 epidemiological picture in our area, including general prevalence of the disease and specific neighborhoods with reported outbreaks.

B. The overall hospital picture over the past 12 hours: admissions broken down into the following categories: relatively mild disease (our policy is to discharge these patients as soon as possible as not to overwhelm the system), severe disease (treated in augmented care corona internal medicine departments) and critical disease (treated in specialized Corona ICUs).

The data in sections A and B are used to plan for the number of beds and staff needed to be diverted from other hospital assignments to care for COVID-19 patients.

Patient and staff safety

- Allocation and use of PPE equipment in the different hospital departments based on the risk of expected exposure to COVID-19.
- Approval and oversight on adherence to appropriate COVID-19 prevention guidelines: use of PPE, work in small capsule groups (implemented in all medical, nursing and support staff units and departments) and implementation of medical and non-medical protocols. Two committees were established to support patient care:
  (1) A therapeutics committee was established to monitor the relevant literature on a continuous basis and publish a current standard of care for COVID-19 patients at our institution.
  (2) An ethics committee, which was not activated, but the rules for its intervention were established, namely to assist caregivers in the allocation of the level of therapy in the event of scarcity of any medical service or device.
- ***Quality and safety controls***: This includes presentation of epidemiological studies following suspected exposure to COVID-19 from patients or peers. These studies allow us to learn and correct failures in staff behavior. These measures are of key importance to prevent absenteeism of staff members due to exposure. We have determined specific hospital and ICU discharge criteria; however, we are monitoring readmissions to allow for ongoing improvement in our decision making process
- ***Hospital stocks***: A quick review of hospital inventory to streamline clinical use of adequate PPE, consumables, medical devices and medications.
- ***Infrastructure***: Adaptation and correction of infrastructure needs and maintenance to support changing hospital-wide activity and the working environment of staff caring for COVID-19 patients.
- ***Patient admission and discharge issues***: As we aim to provide services to all our patients we proactively act to reduce non-shows, as well as actively monitor adequate patient segregation.
- ***Open table discussion***: Addressing key problems brought up by the teams in the different corona units and hospital departments.

4. FINANCIAL ASPECTS

Similar to other medical institutions worldwide we have experienced cancellation of much elective activity during the

first phase of the COVID-19 pandemic and a sharp increase in our spending on medical equipment and medications.[7] This has created a sharp decrease in income that has major consequences to any medical system. Hence, management has decided to prioritize expenses that are key for COVID-19 preparedness and to cut or delay other expenses. However, such an approach will have marginal impact on the medical systems balance sheet as the need for medical staff has increased and prices of medical and laboratory equipment and drugs has significantly increased. As a result, we decided to halt long term projects and focus the hospital's investments towards COVID-19 preparedness. To support other non-COVID-19 related services, we established a business development team tasked with increasing telemedicine scope and services, and continued targeted marketing activity.

5. TECHNOLOGY

To oversee all medical activity and financial results of the medical system a financial and clinical management dashboard exists. However, to assist management in COVID-19 specific tasks a COVID-19 management dashboard was established presenting on-line data on key COVID-19 related issues: Biological ER admissions; RT-PCR performed for patients; number of hospitalized patients presented by severity of COVID-19 picture (mild; moderate; severe and critical); patient severity by age; location to which patients were discharged, patients readmitted because of worsening symptoms; number of patients by department and hospital staff on sick leave or preventive isolation (see Figure 2).

As previously noted multiple information technologies (IT) are introduced into the medical environment as part of the reorganization to care for COVID-19 patients and others to cater for the non-COVID-19 patients using an array of telemedicine platforms. Some are hastily implemented because of an urgent clinical need and others due to the necessity to protect medical personnel. However, it is important to remember that, especially in these times, it is of critical importance to maintain increased personnel awareness of cyber security in critical medical infrastructure devices as well as on supervisory control data acquisition (SCADA) systems to prevent heightened exposure to cyber-attacks.

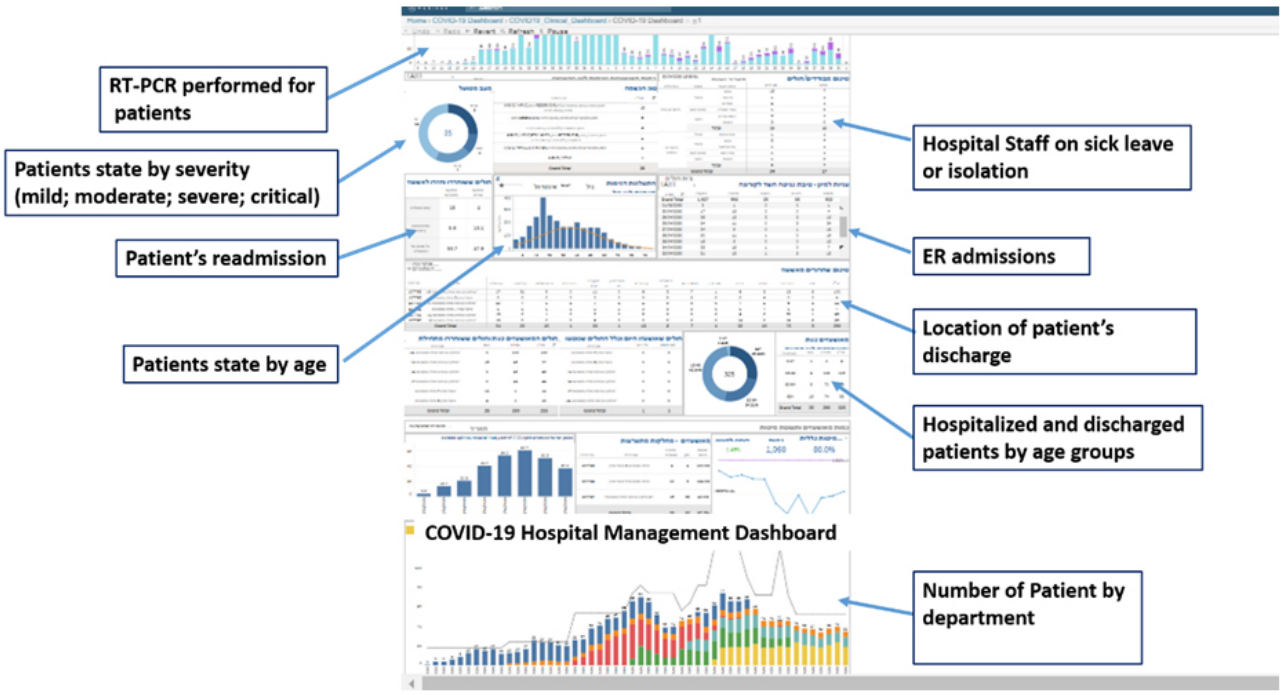

Figure 2. COVID-19 hospital management dashboard

Finally, during this period of massive disruption of regular protocols, procedures and infrastructure, top management must be fully accessible to all hospital staff members. Top management must be in regular daily contact with key persons in all hospital services treating and servicing disrupted or newly created COVID-19 services. It is of key importance to morale that top management is seen in all areas of the hospital on a regular basis.

To conclude, in this short report we have reviewed the key changes that must be implemented in hospital management

and activity to prevent disruption of key services due to the COVID-19 outbreak and the maintenance of high quality of care to all patients while ensuring the highest standards of staff and patient safety.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare they have no conflicts of interest.

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