Ilkogretim Online - Elementary Education Online, Year; Vol 20 (Issue 5): pp. 1029-1034
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.05.112

MODERN AND INTEGRATED APPROACH FOR SAFETY ISSUES IN HEALTHCARE DURING COVID-19

Manoranjan Mohapatra, Professor, Radiology department, KIMS, Kiit University, Bhubaneswar, Odisha, India
Ruby Mishra, Associate Professor, SME, Kiit University, Bhubaneswar, Odisha, India

ABSTRACT- The starting of the year 2020 has seen one of the worst pandemics in the earth's history. The biggest and the worst pandemic after the Spanish flu, novel coronavirus, or COVID 19 has affected nearly all countries of the world and killed over lakhs of people till now. Most of the hospitals, all over the world, are overloaded with COVID 19 cases. A sudden and unexpected gap between the demand and supply of resources in this pandemic has put tremendous pressure on the health care system,yet resilient. It is impossible to bridge the gap between them in a short period to control the pandemic. As the health care personnel are in short supply and the novel coronavirus's infectivityis very high, it is vital to protect them from getting cross infections while treating COVID-19 cases. A significant number of new cases are added daily. Strategic planning and optimumutilization of resources need the hour to runthe health care system for a longer period in this pandemic and simultaneously protect healthcare personnel. In this article, multilevel safety methods for protection against the coronavirus infection in a healthcare facility using different methods like artificial Intelligence, smartphone apps, personal protective kit, andworkflow pattern modification are discussed.

Keywords: Healthcare, Safety, COVID-19, Artificial intelligence, Smartphone

I. INTRODUCTION

Since the first report of COVID-19 infection from Wuhan city of Hubei province of China in Dec 2019, the total number of cases in the world reached 4.2 crores with 11 lakh mortality as of 22nd October 2020. On March 11, 2020, the WHO has declared this as Pandemic and almost every country in the world took measures like lockdown, short down, etc to control the spread of the disease. The coronavirus is transmitted through aerosol, droplets, and fomites. Staying at home, maintaining a social distance of a minimum of 2meters, use of masks, hand washing, or hand sanitizations are recommended methods to prevent transmission of the virus. Though this measure has delayed its transmission to a certain extent, still there are no signs of any control over the pandemic, and 3.4lakh new cases are added every day. In these last 8 months of the pandemic, almost all the countries have experienced overcrowding of hospitals with COVID-19 cases, shortage of ICU beds, ventilators, and healthcare workers. As per the statement from WHO, the novel coronavirus has infected approximately 10% of the world population. In most of the COVID-19 cases, around 80% have no or mild symptoms, which creates difficulty in detecting cases and carries the potential threat of transmission to others. Of the remaining 20% cases, 15% require oxygen support and 5 % require ICU support. Even though the symptomatic cases are lesser in percentage, still the numbers are high enough to put tremendous pressure on existing health care facilities and possess a serious threat of infection to healthcare workersAccording to WHO, around 14% of the covid-19 cases reported to them are of health workers in developed countries and it is around 35% in some low-to middle-income economies. While health workers represent less than 2% of the population in most low-to middle-income countries, thousands of health workers globally have succumbed to the novel coronavirus as per WHO data.(Facts et al., 2020).Those frontline healthcare workers in China, who managed COVID-19 patients reported distress (71.5%), anxiety (50.4%), and insomnia (34%) because of fears regarding shortages of PPE and increased risk of infections for self and family. In a recent statement made by WHO, that no country, hospital, or clinic can keep its patients safe unless it. keeps its health workers safe. Health care workers' safety includes protection from physical violence, infectious agents like viruses and bacteria apart from a safe work environment like any other industry.(Charter, n.d.).

There are various methods to protect health care workers, against coronavirus. The first and most essential step to provide a safe work environment in the hospital is to prevent hospitals' overcrowding with patients. The second step is to segregate the patients into three groups; suspected covid, established covid, and non-covid groups on entry to the hospital and channelize accordingly. The third step includes manpower planning and provision for appropriate personal protective kit for health care workers,

patients, and other support workers. The fourth step is to provide care to patients with no/minimal contact.

1. PREVENTION OF OVERCROWDING IN HOSPITAL

A retrospective study conducted in China on cancer patients showed that recurrent visits to hospital and admissions were the potential risk factors for COVID-19 infection.(Cinar et al., 2020).More the patients, more are the risk of transmission which will affect both patient and health care workers alike. Remote monitoring and video consultation can avoid direct contact between health care personnel and the patient, which will benefit new and follow-up patients. Similarly, many smartphone applications as well as smartwatches, can provide health monitoring of self.(Zhang et al., 2015).These devices can screen health parameters like BP, Blood Sugar, SpO2, Heart rate, ECG, etc. Those having abnormal parameters can take teleconsultation or seek hospital care, thereby reducing the hospital load. In some cities, real-time data on the availability of general beds and ICU beds are uploaded into AI linked centralized Covid surveillance cell. Any user through mobile application can access real-time information about, general, ICU beds and ventilators in the nearby hospital in case of need. This is depicted in flow chart mentioned below in figure 1.

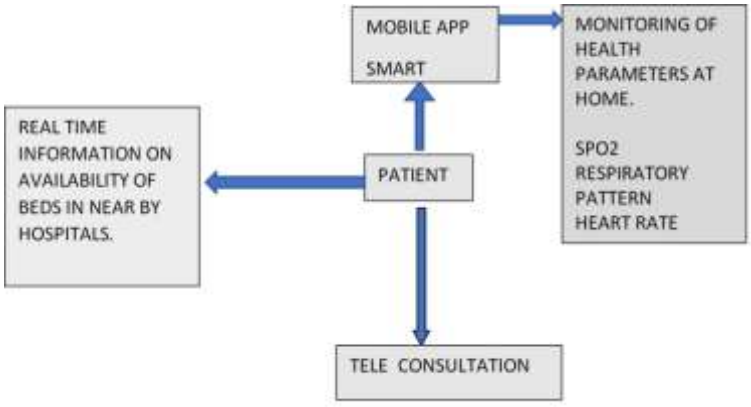

Fig.1. Various application of smartphone for health monitoring

2. SCREENING AND SEGREGATION OF COVID CASES FROM NONCOVID CASES ON ENTRY TO HOSPITAL

Large-scale screening can be done by no-touch systems that include infrared thermal imaging technology for the detection of fever and camera-based motion detection software for abnormal breathing patterns. These can be linked to the AI system for quick analysis and are extremely useful for mass-scale rapid screening using minimal manpower.(Adly et al., n.d.).These devices can be deployed at the hospital's entry point for screening and segregation of covid suspect cases from non-covid cases. Once it is done, they can be channelized to separate blocks inside the hospital having independent entry and exit.

3. MANPOWER PLANNING, PERSONAL PROTECTIVE EQUIPMENT KIT AND ENGINEERING METHOD FOR PROTECTION OF HEALTHCARE WORKER.

In the present covid pandemic with an increasing number of cases, health-care systems globally are likely to continue to operate with a maximum capacity for a longer period. But health care workers, unlike wards or ventilators, cannot be urgently produced on large scale to run at full occupancy for long periods.(*COVID-19 : Protecting Health-Care Workers Ebola in DR Congo : Getting the Job Done*, 2020). On top of this, they can get infected and may remain unavailable in an effective workforce. This needs strategic planning. The health care workers are broadly divided into two groups, those who are likely to contact covid cases where the risk of exposure is high from those at no/low risk. In the first group nurses, food, cleaning and laundry staff, etc are included, and in the second group, the administrative staff are included.

The Occupational Safety and Health Act (OSHA) from the US Dept of Labour has provided the risk stratification of health workers which is mentioned below(*Healthcare Workers and Employers Interim Guidance for Workers and Employers of Workers at Lower Risk Of*, 1910).

Examples of Healthcare work tasks associated with exposure risk levels are shown in Table.1.

Table.1.Examples of Healthcare work tasks associated with exposure risk levels

Lower(caution)	Medium	High	Very High
Performing administrative duties in non-public areas of healthcare facilities, away from other staff members. Note: For activities in the lower (caution) risk category, OSHA's Interim Guidance for Workers and Employers of Workers at Lower Risk of Exposure maybe most appropriate.	Providing care to the general public who are not known or suspected COVID-19 patients. Working at busy staff work areas within a healthcare facility.	Entering a known or suspected COVID-19 patient's room. Providing care for a known or suspected COVID-19 patient not involving aerosol-generating procedures.	Performing aerosol-generating procedures (e.g., intubation, cough induction procedures, bronchoscopies, some dental procedures, and exams, or invasive specimen collection) on known or suspected COVID-19 patients. Collecting or handling specimens from known or suspected COVID19 patients.

Adapted from the Occupational Safety and Health Act (OSHA) from the US Dept of LabourHealthcare Workers and Employers Interim Guidance for Workers and Employers of Workers at Lower Risk Of, 1910.

The health care workers should be distributed into different groups based on risk stratification. The number in each group and their frequency of rotations depending on the workload in the COVID and the non-COVID areas of the Hospital. The Health-Care staffs who are more than 65 years old, with comorbid conditions or other risk factors like immunocompromised states may be allotted to work in the non-COVID area or kept in the reserve group. Sharing of workload within a group can reduce the manpower requirement in the COVID and the non-COVID group, reducing the risk of exposure risk. Stay-at-home alternating with return-to-work can reduce the exposure risk.(N et al., 2020). The hospital should have a policy of 'No mask no entry' and should be prominently displayed on entry points. The effectiveness of the mask depends on its type and duration of use. Every mask has a life span and it needs to be properly disposed of after each use. The cloth mask provides minimal protection and should be cleaned with a detergent solution and sun-dried after every use. As the efficacy of the patient's mask and their accompanying person cannot be verified, they should be provided with a new surgical mask in the registration area for same-day use in the outpatient department. It should be worn over the existing mask for better safety.

Occupational Safety and Health Act (OSHA) recommends using a combination of standard, fomite, and airborne precautions to protect healthcare workers from exposure to biologic agents like a virus. Training healthcare workers with additional activities like housekeeping and meal services can reduce the need for other workers to enter isolation areas were suspected or confirmed COVID-19 patients are kept. This act has also suggested safe work practices like segregating clean areas (e.g., where no protective item is kept) from potentially contaminated areas (e.g., where used masks, face shields, PPE are discarded), proper handling of waste and other potentially infectious materials along with cleaning, disinfecting, and maintaining the reusable equipment. (*Healthcare Workers and Employers Interim Guidance for Workers and Employers of Workers at Lower Risk Of*, 1910).

They also recommend that the health care workers who are likely to come in contact with confirmed or suspected COVID-19 patients should wear:

Disposable N95 filter facepiece respirators

Goggles

Face shield

Gloves

Gowns

OSHA recommended Engineering Controls

This includes partitions or physical barriers in designated areas to guide patients, curtains separating patients in semi-private areas, and airborne infection isolation rooms (AIIRs) with proper ventilation. The purpose is to shield healthcare workers and others from individuals with suspected or confirmed COVID-19.(N et al., 2020).

4. INDOOR AND ICU CARE OF CONFIRMED COVID CASES:

Due to the use of protective barriers like face shield and mask acting as a sound barrier and maintaining social distancing norms, the verbal and direct communication between doctors and patients is often lacking during this pandemic. It leaves the patient and the family 'in the dark' and unsatisfied. This creates mistrust between family members of patients and doctors, occasionally resulting in verbal abuse. The hospitals should designate some social workers and counselors to coordinate with them regularly to allay any fears.(To et al., 2020).

COVID-19 is one of the most infectious and communicable diseases which are a threat to medical professionals. The transmission of this disease occurs rapidly when COVID-19 infected patients completely occupy hospitals. To reduce the risk of exposure, only essential healthcare workers should be allowed to enter patient rooms, multiple activities should be bundled together to minimize the number of times a room is entered and remote monitoring of vital parameters of the patient should be encouraged.

Much factual information about temperature, heart rate, respiratory rate, blood pressure, oxygen saturation, and other vital signs along with status, condition, severity, and existing comorbidities of COVID-infected patients can be got by developing a video-imaging based high-speed central monitoring with a two-way communication system. These parameters need to be analyzed to assess the severity of the disease. Data can be collected from the patients' smartphones and other electronic gadgets and monitored by Artificial Intelligence systems. These data can be kept and stored in electronic health records (EHRs) of patients, where they can be quickly shared when required without any effort. The collection, analysis, and interpretation of the vital parameters of the patients from the monitors can be automatized using Artificial Intelligence, which will not only diminish the burdens imposed on medical staff to constantly collect, store, inspect, and give results based on these data but also reduce the infection risk which may arise while they are collecting and maintaining the information.

Figure 2 explains when the COVID-19 case gets admitted to the hospital, the health monitoring app of the smartphone of the patient can be connected to the nursing station located outside the room for transmitting vital parameters like spo2, respiratory pattern, and BP. CCTV over each bed can be installed and the monitor screen can be connected to the mobile of treating physicians for remote monitoring so that the health care workers will be minimally exposed. A basic flow chart showing monitoring of COVID cases in ICU.

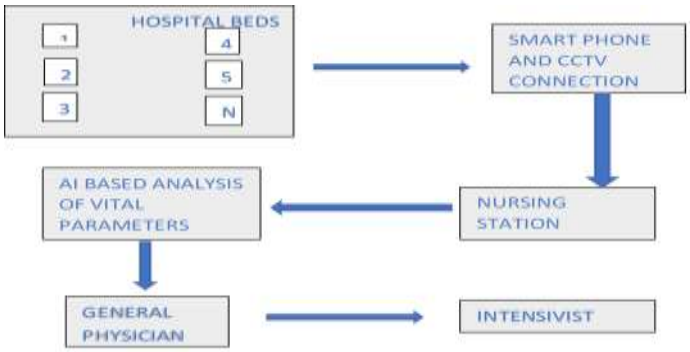

Fig.2. Flow chart showing contactless monitoring in ICU.

Teleoperated robots can accomplish common nursing tasks, which are risky for any medical professional or nurse, in infected areas such as delivering food and medicines, collecting specimens, and transporting waste. A significant benefit of using robots is that a single human or robot operator can control multiple other robots working in different hospital areas by sitting at just one place. A real-life instance of it is a robot named TRINA (Tele-Robotic Intelligence Nursing Assistant). It was used to perform error-free risky nursing jobs and showed promising results.(Zhang et al., 2015).

B Naveen Naik et al in an article discussed the use of Tele-ICU technology with remote consultation engaging a few intensivists and staff for proper monitoring of ICU cases with minimal risk to health care personnel. (Naik et al., 2020).They used commonly available gadgets like closed-circuit television (CCTV) cameras and smartphones for remote monitoring of ICU patients in northern India's large tertial care

hospital. CCTV cameras were fitted over each ICU bed for monitoring the patient and their vital parameters. For visualising the vital parameters like SpO_2, temperature, heart rate, ECG, blood pressure, pCO_2, etc., over smartphones from the off-site location, they installed a remote mobile health monitoring system and server structure. It assisted the skilled intensives to monitor, alert, and manage patient care without being physically present near the patient.

These are the multilevel safety measures that can be taken for the protection of health care workers during the present pandemic. Additionally, general safety measures similar to any other industry should also be provided. Recently WHO released a Charter for World Patient Safety Day on 17th September 2020, that includes steps to protect health workers from violence; to improve their mental health; to protect them from physical and biological hazards; to advance national programs for health worker safety, and to connect health worker safety policies to existing patient safety policies. This is a welcome step for health care workers which every country should adopt in its policy.

OUR EXPERIENCE

In March at the outset of the coronavirus pandemic, we conceptualized and implemented a multilevel protective measure for our health care workers in a small hospital, named Gastro and Kidney Care Hospital located in Bhubaneswar, a tier 2 cityin India, having 40 indoor beds including 4 ICU beds with approximately 200 to 240 daily out-patient turnover. We have applied the following multilevel protection methods mentioned below Remote consultation using telephone and social media.

1. Screening at the entry point of the hospital.
2. Mask distribution at the registration area.
3. Manpower planning and protection.
4. Remote monitoring using CCTV

REMOTE CONSULTATION USING TELEPHONE AND SOCIAL MEDIA

At the beginning of the pandemic, we encouraged our patients to consult over the telephone, e-mail, or social media like WhatsApp. The patients were evaluated for severity of symptoms and those having minor ailments were encouraged for treatment at home, and those having severe ailments were asked to visit the hospital.

SCREENING AT THE ENTRY POINT OF THE HOSPITAL

Signageswere put in multiple locations near the main entry displaying a message - 'No mask, No entry'. The staff at the main gate provided alcohol-based hand sanitizer and screened every individual with thermal scanners; those with high temperatures were asked to get a Covid test done. Only those with normal temperature were allowed to enter inside the screening area of hospital premises. Inthe screening area, each patient was asked a set of questionnaires related to any Covid like symptoms or recent contact with Covid cases. Those having Covid-like symptoms were channelized to the Covid section for further evaluation. The remaining patients were allowed to enter the registration area of the hospital.

MASK DISTRIBUTION AT THE REGISTRATION AREA

In the registration area, every patient and their relatives after registering their details were provided with surgical masks to be put over the existing mask.

MANPOWER PLANNING AND PROTECTION

We created a standard operating procedure for healthcare workers after stratification of risks taking into consideration their place of deployment, age, and comorbidities. For example, the administrative staff were asked to wear a face shield, mask, gloves, and gown. Whereas the frontline workers were asked to wear full PPE. The staff were divided into four teams. In each team doctors, nurses, paramedics, and housekeeping staff were included. They worked in three shifts a week and one team per shift was deployed. The fourth team was kept as a reserve to provide support as well as a replacement ifany member of a team gets infected.

REMOTE MONITORING USING CCTV

A CCTV was installed over each ICU bed and connected to a large LCD monitor placed outside the ICU room for remote monitoring of patients. We could not include smartphone-based remote monitoring due to the additional cost.

Using the above methods, the cross-infection amongst health carepersonnel was limited to 0.05% which is significantly low.

II. CONCLUSIONS

Protecting healthcare personnel is crucial for any country because it is the most critical resource at the time of a pandemic which cannot be replenished urgently if the existing manpower succumbs to infection and death. Health workers cannot provide high-quality and safe care to patients in environments where there is a biological, physical threat to their safety and they are fatigued and stressed. With the increasing number of health personnel getting infected with COVID-19 disease, it is much needed to ensure appropriate safety measures to protect its health care worker from getting infected with COVID-19 disease. This will be only possible with proper planning and implementation of safety measures jointly by the health care personnel, health care promoter, and the government.

REFERENCE

1. Facts, P., Reads, L., Perish, P. O., Monika, M. W., Conversation, M. M., & Sharma, N. C. (2020). 14 % of global covid-19 cases are among health workers : WHO. 1–14.
2. Charter, T. (n.d.). Charter Health worker safety : a priority for patient safety.
3. Cinar, P., Kubal, T., Freifeld, A., Mishra, A., & Shulman, L. (2020). Safety at the Time of the COVID-19 Pandemic : How to Keep Our Oncology Patients and Healthcare Workers Safe. 18(5), 504–509. https://doi.org/10.6004/jnccn.2020.7572
4. Zhang, Y., Liu, H., Su, X., Jiang, P., & Wei, D. (2015). on Smart Phone and Browser / Server Structure. 6(4), 717–738.
5. Adly, A. S., Adly, A. S., & Adly, M. S. (n.d.). Approaches Based on Artificial Intelligence and the Internet of Intelligent Things to Prevent the Spread of COVID-19 : Scoping Review Corresponding Author :22(8), 1–15. https://doi.org/10.2196/19104
6. COVID-19 : protecting health-care workers Ebola in DR Congo : getting the job done. (2020). 395, 2020.
7. Healthcare Workers and Employers Interim Guidance for Workers and Employers of Workers at Lower Risk of. (1910).
8. N, M. M., Radhakrishnan, C., & Indira, P. (2020). COVID-19 : Striking a Balance between Health Care Provider Safety and Patient Care in the Indian Hospital Settings. Figure 1, 1–12.
9. To, S., Violence, C., Faced, C., The, B. Y., & Workers, H. (2020). Current situation with doctors and healthcare workers during COVID-19 pandemic in India. April. https://doi.org/10.1136/postgradmedj-2020-138496
10. Naik, B. N., Gupta, R., & Singh, A. (2020). Real-Time Smart Patient Monitoring and Assessment Amid COVID-19 Pandemic – an Alternative Approach to Remote Monitoring. 2–3.
11. Management of ill travellers at points of entry – international airports, seaports and ground crossings – in the context of COVID -19 outbreak. World Health Organization. 2020 Mar 19.
12. Occupational health Health workers. (2020). 1–3.
13. Behera, D., Praveen, D., & Behera, M. R. (2020). Protecting Indian health workforce during the COVID - 19 pandemic. https://doi.org/10.4103/jfmpc.jfmpc
14. Covid-, T., Director-general, W. H. O., Worker, H., & Charter, S. (2020). Keep health workers safe to keep patients safe : WHO. September, 2–5.
15. Health, J., Sinai, M., & Permanente, K. (2020). New engla nd journal. 1–3.
16. Lee, I., Wang, C., Lin, M., Kung, C., Lan, K., & Lee, C. (2020). Letter to the Editor Effective strategies to prevent. Journal of Hospital Infection, 105(1), 102–103. https://doi.org/10.1016/j.jhin.2020.02.022