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RESEARCH ARTICLE OPEN ACCESS

Innovative Virtual Intensive Care Unit

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Abstract— Virtual ICU aims to investigate and monitor the epidemiology and treatment given to the patient and evaluate the implementation of evidence-based ICU care and its association with the outcomes of patients with acute respiratory distress syndrome admitted to the ICU. The virtual ICU setup has to be made available for the patients which is integrated with well automated equipments such as ventilation settings, respiratory conditions, nutrition and rehabilitation facilities are to be provided to the patients that will be monitored on daily basis. Virtual ICU care helps patients suffering with chronic disease as well as patients with acute respiratory distress syndrome (ARDS). It helps to improve and monitor Epidemiology, Treatments and Evidence-based ICU care. It improves Mortality rate of the population. Based on the quality of the VICU patients can get the fast treatment so that it can save more lives.

Keywords—ICU, ARDS, Epidemiology, ventilation, treatment.

I. INTRODUCTION

World population is nearly 8.1 Billion. Country like India one medical doctor per 1000 people. The survey says that 65% country population lives in rural areas with ought proper medical facilities.

Acute Respiratory Distress Syndrome (ARDS) is a condition associated with hypoxemia due to non-cardiogenic causes and results in high mortality. However, the epidemiology and treatment strategy for ARDS may have changed significantly due to the accumulation of a large body of knowledge, following the two-year pandemic of the novel coronavirus (SARS-CoV-2) of which the primary manifestation is ARDS. To improve the quality of ICU care that patients receive after admission to the ICU, a variety of academic societies, are currently developing evidence-based guidelines and consensus guidelines and statements regarding ABCDEF bundles, nutritional therapy, ICU diary. The ABCDEF bundle, nutritional therapy, and ICU diary have been developed and are being promoted for implementation in hospitals around the world. The implementation of evidence-based ICU care is strongly recommended, especially for patients with Acute Respiratory Distress Syndrome who frequently require ventilators to maintain their lives, because their patient outcomes are worse than those who were admitted to ICU with other causes.

This study has the potential to increase the generalizability of the results which will be obtained from all regions of the world, including Asia, Europe, North and South America, Oceania, and Africa. Therefore, the results will potentially contribute to improving patient treatment and outcomes in all regions of the world. Furthermore, the results obtained will provide a detailed picture of the current ICU care given to patients with ARDS in the ICU. The association/correlation analysis between its implementation and patient outcomes will identify the content of ICU care which can maximize improvement in outcomes for ARDS patients. As a result, this study will contribute to the development of ICU care guidelines and thereby improve the outcomes of patients with ARDS. The study will play a significant role in improving outcomes for patients with ARDS worldwide. In addition, the results of this study will serve as basement data for future interventional research.

Due to the nature of this prospective observational study, it is not possible to prove a causal relationship between ICU care and patient outcomes. However, a randomized controlled trial of evidence-based ICU care as an intervention is considered a very high

hurdle to conduct due to ethical aspects for the group that does not receive the intervention. Therefore, we are unable to conduct a randomized controlled trial at this time and have decided that an observational study is the best research design. However, this study will extract factors that are strongly associated with patient outcomes by collecting details of daily ICU care and treatment, which have not been available in previous studies, and will consider setting up interventions and randomized controlled trials based on our results.
However, there is still little evidence on how the quality of ICU care (compliance rate) correlates with patient prognosis and outcomes, and there are currently no clear goals or indicators for the ICU care we should need.

II. EVIDENCE BASED VICU CARE AND TREATEMENT

Patient data collection record should be online in a daily basis from the first day of admission in VICU unit of hospital up to discharge. The following facilities are to be integrated in VICU

ABCDE Bundle

The Airway, Breathing, Circulation, Disability, Exposure (ABCDE) is the one of the clinical emergency approach for immediate assessment and treatment. The approach is widely accepted by experts in medical domain and also health care professionals focusing on the most life-threatening clinical problems. In an acute setting, high-quality ABCDE skills among all treating team members can save valuable time and improve the availability of treatment for needy people on the emergency.

A. ICU patients routinely experience pain, both at rest and with routine ICU care such as procedures or wound care. Lack of treatment of pain can result in many complications including delirium. The pain is routinely monitored in all ICU patients. Self-reporting is the gold standard for assessment of pain. Vital signs should not be used alone for assessment of pain in patients that are unable to communicate. The Behavioral Pain Scale (BPS) and the Critical- Care Pain Observation Tool (CPOT) are the most valid and reliable behavioral pain scales for assessing pain in adult, ICU patients unable to communicate pain.

The CPOT includes evaluation of four different behaviors (facial expressions, body movements, muscle tension, and compliance with the ventilator for mechanically ventilated patients or vocalization for non incubated patients) rated on a scale of zero to two with a total score ranging from 0 to 8. The CPOT is feasible, easy to complete, and simple to understand.

B. By ensuring Spontaneous Awakening Trials (SAT) and Spontaneous Breathing Trials (SBT) in VICU for the patients to reduce the length of mechanical ventilation, thereby reducing the risk for developing ventilator-associated pneumonia (VAP).

C. Sedation and analgesia are essential in the VICU in order to promote control of pain, anxiety, prevent loss of materials, accidental extubation and improve the synchrony of patients with ventilator.

D. Delirium is a type of confusion that affects the patient's ability to focus on their own activities. It is more common for patients who are long term hospital stay or long term care facilities. In order to examine patient's mental status the VICU has to facilitate neurological exams, psychological tests, blood tests.

E. Early mobility and exercise is physical rehabilitation content based on the VICU. Prolonged periods of immobility have often been reduced

F Family engagement and empowerment-can be improved with VICU.

III. INNOVATIVE VIRTUAL ICU

Intensive Care Unit and Critical Care Unit or Coronary Care Unit is specific care units utilized as a part of doctor's prescription in different nations that gives intensive care medicines. Innovative Virtual ICUs are well equipped with medicinal devices, mechanical ventilators, bedside monitors, digital cardio tachometers, pacemakers, defibrillators, dialysis instruments and so on. The biological data related with the patient from the bedside monitoring devices can analyzed by the concerned doctor or nurse in order to provide better care for the patient. The quality of care of a VICU relies upon the automated equipment which is operated by the doctor or trained nurse at the VICU. It improves patient to nurse ratio. Monitoring parameters of patient from each ICU Unit can be sent to the central monitoring unit for proper medication. Likewise the different parameters from various ICU units can be sent to a central monitoring console for detailed analysis and care fig 1 shown VICU.

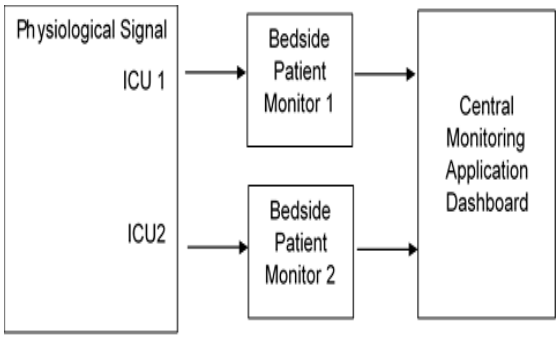

Fig 1. Virtual ICU

World Heart Day reports say that 27% of deaths in India are caused by cardiovascular diseases. At the same time doctor-patient ratio is one doctor per 1,000 people. So more ICU (Critical or coronary) care units are required to treat the patients who is diagnosed with heart related problem. The principle highlight of VICU is the accessibility of telemetry or the consistent monitoring of ECG in order to check the proper functionality of heart.

VICU has following facilities which can be visualized and monitored connected systems through AR-VR

A. Cardio Tachometer

It should be present the beside patient for monitoring the heart beat rate of the patients at regular intervals of time and display the pulse rate.

B. Electrocardiogram (ECG)

An electrocardiogram (ECG) records the electrical signal from the heart to check for different heart conditions. Electrodes are placed on the chest to record the heart's electrical signals, which cause the heart to beat.

C.Sphygmomanometer:

It is used to measure arterial blood pressure of the patient. It is the process of manually measuring one's blood pressure in order to treat the patient .

D. Pulse Oximeter:

Pulse Oximeter measures blood oxygen levels of the patient. A low level of oxygen saturation may occur if the patient has certain health issues.

Glucometer: Glucometer is a medical device used for determining the approximate concentration of glucose in the blood.

Security of cardio tachometer: ----------write ---- content

Explain about the diagram Security of cardio tachometer

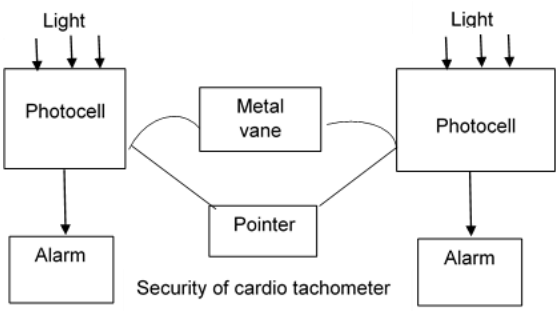

Fig 2: Security of cardio tachometer

B. Ventilator

Device with light source to assist intubation. Measuring the right position of the tube. Visualization of airway entrance to put the tube. Cuff inflation to avoid air leaving the lungs and durt going into the lungs.

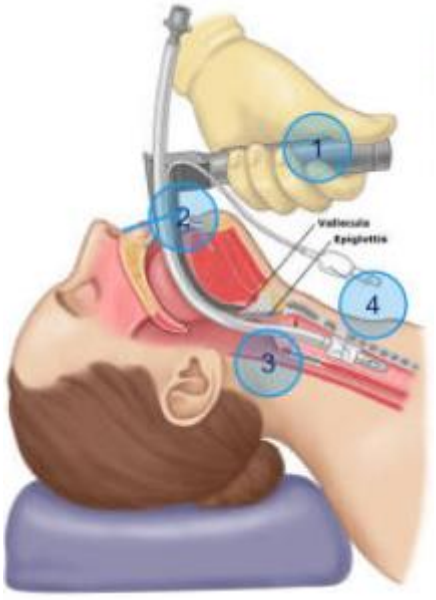

Fig 3- Ventilator

C. Continuous Veno-Venous Hemofiltration (CVVH)

It is a temporary treatment for patients with acute renal failure who are unable to tolerate haemodialysis and are unstable. Renal placement therapy support the kidneys when they fail. Kidneys are responsible for removing liquid and toxins. Observation of the renal function through an urinary catheter directly in the bladder connected to a container. When the kidneys fail, the patient connected to the dialysis machine (Renal placement therapy). Connected with two tubes: one to take the blood to the machine and one to bring the filtered clean blood back. Two bags: One will remove the

blood, and the second one to bring back the clean blood. A monitor screen shows the functioning of the machine and different parts of it.

D. Extracorporel Membrane Oxygenation (ECMO)

It supports the lungs and the heart function when the lungs are not able to provide oxygen to the blood. It is used if the breathing machine and medication ae not enough to support your organs and oxygen. Blood will take out of the body a cannula, filtered and provided with oxygen. The blood is pumped with a certain pressure to sustain the necessary blood pressure through cannula. Perfuse with pressure and enough oxygen all the organs to keep the patient live..

E. Patient Electronic Record

General view of the condition of the patient day by day. First block of data are coming from the machines connected to patient. Second block of data are all the medicines and treatments to treat the patient. Third block of data are coming from the examination and lab results. All the data are combined and evaluated at every moment.

F. Hemodynamic Monitor

It monitors Heart (ECG) line and hearth rate (Beats per minute), SpO2 Oxygen Saturation percentage, Blood pressure (Sysolic and Diastolic pressure in mmHg), Central body Temperature (degree celcius).

Fig 4. Hemodynamic Monitor

G. Virtual Bed

Bed on patient monitored through virtually day by day.

H. Defibrillators

It is used to provide an electrical charge that stops your heart's abnormal rhythm so your heart can get back to a normal rhythm.

I. Infusion pumps

Plastic tubes in your vessels. To provide with medicines and machines. The tubes are connected with a plastic needle (catheter). Dosing Very correctly the drugs and amount of fluids.

J. Pulse oximeter

It measure the oxygen level in the blood. An infrared light through the tip of the finger. Connected to a monitor that reads out the oxygen level. Shows the percentage of the red blood cells saturated with oxygen. Very important information for evaluation of the oxygen that reaches the organs.

K. Emergency Trolleys

Airway trolley for airway problems (Failure of the breathing). Crash trolley is used for circulatory problems (Failure of the heart). Different devices to support an airway emergency situation. Difibrillator and medication is part of the crash trolley to assist an emergency circulatory (heart) problem.

L. Patient

General view of the patient day by day monitored.

Fig 5. Virtual ICU

M. Infusion pumps

It delivers fluids, such as nutrients and medications, into a patient's body in controlled amounts.

N. Pulse oximeter

It monitors patients oxygen level.

CONCLUSTION

Evidence based ICU helpful to monitor patient day to day basis. It aims to investigate the epidemiology of patients with ARDS on non-invasive/invasive mechanical ventilation admitted to the ICU including short-term post-hospital discharge employment status, quality of life, physical, cognitive and mental dysfunction. It investigates the treatment provided to patients with ARDS on non-invasive/invasive mechanical ventilation admitted to the ICU. It investigates the implementation of evidence-based ICU care and its association with patient outcomes.

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