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A Study of Biomedical Instrumentation Equipment and Telemedicine Integration

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Abstract: ***Biomedical Engineering involves developing new devices and procedures that solve medical and health-related problems by combining advanced technologies like Artificial Intelligence and Machine Learning to improve the human health. Bioengineers developing electrical circuits and software's for Biomedical Instrumentation. In Biomedical Instrumentation equipments are some may be used for recording such as ECG, EEG, EMG and ERG. Some may be used for critical care patients such as pacemakers, defibrillators and ventilators. Some equipments are used to diagnose defect in human body such as X-ray, CT scan, MRI. Advantages of telemedicine in COVID are also reviewed in this paper.***

Keywords: Biomedical equipments, Imaging, COVID, Telemedicine. and Medical Devices

1. Introduction

Medical Instrumentation engineering involves developing new equipments that are used to solve healthcare and medical issues with reduced cost[1]. Pulse oximetry is monitor peripheral oxygen saturation and pulse rate of the patient [2].

The importance and deployment of Telemedicine in during COVID-19 [3]. Telemedicine is not a technology or new branch of medicine but it is the delivery of health- care for long distances [4].

The important and transformation precaution during pandemic [5]. Telemedicine is a complex system which has both trust and collaboration [6].The effectiveness of telemedicine in various domains such as Neurology, Cardiology, Dermatology, Psychiatry, Home health care[7].
Biomedical Instrumentation system contains five components, which are Mesurand ,Transducers or Sensors, Signal Conditioning, Output Display and Auxiliary components. Measured measures BP, ECG, IR and tissue sample such as Blood or a Biopsy. The sensor converts input physical quantity to an electric output. Signal conditioning convert analog sensor output to digital form. Display output displays the results in the form of numerical, graphical, discrete or continuous. Auxiliary components contains data storage, data transmission and data recording.

The device convert ionic potentials into electronic potentials are known as electrodes. Electrodes are mainly two types, polarized and non-polarized electrodes. There are micro-electrodes, body surface electrodes and needle electrodes are used for measuring purpose.

2. Review of Biomedical Equipments

Biomedical equipments are mainly three types, type B, type BF and type CF. Type B equipments are non-invasive, BF type equipments are floating type defibrillator paddle and type CF are floating type ECG module.

There are some equipments used to measure bioelectric signals such as ECG, EEG, EMG and EOG. Electrocardiography which is used to record the electrical activity of the heart. Electroencephalography is the graph obtained by the electrical activity of brain. Electromyography is a method of recording electrical activity of muscles. Electrooculography is a technique of measuring the resting potentials of retina. For these equipments, some electrodes are used such as metal disc electrodes, chloride silver disc, dry electrodes, surface electrodes, needle electrode, single channel recorder, three-channel recorder, vector cardiograph and continuous recording.

Pacemaker, defibrillator, hemodialysis machine, spirometry, diathermy and ventilators are used when the patient in critical care. The purpose of using pacemakers was to control electrical impulses, restore normal activity and improve heart function. Pacemakers are mainly two types internal and external. Internal pacemakers are permanently placed for who suffers permanent heart attack. External pacemakers are used to temporary heart problem patients. The electronic device used for electric shock are known as defibrillator. There are two types internal and external defibrillators. AC, DC, synchronized, square pulse, double square pulse and biphoric DC are different types of defibrillators based on nature of voltage applied.

The process of removing waste products from the blood and restore normal PH value of the blood is called dialysis. Hemodialysis and peritoneal dialysis are two types of dialysis. Peritoneal dialysis takes more time than hemodialysis. The device used to take spontaneous breaths for patents are known as ventilators. The breathing support through an external interface are known as noninvasive ventilators. Invasive ventilators are for patients on long-term ventilation. A therapeutic treatment for muscles and joints known as diathermy.

Radiography, computer radiography, CT, MRI, SPECT, PET and ultrasonography these equipments are used for imaging purpose. X-rays are familiar because they are used in

medical imaging and to view bone structure. Computed Tomography scan is a combination of X-ray and computer. It is used to diagnose of organs in 3D image. CT scan produces 360 degrees image.

Magnetic Resonance Imaging (MRI) is the process of applying external magnetic field to the patient which causes the magnetization of hydrogen atoms in the body. Due to the external magnetization photons align themselves and photons undergo some precession. The MRI system components are magnet, RF transmitter system, RF detection system, Gradient system and imager system. MRI produces cross section images. SPECT is Single Photon Emission Computed Tomography in which gamma camera detects the emitted radiation. It has good sensitivity and more widely available. It gives 3D information. PET is functional imaging where as MRI and CT is structural imaging. The principle in PET is coincidence imaging. Combining PET and CT which can form PET-CT. It can identifies the location of hot spot in particular organ.

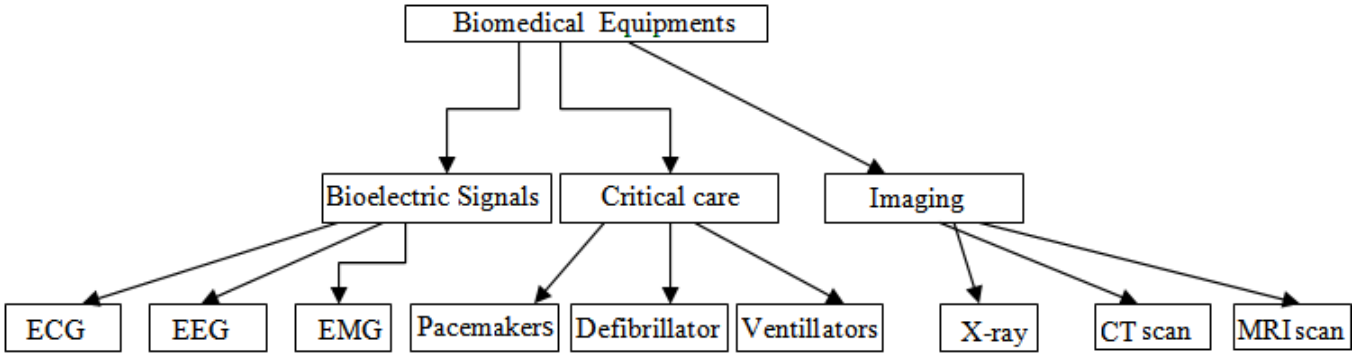

Figure 1: Biomedical Equipments

Telemedicine

Telemedicine is the technology uses Telecommunication and Information technology to provide medical facility from a distance. It is mainly useful for rural communities. It is also used save lives in critical care and emergency conditions. The diseases between patients and medical staff can be eliminated by telemedicine. It includes hardware, software, medical equipments and communication links. Modern information technology used to deliver timely health services to the patients. Telemedicine used for traditional services where as telehealth for traditional and non- clinical services.

There are some disadvantages of telemedicine,

- Difficulty of claiming reimbursement
- Inability to start treatment immediately

Figure 2: Medical imaging equipments

3. Advantages and Disadvantages

Advantages:

- X-rays are readily available and cheap.
- EEG has poor SNR
- Cost of EEG is low and portable
- ECG data in topographic form
- Cost of SPECT is lower than PET.

Disadvantages:

- X-rays are radiation harmful , no depth information and cannot observed organs movement.
- In ECG , wires and probes restricts patient body movement
- Cost of SPECT is higher than echocardiography.

4. Applications

- Ventilators are maintain or improve O_2 and CO_2 levels in the blood, quality of sleep increases and rest for muscles
- EEG gives patient mental health states and thoughts
- Diathermy is used to treat back pain, muscle spasms and neuralgia
- X-rays may be analyze paintings and create art.
- PET can detect cancer
- Telemedicine plays major role in radiology, pathology, cardiology, tele-education and consultation

5. Conclusion

Instrumentation equipments plays major role in human life and medical field. The equipments such as ECG, EEG, EMG , X-ray, CT scan, MRI scan are identify the problems like heart attack, tumors in brain and cancer of the patients. Pacemakers, defibrillators and ventilators are save lives in patients at risk.

Both CT scan and MRI scan are complementary. CT scan gives distinct contour of bones but MRI gives shape of

ligaments and bones.

Telemedicine is for traditional services. It has many applications in different fields. 83% of patients prefer telemedicine because no need to wait for long time for consulting doctor and no need to visit clinic regularly. Telemedicine is beneficial for travelers.

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