SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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DEPARTMENT OF MECHATRONICS ENGINEERING

19MCE305 – MEDICAL MECHATRONICS

UNIT 5 – RECENT TRENDS IN MEDICAL INSTRUMENTATION

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Radiation Therapy

Radiation therapy (also called radiotherapy) is a cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumors. At low doses, radiation is used in x-rays to see inside your body, as with x-rays of your teeth or broken bones. At high doses, radiation therapy kills cancer cells or slows their growth by damaging their DNA. Cancer cells whose DNA is damaged beyond repair stop dividing or die. When the damaged cells die, they are broken down and removed by the body.

Types of Radiation Therapy:

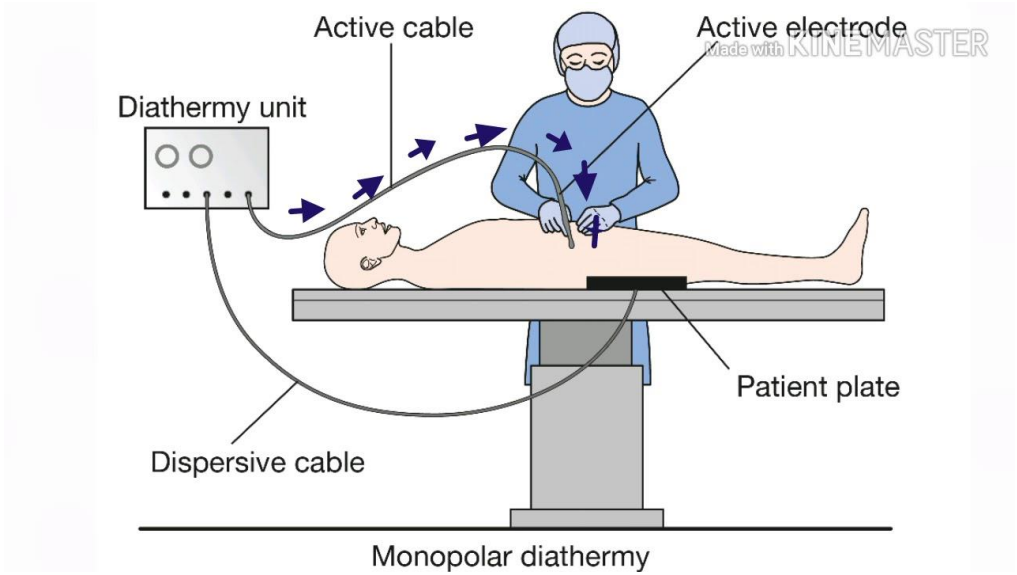
- Intensity-modulated radiation therapy
- (IMRT) Volumetric modulated radiation therapy
- (VMAT) Image-guided radiation therapy (IGRT)

Diathermies:

Diathermy is a treatment option that uses energy sources to deep heat areas of your body. Rather than a heat source, diathermy uses sources like sound and electricity, which are converted into heat by your body. Diathermy, also called “deep heating,” heats deep below the surface of your skin. It targets muscles and joints to provide therapeutic benefits.

Types of Diathermy:

- Radiowave Diathermy
- Microwave Diathermy
- Ultrasound Diathermy



Types of Diathermy:

Radio wave Diathermy:

Radio wave diathermy is also called high-frequency diathermy and shortwave diathermy. This treatment uses high-frequency electromagnetic currents transmitted deep into your tissue.

Microwave Diathermy:

This type of diathermy uses microwaves, a type of electromagnetic radiation. Microwave diathermy uses the same very high frequencies as a microwave oven!

Ultrasound diathermy:

This method of diathermy is also called ultrasonic therapy. It uses high-frequency sound to create a gentle heat.

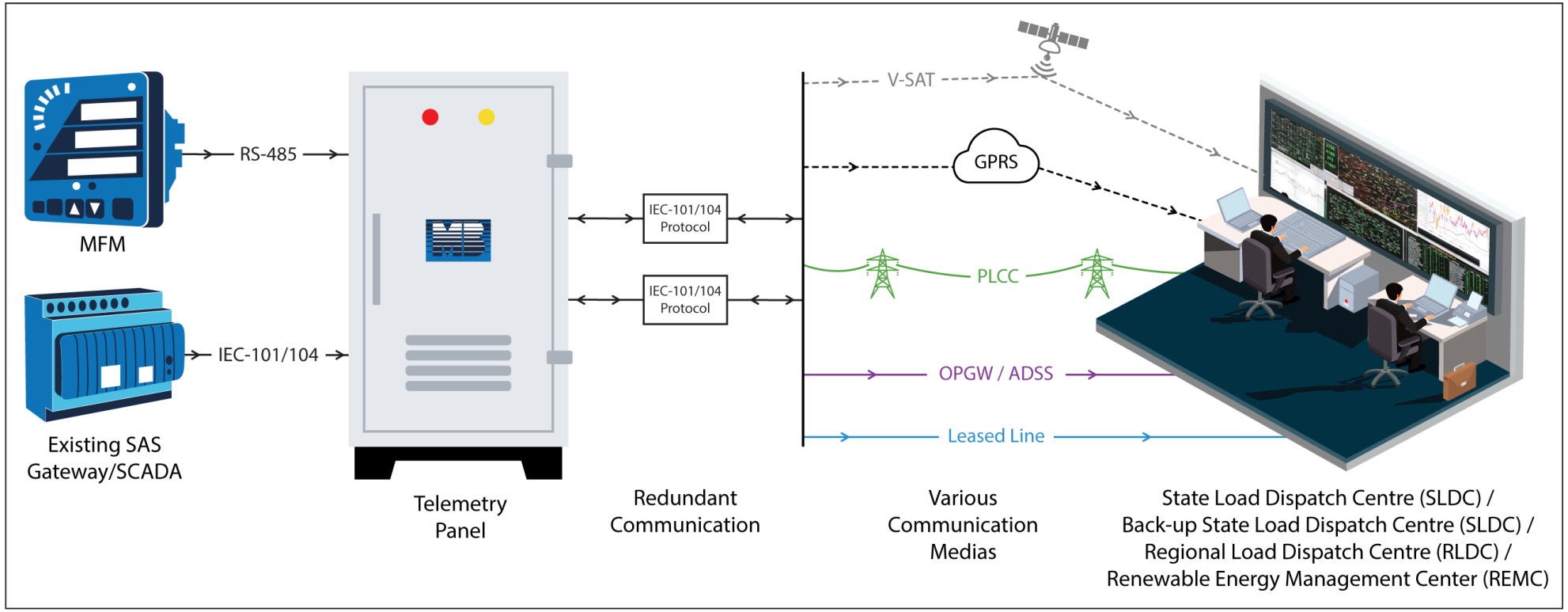
Telemetry and its Principles:

Telemetry is the automatic recording and transmission of data from remote or inaccessible sources to an IT system in a different location for monitoring and analysis. Telemetry data may be relayed using radio, infrared, ultrasonic, GSM, satellite or cable, depending on the application (telemetry is not only used in software development, but also in meteorology, intelligence, medicine, and other fields).

In a general sense, telemetry works through sensors at the remote source which measures physical (such as precipitation, pressure or temperature) or electrical (such as current or voltage) data. This is converted to electrical voltages that are combined with timing data. They form a data stream that is transmitted over a wireless medium, wired or a combination of both.

At the remote receiver, the stream is disaggregated and the original data displayed or processed based on the user's specifications.

Telemetry System:



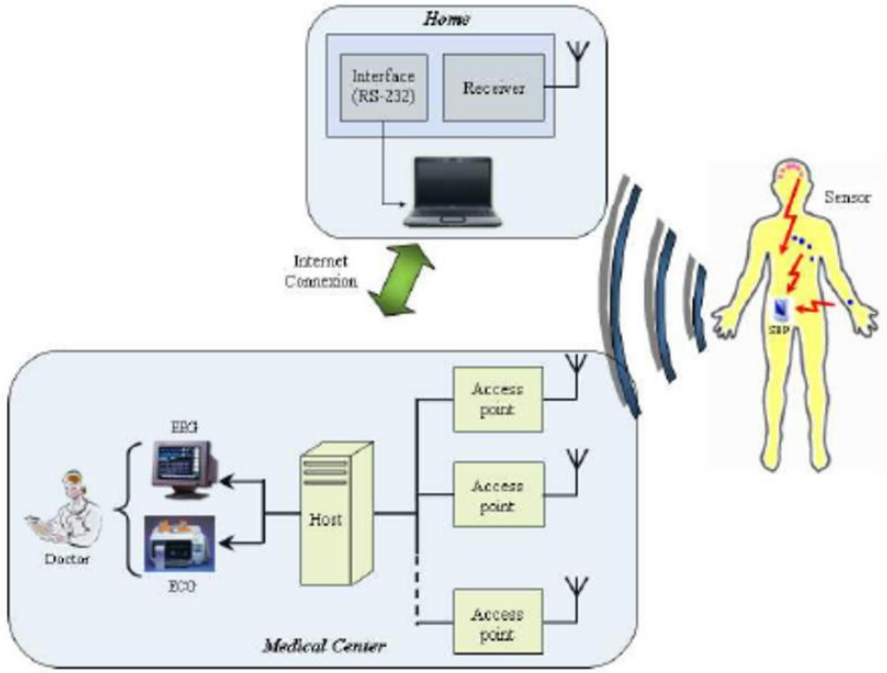
General Architecture of Telemetry System

Biotelemetry:

Biotelemetry (or medical telemetry) involves the application of telemetry in biology, medicine, and other health care to remotely monitor various vital signs of ambulatory patients. The most common usage for biotelemetry is in dedicated cardiac care telemetry units or step-down units in hospitals. Although virtually any physiological signal could be transmitted, application is typically limited to cardiac monitoring and SpO2.

A typical biotelemetry system comprises:

- Sensors appropriate for the particular signals to be monitored
- Battery-powered, Patient worn transmitters
- A Radio Antenna and Receiver
- A display unit capable of concurrently presenting information from multiple patients



Telemedicine:

Telemedicine refers to the provision of remote clinical services, via real-time two-way communication between the patient and the healthcare provider, using electronic audio and visual means. Telemedicine, which enables video or phone appointments between a patient and their health care practitioner, benefits both health and convenience. More health care providers are offering to “see” patients by computer and smartphone.

With telemedicine, you don’t have to drive to the doctor’s office or clinic, park, walk or sit in a waiting room when you’re sick. You can see your doctor from the comfort of your own bed or sofa. Virtual visits can be easier to fit into your busy schedule. With telemedicine, depending on your schedule, you may not even have to take leave time from work or arrange for child care.

Insulin Pumps:

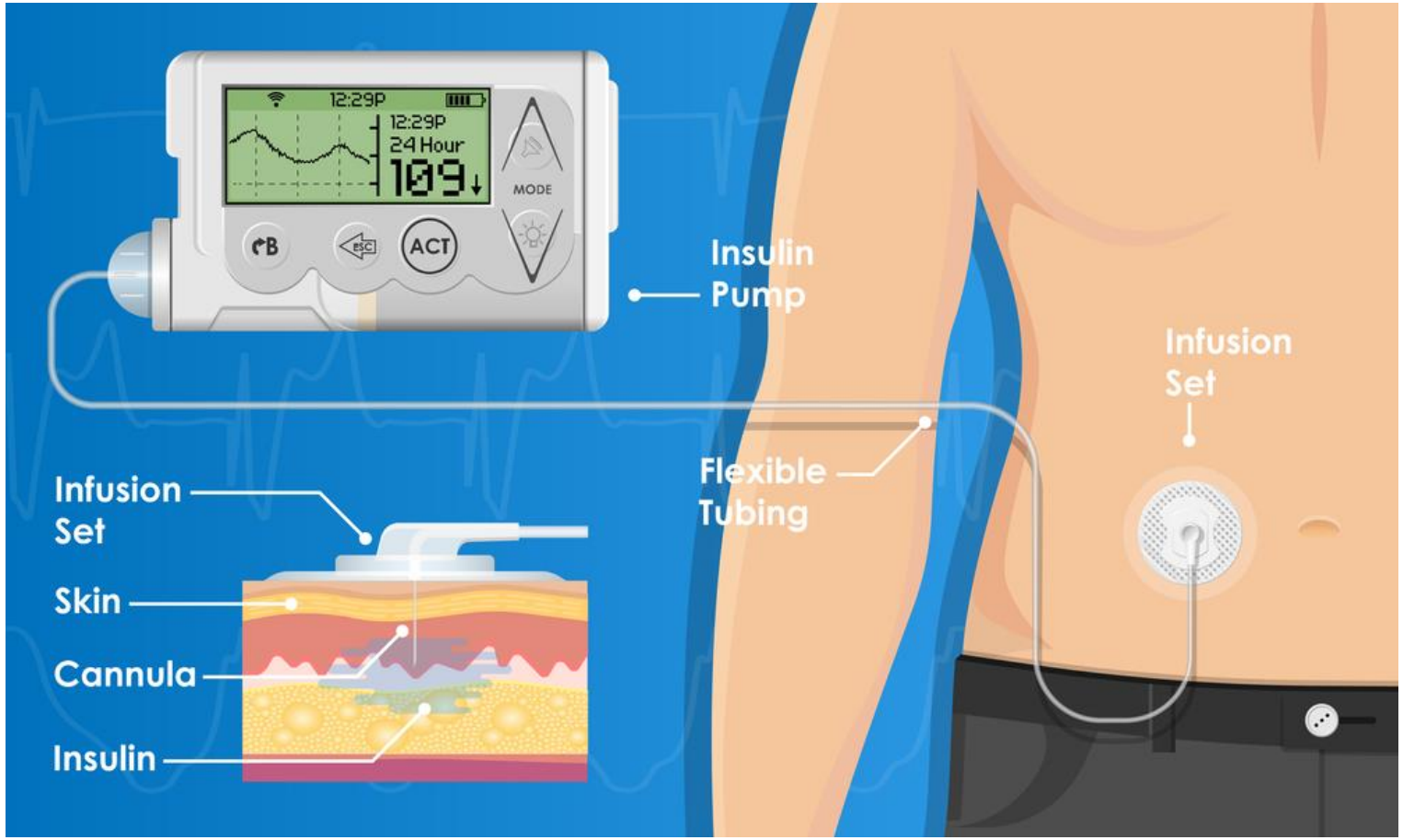
An insulin pump is a small computerized device. It delivers insulin through a thin tube that goes under your skin.

How an Insulin Pump Works

The device releases insulin almost the way your body naturally would: a steady flow throughout the day and night, called basal insulin, and an extra dose at mealtime, called a bolus, to handle rising blood sugar from the food you eat. You program the pump for both basal and bolus doses. If you eat more than normal, you can program a larger bolus to cover the carbs in your food. A bolus can bring down high blood sugar at other times, too.

The pump is about the size of a smartphone. You attach it to your body using an infusion set: thin plastic tubing and either a needle or a small tapered tube called a cannula you put under the skin. The place where you put it in -- your belly, buttock, or sometimes thigh -- is called the infusion site. Some pumps come with inserters for easier placement even in hard-to-reach areas.

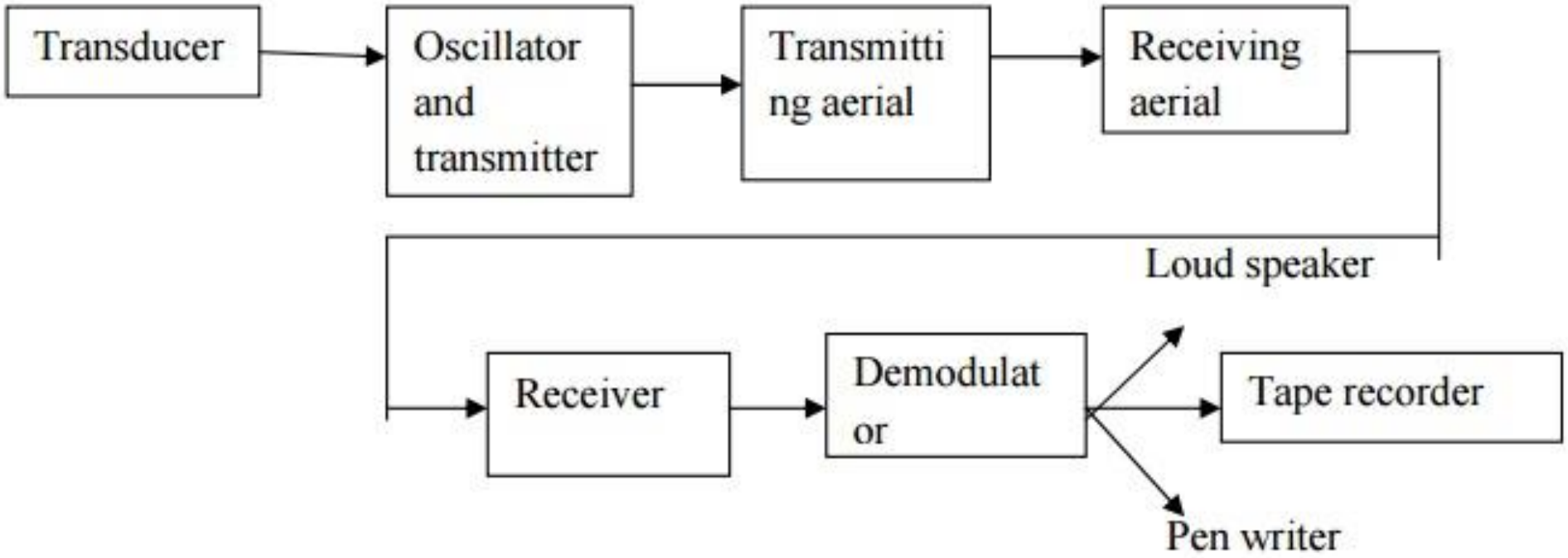
Insulin Pump:



Radiopill:

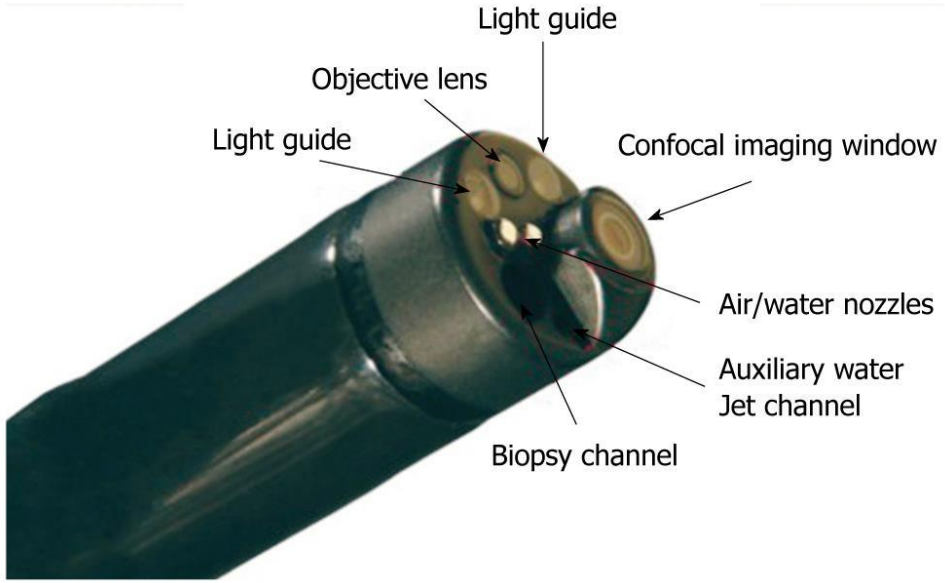
Radio pill is an instrument that transmit measurement by radio impulses from within the body. A capsule containing miniature radio transmitter that can be swallowed by a patient. During its passage through the digestive track a radio pill transmits information about internal condition. It is modern wireless type of endoscopic monitoring system. The Radio pill is a small capsule shaped electronic pill that can be comfortably swallowed by any normal patient. It consists of lens, antenna, transmitters, camera or sensors and battery. It can reach regions such as small intestine and provides the video wirelessly to the receiving device connected to the monitoring system outside the human body and kept at distance of 1 meter. The transmission of data takes place through the radio communication between electronic pill transmitter and external receiver This is mainly used for diagnosis of internal part mainly gastrointestinal system which cannot be easily done with the help of normal endoscope.

Radio Pill Block Diagram:



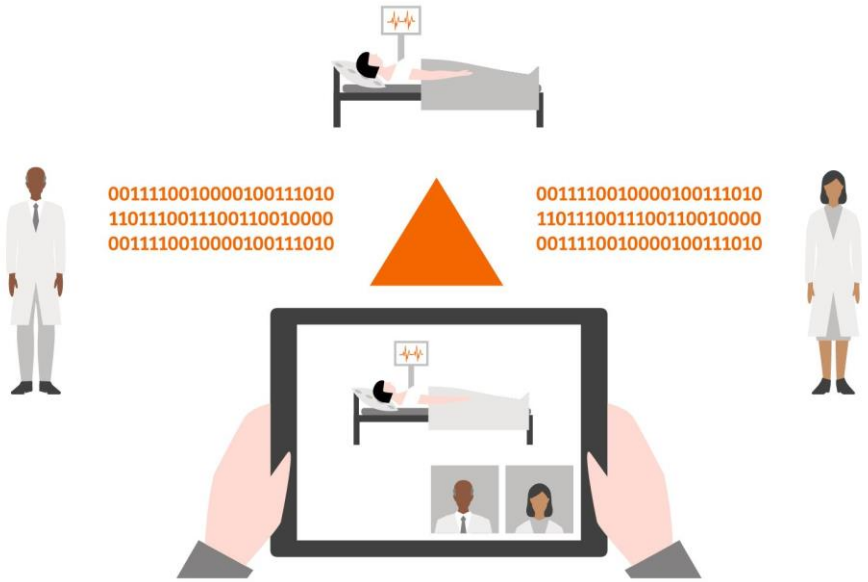
Endomicroscopy:

Endomicroscopy is a technique for obtaining histology-like images from inside the human body in real-time, a process known as ‘optical biopsy’. It generally refers to fluorescence confocal microscopy, although multi-photon microscopy and optical coherence tomography have also been adapted for endoscopic use. Commercially available clinical and pre-clinical endomicroscopes can achieve a resolution on the order of a micrometre, have a field-of-view of several hundred µm, and are compatible with fluorophores which are excitable using 488 nm laser light. The main clinical applications are currently in imaging of the tumour margins of the brain and gastro-intestinal tract, particularly for the diagnosis and characterisation of Barrett’s Esophagus, pancreatic cysts and colorectal lesions. A number of pre-clinical and transnational applications have been developed for endomicroscopy as it enables researchers to perform live animal imaging. Major pre-clinical applications are in gastro-intestinal tract, toumour margin detection, uterine complications, ischaemia, live imaging of cartilage and tendon and organoid imaging.



Virtual Hospitals:

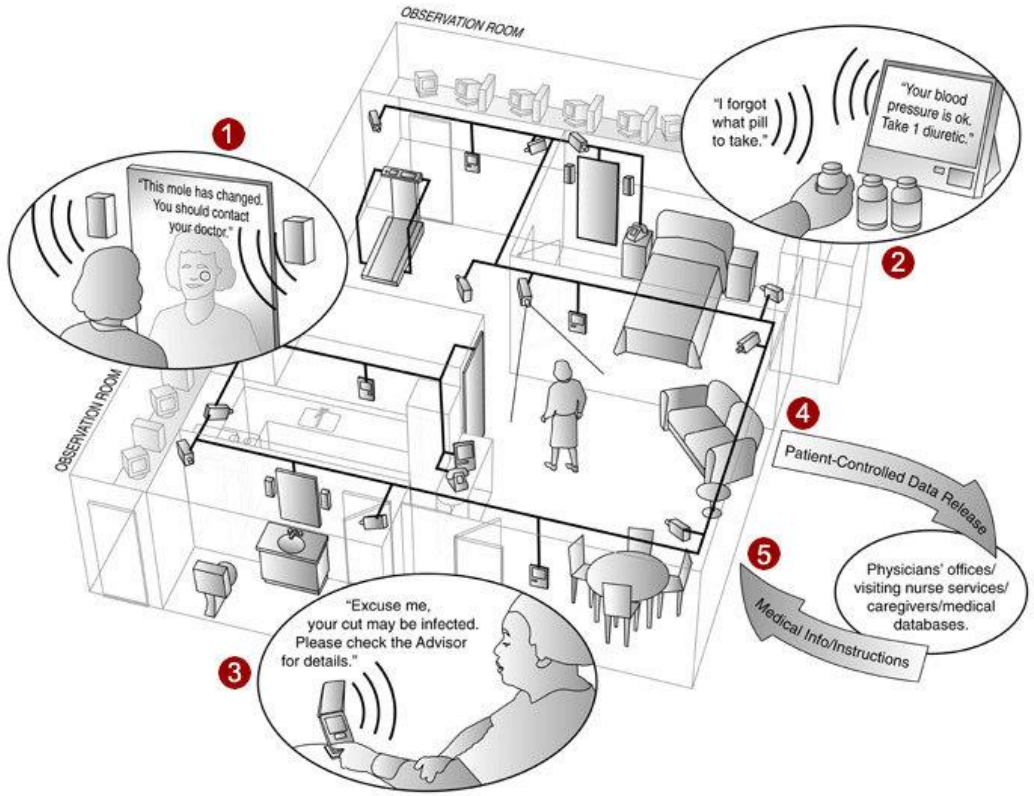
Virtual Hospital is an international non-government organization that operates as part of Virtual Healthcare Limited. Virtual Hospital uses telemedicine to deliver medical care to the developing world. Virtual Hospital interconnects villages in the developing world with their main county hospitals, and hospitals in the West using Telemedicine. Virtual Hospital is based on a traditional healthcare referral system, where the patient's medical information is collected by e-clinics in rural third world communities using a computer, or mobile phone and sent to a general medical practitioner (GP) based at the Virtual Hospital (Hub). The GP at the Hub then either provides a diagnosis or refers the patient to the relevant Virtual Hospital Department where specialist consultants across the world are linked together through the Internet.



Smart Medical Homes:

Smart medical homes, also known as smart healthcare homes or intelligent medical homes, refer to residential dwellings that are equipped with advanced technologies and interconnected systems to support healthcare delivery, monitoring, and management. These homes leverage the concept of the Internet of Things (IoT) and integrate various devices, sensors, and digital platforms to provide personalized and efficient healthcare services within the comfort of one's own home.

The ultimate goal of smart medical homes is to enhance patient care, improve health outcomes, increase convenience, and reduce healthcare costs by enabling preventive care, early intervention, and efficient healthcare delivery within the home environment.



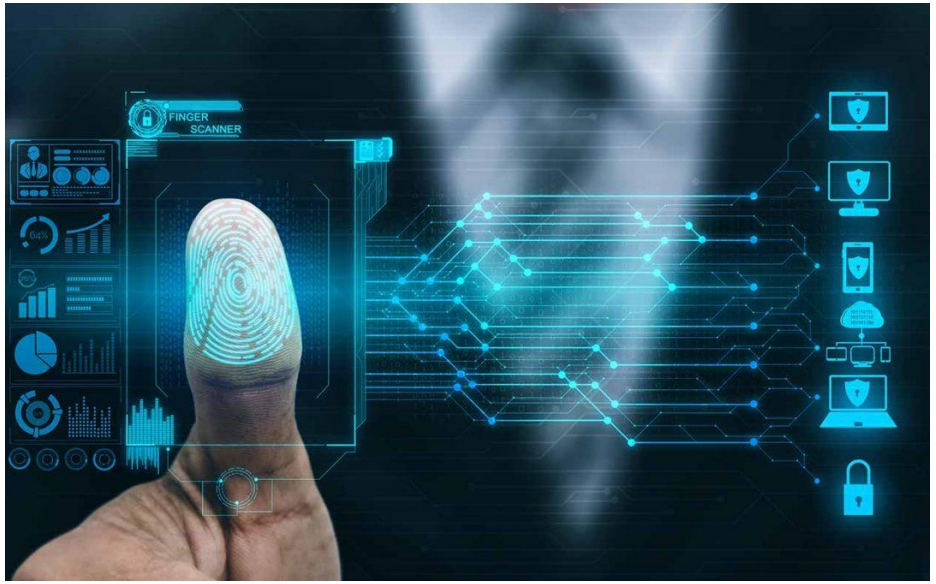
Personalized E-Health Services:

Personalized e-health services refer to healthcare services delivered through digital platforms that are tailored to meet the specific needs of individual users. These services leverage technology, data analysis, and artificial intelligence to provide personalized healthcare experiences, improve patient outcomes, and enhance the overall efficiency of healthcare delivery.

1.Telemedicine: Telemedicine allows patients to connect with healthcare providers remotely using video calls or messaging platforms. Through telemedicine, individuals can receive personalized consultations, discuss their symptoms, and receive medical advice without visiting a physical healthcare facility.
2.Health Monitoring Apps: Various mobile applications are available that enable users to track their health parameters, such as heart rate, blood pressure, sleep patterns, physical activity, and more. These apps can provide personalized insights, reminders, and notifications to help individuals manage their health effectively.
3.Personalized Health Recommendations: E-health platforms can analyze an individual's health data, such as medical history, genetic information, lifestyle choices, and preferences, to provide personalized recommendations. These recommendations may include diet plans, exercise routines, medication reminders, and preventive measures.

Biometrics:

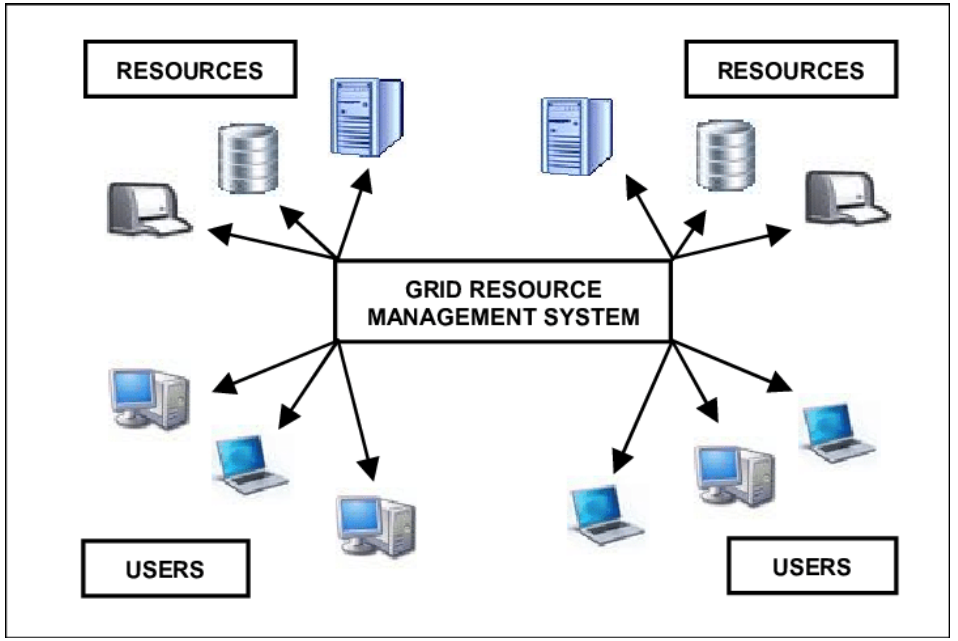
Biometrics refers to the use of unique physical or behavioral characteristics of an individual to identify or verify their identity. These characteristics can be biological, such as fingerprints, facial features, iris patterns, voice, and DNA, or behavioral, such as keystroke dynamics, gait, and signature. Biometric authentication involves capturing and comparing these unique characteristics to an existing database to establish or confirm an individual's identity. Biometric systems use sensors and algorithms to capture and analyze the biometric data, and then generate a unique identifier or a score that can be compared with the stored reference data to authenticate the user. Biometric authentication has become increasingly popular in various industries, including banking, healthcare, law enforcement, and government agencies. Biometric systems offer several advantages over traditional authentication methods such as passwords and PINs. For instance, biometrics are difficult to forge, and they cannot be lost or stolen like passwords or tokens. Biometric systems can also provide a more convenient and efficient user experience, as users do not have to remember or type in passwords or tokens.



GRID and Cloud Computing in Medicine

GRID Computing: GRID computing refers to the sharing and coordination of computing resources across different organizations or institutions to solve complex computational problems. In the context of medicine, GRID computing can be used to aggregate and process large amounts of medical data, such as genomic data, medical images, electronic health records (EHRs), and clinical trial data.

By leveraging GRID computing, medical researchers and healthcare professionals can collaborate and access shared computing resources to perform data-intensive tasks, simulations, data mining, and analysis. This can lead to accelerated research, improved diagnoses, personalized medicine, and better understanding of diseases and treatment options. GRID computing can also facilitate distributed computing, where computing tasks are divided among multiple interconnected systems, enabling faster processing and increased computational power. This is particularly useful in medical imaging analysis, drug discovery, and genetic sequencing, where vast amounts of data need to be processed and analyzed in a timely manner.



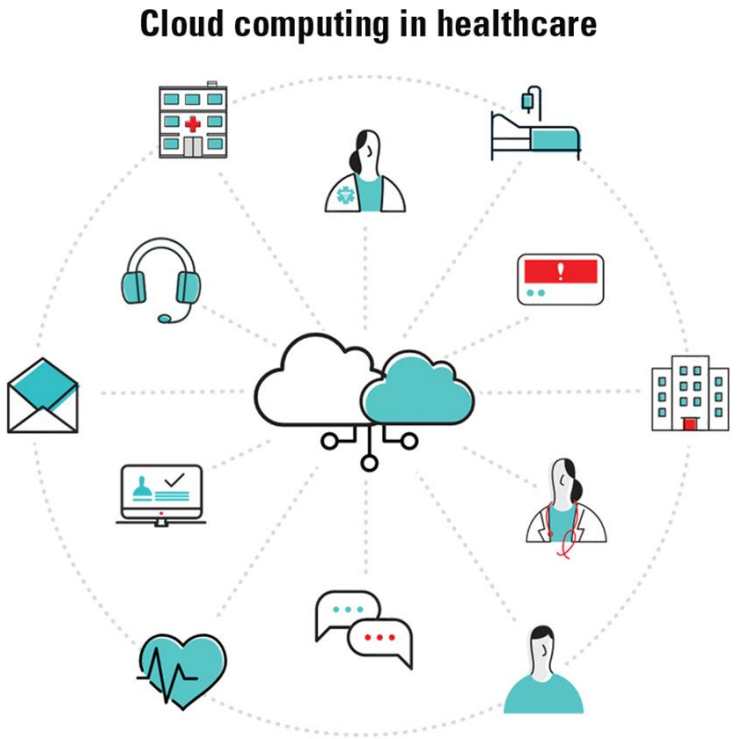
Cloud Computing: Cloud computing refers to the delivery of computing resources, including storage, processing power, and software applications, over the internet on-demand. In the medical field, cloud computing can offer several benefits:

•Data Storage and Accessibility: Cloud storage allows healthcare providers and researchers to store and access large volumes of medical data securely. This enables easy sharing of data across different healthcare facilities and facilitates collaborative research.

•Scalability and Flexibility: Cloud computing provides scalability, allowing medical organizations to scale up or down their computing resources based on demand. This flexibility is particularly valuable for handling peak loads, such as during a pandemic or clinical trials, without the need for significant upfront investment in infrastructure.

•Data Analysis and Machine Learning: Cloud computing platforms offer powerful data analysis and machine learning tools that can be used to process and analyze medical data, identify patterns, and develop predictive models. This can aid in medical research, drug discovery, and clinical decision support systems.

•Remote Access and Telemedicine: Cloud computing enables remote access to medical applications and data, facilitating telemedicine services. Healthcare providers can securely access patient records, collaborate with other professionals, and deliver virtual care using cloud-based platforms.




Thank You