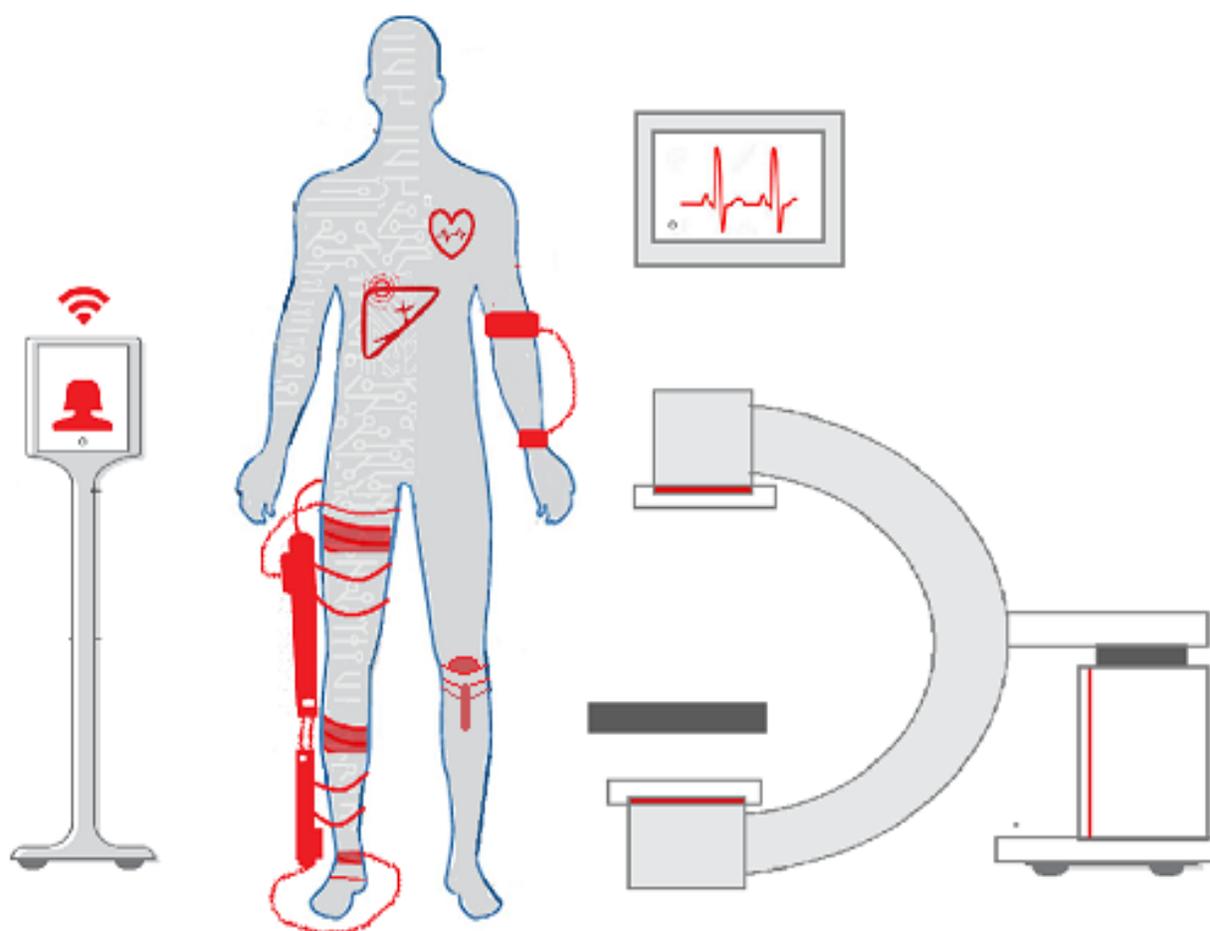


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# Biomed Arena

e-magazine by iambiomed



[www.iambiomed.com/biomedarena](http://www.iambiomed.com/biomedarena)

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## Editor's Note

It is our great pleasure to present “**Biomed Arena**” an e-magazine by iambiomed. We launched iambiomed.com in 2012 as an educational portal for biomedical engineering students.

We are grateful to everyone who has been a part and has contributed to iambiomed. We thank our users who are the reason for our success. They are the ones who give us the confidence. We in turn want to work and make the service better and more user-friendly.

Over the years we have been experimenting with new features, new designs and new ideas. Some of them didn't turn out to be as expected while some of them have succeeded exceedingly. With each passing day, technology improves, a new discovery is made, we work to keep pace with it so that we make iambiomed a better product and you get the best in your hand.

With Biomed Arena, we plan to converge knowledge and industry.

There is a huge need to get everyone in this field connected, to give everyone a voice and to help transform society for the future. We are ready to take up this challenge.

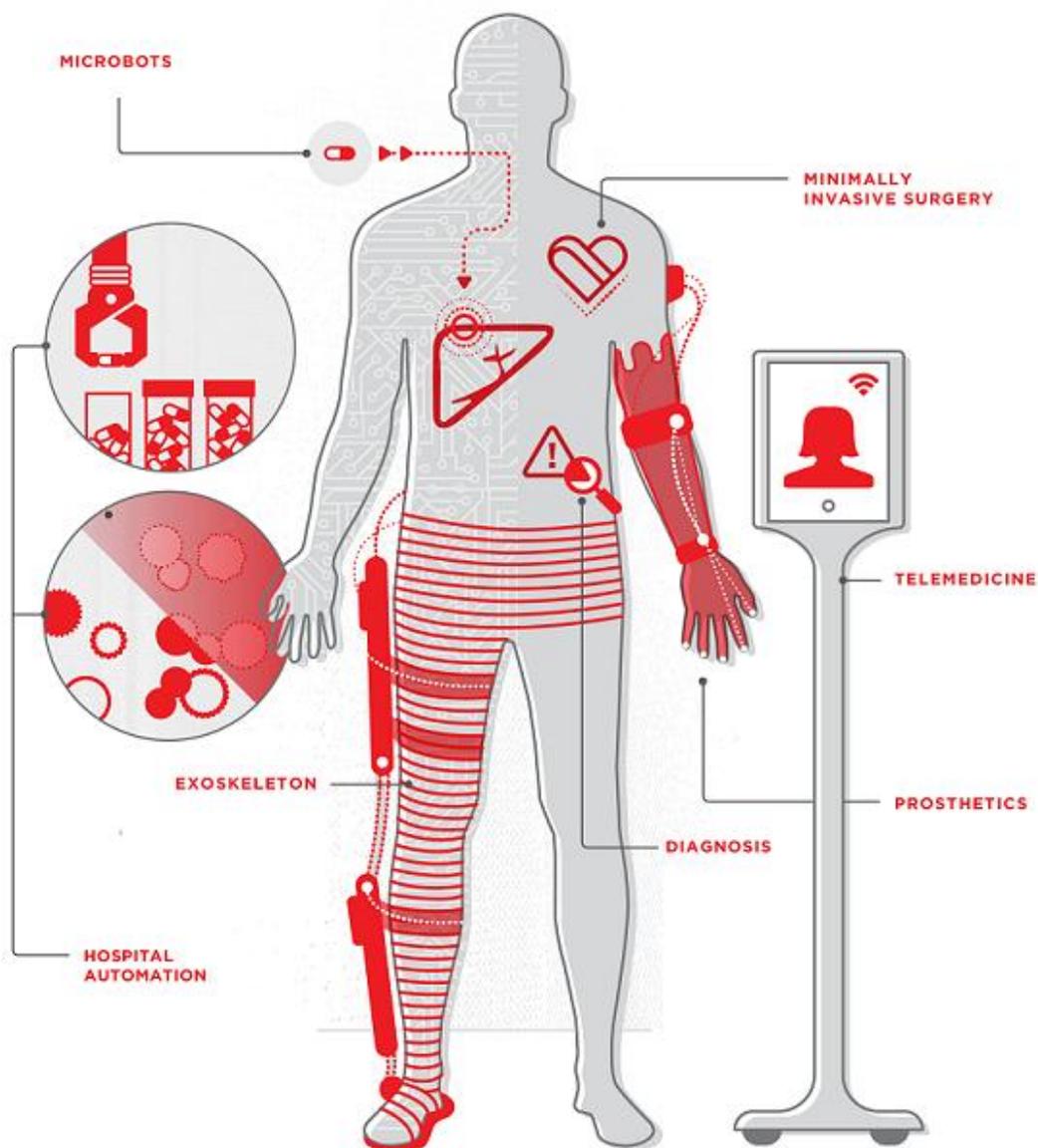
- Aditya Ekawade.

(Founder iambiomed.com)

# Robotics in Healthcare - Article

- Aditya Ekawade (Biomedical Engineer)

Robotics has always been an exciting, dynamic and interdisciplinary field of study and it is now revolutionizing the healthcare industry. Robotics is proving its potential for improving the quality of patient care, as well as making it more sustainable and affordable. Here is a summary of innovations and applications of robotics in healthcare.



## **ROBOTIC SURGERIES**

Robotic surgery is a method used to perform surgeries using very small tools attached to a robotic arm. The surgeon controls the robotic arm with the help of a computer. Robotics in Surgery includes the use of robotic and image processing systems to interactively assist a medical team both in planning and executing a surgery. Physicians use a robotic arm to perform complex heart valve and spine surgery and execute precise insertions of hip and knee implants.

These new techniques can minimize the side effects of surgery by providing smaller incisions, less trauma, and more precision.

## **MICROBOTS**

Microbots are free-roaming robots that carry out precise, delicate tasks inside the human body. Microbots can be used to remove plaque from arteries thus eliminating the risk of artery blockages. Robotic pills can dispense drugs at any location and at a rate programmed by your doctor. They can be used for diagnostic applications such as imaging.

## **PROSTHETICS**

The first FDA-approved, mind-controlled arm restores functionality for individuals with upper extremity amputations. It can perform multiple, simultaneous powered movements controlled by electrical signals from electromyogram (EMG) electrodes.

## **EXOSKELETON:**

Exoskeleton is a wearable, bionic suit allows paralyzed patients to regain the ability to stand upright and walk. It helps survivors of stroke, spinal cord injury and other forms of lower extremity weakness to walk again. The 2014 FIFA World Cup Brazil made history when a 29-year-old paraplegic man named Juliano Pinto kicked a soccer ball with the aid of a robotic exoskeleton during the opening ceremony in Sao Paulo.

## **DIAGNOSIS**

Diagnostic robots are diagnosis tools in the form of a physical robot or a software expert system. Super computer IBM Watson is learning to make cancer diagnosis and treatment recommendations.

## **TELEMEDICINE**

Robots allow for real-time communication between patients and remote medical providers. Robots are used before, during, and after surgery and for cardiovascular, neurological, prenatal, psychological, critical care, and examination uses. The robot allows for real-time audio and video communication between patients and hospital attendants and a remote physician.

In addition to allowing a physician to control the robot remotely from a computer, the robot has the ability to map its own environment for future reference and sense objects in its path and move around without interfering in a busy hospital setting

### **DRONES:**

Drones are being used in remote areas to deliver medical supplies. The ambulance-drone is capable of saving lives with an integrated defibrillator. This drone folds up and becomes a toolbox for all kind of emergency supplies. Future implementations will also serve other use cases such as drowning, diabetes, respiratory issues and traumas.

### **HOSPITAL AUTOMATION**

Pharmaceutical dispensing systems are being used to pack prescriptions more efficiently and accurately. They create better workflow to improve how medications are managed.

**Pneumatic Hospital transport system** is an innovative means of transporting services in modern Hospitals. It helps hospitals to meet patient needs by efficiently transporting drugs, documents and specimens to and from nurses' stations, labs, inpatient and outpatient pharmacies, blood banks and the ED (emergency department). This system saves not only time, but also space. Pneumatic tube system helps increase efficiency since the staff is no longer busy running errands, allowing the wards to stay occupied all the time.

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# Implantable Orthopedic Smart Device

## -Review Article

- Gayatri Vedula (Trainee Biomedical Engineer, HSC, A unit of Zintec software)

An implant is a medical device manufactured to replace a missing biological structure, to support a damaged biological structure, or to enhance an existing biological structure. Medical implants are man-made devices. In contrast to a transplant, which is a transplanted biomedical tissue, implants are materials that are not live. The surface of implants that contact the body might be made of a biomedical material such as titanium, silicone or apatite depending on what is the most functional. In some cases implants contain electronics e.g. artificial pacemaker and cochlear implants. Some implants are bioactive, such as subcutaneous drug delivery devices in the form of implantable pills or drug-eluting stents.

An orthopedic implant is a medical device manufactured to replace a missing joint or bone or to support a damaged bone. An orthopedic implant is a structure submitted to forces responsible for its possible failure. Self-protective smart devices are an example of the next generation of orthopedic implants.



This new technology has the potential to eliminate periprosthetic infection, a major and growing problem in orthopedic practice. A smart implant is to measure the specific information and translate into a signal for decision making process. Smart orthopedic implants can provide real-time feedback to physicians or patients on how the implants are performing, what is happening inside a bone or joint, or if a patient has exceeded the device's optimal range of motion.

The study is based on material; information science and creates an implant having functions as sensor and processor combined with the usual properties of the material. Orthopedic implant acts as a carrier for sensor. A sensor provides opportunities to make specific detailed diagnostic for a patient. The sensor used in this method is a wireless and battery less and requires no telemetry within the body and is less prone to failure. This smart device is to reduce significantly the failure of high risk osteosyntheses and to develop an implantable miniature transducer. This smart device is mainly used for monitor load, strain, motion, and temperature within the body.



In addition to sensors, it uses microelectronics and wireless communication to provide real-time data associated with soft tissue tensioning and knee kinematics to surgeons

The surgical procedures for each implant involve removal of the damaged joint and its replacement with an artificial prosthesis. Orthopedic implants are mainly made from stainless steel and titanium alloys for strength and lined with plastic to act as artificial cartilage. Few are cemented into place and others are pressed to fit so that your bone can grow into the implant for strength.

**Need for Orthopedic Implants:**

Osteoarthritis is the primary reason for orthopedic implants. Also called degenerative joint disease, Osteoarthritis causes cartilage to worn down resulting in painful bone to bone contact. Cartilage break down occurs as a result of excess body weight and/or the lack of joint movement. Doctor will suggest implants as an option only when all non-surgical treatments have failed, including weight loss.

**Advantages & Disadvantages of Orthopedic Implants**

The major point to remember is that orthopedic implants are designed differently by different manufacturers. This means manufacturers use different theories to develop implants for each specific application. Orthopedic implants not only give back quality of life but also help in increasing mobility and reducing pain. Strict post-surgery recovery plan, infection, and possible malfunction are some of the disadvantages of Orthopedic Implants.

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**Dräger opens Design Center in India**

The Dräger Design Center replicates a hospital's environment and is a functional space where medical users, planners and architects can experience a range of equipment arranged in a solutions format.

**Experience cutting-edge Dräger medical technology in real-life setting**

The Dräger Design Center marks an open invitation for our customers to come and experience this functional space where we have recreated acute care areas. Visitors of the "hospital area" can experience their workplace before it is actually setup.

**Comprehensive Solutions**

The visitors of the Design Center can trace a patient's progress through the stages of transport ventilation, resuscitation, induction, surgery, post-operative, recovery and intensive care.. This gives visitors first-hand experience with various Draeger devices in action, such as Central gas supply Systems, Ceiling supply units, Modular OR, Anaesthesia workstations, ICU ventilation, Patient Monitoring and information Management and Neonatal Care Systems with accessories / consumables for all these devices.

**Modular Operation Room**

In addition to the devices, we also showcase other solutions along the clinical pathway, such as a modular operation room. Upon request, a room can be set up according to the exact specifications desired by customers for their own hospital. This enables them to sample, test and see if it fits in with their established working practices, or if any changes are necessary.

**Customization**

Using a 3D computer application, the desired configuration can then be created as a virtual working environment and documented. This results in a customized solution that is tailored to the client's precise specifications, without the need for costly modifications after installation.



To schedule a personal Dräger Design Center tour, contact the local sales representative, who will accompany the tour.

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# Automated Blood Transfusion System

## - Technical Paper Review

- Sayali Kulkarni (Biomedical Engineer, GuruNanak Hospital & Research Centre)
- Falgun Khira (senior sales executive, atrian Medicals)
- Pramod Salvi (Service engineer, Air liquide healthcare)
- Rohit Bedmutha (Sales and application engineer, Cyronics instruments Pvt. Ltd. Pune)

### Abstract:

Auto transfusion is a process wherein a patient receives his or her own blood for transfusion, instead of banked donor blood. Blood can be pre-donated before a surgery, or can be collected during and after the surgery where there is expected a large volume of blood loss. This can be achieved by using a device commonly known as Cell Saver.

The main aim of this system is automated collection of blood from patient and controlling the path of blood using temperature controller and bubble detector to make safe blood transfusion.

### Introduction:

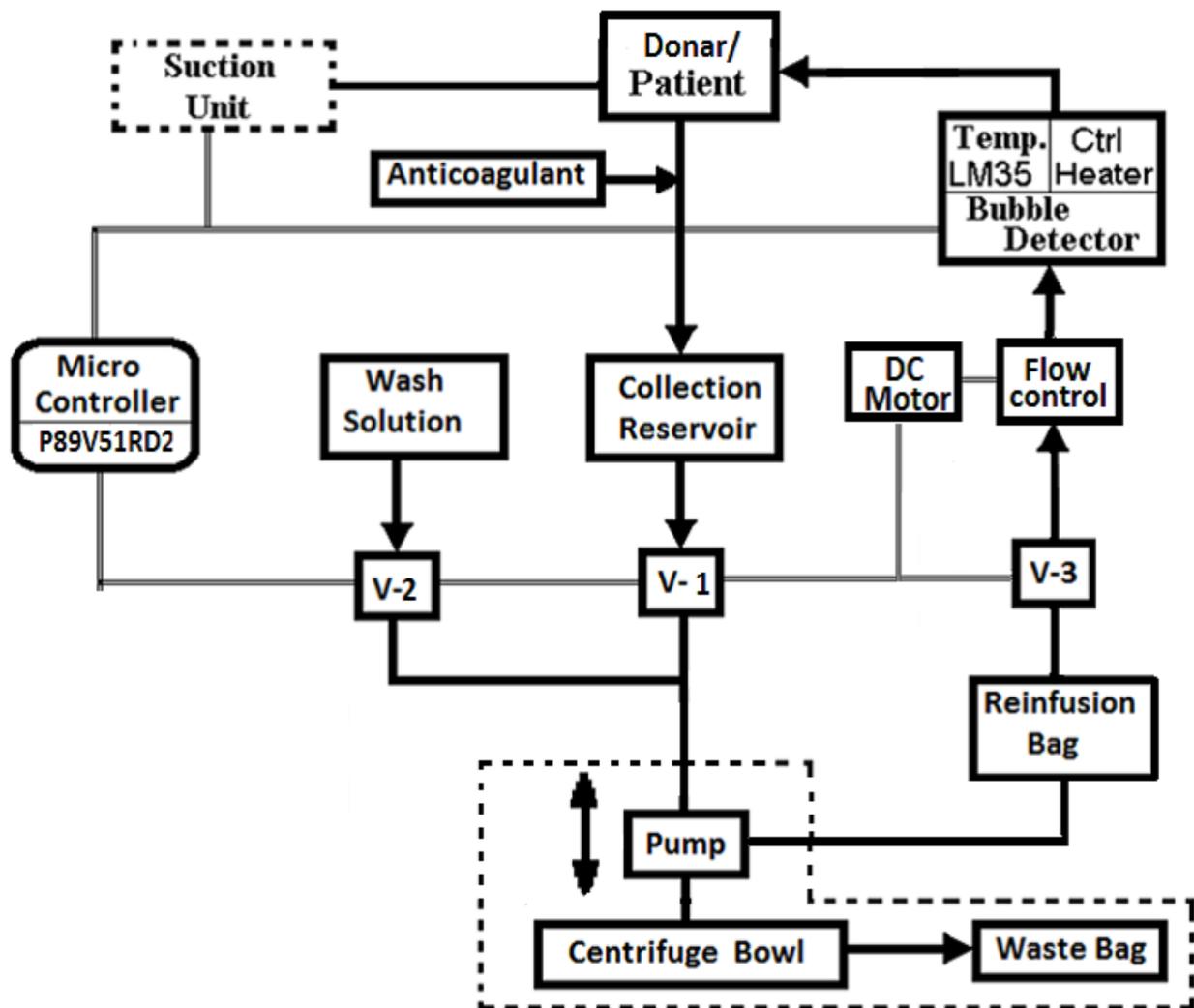
In case of patients having rare blood group it is very difficult to find matched donor. It is not possible every time that blood of required blood group is available in blood bank or hospitals. Allogenic blood transfusion may lead to immunologic and infectious effects leading to death. The Cell Saver is utilized in surgeries where there is expected a large volume blood loss- e.g. aneurysm, total joint replacement, and spinal surgeries. It applies a gentle vacuum suction to the wound drain. The blood from the surgical site is collected, filtered, and washed.

Any blood safe to give back to the patient after this washing is separated and sent into its own bag. When enough blood is collected, it is infused back to the patient.

### Automated Blood Transfusion System:

Using a dual lumen tube, anticoagulant is fed to the operation site to be mixed immediately with shed blood and sucked away. Blood and anticoagulant are carried into a sterile reservoir by vacuum where it is filtered to remove large clots and debris. Blood and anticoagulant are drawn from the collection pot into a centrifuge to be processed through middle valve (v-1). Now only v-1 will operate, v-2 and v-3 will remain off. A sterile isotonic saline solution is pumped into the centrifuge bowl through first valve (v-2). Blood is washed with a saline solution and required blood cells are separated from waste products inside the centrifuge. Packed blood cells are collected in a separate bag. Now these required blood cells are sent towards patient by controlling the path of blood.

First blood will pass through last valve (v-3) to the Flow Control Circuit for controlled flow of blood towards patient. This flow controller will be driven by DC motor. Now only v-3 will operate. Then this blood will pass through temperature controller circuit. If temperature of blood falls below 360C heater will start to bring the temperature of blood to normal and if temperature goes above 380C heater will be turned off. Also there is bubble detector circuit which uses principle of IR transmitter and receiver to detect if there is any air bubble in blood flow, if bubble is detected, this circuit will turn off the whole system and will stop the blood flow towards patient.



**Application:**

This system can be used on large scale at blood donation camps or at blood banks and also during various cases such as orthopedic surgeries, spinal surgeries, open heart surgeries etc.

**Advantages**

Blood Donors: One can donate only required blood components.

For Patients:

- No need to find matching donors.
- No worries for rare blood groups
- No infectious or immunologic effects after blood transfusion
- Less or no blood loss during surgery
- Safe method
- Faster recovery

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## Helping you breathe -Technical Article

- Nagesh Utekar (Director, Rescare Medisys (India) Pvt. Ltd)

To understand a process of Mechanical Ventilation let us first understand the basics of Exchange of Gases in Human Beings.



In breathing process, air is inhaled through the mouth and/or nose, pharynx, larynx, trachea and bronchial tree into tiny alveoli sacs in the lungs, where air mixes with the carbon dioxide-rich gas from the blood. Gas exchange in the lungs supplies oxygen to the blood and removes carbon dioxide collected from the cells. The air is then exhaled.

Ventilation is the “tidal” volume of gas entering or leaving the lungs in a given amount of time, and determines if the gas exchange is sufficient.

Normally this cycle repeats at a breathing rate, or frequency, for adults of about 12 breaths per minute. Infants and children breathe at a faster rate.

### **Breathing Mechanism**

For mechanical ventilator to work, it must produce the right tidal volume and breathing rate for the body.

Conventional ventilators produce the normal breathing patterns of children and adults, about 12-25 breaths per minute.

Two forces expand the lungs and chest wall during breathing: the contraction of the muscles (including the diaphragm) and the contrasting pressure at the airway opening (mouth and nose) and on the outer surface of the chest wall.

Normally, the respiratory muscles expand the chest wall. This decreases the pressure on the outside of the lungs, so they expand. This enlarges the air space in the lungs and draws air into the lungs.

When respiratory muscles are unable to do the work for breathing, either one or both of these forces can be manipulated with a mechanical ventilator.

### **What is Mechanical Ventilator?**

A positive pressure ventilator delivers gas to the patient through a set of flexible tubes, called a patient circuit. Depending on the ventilator design, this circuit can have one or two main tubes.

The circuit connects the ventilator to an endotracheal tube, tracheostomy tube for invasive ventilation or a noninvasive mask/prong.

For invasive ventilation, an endotracheal tube is inserted through the patient's mouth or nose, or a tracheostomy tube is inserted through an opening made by incision in the neck. In noninvasive ventilation, the patient circuit connects to a mask covering the mouth and/or nose or nasal prongs. The tube used for invasive ventilation may have a balloon cuff to provide a seal. The noninvasive mask has a seal around the mouth and nose to prevent the loss of gas/air, ensuring the patient receives appropriate ventilation.

Mechanical ventilation may be used at night, during limited daytime hours, or around the clock, depending on the patient's needs. Some patients require mechanical ventilation for a short period, such as during recovery from traumatic injury. Others require ventilation long-term, and over time the needs could increase or decrease, depending on the patient's medical status.

### **Types of Ventilators**

- 1) Volume Ventilators
- 2) Pressure Ventilators
- 3) High Frequency Ventilators

**Ventilator control system**

A control system ensures that the ventilator produces the correct breathing pattern.

This requires setting basic controls, including:

- Size of the breath
- How fast and often the breath is brought in and let out
- How much effort, if any, the patient needs to exert to start a breath

A spontaneous breath occurs when the patient can control the timing and size of the breath. This is normally referred as cycled ventilators. These are as follows:

- 1) Volume Cycled
- 2) Pressure Cycled
- 3) Time Cycled

**Ventilator Modes**

The effort of gas exchange involves a mandatory breath. A particular pattern of spontaneous and mandatory breaths is referred to as a ventilation mode.

Numerous ventilation modes allow ventilators to produce various breathing patterns, to suit the individual needs of the patient. These modes coordinate with ventilator functions. They are as follows:

- 1) Volume Modes
- 2) Pressure Modes

Further classified as follows:

**In Volume**

- a) Assist Control (AC)
- b) Synchronized Intermittent Mechanical Ventilation (SIMV)

**In Pressure**

- a) Pressure Controlled Ventilation (PCV)
- b) Pressure Support Ventilation (PSV)
- c) CPAP / PEEP
- d) BiPAP

**Ventilator Settings / Controls**

Every Human Being requires different settings depending on his Height, Weight, Sex and other clinical parameters. So settings in Ventilators are the most important parameter. The most common settings are

- 1) Tidal Volume
- 2) Minute Ventilation
- 3) Breath Rate
- 4) FiO<sub>2</sub>
- 5) I:E Ratio
- 6) Pressure support
- 7) Peep

**Ventilator monitors**

Most positive pressure ventilators have an airway pressure monitor to assess the pressure in the circuit. They have a volume measure to assess the volume of the patient's breaths. These also monitor if the patient is properly connected to the ventilator.

Many positive pressure ventilators have sophisticated pressure, volume and flow sensors. These sensors control the ventilator's output and monitor the interaction between the patient and the ventilator. These monitors allow the caregiver to follow the patient's condition in form of Loops & Graphs too.

**1) Patient Monitoring Parameters**

- a) Exhaled Tidal Volume
- b) Delivered FiO<sub>2</sub>
- c) Patient Breath Rate

**2) Graphs**

- a) Pressure VS Volume
- b) Volume VS Flow

**3) Loops**

- a) Pressure VS Time
- b) Volume Vs Time
- c) Flow Vs Time

### Alarms

When the patient or Ventilators behave abnormally or if there is any trouble there has to be a indication, and for that, Alarms become the important parameter for the end user to understand the patient and change the settings accordingly. Also if the ventilator malfunctions or if there is any other technical issue alarm system is the indication the end users can understand .The commonly featured alarms are as follows:

- 1) High Pressure
- 2) Low Pressure
- 3) Apnea
- 4) Low Oxygen
- 5) Service

# PACS- An Introduction -Review Article

- Ganesh Nair (Biomedical Engineer, Medical Coder)

*Medical Imaging is one of the vast domains in the area of Biomedical. I have taken smallest part of this large domain which says about digitizing of the medical imaging in every manner right from taking an appointment of radiologist till the acquisition of reports by the patient.*

Imaging informatics is a subspecialty of radiology that tries to achieve efficiency, accuracy and reliability of radiological service in a hospital/medical field.

Imaging informatics previously known as Radiology Informatics is sometimes thought only as the study of how images get transferred from place to another but in reality it has a much wider scope. It involves calling a colleague for patient history, calling a technologist to apply a protocol to check an image, reviewing images with a clinician, teaching a trainee, producing a formal report, justifying an examination to a third-party payer.

These range of events fall under the category imaging informatics thus making the services reliable, efficient and accurate along with interpretation of images.



*A typical PACS workstation. Image only for representation purpose*

**Picture Archiving and Communication Systems (PACS)** is one of the major that focuses on imaging informatics though there are many other technologies which can improve the services of individual radiologists and the entire department.

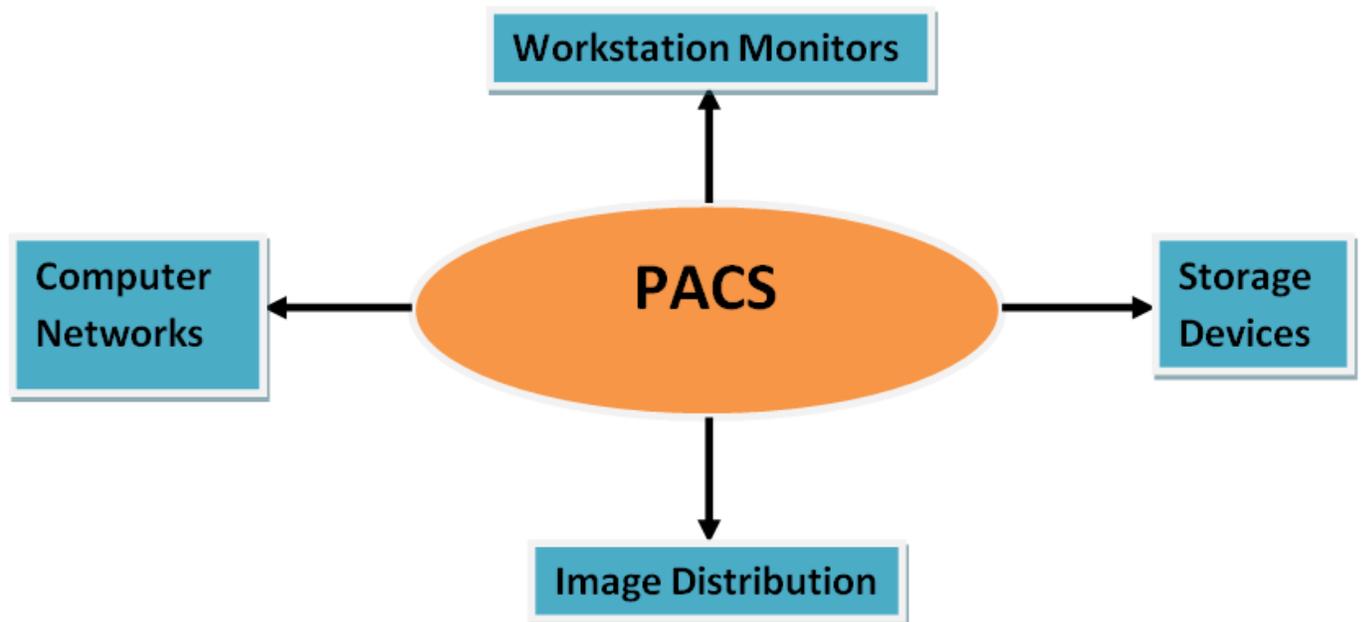
Picture Archive and Communications System is a computer system which allows the digital capture of x-rays and other scans, such as CTs and MRI, viewing, storing and transfer of these images.

These images and reports are transmitted digitally via PACS.

PACS is a server-client node system in which one or more computers act as servers to store data and programs that are accessed by client computers on the system

PACS software can interface with most computers commonly used in medicine to include the hospital information system (HIS) and radiology information systems (RIS).

A PACS require many components working in close communication with each other. Vast amount of data pass through any PACS system, and there is always and almost constant demand for the access of these data from radiologist and clinician.



*Block diagram of PACS system*

**Workstation Monitors:**

With transition from film to filmless images, traditional film image alternators have been replaced by workstation monitors. Instead of backlit view boxes, images are viewed on computer monitors. When choosing equipment care is to be taken about monitor technologies and hardware options.

**Computer Networks:**

An infrastructure of network of computers that allows the data to pass from modalities to PACS and then to radiologist workstations to a long term storage devices. The network allows the dictations of radiologists to be distributed to clinicians and also enables communication tools such as e-mail.

**Storage:**

Earlier films were stored in warehouse like film libraries and often required hours and days to retrieve them back. The films would get destroyed on a long run. On other hand, in PACS rapid retrieval of images is expected.

**Image Distribution:**

One of the major benefits of PACS is efficient distribution of images. Multiple users can view the same study at the same time. Also the images can be sent to any location almost instantly.

PACS has become an essential element in many radiology practices.

*This is just an overview of what PACS contain. I will be back more information in our next edition.*

# Summit Healthcare Pvt.Ltd. -Sponsored Post

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