INTERNET OF THINGS (IOT): MEDICAL AND HEALTHCARE INDUSTRY

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ABSTRACT

The bottleneck and the challenges which the medical and healthcare information encounter, the analysis of the Internet of Things (IoT) has an obvious advantage in the interpretation, transmission and execution of the information, which eventually has a broader application in the medical and healthcare industry. And, for the same, with a very strong stand and guaranteed deal of the Internet of Things (IoT), an intelligent, accessible, forthcoming and expressive system would be a certain trend of the development in future. The article will also focus on the specificity of the Internet of Medical Things (IoMT) such as; telemedicine and mobile medical care, medical information management, personal health management, medical equipment and medication control, etcetera along with some examples of the Medical Devices with regards of the Internet of Medical Things (IoMT).

Keywords: Internet of Things; Healthcare Industry; IoT; IoMT; Medical Devices.

INTRODUCTION:

The healthcare industries worldwide are becoming more open for the latest technologies developed and also for the Information Technology (IT) departments and that have directly or indirectly brought a tremendous change in these industries.

And such is an online computer network application called Internet of Medical Things (IoMT).

Internet of Things (IoT) is the main broader term which is a collection of devices and applications that are interconnected via online computer networks.

IoMT is a subdivision of IoT in which Medical Devices and Medicare are connected to Healthcare IT. The basis of IoMT is a set of communication between two machines in which the Medical Device has to be equipped with the Wi-Fi or Near Field Communication Technology.

OBJECTIVE:

To provide beneficiary knowledge regarding the blooming field of Internet of Things (IoT): Medical and Healthcare Industry and torch a light towards various smart medical devices.

METHODOLOGY:

NEW ADVANCES IN HEALTHCARE:

1. Clinical Efficiency
2. Home Monitoring
3. Biometric Sensors/Wearables
4. Fitness Wearables

There are various examples with regards to the IoMT such as:

- Remote patient monitoring
- Tracking medication orders
- Tracking patients admitted to hospital
- Medication adherence
- Telemedicine
- Wearable medical health devices

The IoMT devices are also a huge part of IoMT:

- Asthma inhalers
- Pill bottles
- Smart heart meters
- Thermometers
- Blood pressure cuffs

APPLICATIONS: [1] [2]

One of the most important uses of the IoMT is that the medical supplies and the equipments can be interconnected so that it becomes easier for the hospitals to keep a track of the available stocks.

In the Medical and Healthcare field, the major portion of the Internet of Things would include following:

- Medical equipment and medication control

- Medical Information Management

- Telemedicine and mobile medical cares

- Personal health management

A. Medical Equipment and Medication

The visualization technology that is a part of Material Management helps in the monitoring of various such as:

o Anti- counterfeit and tracing of medical equipment and medication that would safeguard peoples' medical safety.

o The process of delivery and production as a whole.

1) The Anti-counterfeit of Medical Equipment

The RFID (Radio Frequency Identification) tags are useful for the tracking of desired tags available with the help of electromagnetic waves.

The RFID Tags are unique and cannot be replicate which will be helpful for the easy inquiry or tracking of any information of product which can eventually lead to the identification of the counterfeit product.

Example: If the information of the medication has been put into any public domain, then the patients or hospitals could be able to check or track the RFID Tags with the help of available record in the public domain and the counterfeit medicines can be identified easily.

2) Constant Real-time Monitoring

During the whole process of production, circulation and its use and the medical research, the all-round monitoring can be carried with the help of RFID Tags.

Specifically, when the automated packing of medicines is done, the readers which are installed in the production line could identify the information of each medicine automatically and then the information is transmitted to the database.

Due to this the quality of the medication can be guaranteed by the monitoring of delivery of medicines and the storage environment.

Anytime if there is any problem in the quality of medication, the tracing back of the defective medicine could be done considering its name, origin, category, processing, batch, delivery, storage, sales and other information.

3) Medical Refuse Information Management

A traceable medical refuse information system could be established with the help of RFID technology and the cooperation of various hospitals and companies that are involved in transport things.

This system can track the refuses related to the whole process from hospitals to the plant processing involved, can avoid illegal disposals of the medical refuses.

❖ At present, Japan has made some achievements in this area of researches that they have launched.

B. Medical Information Management:

The Internet of Things has a variety of huge role in the management of medical information in the healthcare departments. Currently, the hospitals' demand for medical management is in a run for the following issues:
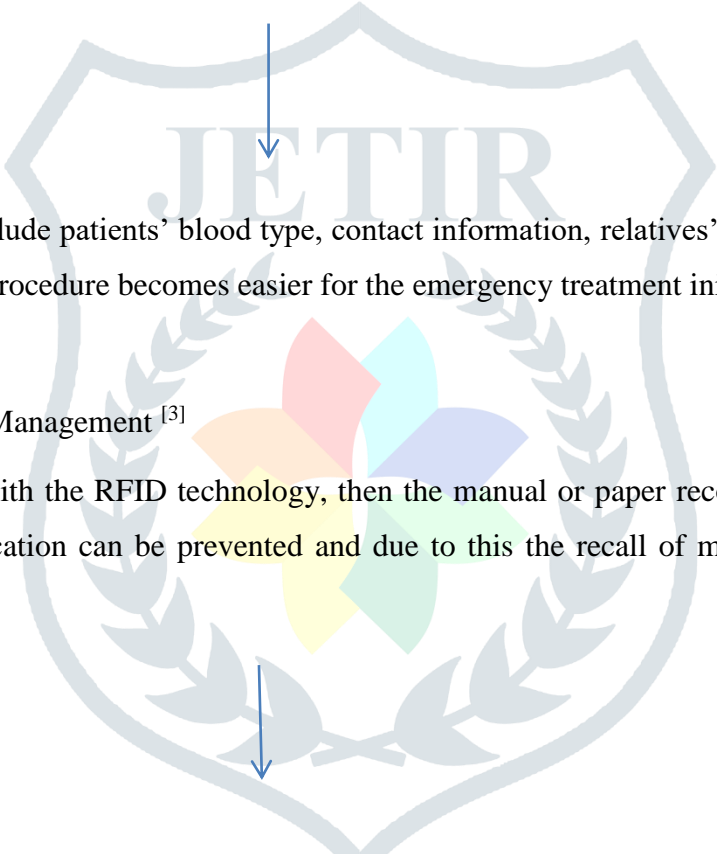
1) Patient Information Management

An electronic medical profile of a patient that includes various information such as medical examinations, side effects, adverse effects, serious adverse events, medical history and previous records of treatments etcetera may be helpful for the physicians to work out with the plan of the treatment.

The healthcare professionals and nurses can also use the information for the constant monitoring of the vital signs, tests and treatments in order to completely avoid the counterfeit medicines or injections and occurrence or recurrence of the fault medications.

2) Medical Emergency Management

Under some unavoidable circumstances such as in the case of huge number of wounded patients and whose relatives are not being able to contact while the patients are in the vital and critical conditions, in such cases due to the help of RFID technology, doctors can immediately identify the patients' information using the reliable data storage in the RFID tags.

This information would include patients' blood type, contact information, relatives' information and contact, due to which the check-in procedure becomes easier for the emergency treatment initiation.

3) Medication Storage Management [3]

If storage can be applied with the RFID technology, then the manual or paper recording can be simplified, the short supplies of medication can be prevented and due to this the recall of medication would become more convenient.

Eventually, avoiding the confusion in the similar looking medication names, their doses and dosage forms.

This would also give strong rooting to the Medication Management and timely supply can be done for the medication.

4) Blood Information Management

   RFID technology to the Blood Management is useful for things such as;

- The bar codes issues of the small capacity drawback can be effectively avoided.
- And, this can help in reducing blood contamination by realizing non-contact identification.
- The multi-target identification can be actualized.
- And, the data collection efficiency can be increased.

5) The prevention from errors in different preparations of pharmaceuticals.

The error prevention mechanism and its construction during the processing of getting the medication and also dispensing and the Information Management of the pharmaceutical preparations while in the process of dosage, medicine taking, medicine distribution, the drug effect and its tracing, the stock control, medication purchase, storage and environment.

The confirmation of the dosage and medication type that the patient is taking can be done.

The medication flow record and the batch number can be recorded which would avoid the medication loss and the patient's safety can be ensured.

6) Medical Equipment and Medication Traceability

The precise records of the Medical Equipment and Medication will include following:

- The specific information of the product involved in the adverse event.

- The origin of the product with quality problems.

- The basic product information and use.

- The patients using the product that have problems in qualities.

- And, the regions where the products that have quality problems are not used.

The easy tracing of the quality problems and also of the patients that are involved in the controlling of all the unused medical equipment and medication.

And, this can also provide the accident cases with a strong support.

China, in 2007, for the first time ever tried with establishing the traceable system that would connect the patients with the medical equipment.

And this has been used widely in the hospitals in the city called Shanghai in China using the system that uses GSI (Geological Strength Index.)
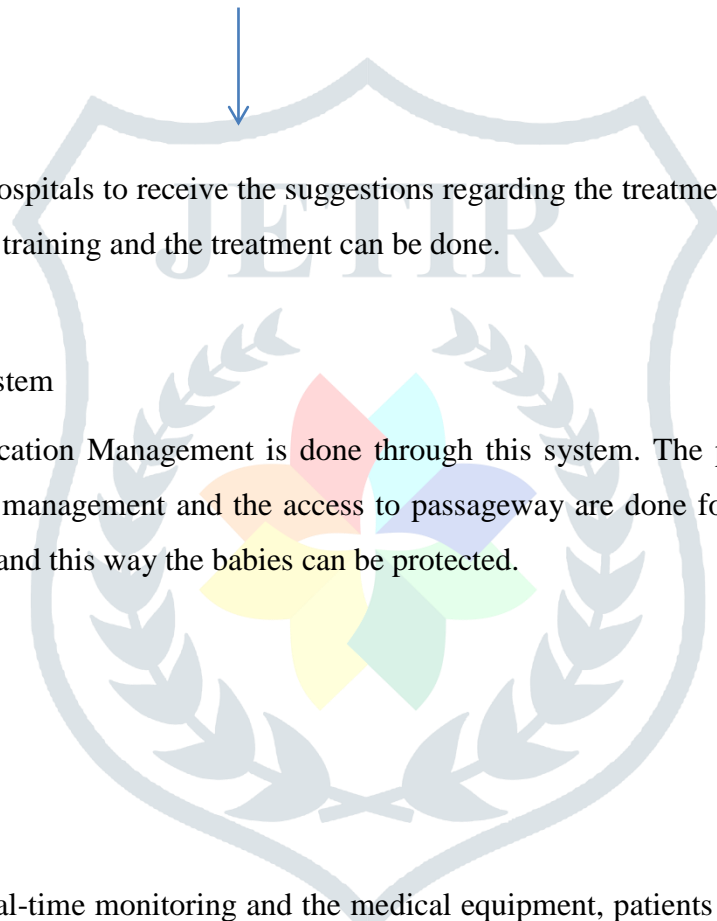
7) Information Sharing

With the sharing of the information of the medication, an advanced formation of the comprehensive medical network can be done.

With the use of this network, the registered doctors can have a look over the medical records, treatments, histories, insurances etcetera.

While the patients could also select or change their hospitals or doctors in particular.

The network also provides or supports the information exchanges between the Community Hospitals and Towns and Central Hospitals.

This would then help the hospitals to receive the suggestions regarding the treatment, by the medical experts and transfer of the medical training and the treatment can be done.

8) Neonatal Anti-theft System

The integration of Identification Management is done through this system. The prevention to theft of the neonates via the anti-theft management and the access to passageway are done for the strangers that come and go throughout the day and this way the babies can be protected.

9) Alarm System

- With the help of real-time monitoring and the medical equipment, patients and hospital tracking, the patients can be sent the distress signal in emergency with the help of alarm system.

- And this will also include preventing the patients leaving from the hospitals without any permission or requirement.

- In the undesirable loss or occurrence of any item that is valuable found to be damaged or theft.

- And the protection of the thermo labile pharmaceuticals and also the samples used in laboratory, etcetera.

C. Telemedicine and Mobile Medical Care: [4]

1) Telemedicine

Telemedicine is a newly introduced medical service, which through combinations of various technologies like computer, communication, multimedia and medical, aims to enhance the results of diagnosis to reduce the cost of health care services and to fulfil health requirements of people.

It is a patient centred service system which is used to perform remote consultation and monitoring of critical patients.

By the enhancement of remote technology, body sensor networks of patients are able to establish communication effectively with the help of advanced sensors.

In prior times, telemedicine was focusing on improving peoples' lifestyle particularly whereas nowadays the focus has diverged to the lifesaving information and the exchange of various medical programs.

2) Mobile Medical Care

The Mobile Medical can be helpful as it establishes the domain/database by monitoring various vital signs for each customer.

The established database would include details such as; weight, protein/fat content, cholesterol level etcetera.

The body state information could be actualized by real time monitoring and the outcome would be retroacted for the community nursing or any medical units in relation.

D. Health Management:

> It is a process which purports to have a control over the appearance of disease and also in the prevention of the development of disease by reducing the medical costs and eventually improvising the life quality.

> The whole process also helps in finding out the factors that harm the health status that is related to the patients and also the groups.

> And, this was it continues in improving all the factors via detection, intervention and assessment systematically.

➢ The body signs like blood pressure, oxygen, heart rate, ECG, EMG (Electromyography) etc. could be gathered by the equipment of medical terminal.

➢ This can then be transmitted further to the household devices such as computer, mobile phones, etc. via the equipment of cordless transmission.

➢ And then finally can be classified into the Health Management Systems, Research Institutes and Hospitals etc. and transferred there as well.

Advantages:

▪ Easy placing of data in the server.

▪ The cloud storage provides effective space for the data.

▪ The related data can be kept together at one place.

▪ Unessential data is avoided.

▪ All users are provided with the uniform services.

▪ Unlike decentralized systems the improvisation of the data security is achieved here.

Disadvantages:

▪ The distance between the data and the user might be too much for the adequate services.

▪ The maintenance of the user authentication to the different users is a clumsy and overhead task.

New Technology File System (NTFS): [5]

The Binary files that are uploaded by mobile users are unstructured and are stored in a table called a file table.

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A file table in particular is a database that has the presence of metadata columns and the files are stored in a New Technology File System (NTFS).

↓

With the help of NTFS the performance of the database is improved.

↓

This technology which is very useful in the processing of the IoT & IoMT was released by Microsoft in the SQL Server 2012.

And this was built upon the Windows File System feature and which was exposed in 2008 SQL Server.

Binary Large Objects (BLOBs) was the issue for which the feature File Stream was introduced.

This would help in performing the searches of full text and also byte streams on BLOBs in spite of SQL which is very complex in statements.

And, the reason being the data not structured particularly in column format or row format.

The exposure of the hierarchy of the file stream folder is done by the file table. The file stream constitutes all the content of the file; this has got a reference in the varbinary column data kind in the file table.

The files and the metadata with its regard are maintained in a synchronized form by the file table.

Transactional or non-transactional, these are two ways to access the file table via Common Run Time (CLR) scripts and APIs of windows.

The data related to the biomedical which is being dealt with could be blood pressure, electrocardiogram, temperature, pulse, respiratory rate through which the health conditions of the patients could be revealed.

Hence, the data used in such application are extremely confidential and its storage must be done carefully so that only authorized people can have the access to view the data.

The deploy of data encryption, authorization and authentication practices is done while used in the medical part of IoT.

Blockchain in Internet of Things: Challenges and Solutions [6] [7]

- There is an extreme growth in the IoT particularly \in the research area and also in industries, but there are still the challenges related to the privacy and security as well and hence counted as vulnerabilities.

- There is again inapplicability in privacy and security of data mainly because of the decentralized topologies and constraint in the resources in almost all its devices used as IoMT.

- Recently the Bitcoin (crypto-currency) that is underpinned by the Blockchain have been in use for the privacy issues with peer knowledge networks and would also work for the security.

Blockchain is basically a chain that helps in tracking of the data from device to the server.

Any disturbance in the Blockchain can lead to breaching of the data.

Hence, in the IoMT the technical staffs make sure they are very particular about their system authentication.

The tech companies appoint highly experienced and smart technicians to work for the

Medical devices when it is related with the IoT.

PILL BOTTLE

Pill bottle is an example of a Medical Device that is connected with the Internet of Things (IoT) and that is how is referred to as the Internet of Medical Things (IoMT) and is a smart device in the context.

Fig. No. 1: Pill Bottle

Introduction:

- Pill bottle is a device that has a use in elderly patients or patients who cannot take care of their medication timely. Hence, a sensor attached in the bottle that has a weight detecting capacity.

- The bottle is tracked with the help of a remote which can be used for the tracking by the doctors, caretakers or the guardians.

- The remote works with the help of a battery which can be charged just like the battery of a cellphone.

- The remote has the presence of a screen that shows with all the information that is required for the tracker to be received.

- The bottle has a weight sensor in it which deals with the duration of the medication taken in the following way:
  - If a medicine is required to be taken thrice a day, then the sensor will measure the weight of the bottle precisely each time a pill is taken out of the bottle.
  - And, if there is no change in the weight of the bottle at the time of medication, the remote that is present with the caretaker will make an already set tune which will remind the caretaker to use the remote buttons for making a reminder to the patient for the medication.
  - There will be an alarm ringing which would have been previously set on a time interval if the medication is not taken.

- And that is how the patient can take the medication on time and the IoT is useful in the healthcare industry.

- And, not just the elderly patients but anyone who is incapable of taking the medication on time can be a beneficiary through this.

SMART ASTHMA INHALER [8]

Asthma is a lifelong disease that is a chronic one and has no cure to it but can only be controlled.

Controlling involves avoiding the triggers that are caused by the environmental factors such as pollens, dust etc., and long term medication to avoid airway inflammation, short term medication to avoid instant attacks which can lead to the emergency rooms or sometimes even death.

Most of the medications are used with the help of inhalers (most of them for the respiratory illnesses, COPD) to the air pathways or lungs.

An inhaler is nothing but a device that provides a measured aerosolized dose of the drug.

Patients who neglect their controlling medication often end up with the use of rescue inhalers which gives a risk of loss in effectiveness.

But now, there is an increase in the number of inhalers that carry a clip-on sensor which can monitor the location of the patient, usage etc. with the help of IoT. With this help, the patients, doctors and healthcare professionals can get thorough information about the incidences.

**Fig. No. 2: Smart Asthma Inhaler**
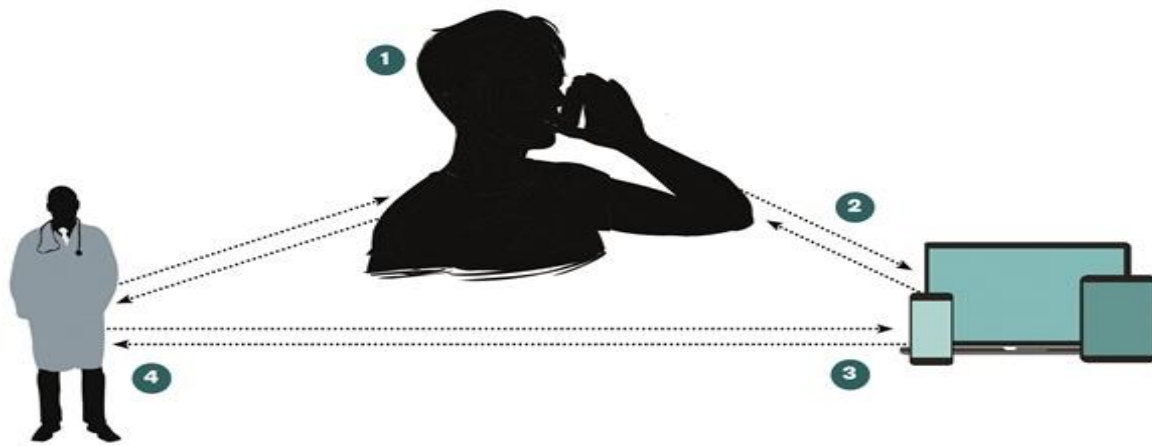
Fig. No. 3: Process of monitoring

❖ The big companies with the portfolios of Asthma or COPD (AstraZeneca, Novartis, GlaxoSmithKline and Boehringer-Ingelheim) are moving in the partnership with the tech companies like Qualcomm Life, Propeller Health and Adherium for the development of smart inhalers.

Result:

- Stringent Monitoring
- Reduced Hospitalization
- Overall reduction in cost
- Improvement is dosage errors
- Multiple devices
- Increased loyalty

SMART PILL [9] [10]
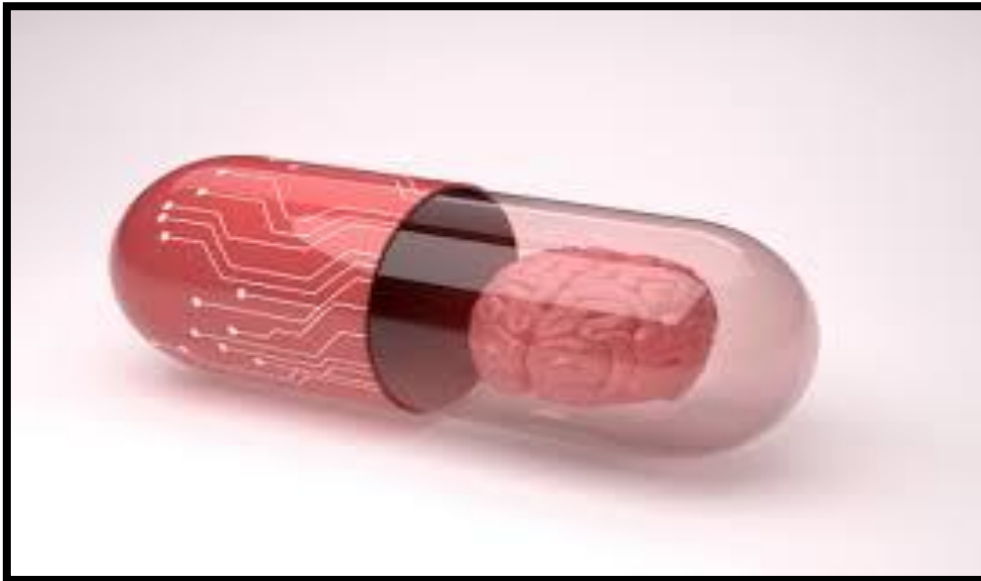
Fig. No. 4: Smart Pill

The first ever smart pill is approved by FDA for the use in USA.

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It is known as Abilify MyCite used for tracking the drug regimen inside the body.

↓

The pill has the drug constituent and an ingestible sensor.

↓

This sensor activates when there is a contact between pill and the stomach fluid.

↓

The pill when the sensor gets activated transmits all the data from inside to a patch which is a wearable one.

↓

And this data then is subsequently transferred in the application which is paired with a smart phone.

This data could be accessed by the physicians or guardians if the patient consents and the access can be done via a web portal.

Describing particularly about this drug used in this pill is, in context with the Schizophrenia drug.
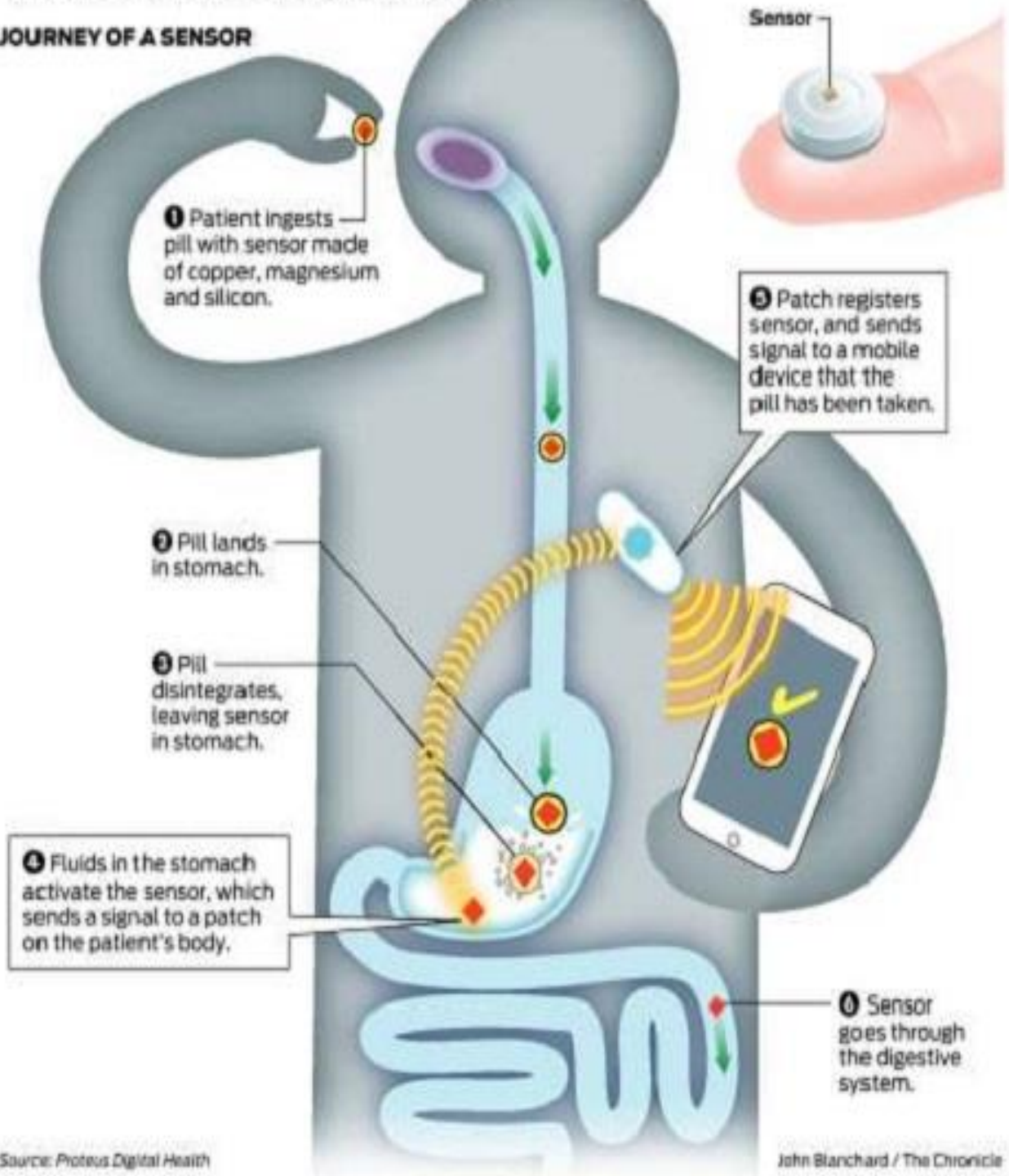

Fig. No. 5: Journey of a Sensor

CONSTRAINT OF THE IoMT:

The building of any IoMT application is not a task of ease due to the complexity to function a medical application and also due to the complexity technically which would include variety of medical equipment and the system that needs to be collaborated.

Henceforth, for maximizing the benefits provided by the technology, the IoMT application must overcome the following technical challenges:

1. **Interoperability:** The health information system when work together in the organization or crossing its boundaries for the delivery of an effective healthcare for the patients and communities that way is called Interoperability.

2. **Integration:** The exchanging of the information and transactions of the data is called Integration of it.

3. **Security:** Keeping a privacy and security of the data as it can damage the patients if their information or details regarding their health are not kept confidential.

The compliance rules/acts: [11]

1. HIPAA: Health Insurance Portability and Accountability Act

This rule belongs to its introduction back in the year-1996.

The healthcare providers that are involved in planning health or any transaction electronically are applied with this rule.

Also, those who provide services to any third party must comply with HIPAA Rule as well. Particularly the rule is applied in compliance with regards to the fraud or abuse.

2. HITECH: Health Information Technology for Economic and Clinical Health Act

It was introduced in 2009 as an extension to HIPAA for the protection of security and privacy of Protected Health Information (PHI).

HIPAA and HITECH both are applied for the information being in use or disclosed about PHI.

The Rights of Individuals and Responsibilities of Administration also are taken care of under this Act.

3. HITRUST: Health Information Trust Alliance

Basically, HITRUST is a private firm in USA.

It is an alliance of Healthcare, Information Safety and Tech leaders which has established a CSF- Common Security Framework.

There are a set of compliant controls that need to be regulated and followed managed by the HITRUST.

This is in particular used for the standard compliance of the data for how it is stored, accessed or transferred etc.

4. PCI DSS: Payment Card Industry Data Security Standard

PCI have set compliant standards for the payment card processors and the ones who accept those cards (Example: Credit cards).

This compliance is required as in the hospitals or any organizations related to healthcare; credit cards are accepted as a mode of payment.

The flow of IoMT throughout the lifecycle of a product:

Healthcare providers: Responsible for providing healthcare to the patients entirely.

Drug/Therapy manufacturers: The Industries where the medicine products are manufactured from raw material to the finished products.

Test developers: The R&D department works over researching various chemical entity, new drug development process, new form of dosages etcetera.

Public and private payers: The people, organization, researchers, manufacturing industries are the role players of the payment flow in the market.

Investors: The investment is a big deal in Pharma Industries for only then the process can move further.

Researchers: People behind the development of the new researches.

Regulators: The Regulatory Bodies, Regulatory Officials and Agents who look through the Regulations being followed or not by the Manufacturing Industries.

Patients: They finally are served for their needs medically and in whichever way possible.

That is how whole regulatory process works start from the manufacturing till the time it reaches the patients.
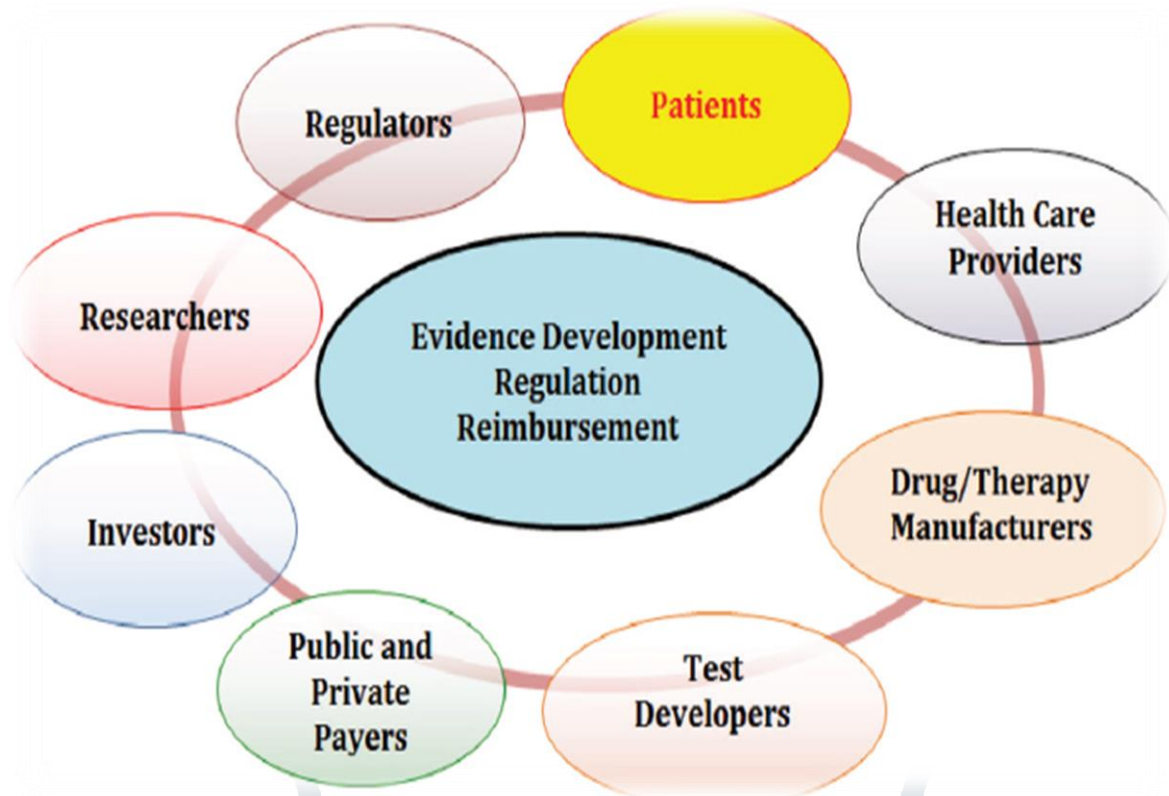
Fig. No. 6: Regulatory Processing

Market of IoMT in Healthcare Industries:

- In the ratio 3:5 in the healthcare companies, now the IoT is used by the installation.

- 60% in the statistics is for the IoT. Specifically for application, 73% that s nearly three-quarters of the healthcare industries use the IoT for the purpose of Maintenance and Monitoring.

- 7:8 healthcare industries that is 87% are currently using IoT that plans to deploy the systems nearly by 2019.

- This figure moreover is higher than the average for businesses in general which is 85%.

- Patient Monitoring represents two-thirds that is 63% of the healthcare industries.

- According to a report by Allied Market Research in 2016, due to a very quick adoption of the IoT by the healthcare industries, the IoMT should be a part of 136.8 Billion industries by 2021.

- In 2015, through the projection of their survey, the IoMT was used maximum for the Patient Monitoring and would also be the continuation till 2021, being a rise of 72.7 Billion.

IoMT needs by the world:

1. **To act on the basis of data.**

   The data collection and the maintenance can be of no use unless implied practically into the action.

   Hence, the data and the action have to walk in parallel hands in hands.

2. **To promote the care regarding prevention in the entire world.**

   The prevention is better than cure and hence, the promotion for the same has to be done.

   This is because the less people fall ill and less do they need the medication.

3. **Patient health advancement.**

   The effective advancement in the tracking and diagnosis of the problems of the patients need to be followed thoroughly.

4. **To boost satisfaction and engagement of the patient.**

   The optimization in the surgical parts for the patients would result in happy customers.

5. **To enhance the health management of the population.**

   The data captured in the cloud through IoT can never be missed out and hence betterment in the health management of the patients.

6. **To enhance the management of care.**

   The management of patient's care in done from home itself by proving the reminders based on the treatment whenever needed.

REGULATORY COMPLIANCES AND THE REASON:

- ✓ Food and Drug Administration guidance for "Postmarket Management of Cyber Security in Medical Devices" (Dec. 28, 2016)

- ✓ The Health Care Industry Cyber Security Task Force report to Congress (June 2, 2017)

- ✓ The Health Information Technology for Economic and Clinical Health Act of 2009, which augmented Health Insurance Portability and Accountability Act requirements to include IoMT devices.

Many such Regulatory responses are issued as guidance but are never enforced.

Also, the prescriptive actions are not included, nor the prescription of specific technical requirements is provided for the maintenance of operations of system.

And, for such reasons and more, the Cyber Security of IoMT must be approached for the patient care and the issues related to the risk management and not as a compliance check.

The protection of patients from any ill effect or harm and organization from any damage or loss in the market.

THE CONNECTED MEDICAL DEVICES ARE CATEGORIZED INTO THREE GROUPS:

1. **The stationary medical devices**

   - The devices that fall under such categories are CT Scanners, MRI Scanners, X-ray, Sonography/Ultrasound machines, Nuclear imaging devices to detect the physiological details.
   - These devices are high tech devices with capital cost which is very high.
   - The information in the form of images is transmitted to the Doctors wirelessly.
   - For the diagnosis purpose, these devices are very critical and are integrated with various applications for the healthcare. It further helps in the quickest possible and accurate and precise decision making for the Doctors.

2. **The implanted medical devices**

   - The devices which are included in such format are Pacemakers, Defibrillators and Replacements for knee, hip etc. and Stimulators such as for nerve, bladder and diaphragm, Biosensors that provide signal processing.

- The patients that are in need of consistent and constant monitoring are made to use these devices that remain inside their bodies.

- For this purpose, invention and medical intervention is used or at times can also be placed in the natural human orifice.

3. The wearable external medical devices

- The devices included are Insulin pumps, defibrillators, skin patches, smart watches and devices to track activity for clinicians' information.

- These devices are used for the monitoring of patients in hospital while they are admitted and after discharge also.

- Also for the on-going patient monitoring who have chronic conditions.

- The wearable that are used in the tracking of fitness or self-monitoring are not a part of these.

TELEMEDICINE:

Fig. No. 7: Telemedicine processing

Venue	Content in use
Remote Clinic	Hospital server, personal desktop
Hospital	Tablet, hospital server
Physician	Smart phone, tablet
Medical Equipment	Video conferencing, smart phone
Ambulance	Video conferencing, personal laptop
Patient	Personal laptop, personal desktop

The telecommunication is very important when the patients cannot move due to any circumstances.

And depending upon the type of casualty, the media of telecommunication could be chosen.

The patient can be comfortable at his place or wherever he is and in any emergency or not, he can be given a proper notice by his physician and the treatment could be provided.

> **One such way of telecommunication is through eVisits.**

eVisits: [12]

eVisit allows a secure functioning via a video conference with your healthcare provider.

This is possible through a various media such as you can eVisit you physician via your desktop from home itself, or via a tablet or also a smartphone works for this purpose.

All that is needed for this purpose is a good internet connection for an easy flow of consultation with your physician.

All the videos would be private and also in a safe position for the communication will be taking place in person or you can accompany your patient as a caregiver and only if the patient is consenting to that.
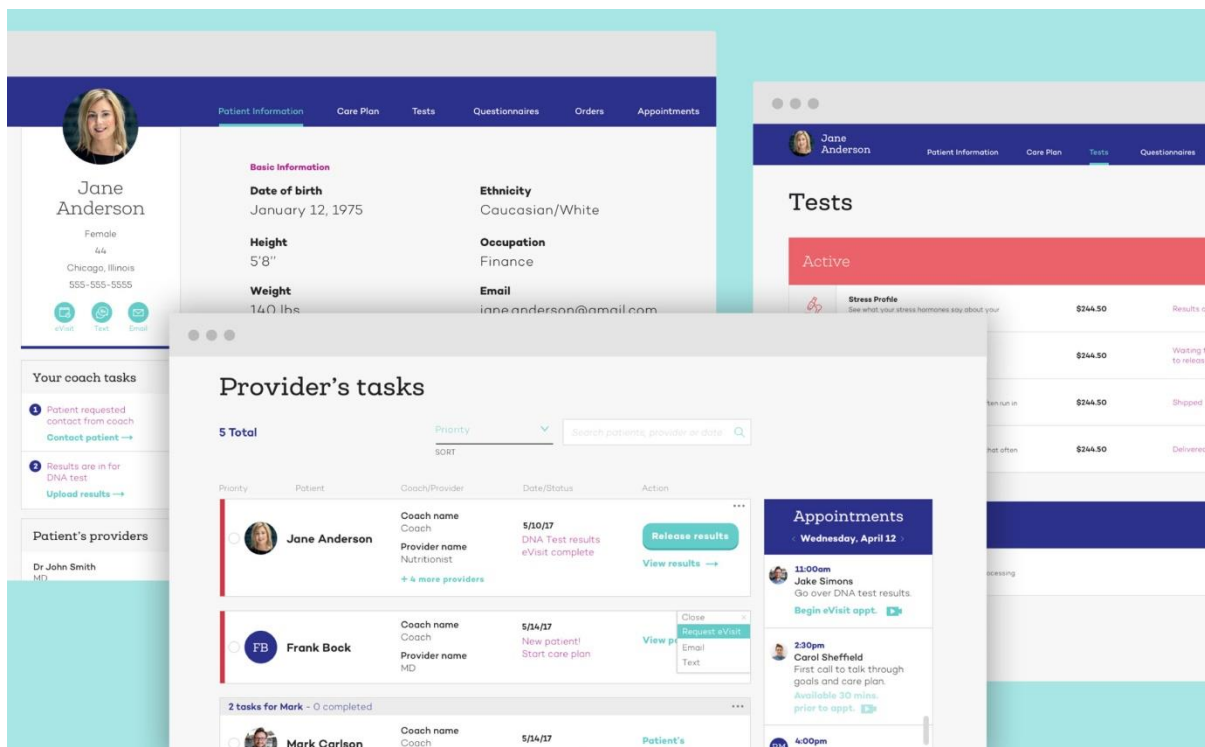
Fig. No. 8: eVisit software counterpart

eVisit is basically a software that helps you by avoiding the travel time inconvenience to various plethora of clinics and sit down at your place and consult the physician.

The appointments are fixed online using this software and those physicians who use eVisits can be out there for your reach to them.

Nowadays, the eVisit is tremendously growing and you can ask your physician if it available and is helpful for you and you can go on an easy way of meeting.
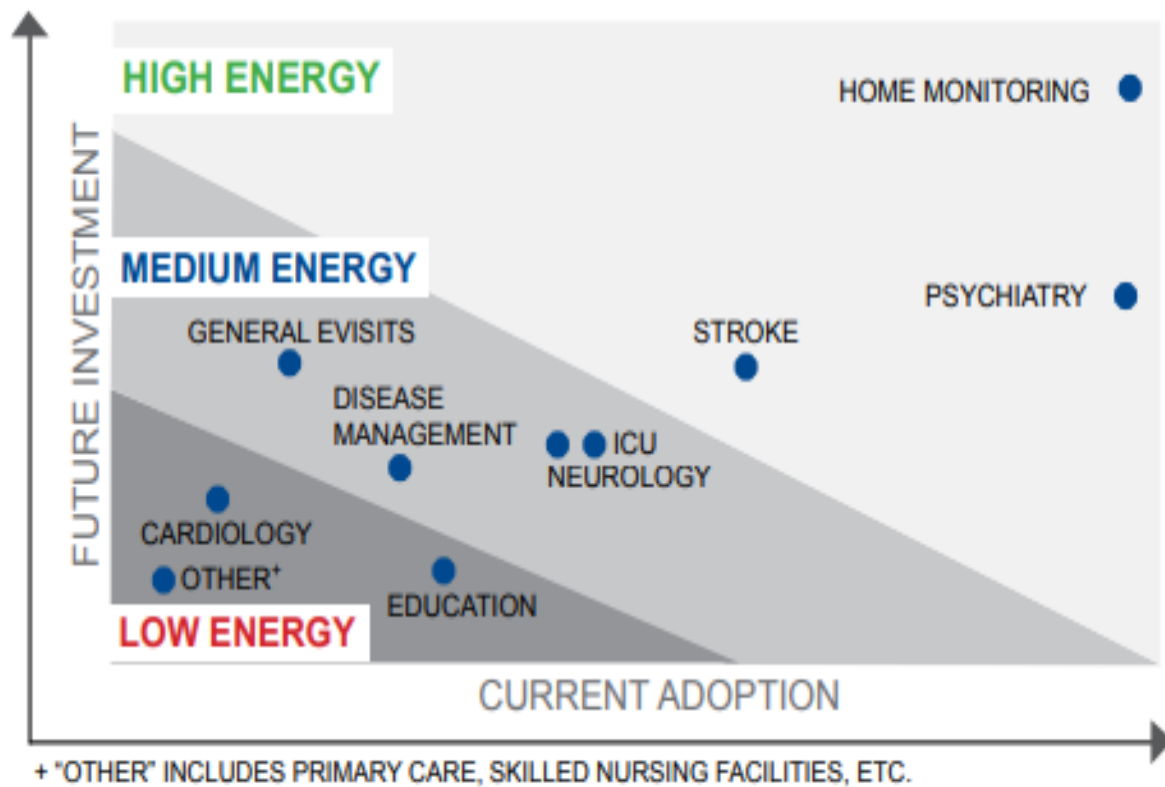
Fig. No. 9: Comparison graph between present and future usage of eVisit

According to this surveyed graph, currently the highest energy shown in telemedicine via eVisit is for home monitoring followed by Psychiatry, stroke etc. as medium energy.

NEONATAL THEFT CONTROL:

Infants are one of the most vulnerable patients of any hospital. And that is how it becomes wholesome responsibility of hospital to take care of them.

There occur various cases of neonatal theft from the hospitals and babies taken away or theft.

Hence to overcome such intense issue, IoMT provides us with a very convenient and useful device called CenTrak.

Fig. No. 10: Neonatal theft control device (CenTrak)

CenTrak: [13]

CenTrak is a device that has a long-lasting battery support which uses second generation infrared and also RFID technology that helps in the transmission of room numbers that are unique and any particular tag in the room would receive the data.

Later, the tag transmits the room number and the unique ID to the server of location.

This would be done using the Wi-Fi in the hospital. And with the help of this the staff can access all the data whenever possible in real-time.

Various benefits for the hospital using CenTrak are as following:

Whenever there is a wrong entry in the room, the hospital staff can quickly detect it via the device, hence benefitted for the quick responses.

With the help of this device, it can always be made sure that the baby is in the right room and with its respective family only, hence easy tracking and not just the alerts in the breaching.

Hospital need not change its system or install something extra or special; hence no capital or resources are used.

The safety of infants can be very much ensured via this.

It is an easily maintained system and hence hospital can stick to its its cost saving goal as well.

Working:

The mother wears the CenTrak device and so is this tagged with the baby which helps in matching properly the baby with its mother.

And so if the infant is approached to any mother that is not the correct one, there will be an alarm sent to the location server.

Hence, till the time the mother is in a part of this facility, the safety and security of the baby will be taken care of constantly.

The device is very convenient because it can be customized based on the requirements by the hospitals.

Whenever the infant is taken or reached any exit point such as doors or elevators, the alarm immediately is sent to the server and because of which the neonatal theft in any way can be avoided.

The reports can also be downloaded based on the location of the infants.

DISCUSSION AND CONCLUSION

ADVANTAGES AND DISADVANTAGES OF INTERNET OF THINGS (IOT): [14] [15s]

Advantages:

The patient monitoring is very easy through IoT as wireless sensors are inserted in patient's body and it can then transmit the data or required details to the network.

The benefits from IoT are received by not only individuals but also community, stakeholder etcetera.

The IoT is a big time cost and time saviour and hence, focussing on quality only.

In IoT, all the things will contact and function themselves and the owner would be able to trace and get the details, hence no manpower.

Disadvantages:

Involvement of multiple vendors for the use of various technologies that are used in IoT, the privacy is a concern.

For working as IoT specialist one must be updated with the latest technologies of hardware and software and this somehow leads to loss of employments for many unskilled fellows.

Interoperability tests are required once the IoT is launched for there in involvement of various vendors with different technologies.

It will take few more time for IoT to be a stable technology as there new technologies arising regularly and which might be beneficial for IoT.

"Patients will become more aware of [their] rights, [which] will impact how organisations create governance around ownership of data. It will depend on the age profile of patients – the younger generation might be happy for data to flow, [whereas the] older generation might not."

Global IOT Partner Manager, Technology Company

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