DISSERTATION

At

Teleradiology Solutions Pvt. Ltd.

COMPARATIVE ANALYSIS OF TECHNOLOGY USED IN TELEMEDICINE

By

MS PURVA GUPTA
(PG/14/052)

Under the guidance of

Dr. Sunita Maheshwari

Post Graduate Diploma in Hospital and Health Management

Year 2012 – 14

International Institute of Health Management Research
New Delhi

Teleradiology SOLUTIONS Internship Training

at

Teleradiology Solutions Pvt Ltd , Bangalore

In
Telemedicine

by

Name: **Purva Gupta**

Enroll No. **PG/14/052**

Under the guidance of

Dr. Sunita Maheshwari and Mr. Harish T.S

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2014-16

IIHMR DELHI

International Institute of Health Management Research

New Delhi

Teleradiology SOLUTIONS

(Completion of Dissertation from Teleradiology Solutions Pvt Ltd.)

The certificate is awarded to

Purva Gupta

In recognition of having successfully completed her Internship in the department of

Project Development

has successfully completed her Project on

Telemedicine

Date 10th May, 2016

at

Teleradiology Solutions Pvt Ltd., Bangalore

She comes across as a committed, sincere & diligent person who has a strong drive & zeal for learning

We wish her all the best for future endeavors.

Training & Development

Signature

Dr. Sunita Maheshwari MD
(Senior Consultant Pediatric Cardiologist,
Chief Dreamer,
RXDX and Teleradiology Solutions Pvt Ltd , Bangalore)

Mr. Harish T.S
(Project Manager)

Sr.Human Resources Manager
(Mr.Cyriac Joy)

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **PURVA GUPTA** student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from **International Institute of Health Management Research, New Delhi** has undergone internship training at

Teleradiology Solutions, Bangalore from **1/03/2016 to 10/05/2016.**

The Candidate has successfully carried out the study designated to him during internship training and his approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

Assistant Professor

Dean, Academics and Student Affairs
IIHMR, New Delhi

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Teleradiology SOLUTIONS

Certificate of Approval

The following dissertation titled **"Telemedicine"** at **"Teleradiology Solutions Pvt Ltd"** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **Post Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

Name — Signature

Dr. Sunita Maheshwari

(Senior Consultant Pediatric Cardiologist,
Chief Dreamer,
RXDX and Teleradiology Solutions Pvt Ltd, Bangalore) _

_____

Mr. Harish .T.S
(Project Manager)

Dr, Anandhi Ramachandran
(Professor, IIHMR, New Delhi)

Teleradiology SOLUTIONS

Certificate from Dissertation Advisory Committee

This is to certify that **Ms. Purva Gupta,** a graduate student of the **Post- Graduate Diploma in Health and Hospital Management** has worked under our guidance and supervision. She is submitting this dissertation titled "**Telemedicine"** at "**Teleradiology Solutions Pvt Ltd**" in partial fulfillment of the requirements for the award of the **Post-Graduate Diploma in Health and Hospital Management.**

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Dr. Anandhi Ramachandran,
Professor,
IIHMR
New Delhi

Dr. Sunita Maheshwari
CEO and Chief Dreamer
Teleradiology Solutions Pvt Ltd,
Bangalore

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **Comparative study of technology used in Telemedicine and discussion article on Tele EEG (An Indian to African Experience)** submitted by **Purva Gupta** Enrollment No. **PG/14/052** under the supervision of **Dr. Anandhi Ramachandran** for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from 1/03/2016 to 10/05/2016 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Assistant Professor

Dean, Academics and Student Affairs
IIHMR, New Delhi

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Teleradiology SOLUTIONS

FEEDBACK FORM

Name of the Student: **Ms. Purva Gupta**

Dissertation Organization**: Teleradiology Solutions Pvt Ltd.**

Area of Dissertation: **Telemedicine**

Attendance: **78%**

Objectives achieved**: Yes as this is a Comparative study she has justified her topic.**

Deliverables: **Comparative Analysis of the Technology used in Telemedicine.**

Strengths: **Quick learner.**

Suggestions for Improvement**: Need to be more focus oriented.**

Signature of Organization Mentor (Dissertation)
Dr. Sunita Maheshwari

Date: **10/05/2016**
Place: **Bangalore**

Acknowledgement

"There are some things in life that may come easy but most things worth having or achieving will come only with dedication and tenacity to get it."

Prima facea, we are grateful to the God for the good health and wellbeing that were necessary to complete this thesis.

I believe, nothing really can be accomplished alone. It's the direction, guidance, involvement, Support and prayers of more than one people around you those results into realization.
My Institute - ***International Institute of Health Management Research (IIHMR), Delhi*** *deserves the foremost appreciation for providing me the opportunities to understand my capabilities. I would like to thank one and all in the IIHMR team for providing me a platform for my professional career as well as for helping me boosting up all my capabilities and making me confident enough to work for health care organisations. I would like to thank* ***Dr. L.P. Singh (Director IIHMR, Delhi)*** *for their continuous support.*
I acknowledge the tremendous contribution of my guide in completion of the project right from the word go.
I would like to render my sincere thanks to ***Teleradiology Solutions, Bangalore*** *for providing me the opportunity to complete my dissertation.*
I convey my deep and sincere thanks to ***Dr.Sunita Maheshwari CEO of Teleradiology Solutions,*** *Bangalore for giving me the opportunity to work under his guidance.*
I extend my words of thanks to all the staff for always being so cooperative and facilitating me.
I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing us for our future.
Finally, my thanks g to all the people who have supported me to complete the research work directly or indirectly.
Thanking you
Purva Gupta

Abbreviations

S.NO.	ABBREVIATED FORM	FULL FORM
1.	ICT	Information, Communication and Technology
2.	.NET	Network Enabled Technology
3.	Web RTC	Web Real Time Communication
4.	SSL	Secure Socket Layers
5.	TSP	Telemedicine Service Provider
6.	TRS	Teleradiology Solutions
7.	TM	Telemedicine
8.	UWB	Ultra Wide Band
9.	PM	Physiological Monitor
10.	RP	Relay Points
11.	WMSN	Wireless Multimedia Sensor Network
12.	WHO	World Health Organization
13.	COP	Care Of Patients
14.	EEG	Electroencephalogram
15.	EMG	Electromyography
16.	EOG	Electrooculography
17.	MRI	Magnetic Resonance Imaging
18.	PET	Positron Emission Tomography
19.	MASN	Medical Ad hoc Sensor Network

20.	ECG	Electrocardiogram
21.	BSN	Body Sensor Network
22.	MOM	Message oriented Motherware
23.	CTP	Collection Tree Protocol
24.	EM	Emplaced sensors
25.	PACS	Picture Archiving And Communication System
26.	DICOM	Digital Imaging Communication in Medicine
27.	MIS	Management Information System
28.	JC	Joint Commission
29.	HL-7	Health Level -7
30.	HIPAA	Health Insurance Portability And Accountability Act
31.	GUI	Graphical User Interphase
32.	LAN	Local Area Network
33.	AGP	Accelerated Graphics Port
34.	ISDN	Integrated Services Digital Network
35.	EMR	Electronic Medical Record
36.	V-SAT	Very Small Aperture Terminal
37.	PSTN	Public Switched Telephone Network
38.	WBS	Work Breakdown Structure

39.	ROI	Return On Investment
40.	IIS 7	Internet Information Service 7
41.	MVC	Model View Controller
42.	MPEG	Moving Picture Experts Group

INDEX

OBJECTIVE OF THE STUDY

I did my internship from Teleradiology Solutions, Bangalore.

The objective of the internship at Teleradiology Solutions was to gather knowledge about the Dimensions of the Organization and various telemedicine technology used.

As a Management Consultant in the Project Development team, , my roles and responsibilities included understanding the current ongoing Projects being handle by my Organization and understand the functioning of the unit. Understanding of various telemedicine technology and platform used all across the globe and apply the insights so gained to succeed in the same industry. Also, the another objective was to write discussion article on Tele EEG (An Indian to African Experience).The 30 patients data of Tanzania were studied and were analysed to find normal/abnormal cases.

ORGANISATION PROFILE

Teleradiology Solutions Private Limited (www. Telradsol.com) is one of the first teleradiology providers to be established worldwide and has ben providing radiology reporting services since its inception in 2002. The services provided include reporting of all noninvasive imaging modalities, including digital radiographs, ultrasound, CT, MRI, PET-CT. Services are provided across the globe , with the focus on rapid turnaround reporting in the emergency/acute setting. Its team of experienced and highly qualified radiologists is situated internationally(two locationsin Israel, five in United States , and one in Europe.) as well as in metropolises, Tier 2 and 3 cities of India (Bangalore, Delhi, Mumbai, Hyderabad).Teleradiology solutions was among the first Teleradiology organisations to obtain Joint Comission accrediation and was rated the No. 1 Teleradiology provider in the US by KLAS (and also awarded the title of Best in KLAS) in an independent survey in the year 2011.

TRS as an organization has a strong academic focus with daily teaching sessions and weekly live e leactures by both its own as well as external faculty using a comprehensive e- learning platform. The sessions are recorded and placed on a Cisco-driven content portal for subsequent review. The organization also hosts a teaching website (http://www.radguru.net) The teaching facilities of TRS have over a 100 academic national and international presentations and publications to their joint credit.

A core mission of the organization as enunciated by its founders is to " effectively use technology to share its own learning's with the largest possible audience worldwide." Till date all online trainings conducted by Teleradiology Solutons have been wholly supported by the Telerad Foundations , without any charge to participating radiologists or residents.

TELEMEDICINE SERVICE PROVIDER:

Over a three year period, Teleradiology Solutions and its multispeciality clinic RXDX Bangalore, Karnataka were connected to 18 PHC's in Madhya Pradesh and Karnataka via Cisco's health presence telemedicine solutions. The aim was to provide basic healthcare and second opinion of patients visiting the PHC's.

Our telemedicine model focuses on both providing primary health communication and consultation to patients depending on the need.

ACADEMIC EXPERIENCE:

The organization compromises a group of international radiologists who are highly qualified and experienced in teaching using the online mode.Till date TRS has conducted 65 online leactures, and have over 150 radiologists signedup for the program with regular

VISION: To excel in the field of International Teleradiology and become the role model for the industry.

MISSION: To offer superior International Teleradiology services clients in underserved sectorsof the maket worldwide.

VALUES: To conduct the practice of International Teleradiology in an ethical manner with patient care, patient safety and patient privacy at the core.

GOALS: To provide the highest quality of service at every level of the organisation.

To focus on technology, innovation, research and operational efficiencies in order to always remain ahead of the compititors to provide the best value to clients.

To provide a fulfilling, satisfying, work enviornment for our employees, without dicrimination.

To educate and train physicians, technologist and support staff, and to use innovative technologies to maximize the reach of such training resources to the community at large.

Key Strengths and Salient Features of Teleradiology Solutions

KEY STRENGTHS:

1. Voted the best healthcare services delivery company of the year by VCCircle 2015
2. Rated the number 1 National teleradiology company in the United States in 2011
3. It was rated as 'Best in KLAS' by an independent health care surveyor in the United States in 2011
4. Telerad Tech awarded "Best Picture Archival and Communications System as a part of prestigious NASSCOM-KPMG Healthcare IT Awards.
5. Medicall Innovation in Healthcare Award 2011 in the Category of Product Innovation in Healthcare.
6. Frost ad Sullivan for Best PACS company in India.
7. Accredited by the U.S. Joint Commission of Accreditation of Healthcare Organizations (JC).
8. Accredited by the Ministry of Health, Singapore.
9. Enables telehealth consultation in remote location with low bandwidth availability.
10. Have nighthawk coverage. (Personalized service, 99.8% accuracy, flexible scheduling, minimal setup cost, no hidden cost).
11. Have 3-D Labs, Subspeciality reads and clinical trial radiology.
12. Products developed , tested and piloted in the radiology eco-system, hence equipped with most efficient, radiology friendly workflow.
13. Integrates and works with existing PACS/EMR/HIS.

14. Integrated Management Information System (MIS).

15. HIPAA compliant software that follows standards such as DICOM,HL-7 etc.

16. HL-7 integration with SmartRIS.NET with facility to manually create orders.

17. Build-in voice recognition reporting.

18. Applications have “DICOM Parallelizer” enables faster study downloads.

19. Automated internet faxing.

20. Easy to use GUI design.

21. Integrated billing system.

22. Macro support for reporting.

23. Time zone based reporting.

24. MIS Reporting functionalities.

25. Provides context based collaboration between referring physician and cardiologist/radiologist.

26. Quality Assurance statistics shows 99.8 % accuracy and quality of reports.

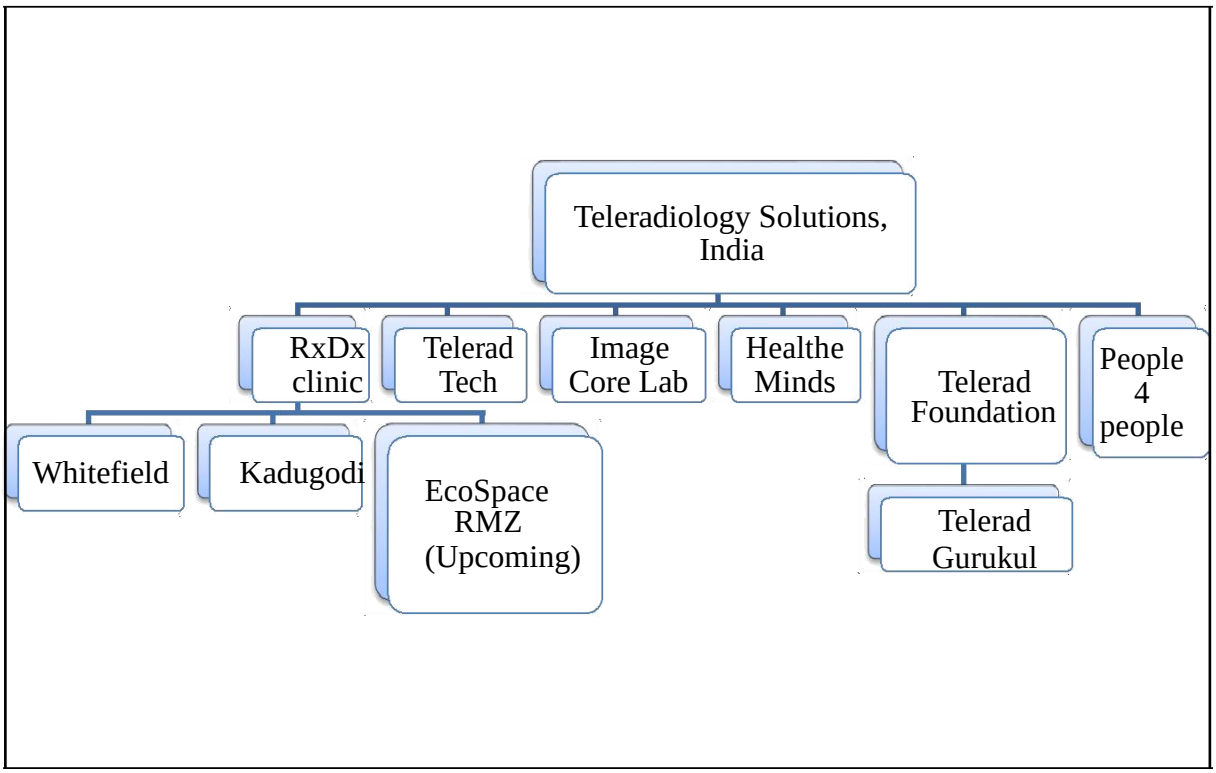
CLIENTS:

Teleradiology clients includes Care providers both in private and government and Diagnostic centres in India and across the world that includes United states, Singapore, Canada, Puerto Rico, Croatia, Georgia, Poland, Denmark, China, Tanzania, Maldives, Brazil, Mexico etc USA

ADDITIONAL FEATURES:

- After 1 pm, consultation is free, there after free treatment is provided to the patients.
- Teleradiology Solutions opened an organization called as people for people , where more that 200 plus playgrounds are constructed in slums areas and government schools, where there is a shortage of funds.

ORGANIZATION CHART-



PART-2

DISSERTATION

COMPARATIVE ANALYSIS OF TECHNOLOGIES USED IN TELEMEDICINE

EXECUTIVE SUMMARY

The **'Comparative Analysis '** is mainly item by item comparison of two or more comparable alternatives, process, products, qualifications, sets of data and systems, to find out the new trends or modify the existing trends. It is used to compare the outcomes of alternate solutions or processes. The increasing need to better healthcare is one of the fiercest challenges faced by both developed and developing countries. The aging population has led to shortage of specialists in the medical field, depriving remote and unprivileged areas of better healthcare. The advances in ICT's offer hope of technologies that have a great potential to reduce mortality and morbidity while improving the healthcare delivery system.

Telemedicine is a magnificent tool the bridges the gap between the specialists and patients, bringing speciality care to the location of the patient in life time.

In this thesis, a comparative review of some of the existing telemedicine technology has been presented. The comparative comparison of telemedicine tools, platform and technologies which was discovered at Teleradiology Solutions India, John Hopkins University, Rochester Institute of Technology, USA, Harvard University Sensor Lab, University of Virginia and University of Wisconsin, Madison, USA. (Abroad) as well as the the initiatives in India.

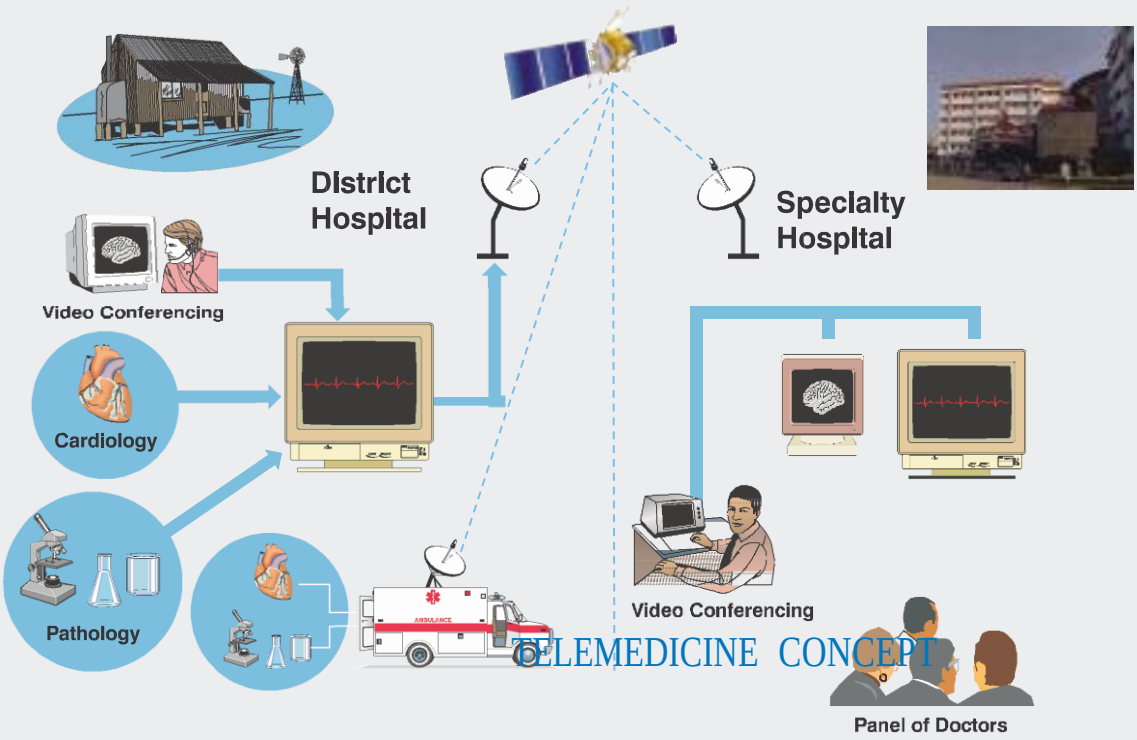
1. INTRODUCTION

Telemedicine (Tele = Distance ~ Medicine) is a concept of providing healthcare to the patient instead of him traveling to unknown and strange places at enormous cost. Most of Telemedicine involves usage of Information and Communication Technology (ICT) as an enabler to expand the reach and provision of Healthcare across physical boundaries.

It has since expanded to mean use of ICT for provision of specialized healthcare (covering almost all specialties), preventive health schemes, disaster management and other healthcare related issues wherein a due to time, space or distance gap separates the healthcare provider – be it the government, large hospital or individual consultant and the health seeker or beneficiary. The term eHealth (e – short for Electronic) is currently used.

Imagine a villager in rural Bihar or Madhya Pradesh with an ulcer in his cheek who urgently needs an opinion whether the disease he is suffering from is cancer or not. In case it is cancer, he has to come to a cancer surgeon and get operated followed by other therapies, which if given early can let him lead a normal life. In case he does not have cancer, he as well as his family members and relatives need not spend any money for travelling etc, providing suitable treatment with minimal time with effective cost. With current technology of instant communication and internet, it is possible to transport the patient virtually to the specialist - in the form of his reports etc., get an opinion at a small fraction of the cost of a personal visit. And also it will be done in almost no time. In the above example, the patient's biopsy slides only need to be transmitted to a specialist pathologist anywhere. Tools exist to enable the pathologist too, if required, manipulate the position of the slide to look for cancer cells in a specific area, as if he had the slide in his own hand.

Telemedicine has been defined as the use of telecommunications to provide medical information and services. It may be as simple as two health professionals discussing a case over the telephone, or as sophisticated as using satellite technology to broadcast a consultation between providers at facilities in two countries, using videoconferencing equipment. The first is used daily by most health professionals, and the latter is used by the military and some large medical centers.



TELEMEDICINE CONCEPT

1.1. *Problem Statement*

- As there is the shortage of Healthcare providers in rural areas, which had led to lack of accessibility to both basic healthcare and speciality care, the concept of telemedicine was introduced.
- Through telemedicine, patients can to get access to healthcare faster, which is a leading factor in improved patient engagement and better outcomes.
- As the healthcare industry is being driven towards value-based care, the use of telehealth technologies results in many positive outcomes including: fewer hospital re-admissions, more faithful following of prescribed courses of treatment, and faster recovery than that of patients not receiving remote intervention.
- Telemedicine allows hospitals to create hub-and-spoke networks to provide each other with support. By easily sharing their expertise outside their own institutions, doctors can offer incredible value to their medical colleagues and those colleagues' patients.
- Remote medical technology is an increasingly effective way to administer preventive medicine and manage chronic conditions.
- Distance should not be a barrier, to access quality healthcare services, telemedicine came into role.

2. BRIEF REVIEW OF KEY TELEMEDICINE DEVELOPEMENT

Historically, the use of the telephone in health care delivery has encompassed a variety of uses, including summoning emergency assistance, obtaining second opinions, scheduling health care activities, providing health care advice, and monitoring patients' conditions remotely. One of the first widely recognized uses of telemedicine occurred in the late 1960s, when a closed circuit television system was set up at the Nebraska Psychiatric Institute and a remote state mental health hospital to provide distance education and teleconsultation. Managed care plans were also early adopters, with the first nurse triage call center established by Kaiser Permanente in the late 1960s.

During the 1970s and 1980s, additional uses of telemedicine were developed for certain remote populations needing health care. For example, the National Aeronautics and Space Administration (NASA) turned to telemedicine for monitoring the health status of astronauts on missions. Other sponsors included employers of workers stationed on oil rigs, organizations sponsoring research expeditions in Antarctica, and the U.S. military.

Interest in telemedicine for the general population took off first in Norway during the 1980s and 1990s, which had both a universal health care system that could subsidize telemedicine development and a significant portion of its population located in remote areas with few medical specialists. The two-way audio and visual links established in that country resulted in findings that diagnosis using telemedicine was equivalent to in-person care, that it was safe and reliable, and that it saved on transport costs.

In the United States, telemedicine has been promoted and financed by the federal government to expand access to care for certain populations, including prisoners and residents of medically underserved rural areas. The Telecommunications Act of 1996 expands the definition of universal communications service to include rural health care providers and provides funds for rural health care centers through the Rural Health Care Program for telecommunications and broadband services. The federal government has also made major investments in development of a technological infrastructure suitable for delivery of telemedicine services. For example, since the enactment of the Health Information Technology for Economic and Clinical Health Act in 2009, an estimated $30 billion has been earmarked for allocation in the form of incentive payments to physician practices across the country that meet “meaningful use” criteria and standards of use for electronic health records. In 2010, the Federal Communications Commission released the National Broadband plan, which made a number of recommendations around encouraging the use of telehealth through greater broadband expansion. Elsewhere in the federal government, the Department of Veterans Affairs (VA) made a major investment in telemedicine starting in 2003 in three areas: home telehealth, clinical video telehealth, and store-and-forward telehealth. As a result, the number of Veterans served through one or more of these modalities in 2013 was estimated to be nearly half a million in fiscal year (FY) 2012 and projected to reach 820,000, or about 15% of the Veteran population, in FY 2013.

2.AIMS AND OBJECTIVES

1. To study about Telemedicine, its workflow and its practical implementation.
2. To assess the existing technology of Telemedicine at Teleradiology Solutions, Bangalore.
3. To compare the Telemedicine initiatives at India and globally.
4. To study the necessity and efficacy of Telemedicine services.

3.REVIEW OF LITERATURE

Antoniotti NM. Current trends and opportunities in TeleHealth: The Jetsons have arrived! Region 4 Genetics Collaborative Regional Meeting. May 3, 2005, Lansing, MI.

"TeleHealth is a tool for access. Can be asynchronous (store and forward) or synchronous (interactive). Technology needed includes: patient exam camera, digital electronic stethoscope, fiber-optic otoscope, fiber-optic opththalmoscope, digital camera, document camera, intra-oral camera, laser caries detector, clinical video (Polycom, Vcom), and clinical exam rooms. In regards to transmission spectrum, you need to have good quality (ISDN and LAN) while maintaining secure lines. Maritime Medical Genetics Service (MMGS) serves about 2 million people (Babineau and Ludman, 2004). Reimbursement can be an issue: some third party payers reimburse, Medicare pays universal (although only from certain sites), and Medicaid does not reimburse. State licensure is an additional issue, although it was suggested that the consultation exception could be used. Future directions of telemedicine include more investigation of reimbursement, transmission costs, financial state of federal and state budgets, interoperability, new compression algorithms, asynchronous patient driven consultations, and internet medicine."

Babineau T and Ludman MD. The Applications of Telehealth in Medical Genetics. In Telepaediatrics: Telemedicine and Child Health. Wooten, R. and Batch, J. (eds.), Royal Society of Medicine Press, London, pp 53-62, 2004.

"The study reports on the Maritime Medical Genetics Service based in Halifax, Nova Scotia, which delivers care to ~2 million people (only regional genetic services). The furthest point is 7.5 hours away by car. The program was developed out of necessity, as some patients were not willing to travel that far. Phone discussions were started but not felt to provide optimal services. At the time of the article, there were 8 locations with telehealth links to the IWK Health Centre where MMGS is located. The MMGS carried out pilot project with cancer genetics. Satisfaction with services was good, and therefore they moved on to other types of genetic cases where a physical exam was not required (includes prenatal genetic counseling and follow-up of metabolic disorders). They also allowed the option of having a second visit and result session for HD predictive testing counseling via

videoconference (the first session was required to be face-to-face). Health care providers did not feel as much of a connection with patients, but the patients reported high levels of satisfaction. A special protocol was developed for individuals with hereditary hemochromatosis, since most patients were treated at time of referral and genetic counseling was not considered urgent. To provide education, a group session was held with a hematologist, hepatologist, geneticist and genetic counselor. 70 people attended in person, 27 went to a telehealth site and participated via videoconference. MMGS has not done telemedicine for consultations where a physical exam would be required due to cost of high resolution cameras and special training to the support staff. They may reconsider since more clinics are obtaining high - resolution cameras. Telemedicine in Maine and Florida has been used for diagnosis of genetic disorders, although it was noted that training of onsite care provider and patient willingness to cooperate influenced the quality of the exam. Overall, the MMGS reports good experiences with telegenetics, although equipment malfunctions periodically occured. Even in Canada, licensure and liability across province lines and reimbursement issues can be a limitation."

Louis et al. (2003) examined 18 observational stud-ies and six randomized controlled trials involving homecare telemonitoring for heart failure.

"Observational studies suggest that telemonitoring; used either alone or as part of a multidisciplinary care program, reduce hospital bed-days occupancy. Patient acceptance of and compliance with telemonitoring was high. Two randomised controlled trials suggest that telemonitoring of vital signs and symptoms facilitate early detection of deterioration and reduce readmission rates and length of hospital stay in patients with heart failure. One study also showed a reduction in readmission charges. One substantial randomised controlled study showed a significant reduction in mortality at 6 months by monitoring weight and symptoms in patients with heart failure; however, no difference was observed in readmission rates. Another ran-domised study comparing video-consultation performed as part of a home healthcare programme for patients with a variety of diagnoses, suggested a reduction in the costs of hospital care, which offset the cost of video-consultation… One randomised study showed no difference in outcomes between the telemoni-toring group and the standard care group."

Hersh et al. (2001a) focused on 28 studies of pediatric and obstetric telemedicine and home-based telemedicine. For store-and-forward telemedicine, they find "some evidence of comparable diagnosis and management decisions" in the areas of pediatric dental screening, pediatric ophthalmology, and neonatology. For self-monitoring/testing telemedicine, they find improved access to care in the areas of pediatrics, obstetrics, and clinician-indirect home telemedicine.

"Access is particularly enhanced when the telehealth system enables timely communication between patients or families and care providers that allows self-management and necessary adjustments that may prevent hospitalization. There is some evidence that this form of telemedicine improves health outcomes, but the study sample sizes are usually small, and even when they are not, the treatment

effects are small.

RESEARCH METHODOLOGY

STUDY DESIGN

The study was non – experimental evidence based in nature. The study was based on observation made. It broadly included:

1. Present status of the telemedicine department (Through collection of primary data and Secondary Data from the organization).
2. Comparison of Manpower for the organization.
3. Designing comparision matrix.

DATA COLLECTION TOOLS

- Interview and discussions with head of the departments.
- Checklists
- Observation.
- Using available information
- Telemedicine tool kit

  Telemedicine guidelines.

STUDY TIME

Study time was of 2 months 10 days which included Review of guidelines, collecting data, compiling data, review of secondary data, Comparitive Analysis analysis and final report compilation.

STUDY METHODOLOGY

The study includes the situational analysis through identification of gaps in technology used in telemedicine through comparitive analysis (Interviews, Observations, Secondary data review, Telemedicine Toolkit) as mentioned and discussed. As per the result scoring was done on a scale of 1 to 5 . Scoring was done to measure the scope of improvement.

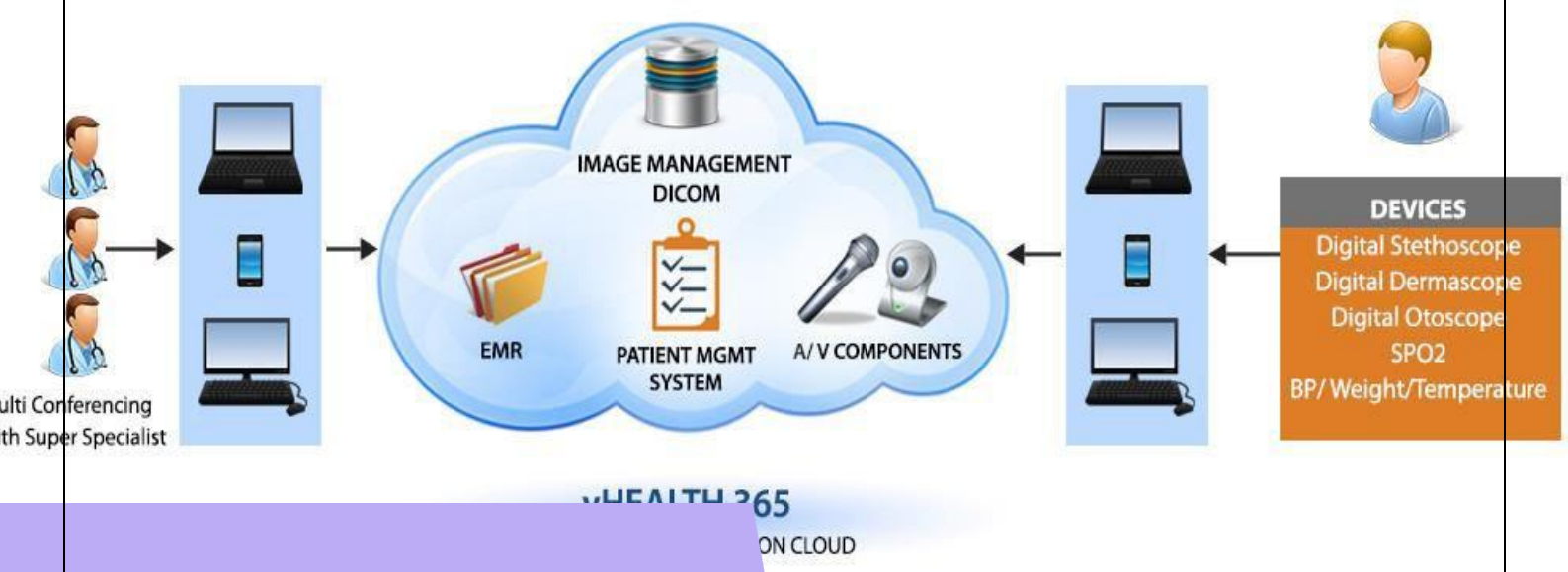
STUDY DATA

1. Primary data:- To study the present status and functioning of department of Telemedicine .
2. Secondary data: - Records of various departments.
    I. Present status of the department.
    II. Comparison with Neurosynaptic communication..
    III. Comparison/ compliance with Telemedicine Standards.

4.TELEMEDICINE TECHNOLOGY AT TELERADIOLOGY SOLUTIONS

TRS Telehealth solutions enables telehealth consultation in remote locations with low bandwidth availability. It offers 360 degree complete telehealth offering technology and services.

1. CLOUD HOSTED TELEMEDICINE PLATFORM AT TRS :



Details of Telemedicine Terminal- For Remote End

A. List of Hardware:

S. No.	Telemedicine Terminal Hardware	Qty
1.	PC Hardware • Intel PIV 2.66 GHz or above with Intel chipset board • 1 Serial, 1 Parallel, 4 USB • 80 GB Hard Disk drive at 7200 RPM • 256MB DDRAM upgradeable up to 2GB • 10/100 Mbps TP LAN / Ethernet Interface with wake on LAN	1

	• 52X Samsung CD writer • Speakers (200 Watt Minimum) • Keyboard • Scroll Mouse & Mouse Pad • 3 PCI Slots • Built-in AGP card • 17" Color Monitor • Add-on video capture card • *ISDN Modem • HP3745 Desk jet Colour Printer • USB Camera with microphone	
2.	Basic Tool kit – Screw Drivers, Noseplier and Cutter	1

* ISDN modem only required when we are not using PC based Video-conferencing.

B. Video Conferencing:

S. No.	Video Conferencing System	Qty
1.	Polycom SP 128	1
2.	29" Flat Sony Colour TV	1
	or	
3.	PC based ISDN/IP Video Conferencing Card	1

C. List of Software:

S. No.	Telemedicine Terminal Software	Qty
1.	Windows 2000/Xp (Single User) Licensed	1
2.	Telemedicine Terminal Software AROGYA	

	a.	Basic module • EMR (Electronic Medical record) • Data & Image Transfer facility	1
	b.	Cardiology Module	
	c.	Radiology Module	
	d.	Pathology Module	

D. Medical Equipments:

S. No.	*Medical Equipments*	**Qty.**
1.	***12 Lead E.C.G. machine***	1
2.	***Image Scanner (Legal size) with TP*** *or*	1
3.	***Image Scanner (A-3 size) with TP***	1
4.	***Pathological Microscope with Digital Camera***	1

Details of Telemedicine Terminal-: **For** Specialist End

A. List of Hardware:

S. No.	Telemedicine Terminal Hardware	Qty
1.	***PC Hardware*** • ***Intel PIV 2.66 GHz or above with Intel chipset board*** • ***1 Serial, 1 Parallel, 4 USB*** • ***80 GB Hard Disk drive at 7200 RPM*** • ***256MB DDRAM upgradeable up to 2GB*** • ***10/100 Mbps TP LAN / Ethernet Interface with wake on LAN*** • ***52X Samsung CD writer*** • ***Plantronic Speakers (200 Watt Minimum)*** • ***8 Megapixel (Logitech) camera with***	1

	supported motherboard • *Scroll Mouse & Mouse Pad* • *3 PCI Slots* • *Built-in AGP card* • *17" Color Monitor* • **ISDN Modem*	
2.	Basic Tool kit – Screw Drivers, Noseplier and Cutter	1

* ISDN modem only required when we are not using PC based Video-conferencing.

B. Video Conferencing:

S. No.	Video Conferencing System	Qty
1.	Polycom SP 128	1
2.	29" Flat Sony Colour TV	1
	or	
3.	PC based ISDN/IP Video Conferencing Card	1

C. List of Software:

S. No.		Telemedicine Terminal Software	Qty
1.		Windows 2000/Xp (Single User) Licensed	1
2.		Telemedicine Terminal Software	
	a.	Basic module • EMR (Electronic Medical record) • Data & Image Transfer facility	1
	b.	Cardiology Module	
	c.	Radiology Module	
	d.	Pathology Module	

S.No	Communication media at both user's end	Features/Facility Available
1.	1BRI/3BRI ISDN Line	1.TV based Video/Audio conferencing 2.Desktop Video/Audio conferencing 3.Image & data transfer 4.Real-time Image (Video) streaming
2.	PSTN – 2 Lines (Simple telephone Line)	1.Netmeeting (low bandwidth) Video conferencing 2.Dedicated (Good quality) Audio Conferencing 3.Image & data transfer
3.	PSTN – 1 Line (Simple telephone Line)	1.Netmeeting (low bandwidth) Video conferencing 2.Netmeeting Audio Conferencing 3.Image & data transfer
4.	V-Sat (≥256 Kbps)	1.TV based Video/Audio conferencing 2.Desktop Video/Audio conferencing 3.Image & data transfer 4.Real-time Image (Video) streaming
5.	Broadband / Lease line with Fixed IP (≥256 Kbps)	1. TV based Video/Audio conferencing 2. Desktop Video/Audio conferencing 3. Image & data transfer 4. Real-time Image (Video) streaming
6.	Broadband / Lease line with dynamic IP (≥512 Kbps)	1. Netmeeting (low bandwidth) Video conferencing 2. Dedicated Audio Conferencing 3. Image & data transfer

Prerequisite: -

1. A well furnished telemedicine room having one table and three chairs.
2. Communication media i.e. ISDN, PSTN, V-sat, Broadband, Lease Line etc.
3. Proper lighting arrangement for videoconferencing.
4. Dedicated Power supply/ generator for Emergency Services.
5. Five Power Plug points of min.5 Amps.

Man-power Requirement –

Eligibility: - Graduate (Any discipline) /Diploma in Electronics or Computers

a) Telemedicine Engineer: - He / She shall be having a knowledge and skill of operating Computers along with the basic knowledge about the Computer Hardware and its Peripherals.

b) Para-medical Staff having experience and adaptability to operate basic Medical equipment and various medical gadgets along with the Capability of imparting training to the Users of Telemedicine.

VARIOUS PARAMETERS	FEATURES/FACILITY AVAILABLE
Workflow	.NET
Audio/video	High definition Web RTC 1.0 video technology
Bandwidth	1 Mbps download/upload
Data protection	SSL encrypted
Telemedicine platform	V Health 365
Data rate	High end devices
Service provider	TSP

WEB- RTC

- ✓ Web RTC (Web Real Time Communication) is a common standard developed by the W3C in close cooperation with the Web RTC standard developed by the IETF.
- ✓ Web RTC functions at a lower protocol layer, Web RTC enables the embedding of this functionality in applications and websites. The protocol is commonly used to support voice or video chat between peers.
- ✓ With Web RTC adaptation quickly across the digital landscape, well supported communication technology standard that makes high definition, high resolution, low bandwidth video, peer to peer data transfer and audio chat easily accessible.
- ✓ Web RTC patients and clinicians no longer be required to install a browser plug in while using Chrome, Firefox or Opera.

- ✓ The peer to peer nature of Web RTC makes this technology the only solution that can provide the scalability and technology neutrality , the healthcare industry will require in order to further the efforts of data interoperability.

V- HEALTH 365 –

- ✓ V- Health 365 is a exclusive telemedicine hubspot. It is a telemedicine platform which enables greater access to healthcare for patients without having to visit a clinic or hospital.
- ✓ It is a telehealth platform that delivers a comprehensive and efficient solutions to the healthcare providers seeking to manage the workflow.
- ✓ Using vhealth 365 platform, Healthcare providers can conduct on demand virtual consultations to reduce avoidable visits to the emergency departments, schedule and conduct follow up consultations for patients with chronic conditions or those undergoing active treatment and provide remote medical services such as occupational health and in school virtual clinics.
- ✓ Various telemedicine hubs are set up in Apartment Complexes, Gated Communities, Corporate Parks, Corporate Clinics etc. Primary care consultations and second options can be availed on mobile or computer without having to take a day off or waste time in travelling and waiting at the clinic.

Work flow of vHealth 365 – Patient and Doctor (one to one teleconsultation)

PBatient Center :

- ✓ The nurse at the patient center schedules the appointment for the patient seeking teleconsultation

- ✓ The nurse also attaches prior medical history records, scans etc of the patient for the doctors reference

- ✓ One the patient arrives at the center for the scheduled consultation the nurse marks the patient as “Arrived” so that doctor is aware of the status on his work list

- ✓ Once the doctor has given the medical prescription , the nurse can download or print the same and give it to the patient

Administrator

- ✓ A designated personnel can assign the consultant to the patient as the nurse at the patient center may not have the knowledge of doctor's availability

Doctor/Consultant

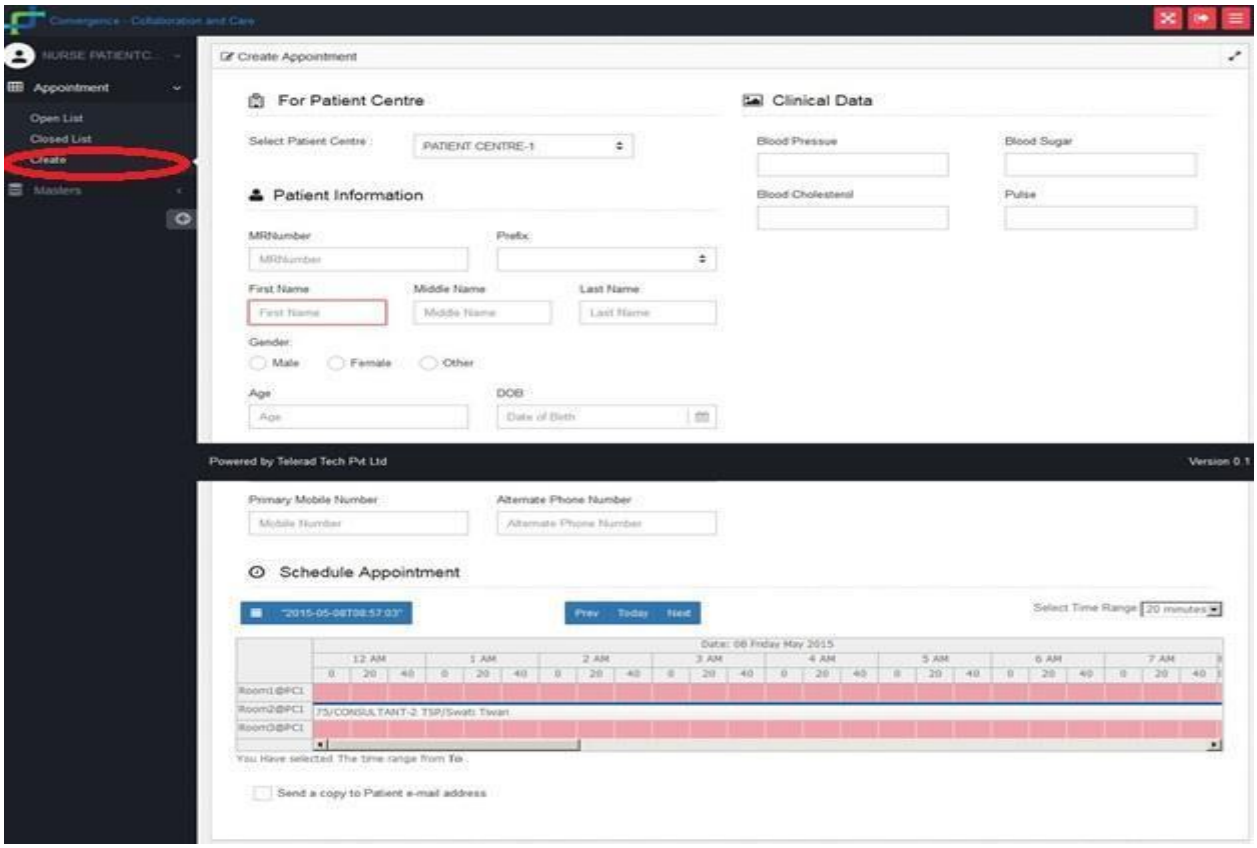
- ✓ The doctor can see only patients assigned to him/her in the work list
- ✓ The doctor can look up previous medical history of the patient through the viewing the attached files
- ✓ The doctor can start teleconsultation by clicking the patient link in his /her work list
- ✓ The doctor can write a medical prescription which is available to the nurse for printing

Steps of using the platform- vHealth 365 :

Step 1 : Log in to www.vhealth365.com

Step 2: Log in as Nurse /patient station

- User id : xxxxx
- Pw :xxxxx



- Click on the **"Create"** Button on the side bar . This will open the Appointment page as shown above .
- Enter the details of the patient in the respective fields

Step 3 : On the scheduler section , drag the mouse on the time for which the appointment is to be given and then click on the schedule button .

Step 4 : Once the appointment is created you can see the patient in the work list

By selecting the Attach files option (marked in red circle) from the drop down area (marked in Blue) , relevant patient history files , scans etc can be attached with the patient record for doctors reference.

.

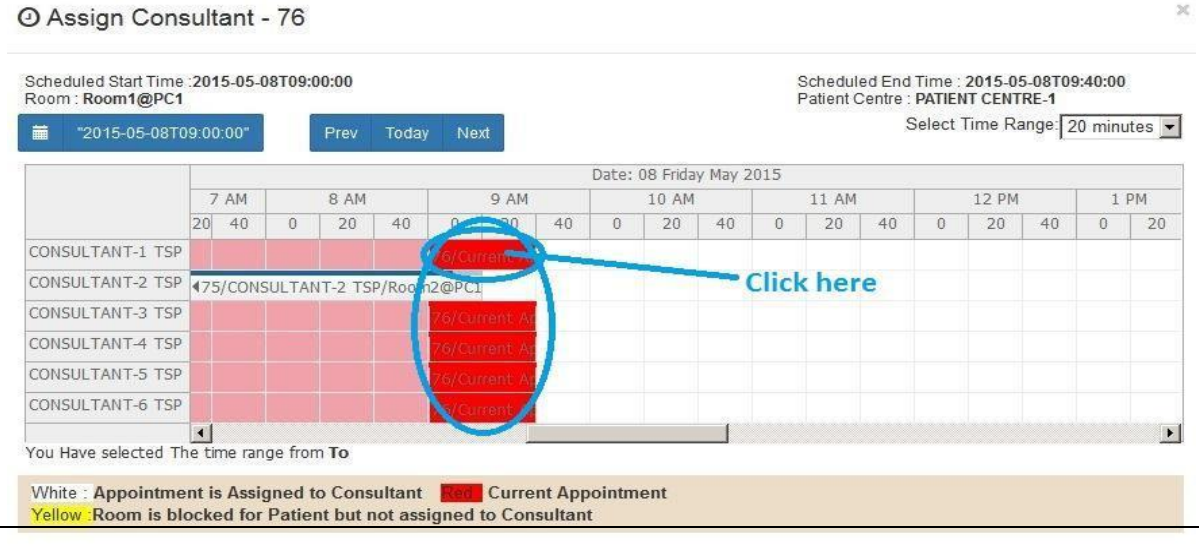
Step 5 : Login as administrator

- User id : xxxx
- Pw: xxxxx

- Select the “Assign Consultant” (marked in red circle) from the drop down field .

Step 6

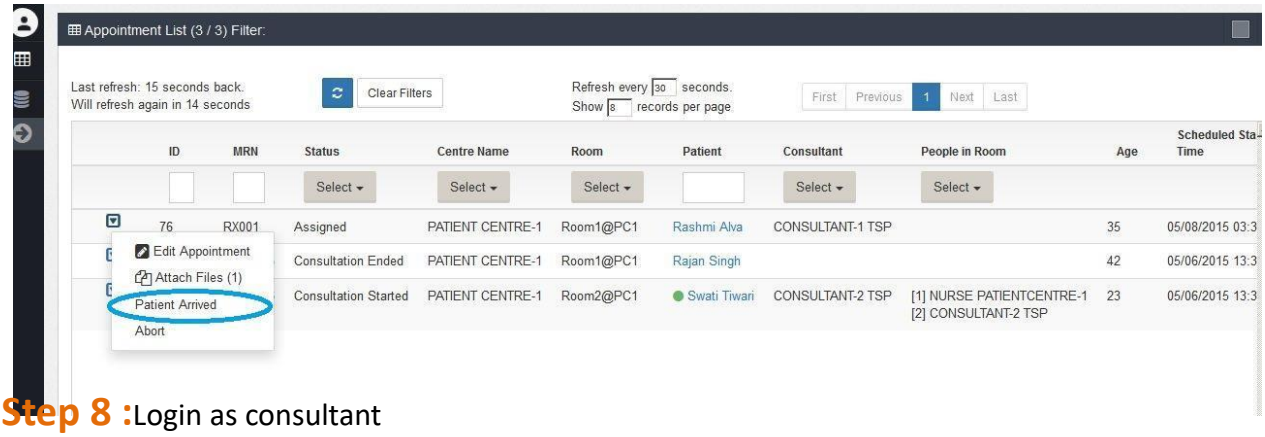
- In the assign consultant option the screen shows the scheduled slot in red font (marked with blue circle)
- Click on the available slot for the consultant who is available . For e.g. if you want to assign the “Consultant 1” to the patient then click on the scheduled slot as shown in the below screen



Step 7: Log in as Nurse /patient station

- User id : xxxxx
- Pw :xxxxx

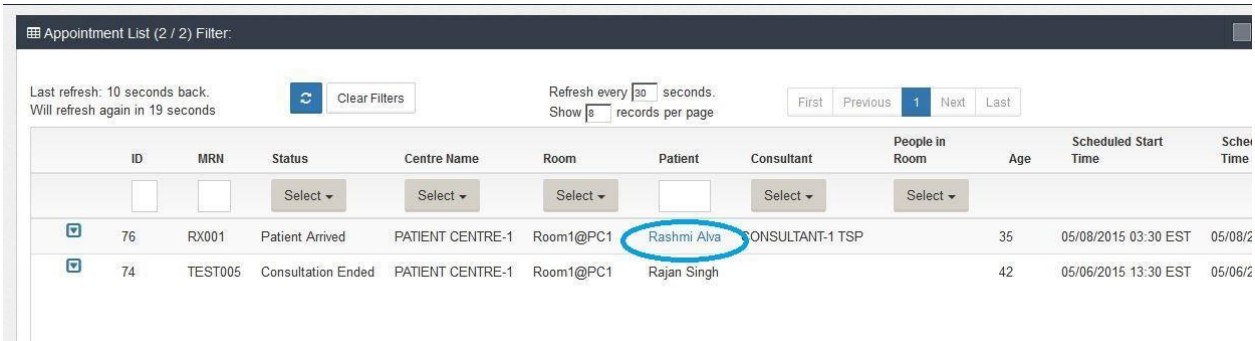
Mark the patient as “Arrived” as marked in blue circle in the below screen shot from the drop down list . This will change the status of the patient to “Arrived” in the work list and now the patient is ready for the teleconsultation with the designated doctor.



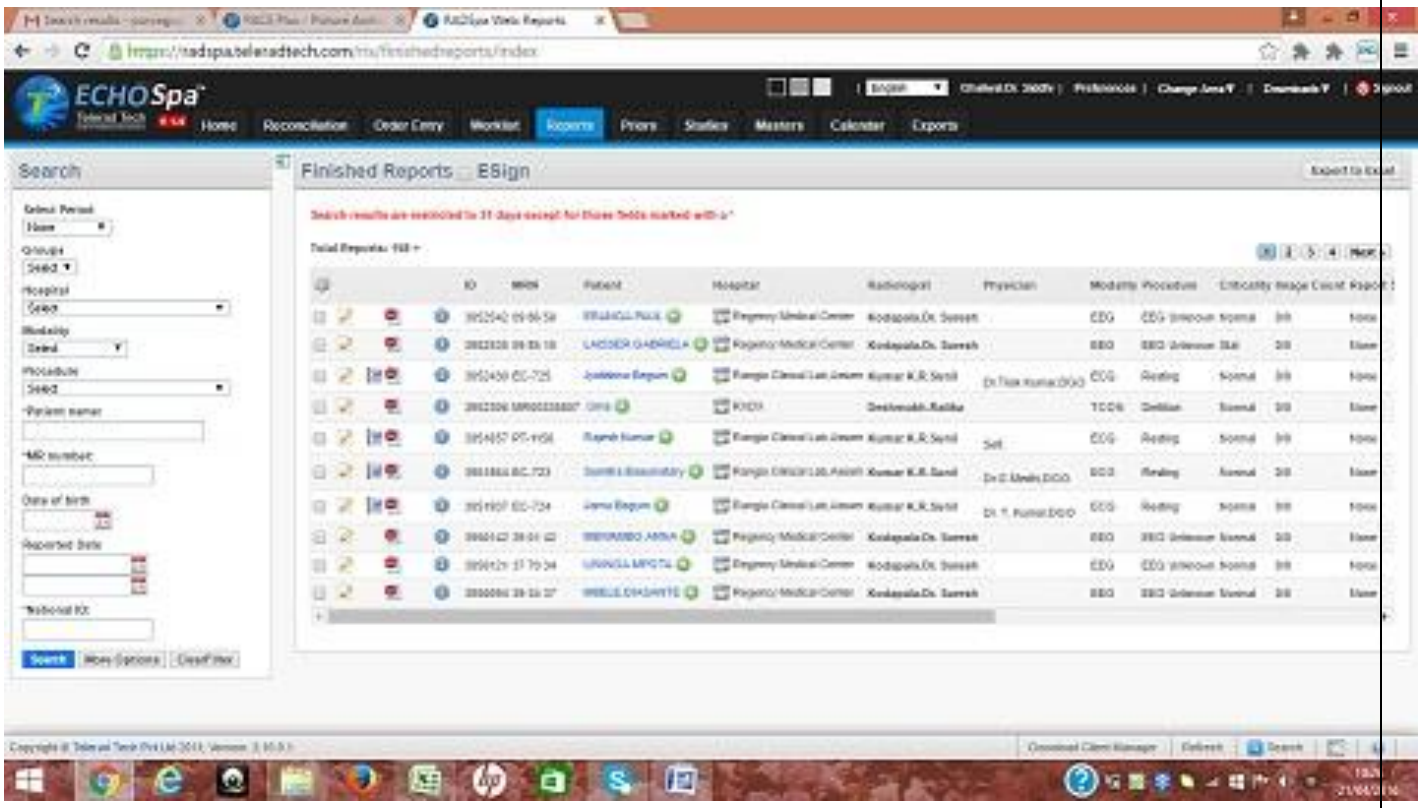
Step 8 : Login as consultant

- User id : xxxxxx
- Pw:xxxxx

Click on the patient link (as marked in blue circle) to begin the teleconsultation.



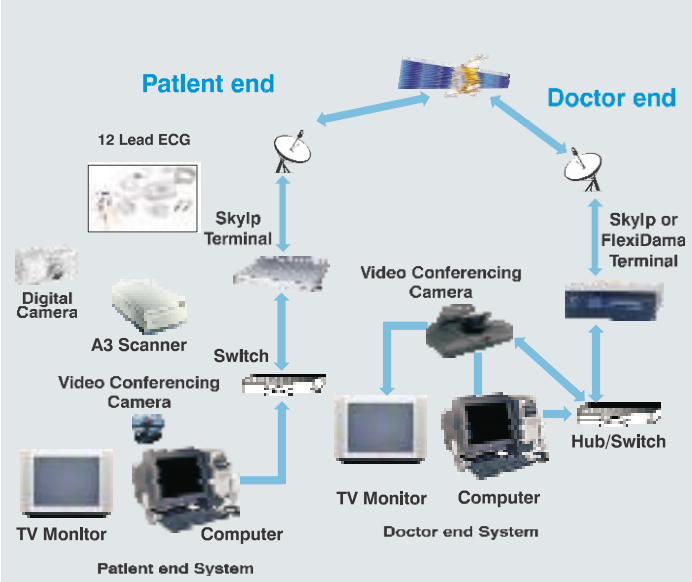
ECHO spa is the platform for reporting of teleconsultation. In this platform, all the diagnostic reports are recorded.



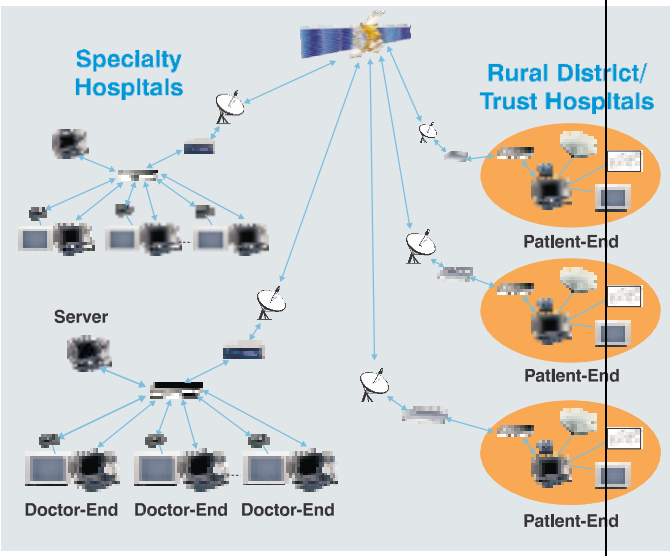
MODE OF CONNECTIVITY :

- Point to Point System - One patient end connect to One Specialist Doctor within the hospital
- Point to Multi Point System - One patient end at a time connect to any of the specialist Doctors'end within the hospital
- Multi Point to Multi Point System - Several patients' end simultaneously connect to different Doctors'end at different hospitals at different geographical locations

POINT TO POINT SYSTEM



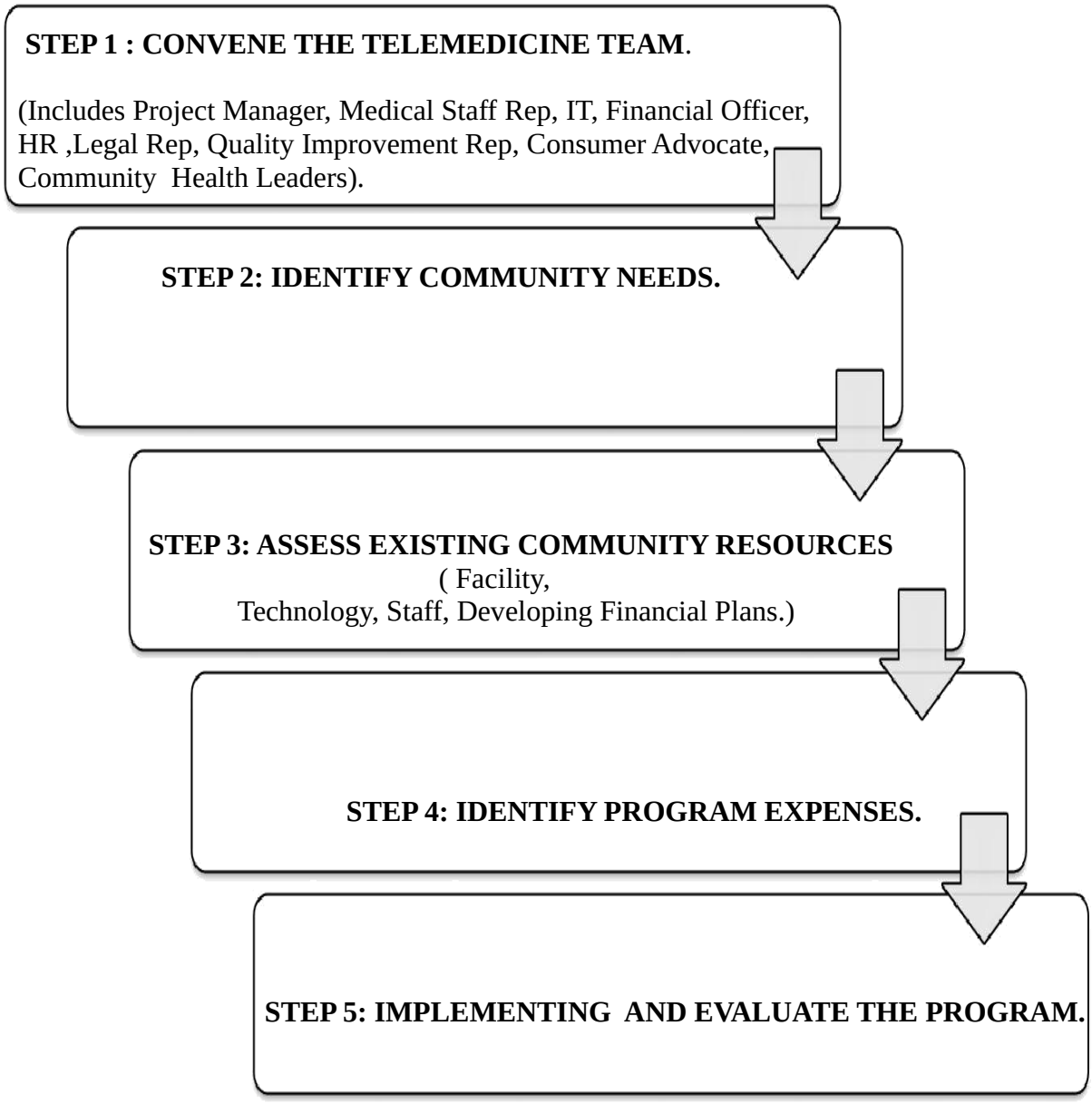
MULTIPOINT SYSTEM



COMPARITIVE ANALYSIS OF VHealth 365 (A PLATFORM OF TRS SOLUTIONS) WITH NEUROSYNAPTIC COMMUNICATION:

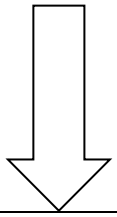
FEATURES	**TELERADIOLOGY SOLUTIONS**	**NEUROSYNAPTIC COMMUNICATION**	**PRODUCT COMPARISION MATRIX (SCALE – 1 TO 5)**	
Bandwidth	1 mbps	32 kbps	4	3
Telemedicine platform	V Health 365	ReMeDi	4	4
System Highlights	Not integrated with HMIS	Integrated with HMIS	3	4
Means of consultation	On demand video consultation	On demand consultation	5	4
Workflow	.NET	No information	5	-
Audio/Video	Web RTC	No information	5	-
Means of Installation	No installation	No installation	5	5
Technology	STUN and TURN	No information	5	-
Technology	Cloud based	Cloud based	5	5
Marketing	B to C Marketing	No information.	5	-
Data protection	SSL encrypted	No information	5	-
User friendly system	User friendly	Comprehensive and User friendly EMR	4	4

6.STEPS OF DESIGNING OF TELEMEDICINE PROGRAMME :

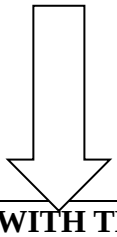


7.STEPS OF IMPLEMENTING TELEMEDICINE IN A HOSPITAL :

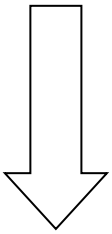
STEP 1 - **CONDUCT MARKET ASSESMENT**



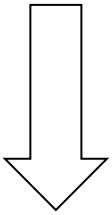
STEP 2- **CONDUCT A SELF ASSESMENT**



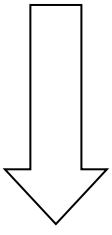
STEP 3- **ALLIGN GOALS WITH THE ORGANIZATION MISSION**



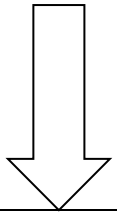
STEP 4- **DEVELOP A TIMELINE FOR IMPLEMENTATION**



STEP 5- **GAIN ADMINISTRATIVE SUPPORT**



STEP 6- **TRAIN PROVIDERS**



STEP 7- **START SIMPLE AND FINALLY INTEGRATE TM WITH OTHER SYSTEM.**

8.STAKEHOLDER ANALYSIS :

Project Stakeholder	Description
Chief Executive Officer	Assigning of the project and providing guidance all throughout the work.
Project Manager	Execution of the project, Guided about project management tactice, prepre the project charter, GANTT Chart, PERT Chart,WBS, Prepare Project charter.
Project Assistance	Guided about the Telemedicine , its platform (v health 365), Workflow.
Human Resource	Hiring requirement, Training, Brief introduction about the organization.
IT department	Technology used in telemedicine, its workflow with practical live.
Sales department	Marketing tactics.
Developer:	Developing the telemedicine platform, and resolving issues related to it.
Medical co-ordinator, Doctors and Physicians	Examining the patients by telemedicine.
End users	Give feedback.

9.PROJECT CHARTER :

<table>
<tr><td>Project Title:</td><td>Study about telemedicine and comparative analysis of technology at
Teleradiology Solutions.</td><td>Key Success Factor</td><td>Person Approving</td></tr>
<tr><td>Project Sponsor:</td><td>Teleradiology Solutions, Whitefield, Bangalore</td><td rowspan="4">Successful.
Got new creative ideas of telemedicine.

.</td><td rowspan="4">Dr. Sunita
Maheshwari
(CEO of Teleradiology Solutions)</td></tr>
<tr><td>Date Prepared:</td><td>9th March, 2016</td></tr>
<tr><td>Project Manager:</td><td>Mr. Harish T. S.</td></tr>
<tr><td>Project Customer:</td><td>Teleradiology clients.</td></tr>
<tr><td>Project Purpose:</td><td>Study about telemedicine platform used in Telerad, its workflow and challenges, to provide cost effective and instant better healthcare services to rural areas.</td><td>Acceptance Criteria:</td><td>Stakeholder Analysis, Comparative analysis of technology of telemedicine.</td></tr>
<tr><td colspan="2">Project Description: The telemedicine project aims to give more user friendly services to the customer. It will be technology leverage between the doctor and the patients. It is helpful to understand various technology and creativity in telemedicine to provide better healthcare services in rural areas.

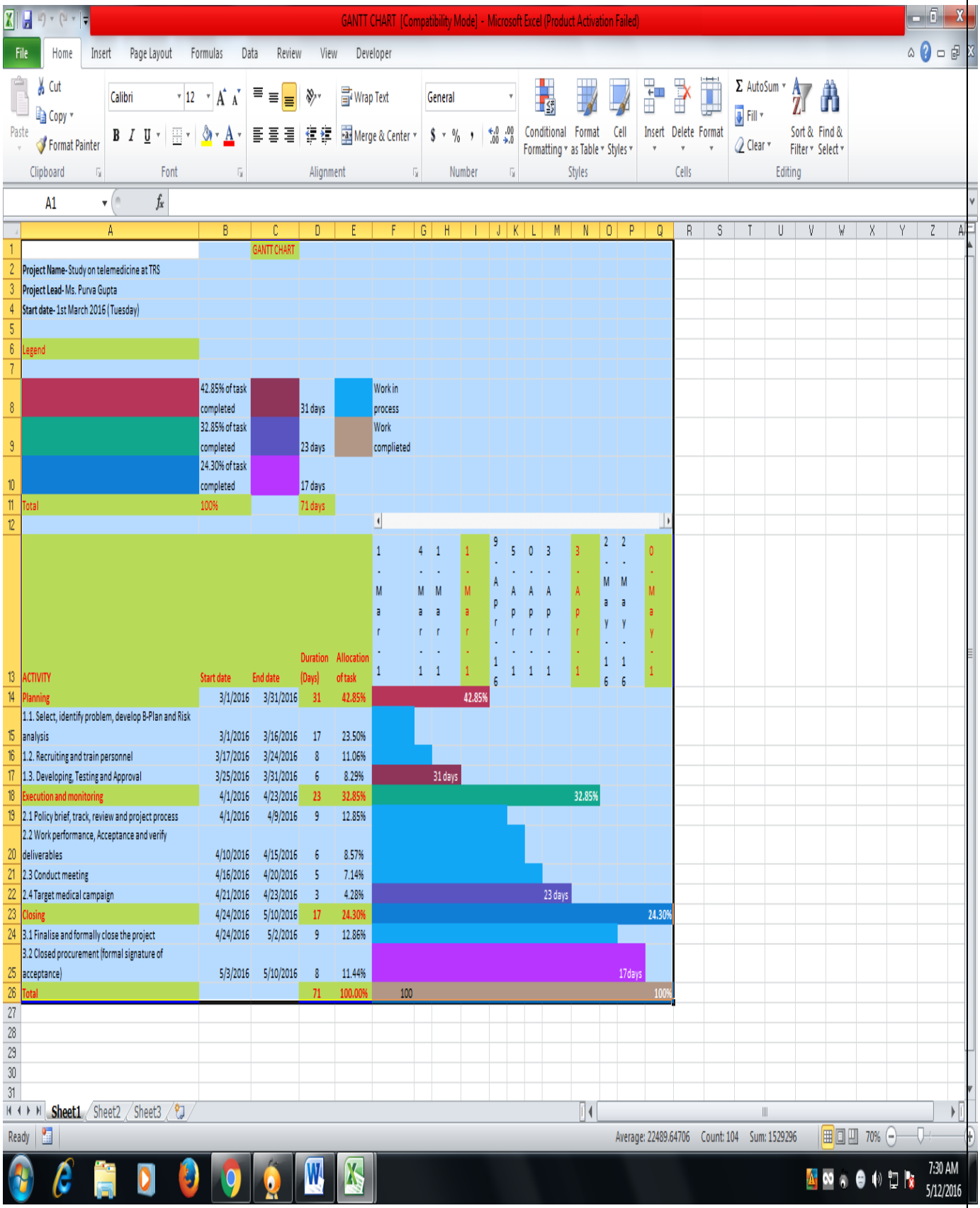
-</td><td colspan="2">Project Manager Authority Level
a. Staffing Decisions: Yes
b. Budget Management and Variance: Yes
c. Technical Decision: Yes
d. Conflict resolution: Yes
e. Escalation Path for Authority</td></tr>
</table>

Project Requirement:	Internal Escalation	External Escalation
Stakeholder listing, service provider, matching of the technology, security, Government and Ethical approval.	Executive Project Manager Administration Team leader	Account Executive Account manager Project manager Team leader
Summary of Budget: Not disclose		
Initial Risk: Cost of the application service, bandwidth Compatibility: With users device, network	Approvals Project Manager	

10.REQUIREMENT DOCUMENTATION :

Stakeholder	Requirement	Category	Priority	Acceptance Criteria
Chief Executive Officer	Success of Project	I	High, High	I : Key Player High influence power and high interest in project. II: Meet their needs High influence power and low interest III: Least important Low influence and low interest IV: Show consideration Low influence and high interest in project.
Project Manager	Manage Project	I	High, High	
Project Assistance	Telemedicine workflow and platform.	III	High, High	
Finance & Accounts Department	Cost Benefit	II	High, Low	
IT department	Technology guidance	I	High,,High	
Sales Department	Manage Project	IV	Low, High	
Marketing Team	Launch	IV	Low, High	
Devolper	Dev. TM platform and resolves issues.	I	High, High	
IT department	Support	II	High, Low	
Medical co-ordinator	Diagnosis and treatment.	I	High, High	
Doctors	Diagnosis the patient using TM technology.	I	High, High	
Physicians	Diagnosis	I	High, High	
Operation owner	Accessibility	III	Low, Low	
End users	User friendly	III	Low, Low	

11.GANTT CHART :



12.TECHNOLOGIES OF TELEMEDICINE DISCOVERED ABROAD :

There are several wireless healthcare researches and projects that have been designed to provide continuous patient monitoring in hospital and during disaster management, real time collection of medical data in-house assisted-living as well as mobile monitoring. The following section gives an overview and comparison of the exiting architectures of wireless medical sensor networks. These include MEDiSN, CodeBlue, MASN, AlarmNet and MobiCare.

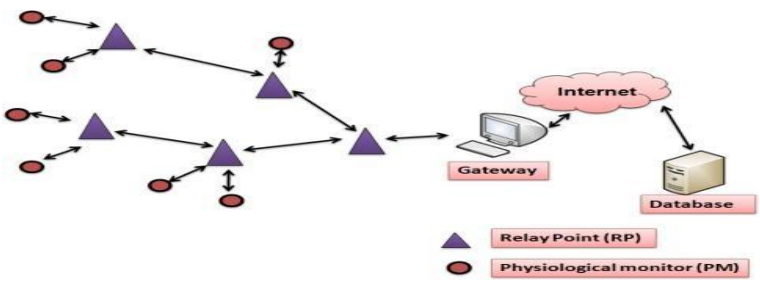
Some of the existing architecture of telemedicine discovered abroad are :

DISCOVERED AT	**NAME OF THE TECHNOLOGY DISCOVERED FOR TELEMEDICINE**
John Hopskin University,	MEDiSN
Rochester Institute of Technology, USA	MASN
Harvard University Sensor Lab	Code Blue
University of Virginia	AlarmNet
University of Wisconsin, Medison, USA	MobiCare

Let us study them in detail, one by one :

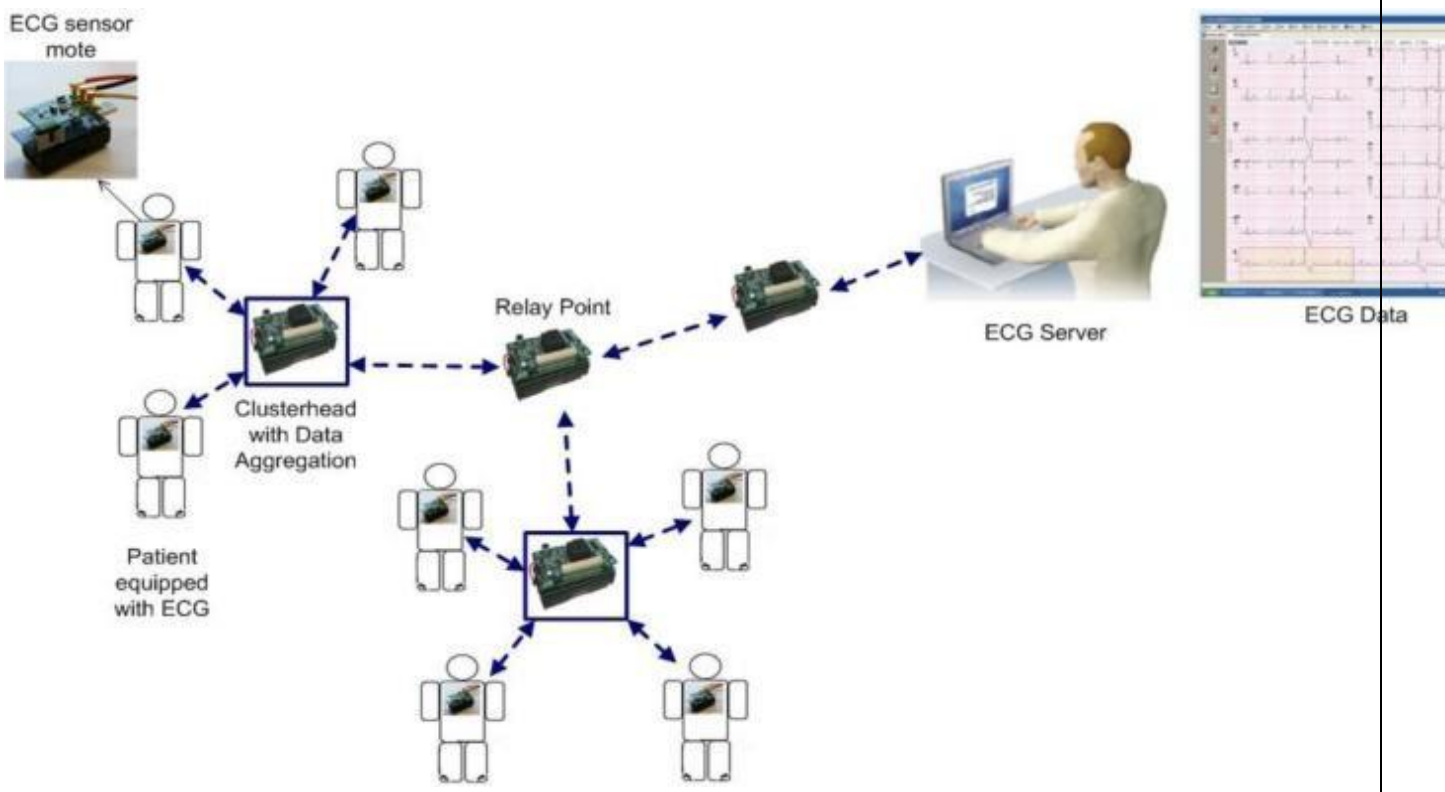
4.1. MEDiSN

MEDiSN was designed at John Hopskin University, especially for patients‟ monitoring in hospital and during disaster events. It consists of multiple Physiological Monitors (PMs) which are battery-powered motes that are equipped with sensors for measuring patients‟ physiological data such as ECG, pulse rate, blood oxygen level etc. PMs temporarily store collected measurements and transmit them after encrypting and signing them. MEDiSN architecture incorporates distinct Relay Points (RPs) which self organize into bidirectional wireless trees connecting the PMs to one or more Gateways. Traffic flowing in both directions is protected using hop-by-hop retransmissions that counter the effects of packet collisions and corruptions. PMs can be mobile while the RPs are stationary in fixed positions. RPs can use the electricity grid in hospital deployments, while in disaster events batteries can power RPs for multiple days.The Figure below shows an illustrative overview of MEDiSN architecture.



1.1. MASN

The robust Medical Ad hoc Sensor Network (MASN) is a practical hardware and software platform developed at Rochester Institute of Technology, USA. It was designed to perform real-time collection of medical data. MASN adopts a reliable cluster-based communication scheme as its routing protocol for transmitting data. MASN consists of large amount of wireless ECG communication units. Each unit is called a „„mobile platform"". These mobile platforms are essentially the wearable ECG devices that would be placed on the patients in order to offer continuous monitoring of the patients" vital signs . The Figure below shows an illustrative overview of MASN architecture.

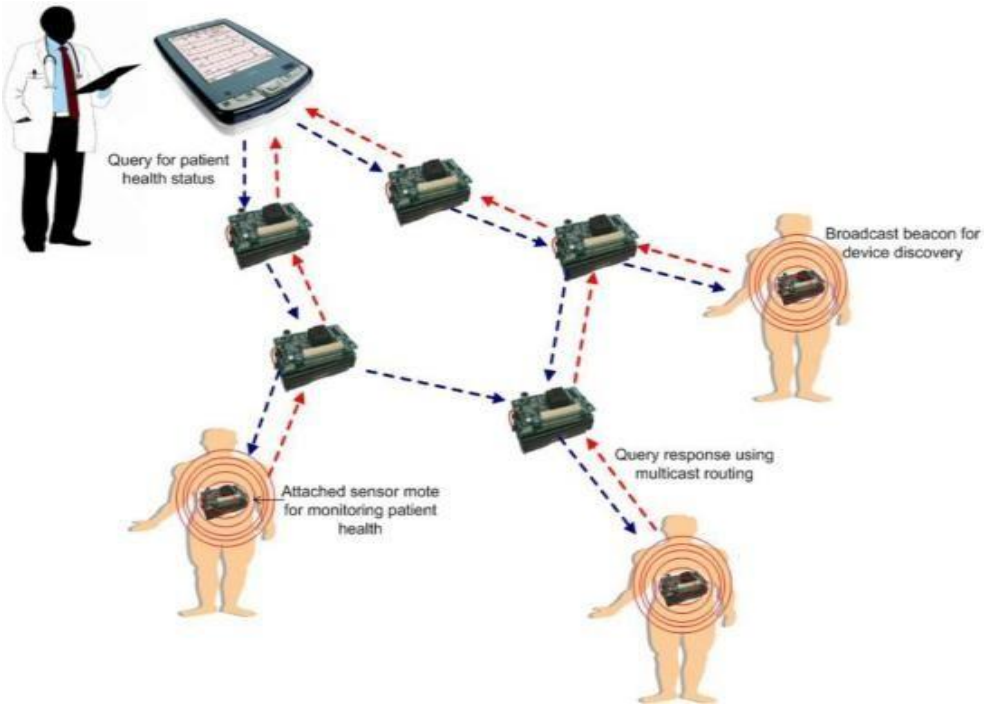


MASN ARCHITECTURE

1.1. CODE BLUE

CodeBlue is a research project on medical sensor network developed at the Harvard University Sensor Lab. In this architecture, medical sensors are placed on the patient"s body to sense medical data and transmit it wirelessly to the medical care givers for further analysis. It is based on a publish/subscribe routing framework, allowing multiple sensor devices to relay data to all receivers that have registered an interest in that data. This communication model fits naturally with the needs of medical applications where a number of caregivers may be interested in sensor data

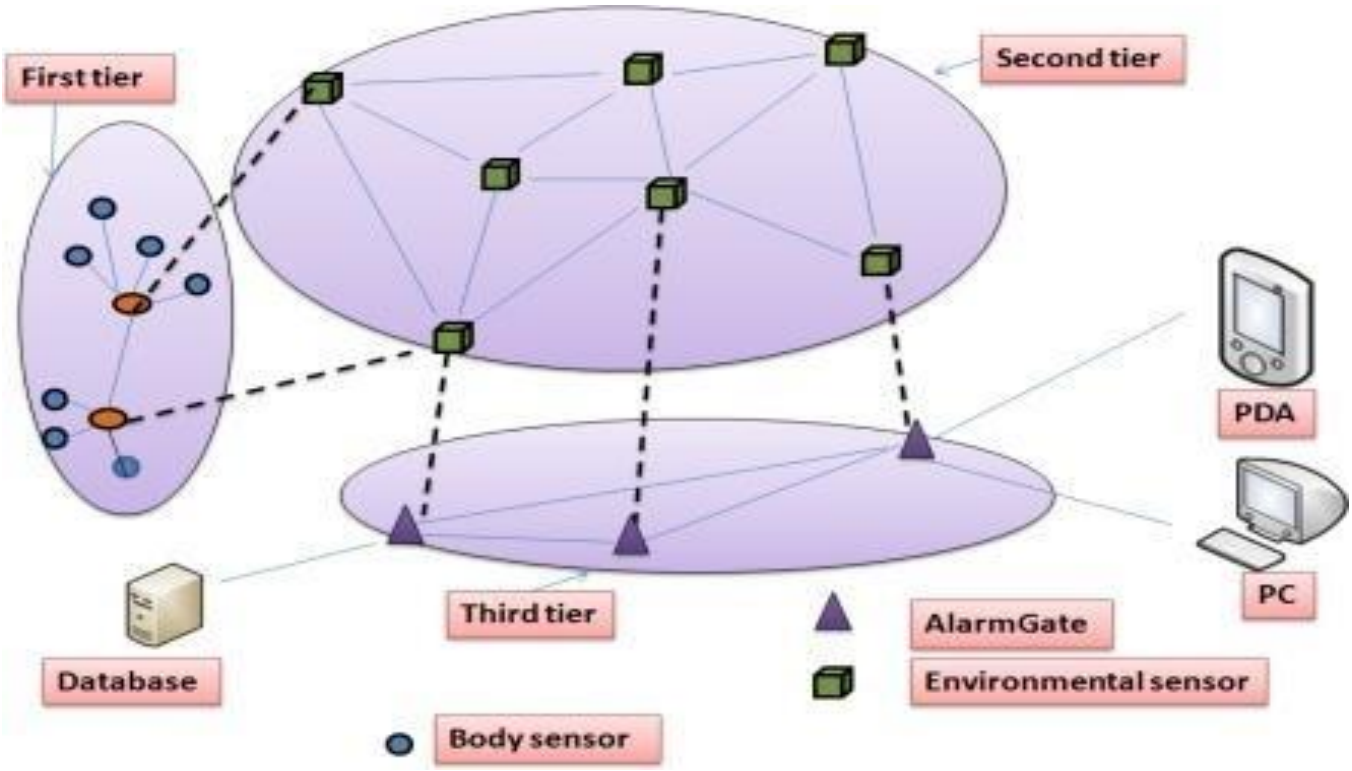
from overlapping groups of patients.The Figure below shows an illustrative overview of CodeBlue architecture



CODE BLUE ARCHITECTURE

1.1. ALARMNET

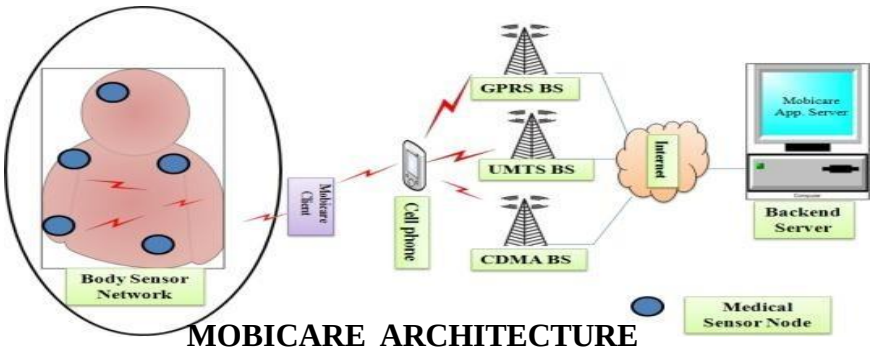
A Wireless sensor networks for assisted-living and residential monitoring was developed at the University of Virginia, integrates environmental and physiological sensors in a scalable, heterogeneous architecture. A query protocol allows real-time collection and processing of sensor data by user interfaces and back-end analysis programs. The mentioned Figure shows an illustrative overview of AlamNet architecture.



ALARMNET ARCHITECTURE

1.1. MOBICARE

MobiCare is a remote wireless patient monitoring system designed at the University of Wisconsin, Madison, USA. It consists of three important building blocks: a body sensor network (BSN) consisting of wearable sensors and actuators with wireless inter-connections; a BSN Manager (also called MobiCare client) that connects the BSN to an „always-on" wide-area communication interface using wide-area cellular wireless link; and back-end infrastructure support (MobiCare servers) at healthcare providers side to implement necessary healthcare functionalities. The mentioned Figure shows an illustrative overview of MobiCare architecture.



MOBICARE ARCHITECTURE

ARCHITECTURE COMPARISION :

Parameter	MEDiSN	CodeBlue	MASN	AlarmNet	MobiCare
Operational Environment	The operational environment constitutes a Dedicated Wireless Sensor Network in Hospital Deployment with RPs and PMs	CodeBlue prototype was validated on 30 Node Ad Hoc Sensor Network Test-Bed, demonstrating its scalability and robustness	Medical Ad Hoc Sensor Network deployed in Nursing homes	Scalable and heterogeneous architecture integrating ESs and PMs in assisted-living and home environment	A remote wireless patient monitoring consisting of BSN, MobiClient and MobiCare Server.
Supported Application	Applied in medical emergency detection for patients monitored in hospitals and disaster scenes.	It was applied in Medical Care and Disaster management	Real-time remote cardiac patient monitoring and collection of ECG Data	Patient health monitoring in the assisted-living and home environment	Wide-Area Mobile patient monitoring
Reliability Mechanism	Message oriented Middleware (MOM), which was JMS-based has been selected to run on the Gateway. While the back-end server is responsible for storing, routing, and retransmitting messages.	CodeBlue was designed to provide for reliable transmission of critical data through content-specific prioritization and dynamic scaling of transmission power.	Enhanced cluster-based, energy-aware data transmission has been proposed, where the ECG data are reliably relayed to the sink in the form of aggregated data packets.	Three-Tier Architecture with Mobile Body network, Emplaced Sensor Network and IP Network	MobiCare designed a secure reliable dynamic code update functionality that is implemented as part of each MobiCare client and sensor device

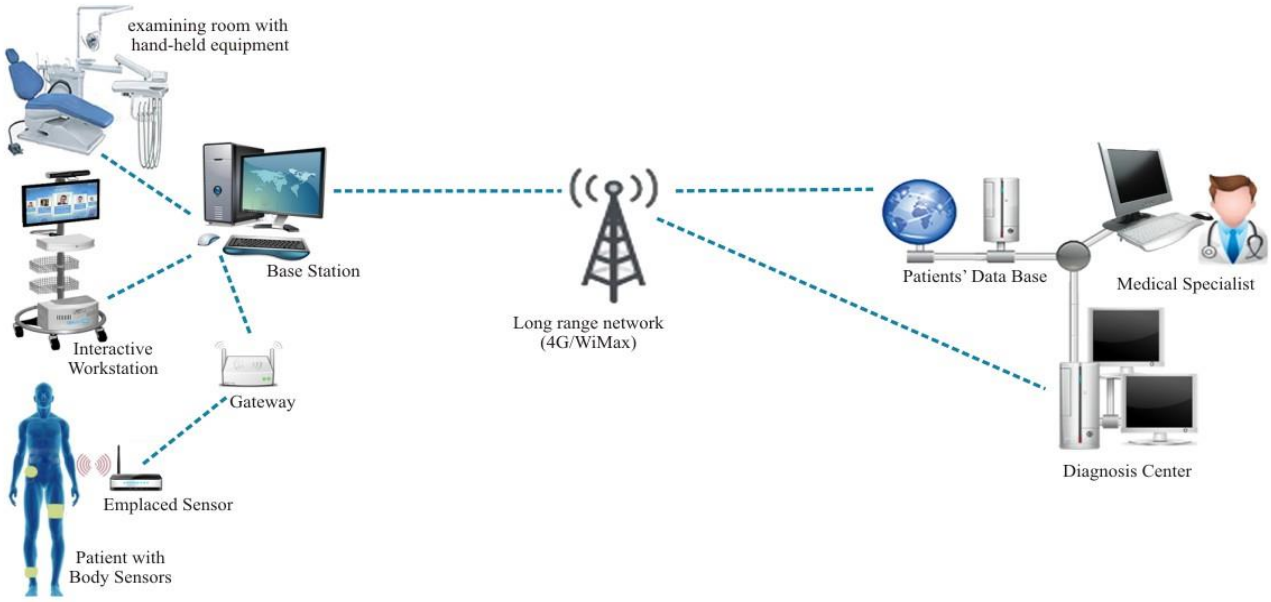
Scheme for Energy Efficiency	The division of functionality between acquiring and relaying data enables PMs to achieve low energy consumption, through duty cycling their radios	CodeBlue uses Berkeley Mica2 sensor nodes which include a low-power, single-chip radio with batteries that will last for up to a week of continuous running. Employing duty-cycling, the device can drop to a very low power sleep state of 10μA	MASN Proposed an Energy-aware cluster formation scheme using event triggered energy level determination of sensor nodes	Context-aware and Open Power Management Scheme (COPM) module was designed, where some nodes are plugged into the wall and others operate on batteries	Propose the use of low-power, low-frequency wireless sensor developed at Harvard University using (using the Berkeley MICA2 mote)
Routing Methodology	Many-to-one and one-to-one communication between PMs and RPs. Collection Tree Protocol (CTP) was also used by the RPs	Based on the Adaptive Demand-Driven Multicast Routing (ADMR) protocol in which sensors publish relevant data to a specific channel and end-user devices subscribe to channels of interest	Used Intra-Cluster and Inter-Cluster Data Relay routing scheme	Single hop at the first Tier, multi-hop at the second tier (i.e., Shortest-path-first routing protocol)	Application layer standard HTTP POST protocol
Techniques for Mobility Support	During mobility PM sends its data to the stationed RP that shares the best link with it	A tracking system named MoteTrack which operates in an entirely decentralized, robust fashion, provide good location accuracy	MASN cannot achieve real-time data collection (delay > 10 s) if the users move quickly such as at 30 mph	Emplaced Sensors (ES) maintain connections with mobile body as they move through the living space	Used always-on wide-area cellular wireless communication interface

UWB AS A SOLUTION

The real-time video conferencing makes telemedicine application a high bandwidth hungry application of WMSN. UWB is a recently approved low power and high speed, short- range wireless communication standard based on IEEE 802.15.3, oriented to high-bandwidth multimedia links . A comparison between UWB and Zigbee, another promising technology for wireless sensor network applications is presented in the Table.

Parameter	UWB	Zigbee
IEEE Specification	802.15.3	802.15.4
Typical Range (Meters)	10	10
Power Consumption	Very little	Low
Spectrum (GHz)	3.1 – 10.6	2.4
Bandwidth	High	Low
Data rate	110-480 Mbps	20 – 240 Kbps
Channel bandwidth	500MHz	0.3MHz-2MHz
Energy efficiency	Very High	Low
Data protection	32-bit cyclic redundancy check	16-bit cyclic redundancy check
Typical Applications	Industrial control and monitoring, sensor networks, etc.	Streaming video, home entertainment applications

2. PROPOSED 4G ARCHITECTURE :



WORKING OF PROPOSED 4G ARCHITECTURE FOR TELEMEDICINE:

The proposed architecture supports heterogeneous networking. Using UWB network, it forms an island of sensors (WMSN), and these different sensors collect the required data from the patient depending on the telemedicine type (i.e. live, store and forward, monitoring telemedicine). The medical data is processed (compressed, encrypted, etc) and then it is sent to the gateway (the only IP addressable component of the WMSN) and it"s also stored locally in the storage server. The gateway provides the connectivity and integration with the WiMAX network. The WiMAX network transmits the data over a long communication range to the specialist in another area. The data is received at the specialist side, the data is checked if it"s valid and then after it can be processed (decrypted, decompressed), Then the data can be analyzed and then used for diagnosis and treatment.

The architecture offers an automatic process for accomplishing tasks.

 The first feature is the monitoring vital signs of a patient with a chronic disease are collected periodically, processed and saved into the patient"s medical record locally. For some special cases, for example a stroke patient, a camera is also used in monitoring. If the readings recorded deviates from the safety margin, an alert will be sent to the doctor. A biometric scheme will also be used to identify the patient and authentic data.

 The second feature of the system is the live telemedicine; Face to face consultation is carried out using the interactive workstation, the physiological data of the patient is measured on real-time from the patient for analysis using wireless hand held devices like digital otoscope, digital

stethoscopes, ophthalmoscope, laryngoscope, nasolaryngoscope, then the appropriate treatment can be recommended by the specialist.

13.ADVANTAGE/BENEFITS OF TELEMEDICINE :

'Telemedicine' is an innovative system of healthcare provision from long distance utilizing the telecommunication and modern information technologies. Though this concept arrived in 20th century with telephone & radio, today diverse advanced technologies, including, video telephone, latest tele-medical devices, mobile cooperation technology, diagnostic methods, distributed client or server applications, etc. have upgraded the quality and extent of Telemedicine service.This system has eliminated distance barriers to deliver clinical healthcare. Some major advantages and disadvantages ofTelemedicine have been stated below:

1.1. ADVANTAGES OF TELEMEDICINE :

The various advantages of telemedicine are :

- Many patients feel uncomfortable to go to hospital or doctor-chamber. This system creates communication among patients & healthcare professionals maintaining convenience & commitment. Moreover, through Telemedicine medical information and images are kept confidential and safely transferred from one place to another. So, people can believe this system and feel comfort to seek help from it.
- It saves lives in the emergency situations, while there is no time to take the patient at a hospital.
- In many rural communities or remote places or post-disaster situations, consistent healthcare is unavailable.Telemedicine can be applied in such places or situations to provide emergency healthcare.
- This system is useful for the patients residing in inaccessible areas or isolated regions. Patients can receive clinical healthcare from their home without arduous travel to the hospital.
- Modern innovations of information technology such as, mobile collaboration has enabled easy information sharing and discussion about critical medical cases among healthcare professionals from multiple locations.
- Telemedicine has facilitated patient monitoring through computer or tablet or phone technology that has reduced outpatient visits. Now doctors can verify prescription or supervise drug oversight. Furthermore, the home-bound patients can seek medical-help without moving to clinic through ambulance. Thus, cost of health care has been reduced.

- This system also facilitates health education, as the primary level healthcare professionals can observe the working procedure of healthcare-experts in their respective fields and the experts can supervise the works of the novice.
- Telemedicine eliminates the possibility of transmitting infectious diseases between patients and healthcare professionals.

DISADVANTAGES OF TELEMEDICINE :

The various disadvantages of telemedicine are:

- The overall cost of telecommunication system, especially data management apparatus and practical training of medical professionals is great.
- Virtual clinical treatment decreases human interaction among the healthcare professionals and patients that increases the risk of error in clinical services, if the service is delivered by inexperienced professional. Moreover, confidential medical information can be leaked through faulty electronic system.
- *Telemedicine* might take longer time for the difficulties in connecting virtual communication due to low internet speed or server problem. Moreover, this system cannot provide immediate treatment, such as, antibiotics.
- Low quality of health informatics records, like, X-ray or other images, clinical progress reports, etc. run the risk of faulty clinical treatment.
- *Telemedicine* system requires tough legal regulation to prevent unauthorized and illegal service providers in this sector.

14.CHALLENGES FACED IN TELEMEDICINE :

There are various challenges faced in telemedicine. Some of them are :

1. **ADMINISTRATOR RESISTANCE** : Seen as costly, can be hard to define ROI.
2. **PHYSICAL RESISTANCE**: Dont want to be technology dependent, don't want to be trained.
3. **INFRASTRUCTURE NEEDS**: Needs strong platform and internet connecion. (Broadband connectivity)
4. **SUSTAINABILITY REQUIREMENT-** Maintenance, Cost and Reimbursement is a big question.
5. **MANPOWER**
6. **COVERAGE AND PAYMENT.**
7. **LOW ELECTROMAGNETIC RADIATION** : Low electromagnetic radiation is one of the notable features o that makes it viable for telemedicine application. As a result, it has

proved to be harmless to human body and has almost no detrimental effect on the environment.

8. **COEXISTENCE AND REDUCED INTERFERENCE** : At the same time UWB can coexist with other wireless technologies due to its low power spectral density. This feature prevents interference on other wireless services.
9. **TRACKING HIGH BANDWIDTH DEMAND** : Telemedicine application involves real-time video conferencing between the patient and the specialist to allow proper diagnosis, the video conferencing requires a high bandwidth for multimedia streaming, and this demand can be met by UWB technology. As seen in the above table, the data rate of UWB is 2000 times higher than that of Zigbee. To maintain acceptable QoS, Zigbee cannot support many devices due to the low data rate. For example in , 24Kbps was taken as the required data rate for ECG monitoring application, but Zigbee can at best provide 240Kbps, implying that a maximum of 10 devices could be connected. Again, at least 640Kbps is required to allow high quality diagnostic video stream (MPEG-4 format) and a minimum 768 kbps for Normal diagnostic video(MPEG-2 format), these data rates cannot be provided by Zigbee devices, UWB can support many devices using the "peer to peer" mechanism while utilizing the available data rates. This makes UWB a viable solution for high bandwidth demand in live telemedicine application.

15.CONCLUSION :

Telemedicine endeavour is expanding its outreach and has the potential to open up new frontiers for facilitating rural healthcare in India. Due to the untiring efforts of various departments like the Department of Space and the Department of Information Technology, State Governments, NGOs and Private and Corporate Hospitals/Agencies, the majority of the rural population all over the country will stand to benefit from Telemedicine Technology that can usher in a revolution for transforming the face of Healthcare in India.

Did the comparative analysis of technology used in telemedicine of the two organization i.e Teleradiology Solutions, Bangalore and Neurosynaptic Communication pvt ltd, Bangalore successfully and compared each of the parameters using comparability matrix (Rating 1 to 5). Teleradiology Solutions uses VHealth 365 telemedicine platform whereas Neurosynaptic Communications used ReMedDi TM plateform. .NET workflow, Web RTC, STUN and TURN technology is used in Teleradiology solutions, whereas no information was provided in Neurosynaptic communication. both the TM platform are user friendly and cloud based and uses store and forward mechanism.

Prepared stakeholder Analysis, Project Charter, Requirement documentation,GANTT chart and WBS of the task performed.

Also, studied various innovations of Telemedicine abroad. MediSN (Discovered at John Hopkins University), MASN (Discovered at USA), Code Blue (Discovered at Harvard University), AlarmNet (Discovered at University of Virginia), Mobicare (USA).

This gave broad spectrum of innovations of Telemedicine and Telehealth.

Thus, Telemedicine can enlarge the gap between life and death and can extend quality Healthcare to the needy and the under privileged rural, semi rural and urban population at large.

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PROJECT 2 : DISCUSSION ARTICLE ON TELE- EEG

RESEARCH ARTICLE

Utility of Tele EEG Reporting: An Indian to African experience

ABSTRACT

Background: *The diagnostic study of EEG is one of the major difficulty. This study aims to find the utility of Tele EEG reporting: An Indian to African experience. At present, there is difficulty to recruit doctors to train in clinical neurophysiology which cases difficulty in delivering services. To overcome this, Tele EEG service was established to record and report EEG at an African hospital, which was unable to attract a resident clinical neurophysiologist.*

Materials and Methods: *EEG data of 1782 patients were sent from a tertiary care hospital to Tanzania to neurologists in India for analysis and interpretation. The EEG's were recorded in digital format and placed on web server to be ready by clinical neurophysiologist in another part of Africa. This is done using ECHOSpa software and email but a backup system was established using other system with suitable encryption. A total of more than 1000 EEGs were reported in between April 2014 to Dec 2015 for patients of all ages. All cases were reported within 24 hrs of recording. The back-up system was used in 60 cases. 30 patients data was studied and analysed . Quantitative EEG characteristics were classified into various categories hemodynamic parameter, Type of surgical operation, Biospectral characteristics, Type of cases (Normal/Abnormal). Their sensitivity, specificity and accuracy in determination of depth of anaesthesia were yielded by comparing them with the recorded reference signals in awake, sleep anesthesia,and the frequency of waves were recorded.*

Results: *Abnormal result i.e. positive case 63.34% cases has been reported, 30% cases are normal i.e. negative case, 8% was found out to be suspicious. Awake EEG and Sleep EEG were observed in the patients.*

Conclusion: *Tele-EEG is a feasible, secure, timely and effective method of providing an EEG service to hospitals which cannot recruit a resident clinical neurophysiologist.*

Key words: *Electroencephalography, PACS, HL7, DICOM, Modality.*

INTRODUCTION

Electroencephalography is a medical imaging technique that reads scalp electrical activity generated by brain structure. The **electroencephalogram (EEG)** is defined as electrical activity of an alternating type recorded from the scalp surface after being picked up by metal electrodes and conductive media. The EEG measured directly from the cortical surface is called as **electrocortiogram**.

ADVANTAGES OF TELE EEG

REPORTING:

Various advantages of reporting of EEGs remotely are:
The EEG investigation of epilepsy is a discipline in which the use of telemedicine of likely to be of particular value, on account of the following characteristics:

1. In most countries, EEG facilities are widely dispersed.
2. Patients may require investigation at locations re-mote from an EEG laboratory, for instance in the operating theatre, home, school or workplace to monitor seizures in a natural environment.
3. Expertise in EEG interpretation is not widely available and particular knowledge of the EEG in epilepsy tends to be confined to special centres.
4. Immediate interpretation may be required, for instance in status epileptics, during electrocor ticography and often to direct the conduct of intensive monitoring.
5. Electroencephalography is a small discipline and its practitioners often work alone or in small groups. audit, clinical governance, research, and continuing medical education, therefore, require collaboration and joint review of records between centres.
6. EEGs are available as digitised signals, which can easily be transmitted by telecommunications systems.

METHODOLOGY

This is longitudinal study based study on general population which included subjects aged between 14 days -64 years old. The record of 1000 patients of Tanzania were analysed , 30 patients data was selected randomly by using simple random sampling technique..
Data collection took place from the period of two years..The data was analysed and results were interpreted based on the various parameters, such as demographic details such as (patients age, gender,date of birth) hemodynamic parameter, type of surgical operations, biospectral characteristics, Type of cases (normal/ abnormal).

TECHNOLOGY USED:

ECHOSpa software Version 3.10.9.1 was used to input the data of the patients. This software is unique and revolutionary radiology workflow solution enhancing user experience and higher productivity gain.

In this software, demographic details(such as patients age, gender, nationality, date of birth) name of the hospital, physician, Modality, Procedure recommended, UHID of the patient,criticality of image were reported and recorded. .As a result, through order entry and worklist, reports were generated.

It is integrated with PACS and DICOM viewer. EEG files are sent to well qualified and trained Neurophysiologist in India for interpretation. The reports are recorded and digitally transmitted to the sending hospital/clinic through a secure portal. Apart from software, various equipments are required.

i) EEG synchrous video recording.7

These are:

a) 32 channel EEG.
b) Secure web cam connected with microphone.
c) PC with speakers.
d) USB powered with plug and play facility.
e) with high speed broadband 786 k down, 384 k upload.
f) Encypted software services.
g) H. 323 Video conference unit.
h) Medical grade.

Other configurations are:

1	CPU	i3 or i5 intel processor and supporting motherboard
2	RAM	4 GB
3	Disk Space	500 GB
5	NIC	10/100/100 MBPS - 2 Nos
6	Operating system	Windows 7 professional 32 or 64 bit
7	Browser	IE9 or later , Mozilla Firefox 13 or later Chrome 20.0 later
8	Input device	Standard keyboard & 3-button mouse with scroll wheel
9	Other software	IIS7,MVC 2.0,DICOM objects,.NET , Adobe Acrobat Reader
10	Internet Connectivity	2-4 MBPS broadband /leased line between the users

RESULT :

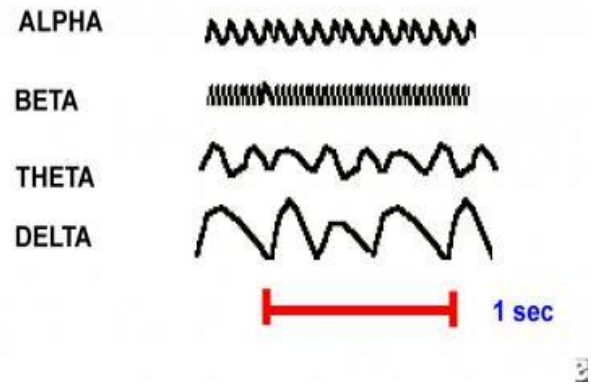
On studying the data of 30 patients, 47 % were males,53 % were females. 63% patients MRI was recommended, 37% patients have no recommendations. Biospectral parameter was also done. 83% was found have photic stimulation.over . 4% high voltage activity is observed over right hemisphere. 3% high voltage rythemic slow waves. 3% of the patients have sleep derived record, 3% of the patients high volume sharp over right hemisphere was observed, followed by 4% assymetrical over right hemisphere.
Abnormal result (i.e positive case) were observed , 17 % having lower epidemic threshold, 33 % have seizure disorder.
Awake EEG report- 9% of the patients having abnormal (epileptic encephalography), 25% awake EEG is within normal limit, 8% of the patients normal result was observed i.e negative awake EEG.
Sleep EEG report- 25% is within normal limit, 42% abnormal i.e positive case. 9% were found to have normal result i.e negative case. 8% have suspicious case, either abnormal or normal case, it cannot be diagnosed.

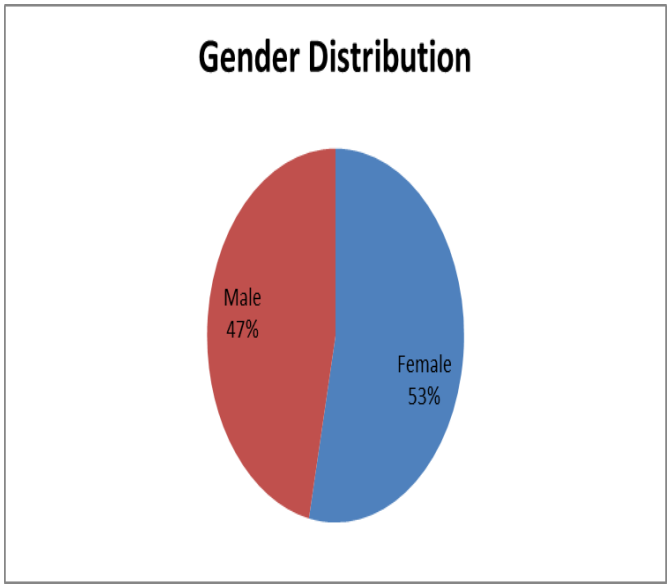
DISCUSSION :

Data of 30 patients were studied, based on various parameters.
Activity of waves were observed.(Alpha, Beta , Delta and theta).
Brain waves were clasiified as:
Alpha – 8 to 13 Hz.
Beta- >13 Hz.
Theta- 4 to 8 Hz.
Delta- 0.5 to 4 Hz.

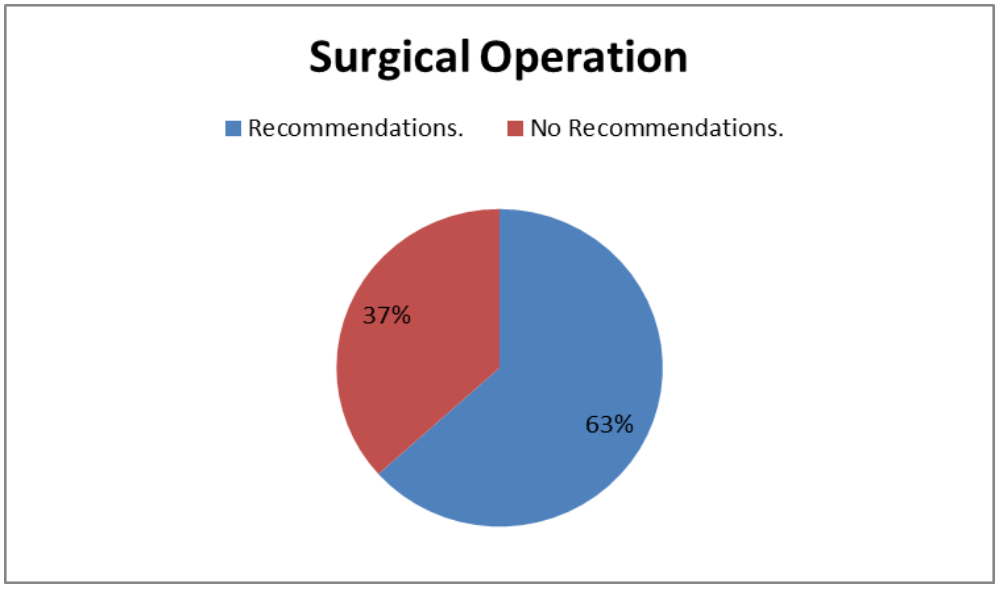
According to the given data, we can analyze that alpha was significant between posterior and central regions, in comparison to other regioins.
In relaxation or drowsiness, alpha activity rises and if sleep appears power of lower frequency band increases.
During normal state of wakefulness, with open eyes, beta waves are dominant.

However,A large amount of data recieved from even one single EEG recording presents difficulty for interpretation.

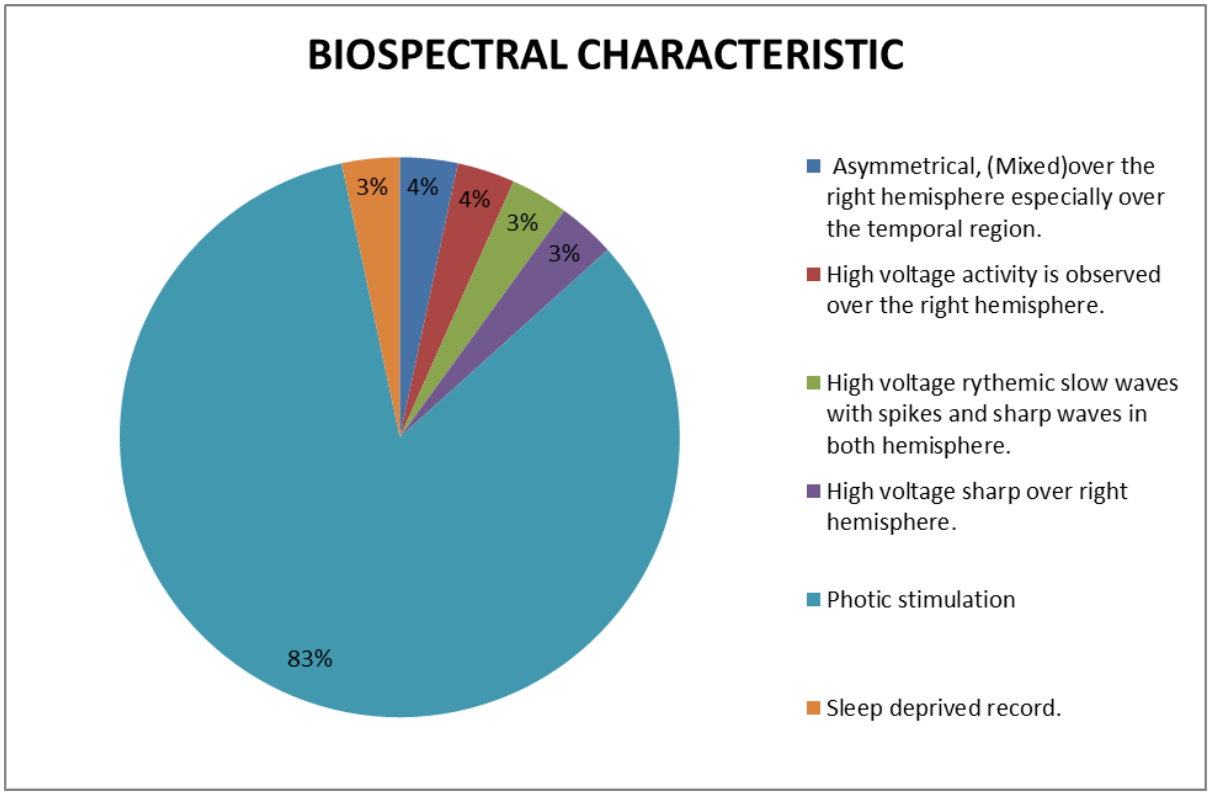




Patient's Gender	Total
Female	16
Male	14
Grand Total	30

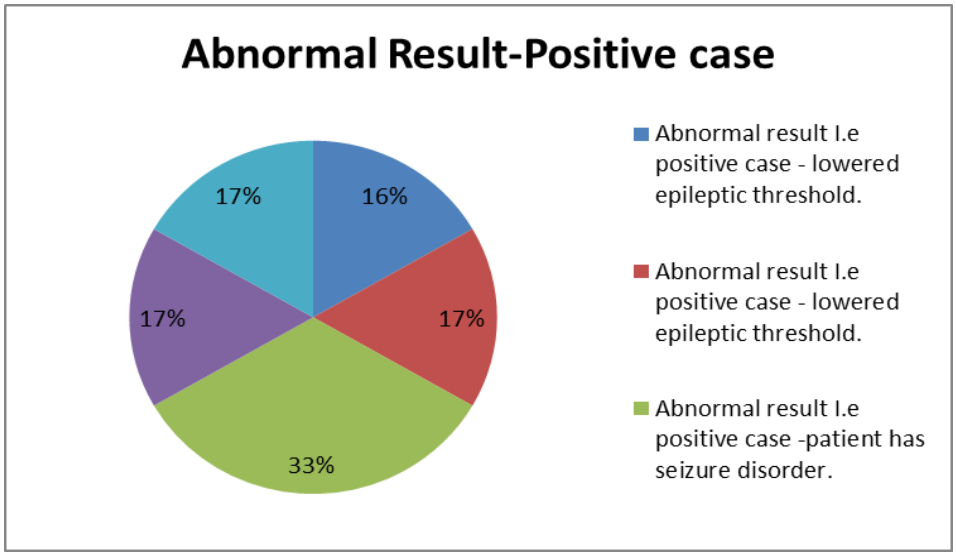


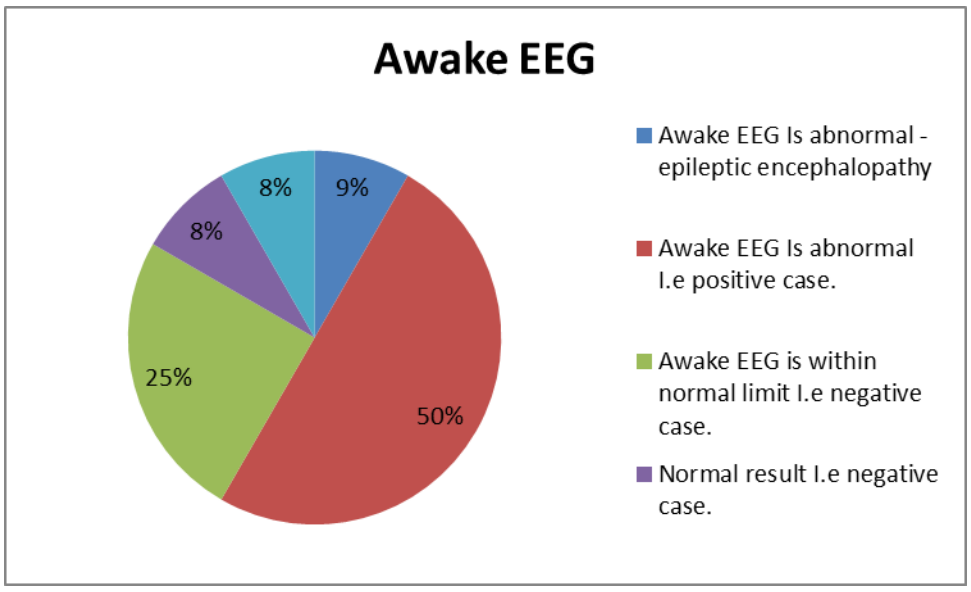
TYPE OF SURGICAL OPERATION (RECOMMENDED)	
Recommendations	19
No Recommendations	11

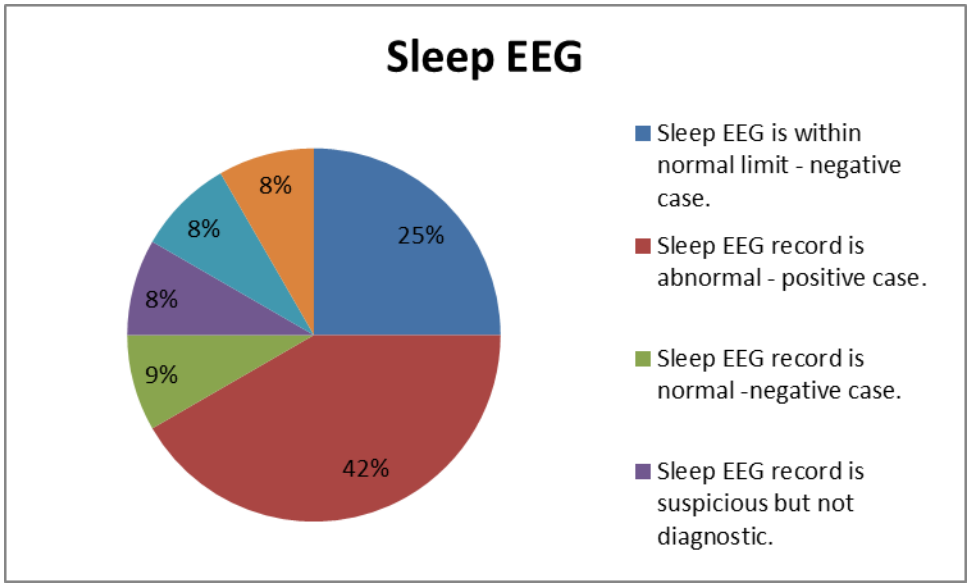


Biospectral Characteristics of Patients	**Total**
Asymmetrical, slow and is higher voltage over the right hemisphere especially over the temporal region.	1
High voltage activity is observed over the right hemisphere.	1
High voltage rhythmic slow waves with spikes and sharp waves in both hemisphere.	1
High voltage sharp over right hemisphere.	1
Photic stimulation	25
Sleep deprived record.	1
Grand Total	30

Type of Cases:







TYPE OF CASES (NORMAL/ABNORMAL)	Total
Abnormal result I.e. positive case (The findings suggest an encephalopathy, likely to be renal, The findings also suggest lowered epileptic threshold.	1
Abnormal result I.e. positive case (lowered epileptic threshold and liability for seizures).	1
Abnormal result I.e. positive case, since the patient has seizure disorder.	2
Abnormal result I.e positive case, since theta and delta slow activity wave was recorded.	1
Abnormal result I.e positive case.	1
Awake EEG Is abnormal (lowered epileptic threshold and liability for seizures. The findings also suggest an epileptic encephalopathy)	1
Awake EEG Is abnormal I.e positive case.	6
Awake EEG is within normal limit I.e negative case.	3
Normal result I.e negative case.	1
Severely abnormal I.e positive case(Child is highly prone to polymorphic seizures).	1
Sleep EEG is within normal limit I.e negative case.	3
Sleep EEG record is abnormal I.e positive case.	5
Sleep EEG record is normal I.e negative case.	1
Sleep EEG record is suspicious but not diagnostic.	1
Sleep EEG record is within normal limit. (Negative case)	1
Suspicious result. (Can be normal/ abnormal)	1
Grand Total	30

CONCLUSION

EEG is a direct measurement of the brain activity, it is a non-invasive technique, it has a high time-resolution; and it can be used in almost any environment. For these reasons, the EEG is an interesting method to investigate the brain activity related to presence research.

Tele EEG eliminates distance reduces traffic tie-ups for patients and helps ensure physicians have reliable information in a timely manner so they can offer their patients the best treatment possible method to investigate the brain activity related to presence research.

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ANNEXURE

DATA ANALYSIS OF TELE EG (PARAMETERS)

W.F. ID	MRN	Order Time	Report Comp Time	TAT	PATIENT	AGE	GENDER
2480361	03 78 88	4/2/2014 18:47	4/2/2014 20:28	01:40	Ms. Aisha	11 years	Female
2481769	29 50 45	4/3/2014 13:16	4/3/2014 17:58	04:41	Ms. Hassan Hajra	4 years	Female
2525281	04 12 72	4/29/2014 16:34	4/29/2014 18:25	01:50	Ms. Rhoda Tuvi	5 years	Female
2627057	04 68 88	6/23/2014 18:22	6/23/2014 20:00	01:38	Mr. Mlisi Said	36 years	Male
2698143	26 98 99	8/1/2014 18:21	8/1/2014 22:05	03:43	Ms. Mhina Mary	52 years	Female
2699728	05 11 13	8/2/2014 13:33	8/2/2014 16:26	02:52	Ms. Mbawala Inviolatha	02 years	Female
2780191	05 60 24	9/15/2014 18:34	9/15/2014 21:14	02:40	Ms. Kashitira Rosemary	1 year	Female
2799979	27 11 01	9/26/2014 18:36	9/26/2014 22:59	04:22	Ms. Mkopi Amina	46 years	Female
3045749	33 91 85	2/6/2015 13:49	2/6/2015 22:52	09:03	Ms. Kessy Luisa	2 years	Female
3312555	08 18 90	6/24/2015 17:29	6/24/2015 21:18	03:48	Ms. Sangu Yasra	2 years	Female
3354468	30 20 19	7/15/2015 17:43	7/15/2015 22:49	05:05	Ms. Hashim Mariam	12 years	Female
3484781	08 65 90	9/12/2015 14:26	9/12/2015 15:47	01:21	Master Mlinga Ahmed	6 years	Male
3558060	37 16 42	10/15/2015 15:17	10/15/2015 21:04	05:47	Ms. Mushobazi Aneth	2 years	Female
3599600	37 34 49	11/2/2015 17:59	11/2/2015 22:19	04:20	Master Seif Nasri	3 years	Male
3686110	09 24 85	12/11/2015 15:03	12/11/2015 16:50	01:47	Master Boha Abdallah	1 year	Male
3002074	06 74 87	1/13/2015 15:11	1/13/2015 20:50	05:38	Master Roman Hellen	2 years	Male
3170135	07 67 81	4/14/2015 17:05	4/14/2015 19:11	02:05	Master Hashim Karim	5 years	Male
3008219	06 57 73	1/16/2015 16:03	1/16/2015 23:16	07:12	Master Jaffer Raziy	4 years	Male
3699099	09 28 25	12/17/2015 14:23	12/17/2015 16:44	02:21	Baby Idris Hirali	17 days	Male
3236077	35 28 66	5/18/2015 14:27	5/18/2015 22:29	08:01	Mr. Mwanjoka Gidion	31 years	Male
3300170	08 16 06	6/18/2015 14:38	6/18/2015 18:32	03:54	Master Mayunga Abraham	4 years	Male
2785161	31 61 61	9/18/2014 15:47	9/18/2014 16:22	00:35	Mr. Rossan Daudi	17 years	Male
2561960	30 19 70	5/19/2014 16:24	5/19/2014 17:10	00:45	Ms. Lilaga Busoga	64 years	Female
2619980	04 65 87	6/19/2014 19:52	6/19/2014 22:08	02:15	Master Kalebe Daniel	4 years	Male
3181286	07 73 36	4/20/2015 14:34	4/20/2015 22:27	07:52	Mrs. Mazegenja Alice	4 years	Female
2683615	05 02 49	7/24/2014 18:50	7/24/2014 19:49	00:58	Ms. Moses Cesilia	6 years	Female
2632657	04 71 26	6/26/2014 15:45	6/26/2014 17:53	02:07	Master Rugambwa Edger	11 years	Male
2743361	05 36 94	8/26/2014 15:23	8/26/2014 15:57	00:34	Master Kiringa Koyesa	7 years	Male
3378635	36 48 10	7/27/2015 13:23	7/27/2015 21:12	07:49	Ms. Zongo Ashura	28 years	Female
2580398	04 44 31	5/29/2014 12:49	5/29/2014 16:46	03:56	Mr. Mutapa Grander	50 years	Female

W.F. ID	HEMODYNAMIC PARAMETER	TYPE OF SURGICAL OPERATION (RECOMMENDED)	BIOSPECTRAL CHARACTERISTIC	TYPE OF CASES (NORMAL/ABNORMAL)
2480361	Alpha activity- 9-10 Hz	No recommendations.	Photic stimulation	Normal result I.e negative case.
2481769	Alpha activity- 8-9 Hz	Sleep deprived record.	Sleep deprived record.	Suspicious result. (Can be normal/ abnormal)
2525281	Theta and delta slow waves	Magnetic resonance image (Strongly Recommended).	Photic stimulation	Severely abnormal I.e positive case(Child is highly prone to polymorphic seizures).
2627057	Alpha activity- 10-11 Hz in the postero central regions.	Liability for seizure,lower epileptic threshold but no recommendations by the physician.	Photic stimulation	Awake EEG Is abnormal I.e positive case.
2698143	Alpha activity- 10-11 Hz in the postero central regions.	No recommendations.	Photic stimulation	Awake EEG is within normal limit I.e negative case.
2699728	Theta activity (fast) and slow delta activity observed. Delta activity predominates.	No recommendations.	Photic stimulation	Sleep EEG is within normal limit I.e negative case.
2780191	Theta and delta slow activity, delta predominates.	Liability for seizure,lower epileptic threshold but no recommendations by the physician.	Photic stimulation	Sleep EEG record is abnormal I.e positive case.
2799979	Alpha activity- 10-11 Hz in the postero central regions.	Imaging studies is recommended.	Photic stimulation	Awake EEG is within normal limit I.e negative case.
3045749	Delta activity predominates	No recommendations.	Photic stimulation	Sleep EEG is within normal limit i.e negative case.
3312555	Theta and delta slow activity.	Liability for seizure,lower epileptic threshold but no recommendations by the physician.	Photic stimulation	Sleep EEG record is abnormal I.e positive case.
3354468	Alpha activity- 10-11 Hz in the postero central regions.	Liability for seizure,lower epileptic threshold but no recommendations by the physician.	Photic stimulation	Awake EEG Is abnormal I.e positive case.
3484781	Theta waves and small amount of alpha activity is observed (8 Hz)	No recommendations.	Photic stimulation	Awake EEG Is abnormal I.e positive case.
3558060	Theta and delta slow waves	Clinical correlation in required.	Photic stimulation	Sleep EEG record is suspicious but not diagnostic.
3599600	Theta and delta slow activity.	Record an awake EEG after suitable interval.	Photic stimulation	Sleep EEG is within normal limit i.e negative case.
3686110	Theta and delta slow activity.	Liability for seizure,lower epileptic threshold but no recommendations by the physician.	Photic stimulation	Sleep EEG record is abnormal I.e positive case.
3002074	None	No recommendations.	Photic stimulation	Sleep EEG record is within normal limit. (Negative case)
3170135	Theta rhythm is observed 4- 7.5 HZ	No recommendations.	Photic stimulation	Sleep EEG record is normal I.e negative case.
3008219	Theta and delta slow activity.	Liability for seizure,lower epileptic threshold but no recommendations by the physician.	Photic stimulation	Sleep EEG record is abnormal I.e positive case.
3699099	None	Magnetic resonance image (Recommended).	High voltage activity is observed over the right hemisphere.	Abnormal result I.e positive case , since theta and delta slow activity wave was recorded.

3236077	Alpha activity- 10-11 Hz	Imaging studies, particularly MRI is recommended.	Photic stimulation	Awake EEG Is abnormal I.e positive case.
3300170	Low epileptic threshhold .	Liability for seizure, but no recommendations by the physician.	Photic stimulation	Abnormal result I.e positive case.
2785161	Theta slow waves of 7 Hz.	No recommendations.	Photic stimulation	Awake EEG Is abnormal I.e positive case.
2561960	Alpha activity- 10-11 Hz	No recommendations.	Photic stimulation	Abnormal result I.e positive case , since the patient has seizure disorder.
2619980	Delta slow activity	Magnetic resonance image and metabolic workup(Recommended)	High voltage rythemic slow waves with spikes and sharp waves in both hemisphere.	Awake EEG Is abnormal (lowered epileptic threshold and liability for seizures. The findings also suggest an epileptic encephalopathy)
3181286	Alpha activity- 9-10 Hz	Magnetic resonance image (Recommended), to rule out structural lesion.	High voltage sharp over right hemisphere.	Abnormal result I.e positive case , since the patient has seizure disorder.
2683615	Theta slow waves.	Imaging studies, particularly MRI is recommended.	Asymmetrical, slow and is higher volatge over the right hemisphere especially over the temporal region.	Awake EEG Is abnormal I.e positive case.
2632657	Theta and delta slow waves	Metabolic workup and imaging studies is recommended.	Photic stimulation	Abnormal result I.e positive case (lowered epileptic threshold and liability for seizures).
2743361	Theta and delta slow waves	Liability for seizure, but no recommendations by the physician.	Photic stimulation	Sleep EEG record is abnormal I.e positive case.
3378635	Theta and delta slow waves, theta activity predominates.	No recommendations.	Photic stimulation	Abnormal result I.e positive case (The findings suggest an encephalopathy, likely to be renal, The findings also suggest lowered epileptic threshold.
2580398	Alpha activity- 10-11 Hz in the postero central regions.	No recommendations.	Photic stimulation	Awake EEG is within normal limit I.e negative case.

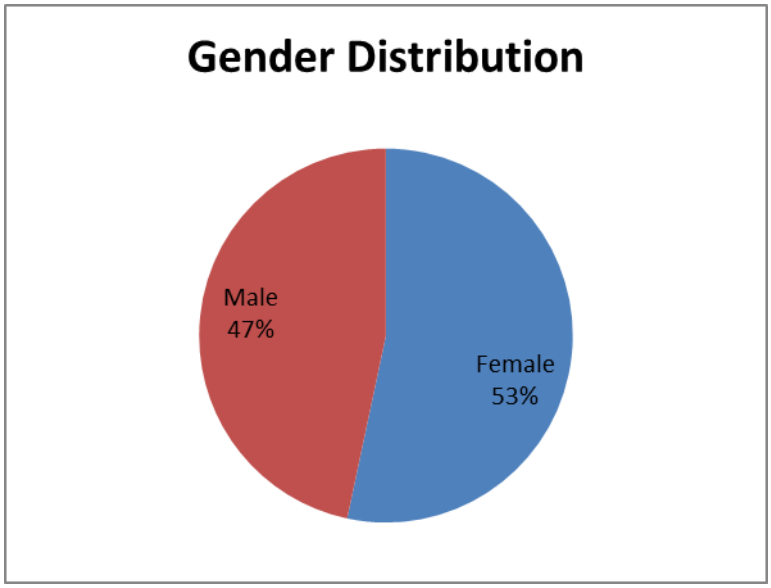


Fig:1: Gender Distribution

COUNT OF NAME OF THE PATIENT	
PATIENT'S GENDER	Total
Female	16
Male	14
Grand Total	30

Count of NAME OF THE PATIENT	
HEMODYNIMIC PARAMETER	Total
Alpha activity- 10-11 Hz	2
Alpha activity- 10-11 Hz in the postero central regions.	5
Alpha activity- 8-9 Hz	1
Alpha activity- 9-10 Hz	2

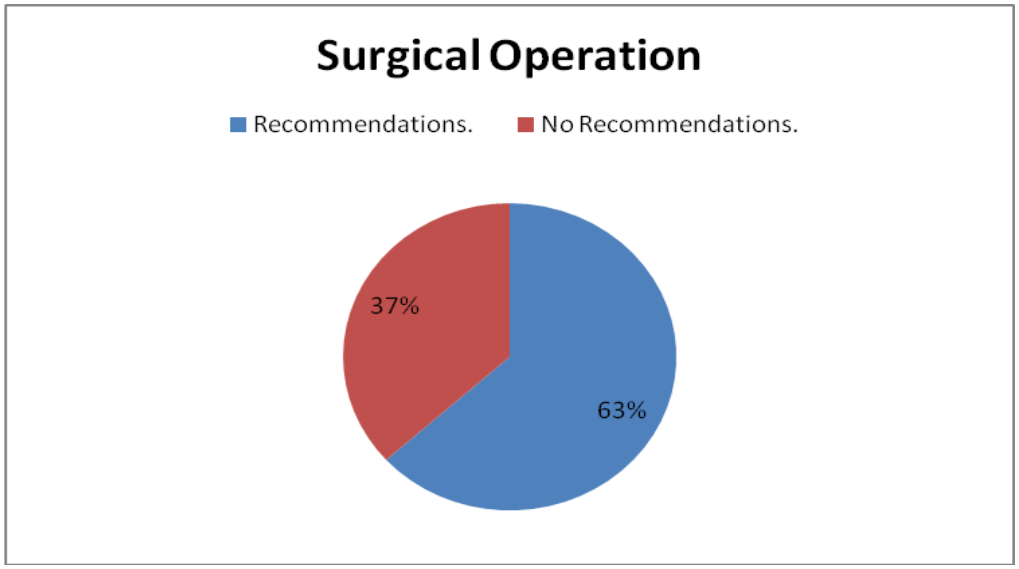
Delta activity predominates	1
Delta slow activity	1
Low epileptic threshold .	1
None	2
Theta slow waves of 7 Hz.	1
Theta slow waves.	1
Theta activity (fast) and slow delta activity observed. Delta activity predominates.	1
Theta and delta slow activity, delta predominates.	1
Theta and delta slow activity.	4
Theta and delta slow waves	4
Theta and delta slow waves, theta activity predominates.	1
Theta rhythm is observed 4- 7.5 HZ	1
Theta waves and small amount of alpha activity is observed (8 Hz)	1
Grand Total	30

Fig 2: **Hemodynamic Parameter**

TYPE OF SURGICAL OPERATION (RECOMMENDED)	Total
Clinical correlation in required.	1
Imaging studies is recommended.	1

Imaging studies, particularly MRI is recommended.	2
Liability for seizure, but no recommendations by the physician.	2
Liability for seizure ,lower epileptic threshold but no recommendations by the physician.	6
Magnetic resonance image (Recommended), to rule out structural lesion.	1
Magnetic resonance image (Recommended).	1
Magnetic resonance image (Strongly Recommended).	1
Magnetic resonance image and metabolic workup(Recommended)	1
Metabolic workup and imaging studies is recommended.	1
No recommendations.	11
Record an awake EEG after suitable interval.	1
Sleep deprived record.	1
Grand Total	30

Fig:3:Type of Surgical



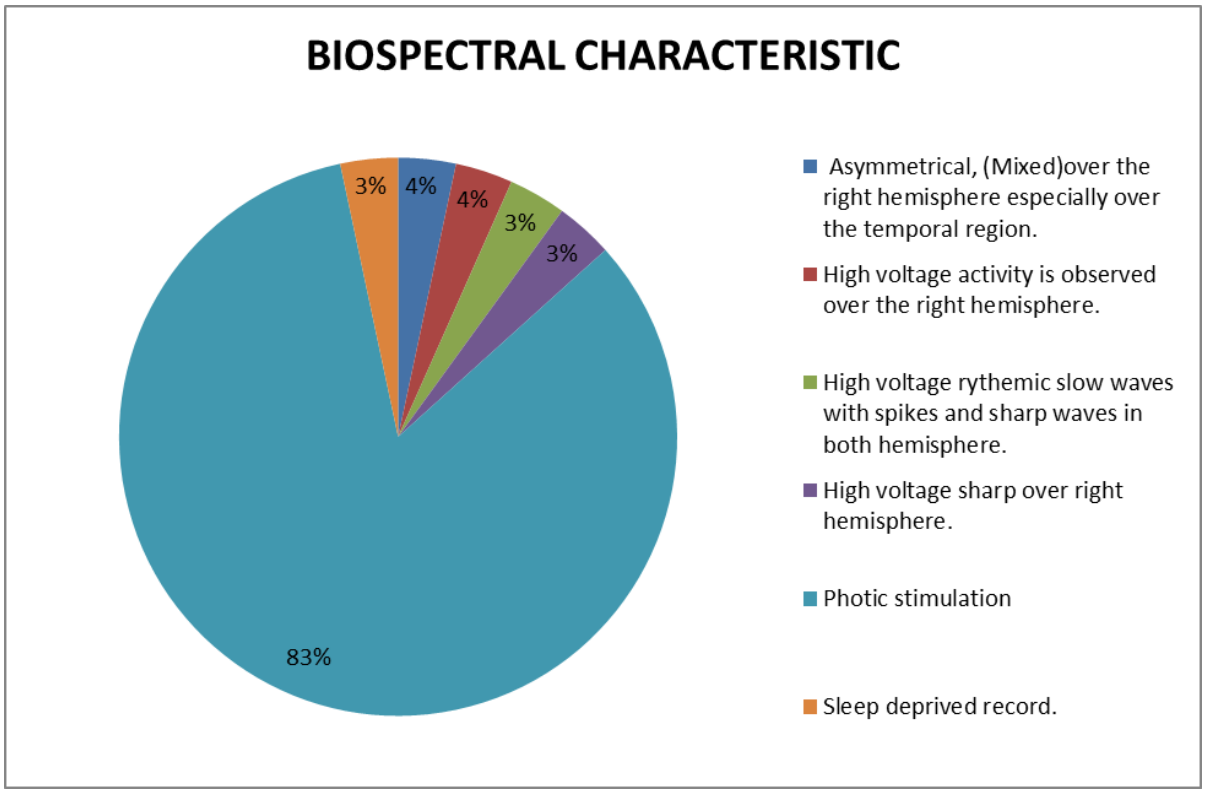
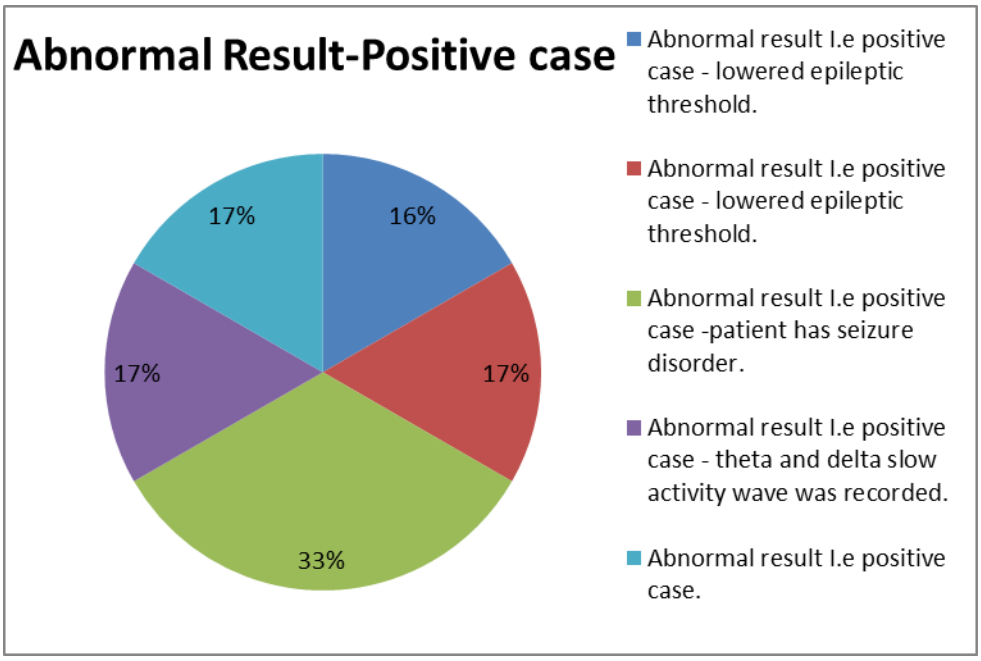
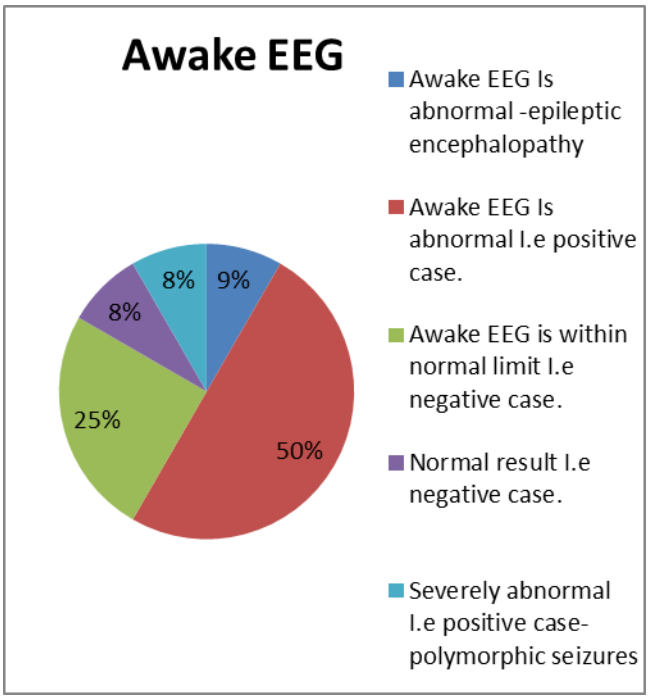


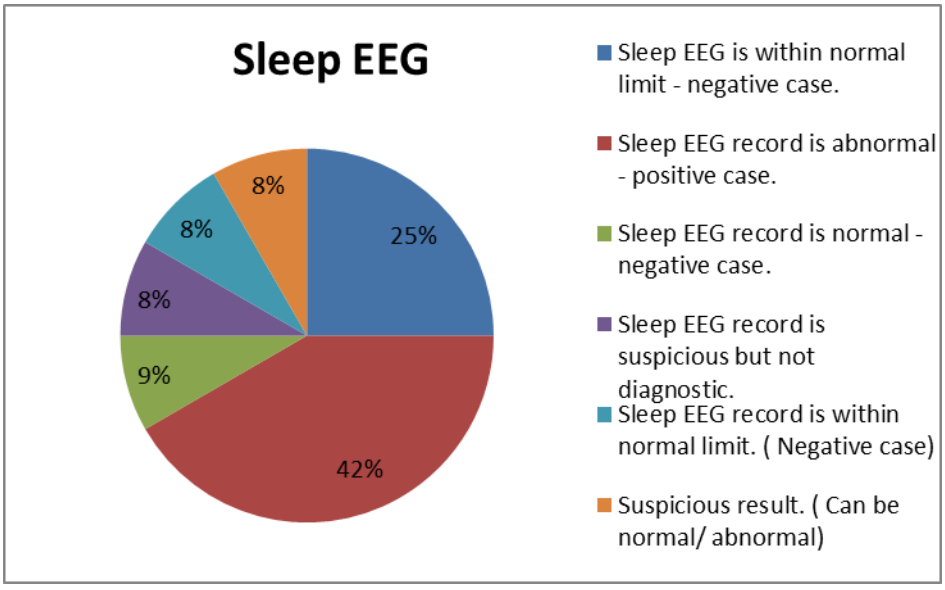
Fig:6: BIOSPECTRAL CHARACTERISTIC

BIOSPECTRAL CHARACTERISTIC	Total
Asymmetrical, slow and is higher voltage over the right hemisphere especially over the temporal region.	1
High voltage activity is observed over the right hemisphere.	1
High voltage rhythmic slow waves with spikes and sharp waves in both hemisphere.	1
High voltage sharp over right hemisphere.	1
Photic stimulation	25
Sleep deprived record.	1
Grand Total	30

Count of NAME OF THE PATIENT	
TYPE OF CASES (NORMAL/ABNORMAL)	Total
Abnormal result I.e positive case (The findings suggest an encephalopathy, likely to be renal, The findings also suggest lowered epileptic threshold.	1
Abnormal result I.e positive case (lowered epileptic threshold and liability for seizures).	1
Abnormal result I.e positive case , since the patient has seizure disorder.	2
Abnormal result I.e positive case , since theta and delta slow activity wave was recorded.	1
Abnormal result I.e positive case.	1
Awake EEG Is abnormal (lowered epileptic threshold and liability for seizures. The findings also suggest an epileptic encephalopathy)	1
Awake EEG Is abnormal I.e positive case.	6
Awake EEG is within normal limit I.e negative case.	3
Normal result I.e negative case.	1
Severely abnormal I.e positive case(Child is highly prone to polymorphic seizures).	1
Sleep EEG is within normal limit I.e negative case.	3
Sleep EEG record is abnormal I.e positive case.	5
Sleep EEG record is normal I.e negative case.	1
Sleep EEG record is suspicious but not diagnostic.	1
Sleep EEG record is within normal limit. (Negative case)	1
Suspicious result. (Can be normal/ abnormal)	1
Grand Total	30




Awake EEG
Awake EEG Is abnormal -epileptic encephalopathy
Awake EEG Is abnormal I.e positive case.
Awake EEG is within normal limit I.e negative case.
Normal result I.e negative case.
Severely abnormal I.e positive case- polymorphic seizures
9%
50%
25%
8%
8%


Sleep EEG
Sleep EEG is within normal limit - negative case.
Sleep EEG record is abnormal - positive case.
Sleep EEG record is normal - negative case.
Sleep EEG record is suspicious but not diagnostic.
Sleep EEG record is within normal limit. (Negative case)
Suspicious result. (Can be normal/ abnormal)
25%
42%
9%
8%
8%
8%

APPENDIX :

Thanks to you all for making my project successful.

1. Dr.Sunita Maheshwari

   (CEO, Senior Consultant Pediatric Cardiologist,

   Chief Dreamer,

   RXDX and Teleradiology Solutions, Bangalore).

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   Teleradiology Solutions, Bangalore).

6. Mr. Prasad

   (Sr. Billing Executive,

   Teleradiology Solutions, Bangalore)

7. Ms Marion Barber

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   Teleradiology Solutions, Bangalore)

8. Mr. Abhijeet Uplopwar

   (Sr. Software Engineer,

Teleradiology Solutions, Bangalore).

9. Nagesh. M

   (IT engineer, RadSPA, TRS)

10. Swarnendra

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11. Ms Kavitha T.A

    (Academic Co-ordinator,

    Teleradiology Solutions, Bangalore)

12. Ms Ashwini. V

    (Executive Assistant,

    Teleradiology Solutions, Bangalore).

