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Advances in Telemedicine: Its present status, applications in India and Abroad

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Abstract: ***Telemedicine*** *is the remote diagnosis and treatment of patients by means of the advancement of latest state of the art technologies of* ***Telecommunication***, ***Artificial Intelligence*** *(AI),* ***Virtual Reality*** *(VR),* ***Compression- Decompression Algorithms*** *and in the advancement of* ***Semi-conductor chip manufacturing techniques*** *and as a result,* ***Telemedicine*** *has come a long way in terms of both healthcare delivery and technology.* ***A major role in this was played by NASA, ISRO and DUKE University in USA. ISRO*** *(Indian Space Research Organization) made a modest beginning in telemedicine in India with a Telemedicine Pilot Project in 2001, linking Chennai's Apollo Hospital with the Apollo Rural Hospital at Aragonda village in the Chittoor district of Andhra Pradesh.[12] Initiatives taken by* ***ISRO****, Department of Information Technology (****DIT****), Ministry of External Affairs, Ministry of Health and Family Welfare and the state governments played a vital role in the development of telemedicine services in India. In an attempt to coalesce the available public health data and provide easy access, the Ministry of Health in the Government of India has taken up projects like Integrated Disease Surveillance Project (****IDSP****), National Cancer Network (****ONCONET****), National Rural Telemedicine Network, National Medical College Network and the Digital Medical Library Network. [13] Setting up of standardized telemedicine practice guidelines by the Department of Information Technology in the Government of India, and setting up of a National Telemedicine Task Force by the Health Ministry, in 2005, were some of the other positive steps by the government. International projects like the Pan-African eNetwork Project and the* ***SAARC*** *(South Asian Association for Regional Co-operation) Telemedicine Network Projects have also been taken up as an initiative of the External Affairs Ministry [14], strategically placing Indian telemedicine in the global scenario. A few noteworthy examples of the successfully established telemedicine services in India include mammography services at Sri Ganga Ram Hospital, Delhi; oncology at Regional cancer centre, Trivandrum;[15] surgical services at Sanjay Gandhi Postgraduate Institute of Medical Sciences, School of Telemedicine and Biomedical Informatics, and many more.[2] Telemedicine also finds its use in places where large populations occasionally/periodically gather at a point of time, where provision of medical care becomes the need of the hour; for example, Government of Uttar Pradesh practices telemedicine during MahaKumbhamelas.[16] In this publication, we shall explore the latest advancements of Telemedicine/Telehealth that has made it a viable part of healthcare.*

Key Words: *History of telemedicine, types of telemedicine, telemedicine in India, applications of telemedicine, telemedicine in family medicine, telemedicine in public health, AI-artificial Intelligence, Virtual Reality, Software compression, Semiconductor Chipset, Bandwidth, ISDN telephone Line, NASA, ISRO, DUKE University, SPO2, CKSPO2, ETCO2, EKG, EMG, EEG, PAN AFRICAN INAUGRATION, WHO, SAARC, ONCONET.*

1. INTRODUCTION:

Overview of telemedicine:

In 1990's, the author of this paper, Dr B. L. Raina was assigned the task of developing the "State of the art Tele-health centre" at Duke University, Durham, NC, USA with Dr Barbara of the Biological Sciences department. The development started in collaboration with the University of Florida at Gainesville, Florida, USA. At the time the bandwidth being low even with the ISDN telephone lines, we had to come up with special algorithms of compression and decompression and put them on a chip set so as to achieve the video rate of more than twenty frames per second and as such, we had a tremendous success in treating the patients for certain ailments especially from remote areas. We also used "VC 7000" for medical discussions between the doctors all over the world. This was the beginning of Tele-Health at DUKE and now over the years, DUKE Tele-health facility is considered one of the best in the world.

Following are some of the Hardware & software tools and equipment developed by Dr Raina and patented, during the development of Tele health system at DUKE University, Durham, NC, USA.

PATENT- 1

PATENT-2

PATENT-3

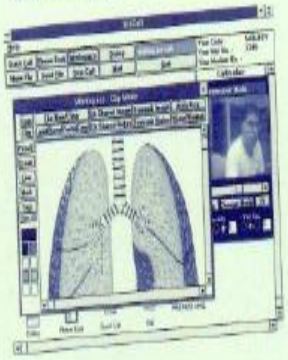
Synapse
DIGITAL TECHNOLOGIES, INC.

VideoLink Video Conferencing System for PCs

VideoLink is a low cost PC based video conferencing system that allows two remote sites to exchange video and data over a single standard (POTS) telephone line. The whiteboard feature allows far flung users to collaborate on documents. VideoLink also supports file and image transfer and an interactive chat utility.

video to other sites. All the other features remain fully operational in this mode. This software-only solution is cost effective in situations where only one way video transmission is needed.

VideoLink offers point solutions to a wide variety of applications ranging from remote training and learning to conducting business meetings remotely, thereby saving time and cost of travel. Remote surveillance, remote product support, remote consultation and telemedicine are some of the applications that VideoLink supports very efficiently.



A complete package includes a digital video camera with a built-in microphone for video and voice capture. It also has a single board with a digitizer, sound processor and a codec. VideoLink can also operate without any special video capture hardware. In this mode of operation, a site can display incoming video images although it cannot transmit

VideoLink features

- Low cost
- Easy to install and use
- Interactive document sharing
- Video transfer at 7 fps
- Support for two remotely selectable video sources
- DCT software video compression
- Auto-answering of incoming calls
- Online easy-to-use phone book
- File transfer
- Interactive chat utility

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VC 7000 Video Conferencing System

VC 7000 is a self contained video conferencing system. Operating on the ISDN basic rate interface and Switched 56 network, the system provides high quality, high speed live video and audio. VC 7000 can support a broad range of auxiliary devices such as additional cameras, slide to video converters, document scanners, overflow monitors, and PCs, augmenting communications and making it more than just a videophone.

VC 7000 can virtually transport the patient for a consultation with an expert radiologist or pathologist.

VC 7000 can also be used to conduct remote meetings and remote training sessions involving a large number of people. Everyone in the meeting becomes an active participant with the use of additional cameras and microphones. Even a personal computer may be attached for displaying the latest sales figures from a spreadsheet or a graphics package. Engineers at different locations can work on a design together using CAD packages installed on the PC.

VC 7000 finds applications in several areas. In telemedicine, VC 7000 can provide the same high quality health care to remote regions as that available at large medical centers. Film scanners, computers, and microscopes interfaced to VC

VC 7000 features

- ISDN and Switched 56 interface
- Nine inch NTSC color monitor
- Single chip CCD color camera
- H.261 compliant video communication
- G.711/G.722/G.728 compliant audio communication
- RS-232 interface for auxiliary devices
- Video up to 30 fps
- Up to 352x288 picture resolution

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...allBusiness
...LE BUSINESS JOURNAL
Page 13

CO.
A Weekly Small Business Profile

...nabling technologies: Ben Raina of Divergent Technologies Ltd.

Durham tech firm links TV and Internet

L. SCOTT TILLETT

DURHAM

What do you get when you cross a ...ch potato and a propellerhead?
Who knows? Whipped potatoes, ...gbe. One thing's for sure, though: ...ch a creature will be a prime target ...rket for what Ben Raina of Durham-...ed Divergent Technologies Ltd. has ...eloped.
...n a nutshell, the products Raina aims ...sell accommodate the Internet via ...evision as well as broadcasting via the ...ernet.
...or the past 11 years, Raina has been ...rking to sculpt a successful business ...ed on his education in computer sci-...ce, mathematics, and video-image ...pression and decompression.
...Now, as telecommunications walls ...ome tumbling down and as technology turns science fiction into fact, Raina is positioning his business to take advantage of the New Information Age. "It's mind-boggling. You can do anything now," he said.

At the heart of his new ventures is a product called the SetTopBox. Raina hopes this product will be embraced by cable companies he's in discussions with.

The device — which is accompanied by a cordless keyboard and mouse — sits like a cable box on top of a television set and will allow users to watch television and also access the Internet for browsing or for e-mail. It can also be attached to a personal computer for downloading and doesn't require phone lines. Rather it requires a cable modem.

The SetTopBox — which has been in

Please see TECHNOLOGIES, page 23

Small Business BUZZ

L. SCOTT TILLETT

HAHT to spiff image

Raleigh entrepreneur Richard Holcomb — the man who sold software company Q+E in 1994 for $34 million to Maryland-based Intersolv Inc. — is busy building an image for his new company, HAHT Software.

Holcomb and company have chosen Chapel Hill integrated marketing firm FGI to be HAHT's advertising agency. HAHT produces a suite of software tools that allow businesses to create applications — not just static text and graphics — on the Internet.

The buzz is that the account will mean close to $2 million a year in billings for FGI. Also in the running for the account were Durham ad shop West & Vaughan and New York's Anderson & Lembke.

Holcomb said FGI was picked because "they were the best." The agency's work for HAHT should make its debut within the next month — on the Internet. Where else? Print ads probably won't surface for a couple of months, Holcomb said.

As if Fran didn't hurt retailers enough, now comes word from the Federal Reserve's Fifth District (which includes North Carolina) that a good number of retailers reported slowed sales activity in August.

Retailers reported to the Fed that overall sales growth for the month was sluggish, with little improvement in shopper traffic.

Service businesses, however, reported a steady pace of activity in August.

In this litigious world we live in, it doesn't seem far-fetched that a food employee would sue an employ-

Show next page (Right Arrow)

TECHNOLOGIES

Continued from page 13

development for about a year — will allow browsers to access the Internet at speeds dramatically faster than a 28.8 modem or ISDN lines, Raina said.

He's recommending that the SetTopBox service be provided by carriers for $4 a month. "The idea is to make it affordable," he said.

The box, if coupled with a camera, would also allow users to send live video images.

In addition to the SetTopBox, Raina has developed an application that brings TVs and the Internet together. The product will let consumers access real-time radio and television programming over the Internet.

Raina — who holds a Ph.D. in mathematics and computer science — hasn't always been in the business of developing Internet applications, though. He had been on a career track for teaching until several years ago, when his mother developed cancer. "It forced me to go into business," he said.

WATCH

Continued from page 13

committee and was expected to lead the charge for the bill originally sponsored by Sen. Slade Gorton of Washington state.

Thousands of small businesses, especially builders and contractors, had mounted a strong campaign against union salting, alleging it is costing the country jobs because small businesses are going bankrupt. Proponents of the bill said the failure by Congress to pass the bill in this year's Congress will result in more small business failures.

"We continue to see salting occur among contractors in almost all states," said Jennifer Boucher, Washington representative for the Associated Builders & Contractors, a vociferous trade group against salting. Officials at the National Labor Relations Board, which administers union activities across the country, believe every worker has a right to form unions in order to protect the collective bargaining process.

NLRB's position mirrored that of the U.S. Supreme Court late last year when the highest court found that companies cannot discriminate against job applicants based solely on the fact that they are union organizers. So, job applicants who are paid or unpaid "salts" for a union are "employees" under the labor

The business Raina began developing is diverse and also includes the sale of videoconferencing equipment.

In the past three years, Raina has sold fewer than 100 British Telecom-built videoconferencing machines that incorporate microphones, cameras and ISDN lines. The machine — the VC 7000 — retails for between $5,000 and $8,000. Raina said he developed the digitizer and circuit board used in the product.

Raina began his business in 1985 but has been operating in the black only since 1988 or 1989. And that's the way Raina — as most entrepreneurs — likes to keep it. "If worse comes to worst, I basically sell a technology," he said.

In financing his business over the years, Raina has seldom gone to ... although he once borrowed $50,000 ... SouthTrust and $200,000 from ... to develop a digitizer card.

But it has been in the development of products that the business has hit ... Raina said he has at times not been able to balance development and sales, focusing too heavily on developing and fine-tuning a product than on ... products.

The challenge for him remains to market his products aggressively.

Revenue for the company ... was less than $1 million. Raina ... to hit the million-dollar mark this ... and if his new products are embraced as expected and if marketing is ... adequately, it's feasible for the company to pull in revenue of $4.5 million in ... he said.

Introduci
The New Comp
The Proven Trac

RISCORP National Insurance Company

As the only North Carolina group self-insured fund to become an insurance company, RISCORP combines the high quality service of a self-insured fund with the security of an insurance company.

We have a reputation for pioneering innovative ways to help employers control costs while providing cost-efficient, care-effective treatment of injured employees.

RISCORP's proven managed workers' compensation programs focus on field-tested loss prevention programs, integrated claims and medical management, and aggressive return-to-work programs.

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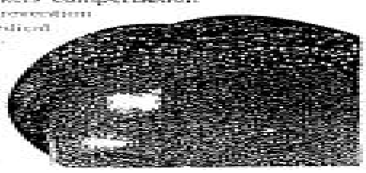
Our back wellness program and ... are just two of the innovative ... in which RISCORP leads the industry ...

Our ded... North Car... care team ... unique ...

Put RISC...

The RI... workers' ... of business



Date ⟶ 7-7-93

Indian Express

The latest 'wonder'

EXPRESS NEWS SERVICE

CHANDIGARH – You can answer a phone call, receive your ... a "Multimedia", a computer developed by a ... computer wizard, R. L. Raina.

This "wonder machine" developed by Raina ... is reportedly the first of its kind in the world. ...

R. L. Raina demonstrating his creation at the Chandigarh Press Club on Tuesday. – Express photograph

The setting up of the National Telemedicine Taskforce by the Health Ministry of India, in 2005, paved way for the success of various projects like the ICMR‑AROGYASREE, NeHA and VRCs. **Telemedicine** also helps family physicians by giving them easy access to speciality doctors and helping them in close monitoring of patients especially in remote areas. Different types of telemedicine services like store and forward, real‑time and remote or self‑monitoring provides various educational, healthcare delivery and management, disease screening and disaster management services

all over the globe. Telemedicine being the remote diagnosis and treatment of patients by means of advanced technologies, thereby providing substantial healthcare to remote and low income regions. It seems now that it is mandatory for the basic related technologies like AI, VR, C&D and Semi-conductor foundries to come up with rapid technology advancements, especially in view of COVID-19 and recent natural disasters, so as to make Telemedicine more viable for all the humanity. There are many browser-based telemedicine software that allow physicians to transmit in real-time, audio, video, EKG, Sp02, pulse, respiration rate, and ETC02. All these signals are simultaneously transmitted from a rapidly deployable Telemedicine Unit with a standard laptop to a telemedicine facility thousands of miles away utilizing a single 64Kbps satellite connection while archiving all the physiological data in a data center.

As an example, Dr. Lynne Gehr, the anesthesiologist from one remote end, was able to monitor, supervise, and verbally communicate details about the patient's condition during surgery performed by Dr. Ronald Merrell, Chairman of Surgery at Virginia Commonwealth University's School of Medicine. **The quality of the video and audio was absolutely amazing considering the 64Kbps bandwidth although at the same time the vital signs were also being sent.** Almost nine hours of live anesthesia monitoring was performed on one day, and another 3 hours of Urology monitoring was on the second day, without the slightest hiccup in performance. In one of the surgeries, when a young woman was undergoing gall bladder operation, Dr. Lynne Gehr even detected an anomaly in the patient's heart rhythm remotely and was able to notify the surgeon on the scene--Dr. Ronald C. Merrell, who was able to correct the problem. "The experience of sitting at my desktop computer in Virginia monitoring a patient's vital signs during an operation in Ecuador was quite remarkable," said Dr. Gehr. The "Web" link provided the same information I would have received if l had been physically in the operating room. There are certain Telemedicine "Webs" that represents a significant advance in telemedicine with far-reaching benefits for both healthcare professionals and their patients. These "Webs" also enables electronic storage of all the medical information on its secure database for easy retrieval or forwarding. Additionally, the software supports a variety of off-the-shelf wired and wireless EKG, EMG, EEG, blood pressure, spirometry and oximetry, and multi-parameter vital sign monitoring devices.The setting up of the National Telemedicine Taskforce by the Health Ministry of India, in 2005, paved way for the success of various projects like the ICMR-AROGYASREE, NeHA and VRCs. **Telemedicine** also helps family physicians by giving them easy access to speciality doctors and helping them in close monitoring of patients especially in remote areas. Different types of telemedicine services like store and forward, real-time and remote or self-monitoring provides various educational, healthcare delivery and management, disease screening and disaster management services all over the globe.

Online Doctor Consultation and other health services will help the patients for their non-emergency or emergency medical requirements especially during COVID-19 pandemic. The websites and with an Android App., Patients can easily consult with the general physicians/specialists as well as contact with other health services providers from home at any time. The outbreak of coronavirus has made it difficult for people to visit hospitals, but the app will help people in such situations, at the same time it will reduce the chances of transmission of the dreaded virus to the patient and health workers at the hospitals and clinics. "The user would be able to contact with any type of healthcare service providers and connect to a doctor through video or audio or chat and get the consultation over phone by using website or mobile app; patients can upload their test reports for doctors to review. The doctors can upload prescriptions on the app. after consultation, which in turn automatically gets sent in to a pre-authorise group of local Pharmacies for delivery of medicines usually within an hour.

2. TELEMEDICINE:

Opportunities and developments:

Three types of solutions for the COVID-19 Pandemic situation

1. Mobile App.: (OPD-Medicine-Emergency-Diagnostic) Complete healthcare solutions with Doctors on Secure Video Call can connect patients with Online Doctors anytime anywhere through Mobile Application.

2. **The-Bike Doc** (Bike Ambulance) with Electronic stethoscope, ENT scope, ECG

Integrated with laptop can be carried by a health staff on a bike along with emergency drugs and blood samples collection kit, the health staff after arriving at patient's home places vitals video calls to a doctor or a group of doctors while examining & performing various tests like ECG etc., provides emergency medicine, collects samples or transports the patient to the hospital as may be advised by the doctor.

3. **Digital Clinic** (A unique telemedicine centre with Diagnostic, Medicine and Sample Collection facilities) can be established at a fixed location to be operated by a health staff.

According to American Telemedicine Association (ATA), "Telemedicine is the natural evolution of healthcare in the digital world". [(1)] **World Health Organization (WHO) has defined telemedicine as, "the delivery of healthcare services, where distance is a**

critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities. [(2)]The word "telemedicine" literally translates to 'healing at a distance'. It often is used as the umbrella term to encompass health care delivery in addition to other activities, such as education, research, health surveillance, and public health promotion. [(3)]

3. HISTORICAL PERSPECTIVE:

The allure of telemedicine is in its ability to communicate medical data over a distance. Earliest published record of telemedicine was in the first half of the 20th century when ECG was transmitted over telephone lines. [(2)] Inventions like electrical telegraph and telephone played a vital role in kick starting the modern telemedicine as we know it. [(4)] Telephone was able to reach a much wider population in a shorter time, as dialling emergency telephone numbers granted faster access to emergency medical care The April 1924 issue of Radio News magazine brought with it a new dream for future public health. The cover showed a patient with a TV and microphone to communicate with a doctor at the other end; it was truly only a dream then because televisions had not yet come into vogue. [5] The first known record of real‑time (live) video consultation occurred in 1959 when the doctors at University of Nebraska used interactive telemedicine to transmit neurological examinations. [6] Telemedicine found its role in disaster management when NASA first used telemedicine services during the 1985 Mexico City earthquake, and in 1988, during the Soviet Armenia earthquake, where the estimated casualties were more than 50,000. [7] With the disruption of all other modes of communication, satellite technology used in telemedicine proved to be quintessential in breaking technological barriers and made a mark in history, especially in the Gulf war in 1990-91 The establishment of a commercial space Centre named MITAC (Medical Informatics and Technology Applications Consortium) at Yale University. [7] In the year 1997 by NASA paved way for the current trend of private participation in public health management using telemedicine. The telemedicine module of the 2009 survey examined the current level of development of four fields of telemedicine: teleradiology, as well as four mechanisms that facilitate the promotion and development of telemedicine solutions in

the short- and long-term: the use of a national agency, national policy or strategy, scientific development, and evaluation. Telemedicine - opportunities and developments. Findings show that teleradiology currently has the highest rate of established service provision globally (33%). Approximately 30% of responding countries have a national agency for the promotion and development of telemedicine, and developing countries are as likely as developed countries to have such an agency. In many countries scientific institutions are involved with the development of telemedicine solutions in the absence of national telemedicine agencies or policies; while 50% of countries reported that scientific institutions are currently involved in the development of telemedicine solutions, 20% reported having an evaluation or review on the use of telemedicine in their country published since 2006. The importance of evaluation within the field of telemedicine cannot be overstated: the field is in its infancy and while its promise is great, evaluation can ensure maximization of benefit. ICTs can be costly, as can be the programmes using them to improve health outcomes. Indeed, the most frequently cited barrier to the implementation of telemedicine solutions globally is the perception that the cost of telemedicine is too high. Closely linked with cost is cost-effectiveness. Almost 70% of countries indicated the need for more information on the cost and cost-effectiveness of telemedicine solutions, and over 50% wanted more information on the infrastructure necessary to implement telemedicine solutions. Wanting additional information on the clinical uses of telemedicine was cited by almost 60% of countries; it was one of the three most requested areas of information by Member States. While developing countries are more likely to consider resource issues such as high costs, underdeveloped infrastructure, and lack of technical expertise to be barriers to telemedicine, developed countries are more likely to consider legal issues surrounding patient privacy and confidentiality, competing health system priorities, and a perceived lack of demand to be barriers to telemedicine implementation. Following the analysis of the survey results, member States can take to capitalize on the potential of ICTs. One such step is creation of national agencies to coordinate telemedicine and eHealth initiatives, ensuring they are appropriate to local contexts, cost effective, consistently evaluated, and adequately funded as part of integrated health service delivery. Ultimately telemedicine initiatives should strengthen – rather than compete with – other health services

4. Modern Telemedicine:

Over the past several decades, as the use of wireless broadband technology has become more advanced and cell phone and internet use has become nearly ubiquitous.[8] Patient education with images and videos, transfer of medical images like X-rays and scans, and real-time audio and video consultations became a reality.[4] Improvement in internet infrastructure such as bandwidth communication speeds, information storage databases, web service backups, standard formats for data transmission, encryption, password protection, HIPAA (Health Insurance Portability and Accountability Act of 1996) guidelines,[9] digitalizing information and establishment of EMRs (electronic medical records) made e-health and telemedicine stress-free and cost effective.[4] The modern day telemedicine uses existing computing devices belonging to the patient or physician and inexpensive, self-owned equipment like smartphone cameras, wearable biosensors, etc., for gathering clinical data which made it easier to use without special training.[4] The recent telemedicine practices reduce travel expenses, saves time, reduces medical costs, provides easier access for the common man to specialist doctors without disrupting their daily responsibilities. It also makes the life of healthcare providers easy by decreasing the load of missed appointments and cancellations, increasing revenue and patient load and improving follow up and health outcomes.(10) Stepping into the 21st century, various national/international organizations like the American Telemedicine Association, Washington DC, have been set up – which are solely dedicated to provision of telemedicine services. [1]

5. Telemedicine in India:

India is a large nation with a population of more than 121 cores [11] of sundry people. Due to this fact, the equitable distribution of healthcare services has proven to be a major goal in public health management time and again. Adding to this is the recent trend of concentration of healthcare facilities to the cities and towns (including 75% of the population of doctors), away from rural India, where 68.84% of the national population live. [11] ISRO (Indian Space Research Organization) made a modest beginning in telemedicine in India with a Telemedicine Pilot Project in 2001, linking Chennai's Apollo Hospital with the Apollo Rural Hospital at Aragonda village in the Chittoor district of Andhra Pradesh.[12] Initiatives taken by ISRO, Department of Information Technology (DIT), Ministry of External Affairs, Ministry of Health and Family Welfare and the state governments played a vital role in the development of telemedicine services in India. In an attempt to coalesce the available public health data and provide easy access, the Ministry of Health in the Government of India has taken up projects like Integrated Disease Surveillance Project (IDSP), National Cancer Network (ONCONET), National Rural Telemedicine Network, National Medical College Network and the Digital Medical Library Network. (13) Setting up of standardized telemedicine practice guidelines by the Department of Information Technology in the Government of India, and setting up of a National Telemedicine Task Force by the Health Ministry, in 2005, were some of the other positive steps by the government. International projects like the Pan-African

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A few noteworthy examples of the successfully established telemedicine services in India include mammography services at Sri Ganga Ram Hospital, Delhi; oncology at Regional cancer centre, Trivandrum;(15) surgical services at Sanjay Gandhi Postgraduate Institute of Medical Sciences, School of Telemedicine and Biomedical Informatics, and many more. (2) Telemedicine also finds its use in places where large populations occasionally/periodically gather at a point of time, where provision of medical care becomes the need of the hour; for example, the Government of Uttar Pradesh practices telemedicine during Maha Kumbhamelas.[16] Telemedicine is one field which was successful in invoking a keen interest in the private sector and making them take an active part in public health management. Some of the current major Indian private sector players in telemedicine include Narayan a Hrudayalaya, Apollo Telemedicine Enterprises, Asia Heart Foundation, Escorts Heart Institute, Amrita Institute of Medical Sciences and Aravind Eye Care.[17] They function with support from the central and state governments and from organizations like ISRO who guide them with appropriate and updated technology.[18] In the past few years, ISRO's telemedicine network has come a long way. It has expanded to connect 45 remote and rural hospitals and 15 super specialty hospitals. The remote nodes include the islands of Andaman and Nicobar and Lakshadweep, the hilly regions of Jammu and Kashmir, Medical College hospitals in Orissa and some of the rural/district hospitals in other states. [19]

6. Current scenario in India:

WHO recommends a doctor-population ratio of 1:1000[20] while the current doctor population ratio in India is only 0.62:1000 [21] Training of new physicians is time consuming and expensive, hence the doctor to patient ratio can be expected to remain low for a long time to come. This deficit is partly being made up by the active telemedicine services in various parts of the country. Telemedicine services in the country come under the combined jurisdiction of Ministry of Health and Family Welfare and the Department of Information Technology. Telemedicine division of MoHFW, GOI has set up a National Telemedicine Portal [22] for implementing a green field project on e-health establishing a National Medical College Network (NMCN) for interlinking the Medical Colleges across the country with Village Resource Centre (VRC): The VRC concept has been developed by ISRO to provide a variety of services such as tile-education, telemedicine, online-decision support, interactive farmers' advisory services, tele-fishery, e-governance services, weather services and water management. The VRCs not only act as learning centres and but also provide connectivity to specialty hospitals, thus bringing the services of expert doctors to the villages. Nearly 500 such VRCs have been established in the country.(26) for the purpose of e-Education and a National Rural Telemedicine Network for e-Healthcare delivery.[22] As a constituent of the e-health wing of the National Health Portal (NHP), National Digital Health Authority of India (NDHAI)/National e-health authority (NeHA) is being set up with a vision of achieving high quality health services for all Indians through the cost-effective and secure use of ICTs in health and health-related fields.(23) To ensure safe data transmission during telemedicine practices, MoHFW has developed a set of Electronic Health Records (EHR) standards in 2013 and a revised version of the same in 2016.(24) Telemedicine practices in India are also extended to the fields of traditional medicine. The National Rural AYUSH Telemedicine Network aims to promote the benefit of traditional methods of healing to a larger population through telemedicine. (25)

Village Resource Centre (VRC): The VRC concept has been developed by ISRO to provide a variety of services such as tele-education, telemedicine, online-decision support, interactive farmers' advisory services, tele-fishery, e-governance services, weather services and water management. The VRCs do not only act as learning centres and but also provide connectivity to specialty hospitals, thus bringing the services of expert doctors to the villages. Nearly 500 such VRCs have been established in the country. [26]

AROGYASREE (27) is another internet-based mobile telemedicine conglomerate that integrates multiple hospitals, mobile medical specialists and rural mobile units/clinics. The project is an initiative of Indian Council of Medical Research (ICMR). They have collaborated with a team of scientists from University of Karlsruhe, Germany who are working on the design of an ECG jacket which can be used for the continuous monitoring of a patient's ECG without hospitalization.

7. Types and applications of telemedicine:

Telemedicine can be classified into 5 basic types: [2] According to the timing of the information transmitted:

- Real time or synchronous telemedicine (where the sender and receiver both are online at the same point of time and 'live' transfer of information occurs).

- Store-and-forward or asynchronous telemedicine (where the sender stores the information databases and sends it to the receiver at a convenient point of time, and the receiver can review the data according to his convenience.
- Remote Monitoring type of telemedicine, also known as self-monitoring or self-testing. Remote monitoring uses a range of technological devices to monitor health and clinical signs of a patient remotely. According to the interaction between the individuals involved:
- Health professional to health professional (giving easier access to Specialty care, referral and consultation services).
- Health professional to patient (providing healthcare to the unreached Population by giving them direct access to a medical professional).

8. APPLICATIONS:

8.1. EDUCATIONAL [17, 28]

- Tele-education: A flexible and interactive long distance learning programme providing easier training and updates of the recent advances for more accurate and effective treatment methods.
- Tele-Conferencing: Discussion and interaction between doctors during workshop, conferences, seminar or continual medical education programs in a virtual room environment.
- Tele-Proctoring: Mentoring and evaluation of surgical trainees from distance with the involvement of sophisticated video-conferencing equipment.
- Healthcare Delivery [29]
  School-Based Health Centres: Helps manage chronic conditions like bronchial
  Asthma, diabetes and obesity. Telemedicine allows a school nurse, remote access to specialist medical opinion.
- Correctional Facilities: Cater to the healthcare needs of the inmates without the expense and dangers of inmate transportation or the need for a specialist doctor to enter.
- Mobile Health Clinics: Provides quick access to a remote physician or medical specialist.
- Shipping and Transportation: Helps avoid evacuations and unscheduled diversions during a medical emergency.
- Industrial Health: Provides medical management and triage advice on-site.
- Healthcare Management [2,17]

✓ Tele-health care: Use of ICTs for preventive and primitive healthcare; it is further divided into teleconsultation and tele-follow up.
✓ Tele-home health care: Monitor patients from a central station (Remote patient monitoring) with the help of a Computer Telephone Integrated (CTI) system for 24 hour vitals monitoring.
✓ Specialties like tele-ophthalmology, tele-psychiatry, tele-cardiology, and tele-surgery.
✓ Diagnostic services like tele-radiology and tele-endoscopy.
✓ Screening of Diseases (30,31)

Examples:

- Diabetic screening project by MDRF: The Chunampet Rural, Diabetes Prevention Project.
- Ophthalmology screening by Aravind Hospitals at Andipatti village.

8.2, DISASTER MANAGEMENT [17]:

A mobile and portable telemedicine system with satellite connectivity and Customized telemedicine software is ideal for a disaster stricken region where all other modes of connectivity are disrupted.
Examples:

- NASA tele-medicine services provided during 1985 Mexico City earthquake and 1988 Soviet Armenia earthquake. [7]
- Amrita hospital tele-medicine services provided during 2004 Tsunami disaster. [32] Role in family medicine with the advent of modern information and communication technologies (ICTs), telemedicine is now migrating health care delivery from hospitals and clinics into homes, both nationally and globally. [33] It facilitates remote patient monitoring with the help of a CTI system enabled for 24 hour vitals monitoring. [17] CTI system allows the family physicians to closely monitor chronically ill patients and receive live vitals alerts when required. When needed, telemedicine also allows a family physician, remote access to specialist medical opinion for cross consultation.[29] A good example would be consulting a cardiologist in order to reconfirm a doubtful ECG or consulting a nutritionist to formulate an idea diet plan for an elderly bed-ridden patient with multiple co-morbidities. Tele- health differs from telemedicine in that it

involves the use of telecommunications and virtual technology to deliver health care outside of traditional health-care facilities. An example would be, virtual home health care, where patients who are chronically ill or the elderly may receive guidance in certain procedures while remaining at home.[34] Tele-health. Services can be of 4 types[35], namely, video conferencing, store and forward, m-health (mobile health) and patient monitoring. In spite of having so many promising traits or assisting family physicians, telemedicine is yet to reach its full potential in family medicine practice. Lack of relevant scientific literature showing the applications and cost-effectiveness of its utilization in family Practice is proving to be the main restriction.

9. Role in Public Health:

The technology involved in telemedicine allows providers and patients to be almost anywhere, this is one of the key factors in providing quality healthcare to the needy. With the advent of telemedicine, distance is no longer a hurdle in providing healthcare to the remote areas.[17,29] The initial challenge for the commencement of the programme posed by the lack of a primary centre for practicing telemedicine services in many remote areas was resolved with the kickoff of mobile telemedicine units with satellite communication.[29] Now, telemedicine services can be made available to all irrespective of time, place, social status or gender. Gujarat Govt.'s e-health scheme,[36] Aravind eye hospital's tele-ophthalmology unit at Andipatti,[31] the concept of village resource centre (VRC) by ISRO[26] are all examples of India's steps towards pioneering in telemedicine services.

10. CONCLUSION:

Seven cases were successfully completed and transmitted using the protocol described during two surgical missions to Ecuador in 2002. In June of 2002, four cases were transmitted, consisting of two general anesthesia and two spinal anesthesia. Three general anesthesia cases were added. Operations consisted of cholecystectomies, herniorrhaphies, and lipoma resections.

The following Figure illustrates the screen and information available to observers on both ends of the connection. *(By now technology and treatment methods have exponentially improved and are saving numerous lives all over the world.)*

The development of low bandwidth telemedicine technology brings the ability to reach out to medically and economically disadvantaged countries that lack medical goods and services. The development of the low bandwidth technology compared with the more traditional high bandwidth enables the use of telemedicine facilities even in areas with poor telecommunication facilities. While low bandwidth operates on a normal telephone line, high bandwidth needs broadband lines that are extremely hard to come by in rural areas and also in developing countries. However, telemedicine cannot be the answer to all problems, but it can be very important in addressing a vast range of problems. Services like tele-health, tele-education and tele-home healthcare are proving to be wonders in the field of healthcare. The importance of satellite communications is emphasized in the field of disaster management when all terrestrial modes of communication are disrupted. International telemedicine initiatives are bringing the world closer and distance is no

longer a barrier in attainment of quality healthcare. Despite having so much potential still telemedicine has not attained the 'boom' which it was meant to create. Lack of awareness and acceptance of new technology both by the public and the professionals are holding it back. Governments are now starting to take a keen interest in developing telemedicine practices resulting in a slow but steady rise in its utilization in public health. Hopefully in a few years, telemedicine practices will reach their true potential.

11. SUGGESTION:

It is strongly suggested that Governments of All the countries should immediately provide dedicated attention to the advancement of telemedicine especially in view of natural disasters like Earth quakes, Cyclones & Covid-19; provide funds, incentives and make it a national priority. It will not only enhance the overall medical treatment but definitely will save many lives all over the world especially in the remote regions having no medical facility much less a hospital.

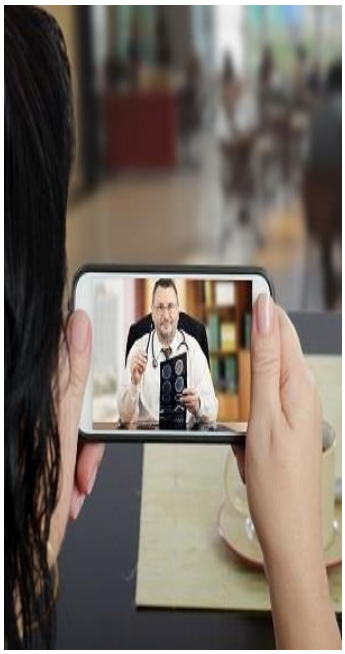
Financial support and sponsorship: Mandatory.

Conflicts of interest: No conflict of interest.

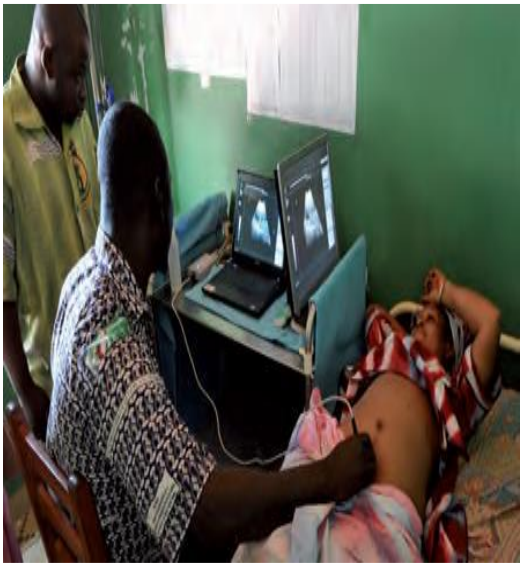
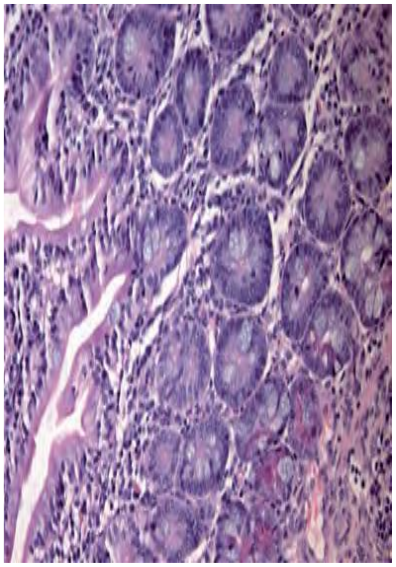
What is the minimum equipment one needs to start a telemedicine centre?

(1) A Good Webcam;
(2) Reliable High-Speed Internet;
(3) A Failover Line; (4) SD WAN
(5) Optional Optimization Tool
(6) Digital Medical Scopes and Accessories;
(7) Tablet(s); (8) Visual Aids






PAN AFRICA INAGURATION: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