

## DEVELOPMENT OF A TELE- STETHOSCOPE: INDIAN PERSPECTIVE

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**Abstract-** Many attempts have been made to develop digital stethoscope for diagnosing auscultation. This study is part of current research project being undertaken at the University of Southern Queensland, Australia. The project addresses the issue associated with telehealth care system, through the development of a digital stethoscope. The objective of this article is to report the user's satisfaction with the information received from the existing digital stethoscope and guide the researchers to adjust its content to the best benefit to those uses the new improved digital stethoscope. University of Southern Queensland, Australia has developed a digital stethoscope composed of software and hardware components and user friendly. The system will be priced competitively and can be used both for telehealth diagnosis and for teaching of cardiology to medical students. The lack of specialized devices and professionals can be minimized with the adoption of solutions, such as this one. This could improve the diagnostic ability of remote clinics at a lower cost and avoid long hour travel.

### I. INTRODUCTION

The famous Time Magazine has called telemedicine as healing by wire. In brief, telemedicine means the use of medical expertise, medical equipment, computer hardware and software, telecommunication infrastructure and internet as a system. Another way to define telemedicine is organizing and integrating information technology in such a way that resources outside the local organization can be used systematically in the activities of health services [10].

Today telemedicine is an advantage to mankind. Secondary and tertiary medical facilities are not available at many places. Hence the primary health care centre has been facilitated by the expert's opinion from a distance place. The scheme is of store and forward type of telemonitoring [11]. In many cases, the local physician could have carried out the treatment of such patients by taking advice from a specialist from a distant place, provided the telemedicine link would have been made available to him.

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In general, there is a tendency of the medical specialists to practice their profession in big cities, where there is a major cluster of the population. This has made medical care sub optimal at most of the places, especially in suburban and rural areas. Telemedicine has become an integral part of health care service in all developed countries including UK, USA, Canada, Italy, Germany, Japan, Greece, Norway and Russia. Its importance has very well been realised by the other countries and it is now being developed and implemented also in developing and underdeveloped countries including India [6].

About 11% of the world's population, which reside in the rural areas of India, remain devoid of quality healthcare [8] In India, where there is shortage of good medical facilities in rural areas, the emerging trend is to provide solution to health care problems via telemedicine. Majority of the population (72.2%) in India are living in isolated villages [3] Telemedicine shortens the distance and put even the rural and remote areas close to the best medical centres, which are generally located in big cities. It partially relieves the pressure on the health care management due to less number of physicians in the rural areas and makes available the most advance medical facilities everywhere. Web based telemedicine solutions are gaining popularity owing to low cost and universal availability of internet. The systems are developed in such a way that an expert physician can monitor the patient stationed at a distant location, and at the same time may even consult some other experts for second opinion. While everyone needs quality medical services, the only way to reduce the costs is to increase its efficiency. This demands maximum utilization rate of the medical equipments and medical personnel and minimization of the non medical expenses of the clinic [5, 12] Thus, telemedicine is a very efficient and effective global health care solution in times to come. Presently, nations are connected together in order to engage them in such projects for the benefit of the people.

Despite countries like the USA that spend over USD 7000 per capita and still the healthcare issues remain unaddressed; the medical expenses in India are approximately one-tenth of that of USA [9]. So just spending more on healthcare does not solve the problem. Hence pro-activeness and innovation in healthcare delivery is needed to address the issue. The major issue is to reduce healthcare cost, avoid chronic disease burden

and increase positive outcomes. Telehealth should be used as the de facto point of care tool for timely disease management. The channels of delivery must also reach pharmacies and other channels nearer to the patients' proximity. Thus telehealth is the only economically viable way to address the elderly population, rural areas, preventive care, chronic diseases and increasing healthcare costs within current limitations.

## II. LITERATURE REVIEW

Stethoscopes have been used as part of the initial evaluation of all patients. An experienced physician can diagnose a large number of clinical conditions from the auscultation of the patient's chest. Stethoscope is the first clinical tool used by medical students. Many attempts have been to develop devices for the teaching of auscultation. One such device is phono-mechano cardiograms that display the cardiac sounds and impulses [4]. This device is surpassed by other non-invasive diagnostic devices such as Doppler echocardiography [13]. Since 1960, researchers focus on the development of special stethoscope [1]. Some of the devices developed allowed group of people to hear the cardiac sounds simultaneously but the intensity of sound is less as many tubes are connected to a single machine [2]. In 80s electronic stethoscopes with various degrees of amplification and filters were launched [7]. However these electronic stethoscopes face distortion of sound. The reliability of tele-health was envisaged since the 90s'. Most research findings show that tele-health is a safe and low cost technology. The osculation of the cardiac sounds is an important part of tele-medical application in cardiology. A biomedical circuit designer was proposed to study the sounds of stethoscopes and to develop an appropriate circuit [7].

Auscultation of the heart sounds is a difficult task. That is particularly so in tele-health scenarios. This is due to sound quality, real-time connectivity, transmission speed and positioning of the stethoscope on the patient's body. Based on these investigations the research project aims to report the user's satisfaction with the information received from the existing digital stethoscope and guide the researchers to adjust its content to the best benefit to those uses of the new improved digital stethoscope.

## III. METHODOLOGY

A qualitative approach was employed to get the primary data from the healthcare professionals, both practitioners and telehealth professionals. This is followed up with an observation technique which infers the issues associated with the existing digital stethoscope and its use in a telehealth settings. While using the stethoscope, a video and audio recording was conducted to capture user's opinion on using the stethoscope. Further interviews were conducted to clarify the needs and priorities of the users and guide the researchers to adjust its content to the best

benefit to those uses the new improved digital stethoscope.

## IV. FINDINGS

The pilot study indicated that the use of digital stethoscopes created echo. The echo sound created a dilemma among the doctors about the source of noise. There is also a delay in the echo. The quality of sound is also distorted due to body noise and friction. When addressed to the users of digital stethoscope the following findings can be highlighted

### Longevity of the equipment

- Wear and tear is high. The equipment lasts for only one year or less than a year.
- The tubing should be tropicalised
- Battery longevity is less. Weekly, battery has to be replaced. It is causing inconvenience to replace the battery during the diagnosis

### Target audience

- Medical students: First medical tool that a medical student must master.
- Medical Professors: While teaching, individual opinion is not correct. While recording the heart sound, one hears multiple sounds. Digital stethoscope helps to identify the various sound and could be discussed in detail with the students and also time saving.
- Clinical cardiologist: Diagnose a large number of clinical conditions from the auscultation of the patient's chest. Some doctors opine that stethoscope is not of much use as supporting investigating equipments such as ECG, ECHO etc are available. But doctors also argue that when the patients come for review stethoscope is a must. Digital stethoscope will be more useful.
- Institutions: Hospitals purchase in bulk for their doctors. They could be educated about the new equipment. Individual doctors may not afford the cost. But institutions can afford it.
- Tele- health centers: This could improve the diagnostic ability of remote clinics at a lower cost and avoid long hour travel. The auscultation of the cardiac sounds is an important part of tele-medical application in cardiology.

### Pricing

- Doctors opine that institutions can afford any price (Price does not play a major role in the selection of the equipments).
- Teaching professional suggest a price of Rs 30000
- A group of individual doctors opine that if the equipment is in the range of Rs 20,000, 50% of the

doctors will buy and if the equipment is in the range of Rs 10,000, 80% of the doctors will buy.

Disadvantages in the existing digital stethoscope

- Non-tropical tubing
  - IR port: Attracts other IR usage thereby the sound is distorted. The latest laptops do not have an IR receiver. Sometime the port doesn't work
  - No provision to connect with Echo, ECG etc in a tele-health set up.
  - The patient proximity to the system is very close
- Brand
- One doctor uses JAPES brand, he suggest it is not user friendly
  - A tele-health manager said the brand TELVAT has replaced the IR with USB which is more convenient and there is no loss of sound. But he opines this brand has no amplifier hence it could not be used in the tele-health setup.

General

- The usage is cumbersome
- Nowadays patients demand evidence based medicine. Here digital stethoscope is more useful.
- More useful during diagnosing obese people
- Patients are thrilled while the doctors use the digital stethoscope.
- Doctors suggest the digital stethoscope to be equipped with heart rhythm recorder and a miniature echo.
- Some doctors opine that in future only digital stethoscope will be in use.
- Some doctors feel the sound is very clear

## V. CONCLUSION

From the discussion it is understood that though the doctors are aware of the product, majority of them haven't used it. Hence awareness and demonstration about the product has to be created. A comparative statement on features among the existing brand can be furnished. The experts opine that the requirement of the device from their end is less. They feel that from the patient end this product will be more useful. The existing brand TYCOS is preferred by the cardiologist to record the auscultations. How different is our product to the existing one has to be probed and has to reach the customer. Based on this the Unique Selling Proposition (USP) has to be developed to launch the product. Users expect the product to be user friendly. Some doctors have one but not using it. We have to find the reason behind it. The positioning strategy to target audience has to be developed. In India the tele medicine centre is the link between two doctors (clinic and an expert at institution). The price is to be fixed at a lower range for bulk

purchase. Some additional schemes like discount is been expected. Users expect service of the product to be made available. This research is work in progress due to this fact that there are other phases to this research project. Though some practitioners opined the usage of stethoscope in decreasing order, overall practitioners are optimistic about the new venture. The challenge today is not confined to overcoming technological barriers, but as which technology is to be implemented and at what cost.

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