

Medical student's perception of electronic stethoscope designing and its use as a learning tool

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Abstract: *Introduction:* In Indian educational setting, clinical examination is taught to Ist M.B.B.S. students in physiology. In auscultation, generally an acoustic stethoscope available in the market is used. It will be, however, interesting to teach auscultation with the help of electronic stethoscope, where they can amplify, record and playback various sounds. Secondly, there is scope of electronic stethoscope in rural setup and telemedicine. As learning through electronic stethoscopic auscultation will better equip students for future and the cost of available digital stethoscope is high, we decided to construct electronic stethoscope and use it in our educational setting and study the perception of electronic stethoscope designing and use in learning and clinical practice. *Method:* Acoustic stethoscope, rubber tubing, condenser mic, headphone cable with 3.5 mm jack, laptop and audacity software. The undergraduate students were demonstrated with the construction of electronic stethoscope, recording and playback of various sounds with it. A questionnaire based on the objectives of use and implication of electronic stethoscope was prepared, the responses obtained were analysed using MS-Excel. *Results:* Most of the students were comfortable using electronic stethoscope, now they can confidently identify the sounds in clinical practice, they also felt it should be used in regular undergraduate teaching. Many agreed that compared to traditional stethoscope, electronic stethoscopic auscultation give better judgment, and also the korotkoff sounds are better appreciated with it. *Conclusion:* We found that electronic stethoscope can be easily constructed and should be used for undergraduate teaching in a medical college.

Keywords: Auscultation, Electronic Stethoscope, Medical Education.

Introduction

In Indian educational setting, clinical examination is taught to Ist M.B.B.S. students in physiology laboratory. The clinical examination of any system is mostly taught under the headings of Inspection, Palpation, Percussion & Auscultation. In auscultation, generally an acoustic stethoscope available in the market is used and the aspects of examinations are taught. There is generally a presumption of the sounds which we are using verbally to describe is understood and perceived by the auditory system of the students. There is tremendous increase in use of smartphones by healthcare professionals as well as the general public [1-3].

The smartphone is a new technology that combines mobile communication and computation in a handheld-sized device, facilitating mobile computing at the point of care. The available digital stethoscope in the market can be used with desktop, laptop, tablet and smartphones.

In some institutes, to better explain the sounds to be auscultated, the audio files on internet websites of stethoscope manufacturer such as thinklab & litmann are incorporated in teaching. To enhance further understanding and clinical importance, auscultation assistant website of University of California, Los-Angeles is also a superb resource. It will be, however, interesting to teach auscultation with the help of electronic stethoscope, where they can amplify, record and playback various sounds. Secondly, there is scope of use of electronic stethoscope in rural setup and telemedicine.

The cost of digital stethoscope is quite high and the sophisticated instruments like phonocardiogram, echocardiograms are not only having escalated cost but also require trained manpower and specialized setup. In a resource limited setting, it is prudent to use electronic stethoscope as it is cost-effective, easy to make, handle and manage. As learning

electronic stethoscopic auscultation will better equip medical students for future and the cost of available digital stethoscope is high, we decided to construct electronic stethoscope and use it in our educational setting. We also studied the perception of students towards use of electronic stethoscope in learning and practice in medicine.

Material and Methods

Part I: To demonstrate the construction of electronic stethoscope and its use in medical education requires following:

Materials required:

- 1) Acoustic stethoscope
- 2) Rubber tubing
- 3) Condenser mic
- 4) Headphone cable with 3.5 mm jack
- 5) Laptop
- 6) Audacity software which is a freeware

Construction: The chest piece of acoustic stethoscope is to be detached. One end of rubber tubing is attached to chest piece and to the other end condenser mic is fitted. Condenser mic can be purchased at local electronic store or mic from computer headset along with its wire can be used. If mic is locally purchased the headphone cable with its 3.5 mm jack is to be soldered to the mic terminals. The electronic stethoscope is now ready and can be plugged into the mic port of the laptop. Laptop should be installed with audacity software which is a freeware on internet. The constructed electronic stethoscope is shown in Figure 1.

Figure-1: Constructed Electronic Stethoscope



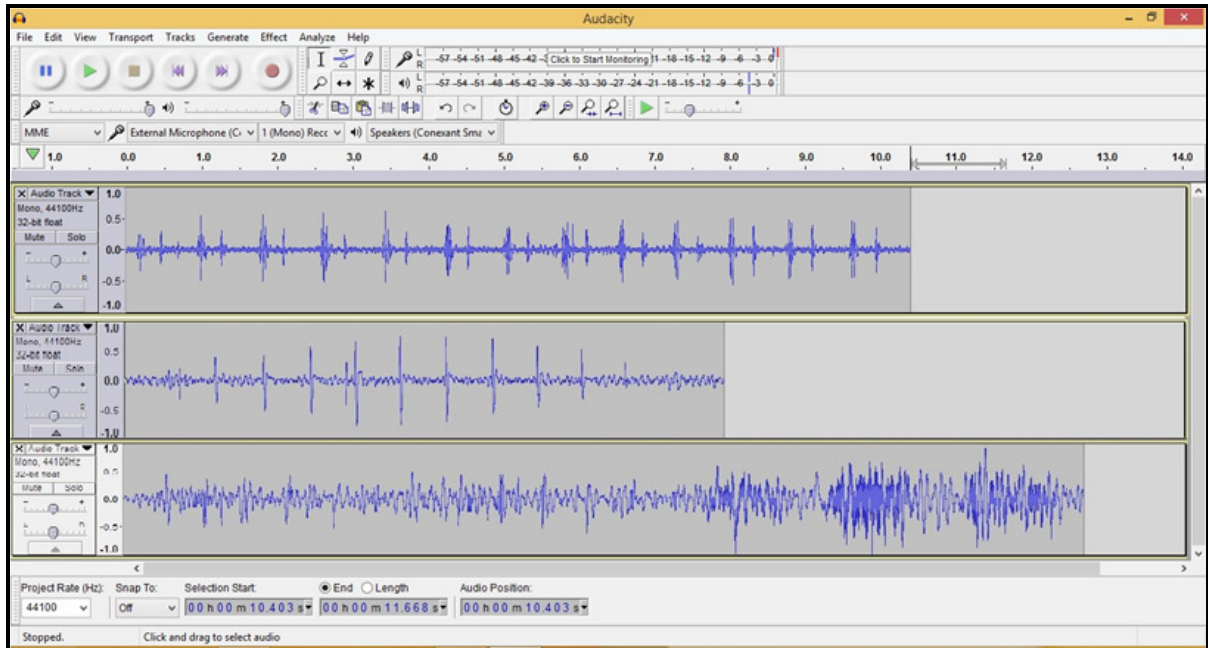
Methodology: After the construction is complete, plug the 3.5 mm jack into the mic port of the laptop and start the audacity software. Place the chest piece on the required part to record the desired sounds, just click the record button and the recording is started, the waveforms of the recorded sounds can be seen on the screen. To hear the recorded sounds click on the play button, the sounds are better heard on earphones. Audacity software also has various options to amplify, edit, and apply various filters in the area of interest of the recorded sounds as per need. It is better to record the sounds without connecting the charger to the laptop to avoid electric interference and for safety precautions. The recorded sound can be saved and shared with any number of people....

Part II: It was a cross-sectional, face to face questionnaire based study. Institutional ethical committee permission was obtained. The sample size was 76. The sampling technique was snowball and convenience sampling. The subjects were undergraduate students from Lokmanya Tilak Municipal medical college. The study duration was 6 months. A questionnaire based on the objectives of use and implication of electronic stethoscope was prepared. The questionnaire was validated. Reliability and internal consistency of questionnaire was determined by using Cronbach α test in a pilot study. Cronbach α value for the questionnaire was determined to be 0.86. This is > 0.7 , which indicates acceptable internal consistency [4-6]. The responses obtained were analysed using MS-Excel and expressed as percentage.

Results

Part I: Demonstration of how to use electronic stethoscope: The undergraduate students were demonstrated with recording and playback of various sounds with electronic stethoscope thus constructed. The students were quite interested in knowing about the design and construction of the stethoscope. Some of the recordings obtained during demonstration are shown in Figure-2.

Figure-2: Recording of Heart Sounds, Korotkoffs Sounds and Breath Sounds



Part II: Analysis of questionnaire: The analysis of questionnaire is summarized in tables 1, 2 & 3.

Table -1: Perception of students towards electronic stethoscope and auscultatory skills					
Questions on electronic stethoscope and auscultatory skills	Not at all	Some confidence/ Comfortable	Average confidence/ Comfortable	Confident/ Comfortable	Highly Confident/ Comfortable
How confidently can you identify the auscultatory sounds you encounter in clinical practice?	1.31 %	7.89 %	34.21 %	36.84 %	23.68 %
How comfortable are you with electronic stethoscope?	1.31 %	2.63 %	22.36 %	34.21 %	39.47 %

Table-2: Perception of students towards electronic stethoscope as a learning tool			
Questions on electronic stethoscope as a learning tool	Yes	No	May be
Do you feel it should used in regular teaching?	81.58 %	0 %	18.42 %
Does it improve your understanding for various auscultatory sound?	97.37 %	0 %	2.63 %
Do you require training in handling electronic stethoscope?	39.47 %	28.95 %	31.58 %
Have you heard of telemedicine and use of electronic stethoscope in it?	30.26 %	61.84 %	7.89 %
Will it be relevant for your practice in future?	86.84 %	2.63 %	10.53 %
Electronic stethoscope should be regularly be used in undergraduate teaching	71.05 %	3.95 %	25 %

Table-3: Comparison of auscultation with conventional versus electronic stethoscope

Questions on conventional versus electronic stethoscope	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Compared traditional stethoscope, electronic stethoscopic auscultation give better judgement	0 %	7.89 %	11.84 %	55.26 %	25 %
As against conventional stethoscopy, the korotkoff sounds are better appreciated in electronic stethoscope	1.31 %	0 %	13.16 %	60.53 %	25 %

Discussion

The stethoscope is an acoustic medical device for auscultation of an animal or human body, often used to auscultate to lung and heart sounds. It is been used to listen to intestines and blood flow in arteries and veins, and commonly in combination with a sphygmomanometer, it is used in the measurement of blood pressure. It is familiar, harmless, portable, and inexpensive, but the sound heard through the stethoscope depends on three main factors: actual sound (vibrations) produced by organs, perception of sound by the human ear (psychoacoustics), and acoustics of the stethoscope itself [7].

The principle of stethoscope was first applied in the 19th century by Rene Theophile Hyacinthe Laënnec, a French physician, who in 1816 invented the stethoscope [8-12] as an experimental creation to avoid an embarrassing situation while examining a female patient [8]. Using this new instrument, he investigated the sounds made by the heart and lungs and established that his diagnoses were supported by the observations made during autopsies [11, 13].

Despite its late invention, the importance of listening to a patient’s chest was first noted in 370 BC by Hippocrates and described by two others prior to the invention of the stethoscope [13]. It has since undergone several modifications with the noteworthy inventions of the diaphragm by Rober Bowles (1926) and the bell in 1961 by Lithmann [14] with many different types including the electronic or digital one existing today [11]. Over the years, stethoscope has become more than just a tool used for

examination but serves as a symbol of identity associated with the physician [7-8].

Several authors have reported that merely reading textbooks and lectures do not improve performance on acquiring auscultatory skills [15]. Currently, although the curricular theory of medicine courses associates theoretical to practical training, the learning process has been increasingly focused on theory and assessment of learning through written tests, leaving little space to practice on the bedside [16]. Electronic stethoscope is simple to construct, it can be used to record various sounds like heart, lungs, bowel etc. The similar idea of electronic stethoscope was floated by Anand Bhaskar who not only designed one of such stethoscope but also found it useful for undergraduate teaching [17].

In the present study, not only demonstration of construction and use but perception of students towards use of the electronic stethoscope was studied. Most of the students were comfortable using electronic stethoscope (Table 1). Now, they can confidently identify the sounds in clinical practice (Table 1). Many felt it should be used in regular teaching particularly undergraduate (Table 2). Using electronic stethoscope will improve their understanding of various auscultatory sounds (Table 2).

As this is a tech savvy generation, not many felt any need for training, in handling of electronic stethoscope (Table 2). Not many had heard of telemedicine and use of

electronic stethoscope in it (Table 2). Many students felt that it will be relevant for their future practice (Table 2). Many agreed that compared to traditional stethoscope, electronic stethoscopic auscultation provide better judgment (Table 3). Many also agreed that as against conventional stethoscopy, the korotkoff sounds were better appreciated in electronic stethoscope (Table 3).

Impact of study: It is a very useful tool where sophisticated instruments like phonocardiogram and echocardiogram are not available. We can record the sounds or the pre-recorded sounds of heart, korotkoff's, sounds can be demonstrated to undergraduate students in a simple way. This will help the students for better understanding of the

auscultatory sounds before they actually listen them and correlate clinically. Hence the electronic stethoscope can be easily constructed and used in routine teaching of auscultation to the undergraduate students. However, faculty perception should also be studied regarding their use in teaching and practice in Indian setting to better understand its implications and challenges. Further use of electronic stethoscope may be studied.

Conclusion

We found that electronic stethoscope can be easily constructed in resource-limited settings and may be used as a learning tool for undergraduate teaching in a medical college.

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