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GTM4Health

Market Insights

Digital Stethoscope:

An Overview

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Overview

Cardiovascular disease (CVD) is recognized as the leading cause of mortality in countries throughout the world, and thus, timely detection, treatment, and prevention are the cornerstone of the comprehensive care that a physician provides to his/her patients.

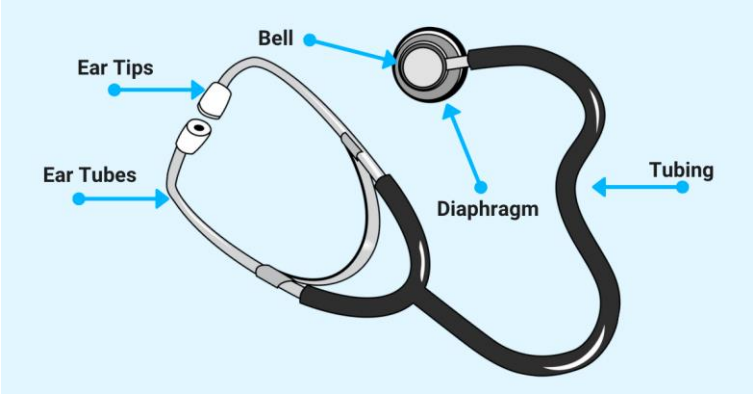
CVD was responsible for 31.8% of all deaths and 14.7% of Disability Adjusted Life Years (DALYs) globally in the year 2017.

As of the year 2017, **CVD was responsible for 26.6% of total deaths and 13.6% of total DALYs in India**, compared with 15.2% and 6.9% (6.3–7.4), respectively, in 1990. The India State-level disease burden study of the global burden of disease (GBD) study group reports that there has been a 2.3-fold increase in the prevalence of both ischemic heart disease (IHD) and stroke in the country between 1990 and 2016.4

The study also reports a greater than two-fold increase in the number of prevalent cases of CVDs, from 25.7 million in 1990 to 54.5 million in 2016.
These, however, seem to be conservative estimates considering the high burden of risk factors in India.

Henceforth, heart auscultation, defined as listening to the heart sound, has been a very important method for the early diagnosis of cardiac dysfunction.

Stethoscope, a medical instrument used in listening to sounds produced within the body, chiefly in the heart or lungs. The instrument was invented by the French physician R.T.H. Laënnec, who in 1819 described the use of a perforated wooden cylinder to transmit sounds from the patient's chest to the physician's ear. This monaural stethoscope was modified to more convenient forms, but it has been largely supplanted by the binaural type with two flexible rubber tubes attaching the chest piece to spring-connected metal tubes with earpieces.



Picture 1: Main components of conventional stethoscope
Ref: https://www.respiratorytherapyzone.com/parts-of-a-stethoscope/

The emergence of digital stethoscope

The emergence of digital/electronic stethoscopes has opened a new field named "computer-aided auscultation". With the recent developments in the technology, from acoustic sensor design, advanced digital signal processing to the computer based machine learning techniques, the acoustic based automatic diagnosis of cardiac dysfunction by electronic stethoscope has attracted much attention in recent years.

A digital stethoscope changes sound into electronic signals, which can be made louder for better hearing. These signals can then be sent to a computer. It has three parts that handle the data before the listener can hear the sound.

The digital stethoscope consists of three different modules, data acquisition, preprocessing, and signal processing, before the listener can appreciate the auscultated sound.

Picture 2: Main components of digital stethoscope
Ref: https://biomedical-engineering-online.biomedcentral.com/articles/10.1186/s12938-015-0056-y

Digital Stethoscope

Electronic stethoscopes utilize advanced technology to overcome these low sound levels by electronically amplifying body sounds. Electronic stethoscopes require conversion of acoustic sound waves obtained through the chest piece into electronic signals which are then transmitted through uniquely designed circuitry and processed for optimal listening. The circuitry consists of components that allow the energy to be amplified and optimized for listening at various frequencies. The circuitry also allows the sound energy to be digitized, encoded and decoded, to have the ambient noise reduced or eliminated, and sent through speakers or headphones.

Picture 3: Digital Stethoscope

Technology Advancement

One of the primary drivers that is expected to drive the global health market during the forecast period. Healthcare specialists are using electronic stethoscopes with bluetooth wireless capability to get the best results while monitoring their patients. Digital stethoscopes can magnify recorded sounds and review them on a visual display. The signal processing module aids in the classification and collection of data for diagnostic purposes.

Digital stethoscopes allow users to choose from a number of frequency response modes, making it easier to assess sounds from lungs, heart and other body part. Record and replay features of digital features help medical professionals retain medical information.

Extensive Usage of Digital Stethoscope in Hospitals and Primary Centres

Based on end-user, the hospitals, & primary centres segment accounted for the largest global market share in 2021. Rise in adoption of technologically advanced products in hospitals and primary centres in driving the segment.

The sounds that digital stethoscope records can also be stored. This helps in reviewing a patient's conditions over time in hospitals.

Some digital stethoscopes have wireless connectivity that enables doctors to share the results with other medical professionals or review them later. Demand for digital stethoscopes is rising among specialists as well as general hospital physicians across the globe.

Features and Functions

Electronic stethoscope design can be any number of variations on the traditional acoustic stethoscope design.

- **Power:** Utilize AC 120 V power cords rather than batteries. They do have a light that indicates they are powered on. The two digitizing units on the market have no internal power supply and no on/off switching capability other than plugging and unplugging the units.

- **Auto-Shutoff:** Utilize AC power and do not have auto-shut off and do not employ any power saving features. As they do not have batteries, digitizing stethoscopes do not have the same need to automatically turn off. The digitizing stethoscopes will never turn off mid-examination. If the plug should come unplugged during an examination, the user will know automatically because the sound will stop transmitting and the LED indicator will turn off.

- **Volume Control & Amplification:** Digital stethoscopes take the collected acoustic sound energy from the chest piece and convert it into electrical energy. As the converted voltage is sent through the electronic stethoscope's internal circuitry, it encounters an amplifier component. This amplifier has the ability to take in small amounts of energy and convert the signal to increase the sound output. The majority of the electronic stethoscope units have volume buttons or a volume dial.
  It can be located on the chest piece, on a module incorporated in the tubing, or directly on the stethoscope module itself. Some of the modules offer a visual or audio indicator of the volume level currently in use, while others do not.

- **Chest Piece:** Most stethoscopes will typically have some sort of button or switch to electronically switch between frequency filtering (listening modes). Some digital stethoscope chest pieces may also utilize a tuneable diaphragm or may require physical changing of the bell and the diaphragm. This switching of modes is simply filtering the frequency being heard, which is explained further in the frequency section. There is one model of electronic stethoscope on the market that requires the

user to plug and unplug the chest piece module from the stethoscope unit to change between transmit and receive modes.

- **Tubing:** is remarkably similar to acoustic stethoscope tubing in general; however there are some notable variations. Some models incorporate modules that are mounted in or around the tubing, where the circuitry for the sound conversion is located. The basic principles of tubing length and thickness are the same in electronic stethoscopes as they are in acoustic stethoscopes. Other models' tubing may internally contain additional circuitry and transducers for sound conversion. Some models do not use a traditional tubing design at all, opting instead for electronic cords.

- **Ear Tips:** Ear tip designs in digital stethoscopes often utilize the same principles as their acoustic counterparts; however, some stethoscope designs are significantly different. The most outstanding difference is that some models of electronic stethoscope do not even contain ear tips. Some of the electronic stethoscopes allow the user to use headphones. It is important to note on this topic that most of the headphones included with the stethoscopes currently on the market have sub-optimal sound quality. This is especially true for the "ear bud" style of headsets that are inserted into the ear.

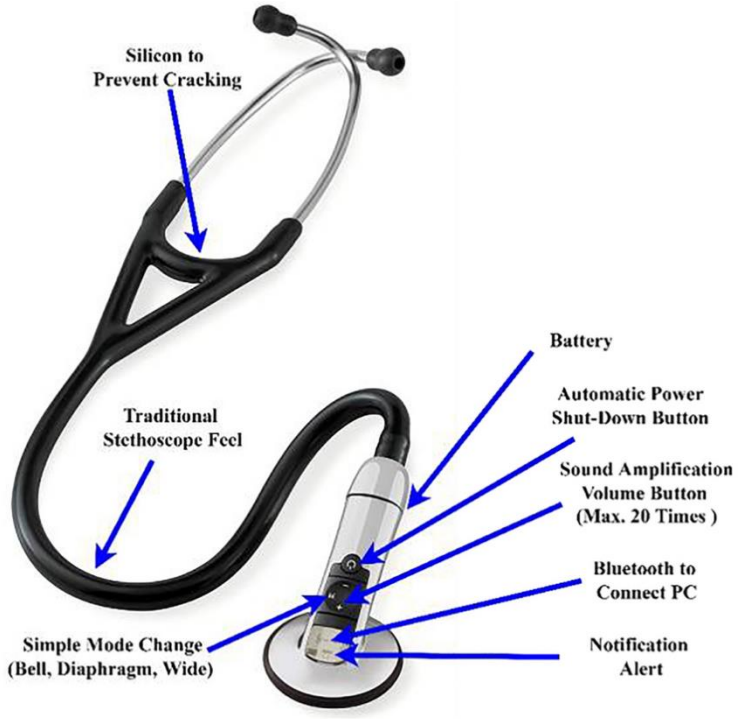
- **Frequency:** The full range of human hearing extends from 20-20000 Hz. The accepted frequency range of human heart sounds is about 20-200Hz and the accepted frequency range of human lung sounds is about 25-1500Hz. Most of the electronic stethoscopes on the market offer Bell mode, Diaphragm Mode and an Extended Range mode. Extended Range is usually referred to as wide, extended, or organ mode. For the most part, each electronic stethoscope has a button or switch to change between modes. The button or switch for changing frequency or mode can be located on the chest piece, on a module incorporated in the tubing, or directly on the stethoscope unit itself.

- **Ambient Noise Reduction:** Ambient noise enters the stethoscope both through the air and through the patient's body. Ambient noise can passively be reduced through the principles of ear tip insertion pressure, ear tip seal, ear tip insertion angle and

good stethoscope design. However, in the case of active ambient noise reduction, the ambient noise is cancelled using technology.

- **Audio Quality:** Digital stethoscopes are 96% more efficient in relation to sound /audio clarity and loudness.

- **Different Stethoscopes for Different Purposes:** Cardiology, pediatric, or general with the feature of audio filters you can change between the cardio, pulmonary or wide. However, for lung and cardiac examinations, one must use a stethoscope that provides superior sound quality. A digital stethoscope just makes these switches very simple.



Picture 4: Parts of Digital Stethoscope
Ref: https://www.researchgate.net/figure/Digital-stethoscope-to-collect-the-sample-respiratory-sound-data_fig1_378851573

Potential Use

Digital stethoscopes have great use potential in telemedicine programs. Digital stethoscopes can take the physical assessment process, a traditionally face-to-face encounter, and enable it to take place over great distances. This is pretty remarkable, considering that just about 150 years ago medical practitioners had to place their ear directly on their patient's body to do a physical assessment.

There are three basic ways the electronic stethoscopes currently on the market can be used. They can be used at the bedside as standalone amplifying stethoscopes; they can be used in conjunction with a software program to send audio clips asynchronously or in a store and forward fashion; they can be used to transmit auscultation data real time over video-conferencing networking, or by a direct network connection to one another.

Key Players in Market

1. **Aisteth:** Ai Health Highway is an Ai-first company focused on making the screening of chronic disease cost effective at primary care clinics - the first point of contact for any patient. AiSteth, an Ai-enabled smart stethoscope has the potential to screen, detect and predict heart and lung disorders using state-of-the-art signal processing and ML capabilities.

2. **AyuSynk:** India's first Indigenous Digital Stethoscope aided by BIRAC, DBT-Government of India. They aim to assist the healthcare professionals with the best screening tool, having the potential to impact millions of lives in the country. Timely diagnosis of cardiac and pulmonary abnormalities will lower sudden and premature deaths.

3. **Ekohealth:** Passionate about finding better ways to understand the heart, constantly expanding the knowledge through thoughtful research and study. They are focused on providing clinicians and health systems opportunities to elevate their patient care with our advanced stethoscope technology.

4. **Saintiant Technologies:** team of technocrats and medical professionals working closely to redefine healthcare with their digital stethoscope product range "spanda" to promote healthier outcome and saving lives.

Summary

A digital stethoscope is an advanced medical device that enhances traditional stethoscope functionality by converting acoustic sound waves into digital signals.

This technology offers several benefits, including improved sound amplification, noise reduction, and the ability to record and store auscultation sounds. Key features and advantages of digital stethoscopes include enhanced sound quality, noise reduction, record, playback, visualization, telemedicine integration, data storage, analysis, and user friendly.

Abbreviations

Abbreviations	Full Form
CVD	Cardiovascular disease
DALYs	Disability Adjusted Life Years
GBD	Global Burden of Disease
IHD	Ischemic Heart Disease
AC power	Alternating Current
LED	Light Emitting Diode
Hz	Hertz
BIRAC	Biotechnology Industry Research Assistance Council
DBT	Direct Benefit Transfer

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