IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 10 Ser.4 (October. 2020), PP 23-29
www.iosrjournals.org

Crossroads: Conventional stethoscope training or modern handheld instruments for advanced medical education?

Prerna Upadhyaya[1] , Ranbireshwar Thakur[2] , Raman Grover[3] , Anshu SS Kotia[4] , Jaswant Goyal[5] , Madhumati Verma[6] , Ravi Singodia[7], Shishir Kumar[8] , DhakanJayraj Manish[9] , Shelja Singh[10] , Kanupriya Bhargava[11] , Priyanshi Ashokbhai Joshi[12]

1Professor & Head, Pharmacology, & Asst Director, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
2 Final year MBBS student, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
3Assistant Professor, Dentistry, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
4Associate Professor, Anesthesia, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
5Associate Professor, Pharmacology, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
6Assistant Professor, Gen Medicine, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
7Tutor, Pharmacology, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
8Associate Professor, Anatomy, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
9Final year MBBS student, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
10 Final year MBBS student, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
11 Final year MBBS student, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India
12 Final year MBBS student, Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur, Rajasthan, India

Abstract:
Background*: Clinical exposure is the highlight of medical education. A paradigm shift is required in the medical education structure to make clinically sound doctors. We undertook this study to ascertain whether the stethoscope still remains the main instrument for auscultation in medical education and or should it, with passing time, be replaced by modern Hi-tech Hand-held gadgets*
Materials and Methods*: A web-based survey was conducted on medical students and doctors comprising of multiple choice and short answer questions to assess their knowledge, clinical utility pattern, accuracy in diagnosis and their opinion on relevance of stethoscope in future. 56 students and 55 physicians answered the survey form. Written informed consent was obtained from the IEC of the institute.*
Results*: All the students were final year MBBS students, mean age was 22.3 years, while 35 Physicians and 20 Anesthetists responded; their mean age was 38.3 years. 82% students had purchased the stethoscope by second year. 71% students had knowledge about the various brands and models and the most popular stethoscope was Littman. 94% students answered that stethoscope can be a useful tool for Lung, heart & Abdominal auscultation. 71% students said that stethoscopes are an accurate modality. When asked whether the stethoscope should be replaced by newer methods of auscultation, 71.4% students and 63.6% doctors were of the opinion that it should be replaced by newer modern handheld instruments. 60% doctors think that their residents cannot use the stethoscope with reasonable accuracy. 78.2% doctors felt that knowledge and experience is important for accuracy and precision of diagnosis on auscultation.*
Key Word*: Stethoscope, handheld ultrasound, Competency based curriculum, Medical education in India.*

Date of Submission: 28-09-2020 Date of Acceptance: 10-10-2020

I. Introduction

The most important part of an art is to be able to observe properly

- René-Théophile-Hyacinthe Laënnec (1781–1826)[1]

Medical Education is undeniably a key factor that impacts the growth and development of a country as well as its future.[2] Earlier medical curriculums based on Flexnerian ideals dictated that students move from laboratory sciences to clinical rotations through successive terms.[3] Fueled by hyper-rationality meant to be reformative and effective at that time, this method lead to rote learning among students and gave rise to a growing inability to integrate what they learned in didactic lectures, and what they actually saw in real patients.[4]

A call for advocating integrative approaches was realized. Presently, it has paved the way to vertical and horizontal integrative teaching standards.[5, 6] Teaching hospitals are now meant to provide the much-needed stimulus through patient-physician interaction. Early clinical exposure, patient simulations, OT visits and research based clinical care reinforces a sense of dream fulfillment and comparatively offers a much more rewarding experience for medical students. [7-10] Physical examination and clinical skill with basic instruments such as the stethoscope has been taught to medical students through didactic sessions, bedside demonstrations, and standardized patients.[11]These skills represent one of the most important diagnostic tools imparted to newer generations of medical students and trainees. It is found to impact patient care, early disease diagnosis and treatment plans, and it also impacts the overall satisfaction perceived by the patient. [12] As a learning tool, the stethoscope, for over 200 years, has held a primal role in the medical sciences for physicians and students alike. Ever since its invention in 1816 by Laennec, who defined and interpreted the human body's acoustic phenomena, it is considered by many to be the cornerstone of evaluation through auscultation.[13] Conventionally, auscultation provides important clinical findings that form the basis of proposing further investigations or examinations to guide a patient's treatment and prognosis.[14]

This grand old device today however, faces an uncertain future, with its utility and relevance being questioned in the wake of rapid technological advancements being made in the fields of radiology and imaging. The divergence of views in the value of the stethoscope as a primary bedside diagnostic tool is quite evident.[15] According to *Dr Jagat Narula*, cardiologist at the Icahn School of Medicine at Mount Sinai Hospital in New York "The stethoscope is dead and its time has gone" [16], while for others the stethoscope is still the state of the heart technology [17] that maintains the all-important physician-patient bond [18], indispensable even in the current CoViD-19 pandemic.[19]

Choosing between today's non-invasive investigational modalities (Ultrasonography, Electrocardiography, Echocardiography, Computed Tomographic (CT) scan, Radioisotope scans, and Magnetic Resonance Imaging) and the time-tested stethoscope is a challenge the modern-day currently faces. One can say that the capability of early diagnosis offered by these newer modalities have devalued the use of the conventional stethoscope. Moreover, the emergence of "computer-aided auscultation" with electronic stethoscope has attracted much attention to the new field in recent years.[20]

In this background, the current study was taken up to ascertain the knowledge of stethoscope-use and its utility among medical students and professionals and, to study the preference between auscultation and modern non-invasive investigational modalities among medical students and professionals.

II. Material And Methods

Study Design: Ours was a descriptive, cross sectional study conducted in the month of May 2020. Two separate web-based surveys comprising of multiple choice and short answer questions were developed to assess the knowledge, usage pattern, auscultatory skills and relevance in the future, of the stethoscope as a primary bedside diagnostic modality, among medical students and professionals. One questionnaire was for the medical students and the second questionnaire was for practicing physicians. Close ended questions were prepared in English from review articles. It took approximately 10 minutes to complete. The Questionnaire consisted of demographic information, questions to test to the knowledge of stethoscopes as a diagnostic modality, its utility, various brands, pattern of usage and whether or not they need to be replaced with modern Hi-tech investigative modalities.The survey form was circulated on social media platforms to 150 students and 100 physicians. 56 students and 55 physicians willingly responded.

Ethical Considerations: Written informed consent was taken from the respondents before their participation in the study and strict protocol was followed to maintain the confidentiality of their responses. Ethical approval was obtained from the JNUIMSRC's Research & Ethics Committee.

Statistical Analysis: All data was entered in MS Excel Spreadsheet. Analysis was done by using Epi Info 7.2.1.0 version. Categorical Variables was expressed as frequency and percentage. P value was calculated for comparison between students and physicians. P value <.05 was taken as Significant.

III. Result

A total of 55 Physicians and 56 Students responded to the survey form and thus were included in the study.

Demographic characteristics: All the students were Final year MBBS students studying in Jaipur National University Institute for Medical Sciences and Research Centre, Jaipur. The mean age of students was 22.3 years, out of 56 students, 32 were females and 24 were males.
In the doctors' group, out of 55 total, there were 35 General Physicians and 20 Anaesthetists. The mean age of doctors was 38.3 years. Out of 55, there were 17 females and 38 males.

Table 1 shows the Demographic data of Physicians and Table 2 shows the Demographic data of students.

Table no 1: Demographic data of Doctors

		Anesthetists (N=20)	**Physicians (N=35)**	**Total (N=55)**	**Mean Age**	**P value**
Age group (years)	**<40**	11 (55%)	24 (68.6%)	35 (63.6%)		0.561
	40-54	5 (25%)	7 (20%)	12 (21.8%)	38.3 years	
	55-69	4 (20%)	4 (11.4%)	8 (14.5%)		
Gender	**Female**	8 (40%)	9 (25.7%)	17 (30.9%)		0.424
	Male	12 60(%)	26 (74.3%)	38 (69.1%)		

Table no2:Demographic data of students

		N	Mean Age	% (out of 56)
Age group (years)	**20 – 25 years**	54	22. 3 years	96.4
	25 – 30 years	2		3.6
Gender	**Female**	32		57.1
	Male	24		42.9

Usability of Stethoscope as a clinical tool
Students (Table 3)

All the students had purchased the stethoscope, 39.3% bought in 1st year, 42.9% bought in second year, 14.3 % bought in 3rd year and only 3.6% bought in final year of MBBS. As the students start with their clinical postings, hence, almost 82% students bought it by the 2nd year of MBBS.

When asked about their knowledge of brands and models of the stethoscopes, 71.4% had the knowledge about various brands and models, but 28.6% had no knowledge about the brands and models. Littmann was the most commonly known brand at 71.4%. When questioned about the usability of stethoscope in various types of auscultations, 94.6% replied that stethoscopes are useful in Lung, Heart and abdominal auscultations. When asked whether stethoscopes are an accurate modality for diagnosis and treatment of a disease, 71.4% said that they can be an accurate modality.

Table no3: Stethoscope related practices of Medical students

		N	% (out of 56)
How many owned a stethoscope?		56	100
When did you purchase your stethoscope?	MBBS 1st year	22	39.3
	MBBS 2nd year	24	42.9
	MBBS 3rd year	8	14.3
	MBBS final year	2	3.6
How often do you use a stethoscope while examining a patient?	In every patient	7	12.5
	In most patients	18	32.1
	In some patients	31	55.4
Do you know about the various brands/models of stethoscopes?	No	16	28.6
	Yes	40	71.4
Name brands of stethoscopes you know of	Littmann	40	71.4
	Classic	1	1.8
	Adscope	2	3.6
	ADC600	6	10.7
	Diamond	1	1.8
	Rossmax MDF	2	3.6
	Easy Care	1	1.8

	WilchAlyn Harvey	1	1.8
	Microtone	1	1.8
	MDF	3	5.4
	Omron	2	3.6
	Dr Morepan	7	12.5
	Dr Odin	2	3.6
	Vkare	1	1.8
	Pulse wave	1	1.8
	Life line	1	1.8
	Eko	1	1.8
	Rajeshx	1	1.8
	Shristi	1	1.8
	Indo surgical	4	7.1
	Dr Trust	1	1.8
	Passionate care	2	3.6
	Microtone	1	1.8
Stethoscopes are of use in	All of the above	53	94.6
	Lung and cardiac auscultation	3	5.4
Do you think auscultation is an accurate modality for diagnosis and treatment of a disease?	No	16	28.6
	Yes	40	71.4

Doctors (Table 4)

40% doctors think that their residents can use the stethoscope with reasonable accuracy while 60% think that they cannot. 78.2% doctors felt that knowledge and experience is important for accuracy of diagnosis on auscultation.

56.4% doctors feel that treatment cannot be started solely on the basis of auscultatory findings. In other important modalities required for starting the treatment, are Chest X ray (21.8%), Lab investigations (20%) and 2d Echo (10%).

Table 4: Stethoscope related practices of doctors

		Anesthetists (N=20)	**Physicians (N=35)**	**Total (N=55)**	**P value**
Do you think that your residents can use their stethoscopes with reasonable accuracy?	**All / Most**	10 (50%)	12 (34.3%)	22 (40%)	0.463
	Many of them can	7 (35%)	14 (40%)	21 (38.2%)	
	Some / None of them can	3 (15%)	9 (25.7%)	12 (21.8%)	
On which factor do you think the precision of auscultatory findings most depend upon	**Auscultation is an objective tool**	1 (5%)	5 (14.3%)	6 (10.9%)	0.568
	Brand/Model of stethoscope	2 (10%)	1 (2.9%)	3 (5.5%)	
	Experience	1 (5%)	1 (2.9%)	2 (3.6%)	
	Experience and Knowledge both	16 (80%)	27 (77.1%)	43 (78.2%)	
	Knowledge	0	1 (2.9%)	1 (1.8%)	
Can treatment be started solely on the basis of auscultatory findings?	**No**	11 (55%)	20 (57.1%)	31 (56.4%)	0.898
	Yes	9 (45%)	15 (42.9%)	24 (43.6%)	
What other modality would you require to start treatment?	**CXR**	5 (25%)	7 (20%)	12 (21.8%)	0.926
	2D Echo	3 (15%)	3 (8.6%)	6 (10.9%)	0.657
	ABG	1 (5%)	0	1 (1.8%)	0.364
	ECG	1 (5%)	1 (2.9%)	2 (3.6%)	1.000
	Lab investigation	4 (20%)	7 (20%)	11 (20%)	1.000
	History and clinical examination	2 (10%)	1 (2.9%)	3 (5.5%)	1.000
	USG	2 (10%)	1 (2.9%)	3 (5.5%)	1.000

Can stethoscope be replaced? (Table 5)

71.4% students say that stethoscope should be replaced by more objective methods of examination, while 63.6% doctors say that stethoscope should be replaced by more objective methods of examination. Although this observation is not statistically significant, yet it is important from clinical point of view.

For other modalities, which can replace stethoscope for auscultation are 2D ECHO gets maximum percentage followed by Hand held USG devices and Electronic gadgets.

Table no 5: Comparison between Doctor and Medical students regarding attitude towards utility of stethoscope

		Doctors (N=55)	Medical students (N=56)	P value
Can stethoscope be replaced by a more objective method of auscultation?	No	35 (63.6%)	40 (71.4%)	0.500
	Yes	20 (36.4%)	16 (28.6%)	
What other modalities can replace the stethoscope?	2D Echo	10 (18.2%)	3 (5.4%)	0.071
	Possible new small devices	2 (3.6%)	2 (3.6%)	0.623
	Chest X-ray	4 (7.3%)	1 (1.8%)	0.349
	USG	3 (5.5%)	5 (8.9%)	0.733
	Hand held USG	2 (3.6%)	2 (3.6%)	0.623
	CT / MRI	2 (3.6%)	1 (1.8%)	0.987
	Spirometry	1 (1.8%)	0	0.993

IV. Discussion

This study was conducted with the main objective to assess the knowledge, utility and relevance of stethoscopes in the present medical education system by means of a web-based survey which was put up to medical students and professionals.In India, the clinical postings start by second year of MBBS, hence 82% students had purchased the stethoscope by second year. 71% students had knowledge about the various brands and models. The most popular stethoscope brand came out to be Littman.94% students answered that the stethoscope is a useful tool for auscultation of the lungs, heart and abdomen.71% students considered it to be an accurate modality. Bagot et al in their study reported that medical students are not exposed to concept of inter-relatedness of scientific, social, professional and interpersonal elements in the beginning of their medical education.[21] This could be the possible reason for their false perception of a stethoscope's accuracy when in fact, they have not put it to use on that many number of patients that is enough to gain experience to qualify as being accurate.

When asked whether the stethoscope should be replaced by newer methods of auscultation, 71.4% students and 63.6% doctors were of the opinion that it should be replaced by modern handheld instruments.In Indian medical curriculum, the students are not exposed to better modalities of diagnosis like Ultrasonography (USG) in the early stages of their education. This is in stark contrast to medical schools in the US where hand held USG devises are made a part of the 1st year curriculums in anatomy blocks. Ireson et al in their study reported that first-year medical students found the handheld ultrasound devices and Insonation to be a valuable tool in learning and understanding of three-dimensional anatomy and how it appears on a diagnostic imaging modality. This prompted eagerness from the students, to engage in structured longitudinal learning who preferred this approach to self-directed learning in other blocks.[22]

Current propositions indicate that the use of a handheld ultrasound, or insonation, will become a fifth pillar of the bedside examination in addition to the inspection, palpation, percussion and auscultation.[23] Although the need to prepare physicians adequately for such technological advances that affect the current state of primary care has been a concern for the medical education programs, various surveys have confirmed that teaching medical students to use handheld ultrasound is not just expedient but it also, compliments conventional physical examination skills[24] and markedly improves diagnostic accuracy.[25] Medical students with only limited training in insonation, in support of Kobal et al study, demonstrated greater diagnostic accuracy compared to the board-certified cardiologists while performing traditional cardiac examination with stethoscopes. [26] With the advent of newer diagnostic technologies and at the rapid pace our medical sector is undergoing change, the need for early introduction of these instruments becomes only logical. A complete abandonment of conventional modalities like the stethoscope might not seem feasible but to augment these traditional examination practices with modern marvels such as Ultrasonography will only prove to be beneficial in our sense of patient care.[27] Educators continually attest that we 'must be proactive and stay ahead of this exciting and rapidly expanding technology to keep the 21st century students engaged'.[28]

A key observation made in our study was that 60% physicians claimed that their residents could not use the stethoscope with reasonable accuracy. 78.2% physicians felt that both knowledge and experience is important to attain accuracy of diagnosis by auscultation. This finding coincides with those of Billelo et al who found a noticeable decline in physical examination proficiency despite conventional educational techniques and significant attention[29] and Mangione et al who reported an alarmingly low identification rate for 12 important and commonly encountered cardiac events among internal medicine and family practice trainees.[30]

From an educational point of view, the new competency-based curriculum for medical graduates put forth by The Medical Council of India (MCI) is a crucial milestone for medical education in India, [31] it represents a paradigm shift. Hailed as an attempt to modernize medical education, it is laudable step by the Council that is in match with recent global trends.[32-34] Where the old curriculum was a time-based summative

evaluation that focused on knowledge building through organization on systems and disciplines, the competency-based learning in contrast, emphasizes on the skills required for a better medical practice and more sensitive patient care. The learning focuses on the critical competencies needed for success in clinical practice and provides standards and framework for measuring performance. [35, 36]

As relevant as this study may seem, it is not without its many limitations. The sample size is much smaller than what can be considered adequate to represent the results with a fair amount of accuracy. Reasons like lack of funding, overworked healthcare systems and general lack of accessibility due to stringent lockdown policies, have contributed to the limited sampling of this study. If this study were to be reconducted in the future, a more accommodative and representative study design would be the precursor that would make certain a better sampling size whose data analysis would call for a combined approach of qualitative and quantitative methods to overcome selection biases.

V. Conclusion

The present study concludes that there is both a desire and an urgent need to move on to modern hand-held instruments or gadgets for better clinical understanding that enables medical students and professionals to reach a diagnosis that is both early and more accurate. Introduction of Hand-held devices into the official curriculum will definitely fulfill the overall objective of Competency-based learning that has been initiated through early clinical exposure in India by the MCI from 2019.

References

[1]. Rene-Theophile-Hyacinthe Laennec. Catholic Encyclopedia. https://www.catholic.com/encyclopedia/rene-theophile-hyacinthe-laennec

[2]. Anshu, Supe A. Evolution of medical education in India: The impact of colonialism. J Postgrad Med. 2016;62(4):255-259. doi:10.4103/0022-3859.191011

[3]. Barkin SL, Fuentes-Afflick E, Brosco JP, Tuchman AM. Unintended consequences of the Flexner report: women in pediatrics. Pediatrics. 2010;126(6):1055-1057. doi:10.1542/peds.2010-2050

[4]. Duffy TP. The Flexner Report--100 years later. Yale J Biol Med. 2011;84(3):269-276.

[5]. Shoemaker B.J.E. Integrative Education: A Curriculum for the Twenty-First Century.OSSC Bulletin. 1989; 33(2): n2. [Google Scholar]

[6]. Harden R.M. Approaches to curriculum planning. Med Educ. 1986; 20(5): 458–466. [PubMed] [Google Scholar]

[7]. McLean M. Sometimes we do get it right! Early Clinical Contact is a rewarding experience. Education for Health. 2004;17(1):42–52. [PubMed] [Google Scholar]

[8]. Nimkuntod P, Kaewpitoon S, Uengarporn N, Ratanakeereepun K, Tongdee P. Perceptions of Medical Students and Facilitators of an Early Clinical Exposure Instructional Program. J Med Assoc Thai. 2015;98 Suppl4:S64-S70.

[9]. Kar M, Kar C, Roy H, Goyal P. Early Clinical Exposure as a Learning Tool to Teach Neuroanatomy for First Year MBBS Students. Int J Appl Basic Med Res. 2017;7(Suppl 1):S38-S41. doi:10.4103/ijabmr.IJABMR_143_17

[10]. Dehghan A, Amini M, Sagheb MM, Shidmoosavi SM, Nabeiei P. Early clinical exposure program in learning renal physiology. J Adv Med Educ Prof. 2017;5(4):172-176

[11]. Mookherjee S, Pheatt L, Ranji SR, Chou CL. Physical examination education in graduate medical education--a systematic review of the literature. J Gen Intern Med. 2013;28(8):1090–1099

[12]. Feletti GI, Carney SL. Evaluating patients' satisfaction with medical students' interviewing skills. Med Educ. 1984;18(1):15–20.

[13]. Evora PRB, Schmidt A, Braile DM. Even Considering the Existing High Technology, Do Not Forget That the Old Stethoscope Is Still a Useful Tool for the Heart Team. Braz J Cardiovasc Surg. 2018;33(3): I-II. doi:10.21470/1678-9741-2018-0603.

[14]. Montinari MR, Minelli S. The first 200 years of cardiac auscultation and future perspectives. J MultidiscipHealthc. 2019; 12:183-189. Published 2019 Mar 6. doi:10.2147/JMDH.S193904.

[15]. Van der Wall EE. The stethoscope: celebration or cremation after 200 years? Neth Heart J. 2016; 24(5):303-305. doi:10.1007/s12471-016-0826-6

[16]. Has the stethoscope had its day? https://www.theguardian.com/society/2016/jan/09/stethoscope-cardiology-doctor-outdated-auscultation

[17]. https://tgwhf.ca/stories/for-many-doctors-stethoscope-is-still-state-of-the-heart-technology/

[18]. Fredricks T. Point-of-care ultrasound: It's no replacement for the stethoscope. J Fam Pract. 2016;65(10):734]

[19]. Vasudevan RS, Horiuchi Y, Torriani FJ, et al. Persistent Value of the Stethoscope in the Age of COVID-19 [published online ahead of print, 2020 Jun 19]. Am J Med. 2020;S0002-9343(20)30508-8. doi:10.1016/j.amjmed.2020.05.018

[20]. Leng S, Tan RS, Chai KT, Wang C, Ghista D, Zhong L. The electronic stethoscope. Biomed Eng Online. 2015;14:66. Published 2015 Jul 10. doi:10.1186/s12938-015-0056-y

[21]. Bagot KL, Lawson M, Jolly B, Mc Call L, Bearman M, Lewis B, et al. International Approaches To Undergraduate Clinical Training, Commissioned by Policy and Strategic Projects Division, Department of Human Services, Monash University, Medicine Nursing. Health Science Journal. 2005. Accessed from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.125.6518&rep=rep1&type=pdf.

[22]. Ireson M, Warring S, Medina-Inojosa JR, et al. First Year Medical Students, Personal Handheld Ultrasound Devices, and Introduction of Insonation in Medical Education. Ann Glob Health. 2019;85(1):123. Published 2019 Oct 15. doi:10.5334/aogh.2565.

[23]. Narula J, Chandrashekhar Y and Braunwald E. Time to add a fifth pillar to bedside physical examination: Inspection, palpation, percussion, auscultation, and insonation. JAMA Cardiol. 2018; 3: 346–350. DOI: https://doi.org/10.1001/jamacardio.2018.0001

[24]. Dinh VA, Frederick J, Bartos R, Shankel TM and Werner L. Effects of ultrasound implementation on physical examination learning and teaching during the first year of medical education. J Ultrasound Med. 2015; 34(1): 43–50. DOI: https://doi.org/10.7863/ultra.34.1.43

[25]. Decara JM, Kirkpatrick JN, Spencer KT, et al. Use of hand-carried ultrasound devicesto augment the accuracy of medical student bedside cardiac diagnoses. J Am SocEchocardiogr. 2005; 18(3): 257–263. DOI:https://doi.org/10.1016/j.echo.2004.11.015

[26]. Kobal SL, Trento L, Baharami S, et al. Comparison of effectiveness of hand-carried ultrasound to bedside cardiovascular physical examination. Am J Cardiol. 2005; 96(7): 1002–1006. DOI: https://doi.org/10.1016/j.amjcard.2005.05.060
[27]. Ultrasound and stethoscope as tools in medical education and practice: considerations for the archives Francis A Fakoya 1 , Maira du Plessis 1 , Ikechi B Gbenimacho Adv Med EducPract, 2016 Jul 13;7:381-7. , doi: 10.2147/AMEP.S99740
[28]. Lane N, Lahham S, Joseph L, Bahner D, Fox J. Ultrasound in medical education: listening to the echoes of the past to shape a vision for the future. Eur J Trauma EmergSurg2015; 41: 461– 7.
[29]. Bilello LA, Dubosh NM, Lewis JJ, Hall MM, Fisher J, Ullman EA. Fourth-year medical students do not perform a focused physical examination during a case-based simulation scenario. Adv Med EducPract. 2018;9:583-588. Published 2018 Aug 17. doi:10.2147/AMEP.S160701
[30]. Mangione S, Nieman LZ. Cardiac auscultatory skills of internal medicine and familypractice trainees. A comparison of diagnostic proficiency.JAMA.1997;278(9):717–722.
[31]. Medical Council of India. Competency Based Undergraduate Curriculum for the Indian Medical Graduate. 2018. [Last accessed on 2019 Mar 05]. pp. 1–3. Available from: https://www.mciindia.org/CMS/information-desk/for-colleges/ug-curriculum .
[32]. Frank JR, Mungroo R, Ahmad Y, Wang M, De Rossi S, Horsley T. Toward a definition of competency-based education in medicine: A systematic review of published definitions. Med Teach. 2010;32:631–7. [PubMed] [Google Scholar]
[33]. General Medical Council. Tomorrow's Doctors: Recommendations on Undergraduate Medical Education. London: GMC; 2003. [Google Scholar]
[34]. Pearson DJ, McKinley RK. Why tomorrow's doctors need primary care today. J R Soc Med. 2010;103:9–13. [PMC free article] [PubMed] [Google Scholar]
[35]. Charles L, Triscott J, Dobbs B, Tian PG, Babenko O. Effectiveness of a core competency-based program on residents learning and experience. Can Geriatr J. 2016;19:50–7. [PMC free article] [PubMed] [Google Scholar]
[36]. Nousiainen MT, McQueen SA, Hall J, Kraemer W, Ferguson P, Sonnadara R. Resident education in orthopedic trauma: The future role of competency-based medical education. Bone Joint J. 2016;98:1320–5. [PubMed] [Google Scholar]

Prerna Upadhyaya, et. al. "Crossroads: Conventional stethoscope training or modern handheld instruments for advanced medical education?." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(10), 2020, pp. 23-29.