

# The advantages and obstacles of implementing an ultrasound curriculum in medical schools: a Brazilian perspective.

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**Abstract.** Ultrasound is a safe and portable tool that allows physicians to visualize anatomical structures and diagnose pathologies. Its use has expanded to multiple medical specialties, and even non-radiologist physicians are increasingly employing it for diagnosis and guidance. These data demonstrate the importance, for physicians, of learning how to handle and understand the equipment, thus making the teaching of ultrasound essential in medical schools. This paper aims to review the literature for evidence of the importance of an ultrasonography curriculum in medical schools, how medical students are learning ultrasound and POCUS worldwide and how it can be applied in medical schools in Brazil. It was found that echography is becoming an essential part of medical education, especially in developed countries, as it is qualified equipment for accurate diagnoses and monitoring of various diseases and health conditions. The lack of a standardized ultrasound training program in Brazilian medical schools is noted, and this review demonstrates potential methods for implementing such a program. Examples of successful ultrasound curricula in other countries are presented, including peer mentoring and online training. The benefits of integrating ultrasound into medical school curricula are highlighted, including improved diagnosis and therapeutic guidance, as well as enhanced learning opportunities for medical students.

**Keywords.** Ultrasound, medical students, medical schools.

## 1. Introduction

Ultrasonography has become an important and resourceful tool in medical practice, since it allows professionals to picture and understand anatomic structures and pathologic variations, being one of the reasons why it is used by physicians in many different fields, from Radiology to Obstetrics-Gynecology. Furthermore, when compared to magnetic resonance imaging and computed tomography, ultrasound represents a safer option, as it minimizes radiation exposure and can be a portable device to make a bedside assessment of patients. Nowadays, the knowledge to operate the equipment and understand the images has already

been considered extremely important and it has been applied by non-radiologist physicians in intensive care, internal medicine, emergency medicine, and surgery, providing a more reliable diagnosis and therapeutic guidance.

In addition, echography imaging can be applied not only in clinical practice but also in a teaching setting [1] [2], to help medical students learn anatomy, physiology, and physical examination. Some studies have concluded that in the not-so-distant future, portable ultrasound can substitute the stethoscope [3] when it comes to a basic physical examination. Therefore, considering the relevance of knowing how to perform ultrasound imaging and understanding its results, it is necessary to

comprehend how physicians are being trained in ultrasonography, from medical school to residency programs.

From a Brazilian perspective, there is a lack of information regarding how ultrasound is taught to medical graduates and physicians. In the country, the approach to ultrasound education tends to be training programs that lack a quality standard. For that reason, the purpose of this study is to understand how medical students are learning ultrasound and POCUS around the world and how it can be applied in medical schools in Brazil, to standardize this knowledge among medical professionals.

## 2. Background

There are many possible ways to implement an echography curriculum in medical schools. However, integrating the technology in question into the medical school curricula is no easy task, in terms of the difficulty of finding trained professionals in ultrasound to teach and the obstacle of the amount of capital necessary to invest in quality supplies and equipment. Among the specialist professionals capable of teaching ultrasound courses, radiologists are the first choice for many programs. However, it has been noted that since ultrasonography is being used by many different medical specialties, it is not all up to the radiology department to implement the training programs in medical schools, evidencing the importance of a multidisciplinary professor team [4].

In the Ohio State University College of Medicine, an ultrasound vertical curriculum was implemented from the first to the fourth year of medical school. In the first year, students were taught basic physics regarding the equipment and how to identify basic anatomical structures in the image. In the second medical school year, students were taught the limitations of the equipment, such as artifacts, and variations in its use, while learning how to use the technology in clinical guidance. In the third and fourth years, students were already able to identify advanced indications for ultrasound use in different clinical scenarios, graduating from medical school to perform ultrasonography in their daily practice as future specialist physicians, in whichever fields they had chosen. The Ohio State vertical curriculum, for example, could be used as a model for other schools to implement ultrasound education for medical students, as it was a successful study to determine that ultrasound can be used as a teaching tool in addition to a clinical and procedural device [2].

As for a teaching method, peer mentoring could be used to overcome the cost obstacle in many schools and countries. A study [5] applied an online and practical ultrasonography course taught by five medical students in their 5th year, who were trained by experienced physicians, to 24 other students. Subsequently, there was an assessment to verify the success rate of the course, and it was proven that

medical students can teach colleagues after a training period.

A recent study [6] randomizing 47 medical students into regular in-person teaching and peer-instructed teleguidance also showed promising results, with proficiency tests applied at the end of the programs. It was discovered that the peer-instructed teleguidance group had an overall similar performance compared to the in-person group, which could represent a more cost-effective way to incorporate ultrasound teaching in medical schools.

Furthermore, from students' perspectives on curricular ultrasound education, a German study [7] showed that there is a high interest in echography among medical students. Among the listed barriers for the students was the lack of a planned curriculum and courses run by medical faculty. In addition, peer-instructed teaching was considered an effective method by 70.3% of the participants, which increases the possibility of adding peer teaching to an ultrasound curriculum model.

Other universities around the world have also implemented mandatory echography training for medical students, which has led to significant outcomes. A study conducted on medical students with no prior ultrasound knowledge after providing a 5-hour Focused Assessment with Sonography for Trauma (FAST) course has found that being introduced to ultrasonography while still in medical school was well received by the students, with 85% of the participants establishing the ability to perform FAST screenings in under 6 minutes. Furthermore, 92% of the students believed echography training should be a part of the curricula, with all of them intending to seek ultrasound formal training [8].

From a Brazilian perspective, a survey regarding the students' assessment of the teaching of point-of-care ultrasound was conducted [9]. 70 medical students from Juíz de Fora Federal University (UFJF) without previous ultrasonography knowledge participated in the study and all of them declared that POCUS can be an extension of the physical exam, which helps to integrate anatomical, physiological, and clinical knowledge. The group also stated that they would like more insertion of ultrasound in their medical school.

As for residency programs, Emergency Medicine, Obstetrics-Gynecology, Internal Medicine, and Radiology residency training in ultrasonography is already required. Although recommended for General Surgery and Anesthesiology, it is still not widely spread [2]. Thereby, it's up to each professional to pursue the training by themselves to manage and benefit from the technology. The laboriousness needed to learn and properly apply ultrasonography hinders its spread among older healthcare professionals, who during their training years didn't have the opportunity to learn the wonders of the stethoscope of the future. Therefore, the introduction and practice of echography/sonography/ultrasonography side by

side with the medical education system are necessary to prepare and insert capable professionals into the health system.

A strategy that could be implemented to spread and enhance the learning of POCUS in medical school curricula is the handheld ultrasound device [2] [10] [11]. This type of portable US, despite offering an imaging quality inferior to laptop-associated devices, can be a key tool in the learning process around the medical universe. A study conducted to evaluate a Certificate POCUS program offered by the American Society of Anesthesiologists has found that these devices are less expensive, more portable, and a great ally of online teaching [11]. The handheld devices can be connected to a wide range of apparatus, such as Smartphones and Tablets, and most of them can store and share the images and frames visualized by the device and send them directly, for example, to a teacher or a colleague. Thereby, its use provides the opportunity for remote and online teaching that can be easily used by medical students in learning institutions without nearby experts in Ultrasonography.

### 3. Discussion

It has already been proven important for physicians to have ultrasound experience in all different medical fields, not only in Radiology or Emergency Medicine [2]. Ultrasonography can represent an extension of a clinical assessment, helping in diagnosis, prognostics, and treatment of health conditions, without excluding an extensive physical examination. However, even after considering the relevance of this tool, there is still a lack of an echography teaching program in medical schools, making it up to each student to learn in unstandardized courses, without quality control. Therefore, this knowledge should be taught to medical students still in medical schools, so that future graduate medical professionals are already capable of performing thorough and effective ultrasound evaluations in their practice.

From an academic perspective, most students demonstrated a high interest in learning how to perform ultrasonography [7] [9], such as POCUS and FAST protocols, and considered it relevant for the medical daily practice, independent of what area of practice they would follow once graduated. Ultrasound is the future of diagnosis and screening diseases because of how fast it can be used, its practicality, and its safety for the patient. It is a non-invasive technology with no radiation and allows healthcare professionals to use this equipment at the bedside. In this way, it is clear how valuable it will be to master the science of using ultrasonography tools in the daily care routines of these future physicians.

In Brazil, the knowledge and the application of this innovative imaging technology are still a lot of steps behind when compared to more developed countries [13], which possess more financial resources and incentives to promote research. On the other hand,

ultrasound represents a cheaper and safer option for the health system to invest in all around the country, as it is portable, radiation-free, diagnostic-valuable, and less expensive than other imaging modalities such as computed tomography and magnetic resonance imaging.

There still are many obstacles to the implementation of an ultrasound curriculum in medical schools, such as the need for a high-cost investment in equipment and supplies, a trained multidisciplinary physicians team able to teach, and a planned course, considering the application in the different years of medical education. To overcome some of these problems, the use of peer tutoring [5] [6] as a teaching method could exclude the need for hiring a new team of professionals, as it has been proven to be efficient and cost-effective and represents a cheaper option for institutions in developing countries. In addition, handheld ultrasound devices can be used alongside online teaching of POCUS, without the need for a nearby expert or an expensive traditional ultrasound machine, being a less-expensive option in both ways [10] [11]. As for a teaching model according to the many levels of medical education, in the first and second years, echography could be mostly used to help in the understanding of anatomy and physiology, applied to ultrasound images of the human body. In the last years, students are already capable of performing anamnesis and physical exams and identifying different pathologies, so the tool can be used as a diagnostic resource alongside clinical evaluation and examination. [2] [12].

However, there is a lack of information available regarding if there is an ultrasound curriculum currently being applied in medical education around Brazil. It was found that Juíz de Fora Federal University (UFJF) was one of the first Brazilian institutions to have an ultrasonography curriculum applied to medical students [9], using US-based teaching models. Thus, further research is necessary to know more about how Brazilian medical schools are teaching echography to their students and to develop a model program to be implemented around the country, to ensure a quality standard of echography practice among future physicians.

### 4. Conclusion

After all the gathered information, it was concluded that ultrasonography is moving towards becoming an essential part of medical education, participating in the learning of basic medical sciences to being an important tool in the diagnosis and treatment of many health conditions. This imaging modality represents a less-expensive and more-accessible option, especially in developing countries such as Brazil. However, even after the undeniable importance of the tool, there is still a deficiency in terms of a standard echography curricular degree to be implemented in medical schools. An effective and cost-effective program model could be with peer-mentoring teleguidance classes, with practical lectures, together with the use of handheld devices,

applied in all different years of medical schools. This teaching method could be used in a Brazilian setting, to overcome the cost obstacle that medical institutions face every day. Therefore, future physicians would enter the health system capable of operating these crucial imaging devices efficiently, improving their clinical assessment and consequently, patient outcomes.

## 5. References

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