CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://zenodo.org/records/13381333

https://www.iajps.com/volumes/volume11-august-2024/27-issue-08-august-24/

Available online at: http://www.iajps.com Research Article

# ER ULTRASOUND: ERROR SOURCES

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**Abstract:**
*In healthcare systems, medication errors remain the most common around the world, and include prescribing errors, dispensing errors, and administration errors. Among these, patients are mostly affected by diagnosis errors that are most commonly found in radiology. The Institute of Medicine asserts that an error is referred to as a failure of any intended action to achieve as expected at first instance, or the execution of an inappropriate plan to achieve a goal. Medical imaging mistakes were detected as back as 1959, but 50 years down the line, the occurrence of these errors has remained the same and is yet to be resolved. At present, ultrasonography is becoming a very useful diagnostic modality for an increasing number of clinical diseases, including abdominal mass detection and evaluation of traumatic abdominal diseases (Pinto et al. 2016). However, emergency ultrasonography has been made particularly liable to errors, misinterpretation of sonographic images creating a big risk in clinical diagnosis.*

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***Please cite this article in press*** *Saeed.S.Barakat* ***et al., ER Ultrasound: Error Sources., Indo Am. J. P. Sci, 2024; 11 (08).***

## INTRODUCTION:

Medication errors are the most prevalent in any healthcare system all over the world and, in detail, include errors in prescription, dispensing, and administration. Among all these, diagnosis errors found in radiology affect the patients the most. According to the Institute of Medicine, an error refers to the "failure of planned activity to achieve the intended outcome or the use of an inappropriate plan to attain an aim. Medical imaging errors were identified as far back as 1959, but 50 years on, the frequency of these errors has stayed the same and remains unresolved. Presently, ultrasonography is becoming a valuable diagnostic tool for a growing number of clinical diseases, including the detection of abdominal masses and the assessment of traumatic abdominal diseases (Pinto et al. 2016). Unfortunately, emergency ultrasonography has been rendered particularly vulnerable to errors, with the misinterpretation of sonographic images posing a great risk in clinical diagnosis. Among the more recent concerns linked to emergency ultrasound errors, which have grown in the last years, are those driven by a combination of unique features that emanate from both aspects related to the fundamental features of the discipline and recent developments. As such, the paper shall expound on the root causes of these errors made in emergency ultrasound imaging.

**Discussion**

Recent researchers have tried to pinpoint the different sources of error within emergency radiography, specifically in ultrasonography. Several causative factors were linked to these failures, such as bad communication with some uncooperative patients, use of inappropriate probes, less concentration on clinical examination and history, limited understanding of the possibilities about differential diagnosis, inadequate knowledge of technical equipment, failure to arrange for additional ultrasound examination, conducting the examination with inappropriate probes, overestimation of personal skills, as well as failure to suggest other imaging modalities like CT or MRI (Rebours et al., 2022).

In ultrasonography, technical errors remain the source of error and include wrong choice of the transducer, use of an inappropriate amount of sonographic gel, and wrong settings of the technical equipment. Proper functioning of the ultrasound transducer remains necessary for accurate diagnosis, particularly in emergency situations. According to Pinto et al (2016), misinterpretation of image artifacts is one of the common sources in clinical ultrasonography, which can occur because of the improper scanning technique or physical limitations. Also, these technical issues are also linked to the operator's competence because it depends on his training, skill, and experience. Even though the new ultrasonography is good at producing images, which may be utilized to diagnose anomalies, a correct diagnosis may only be attained by highly competent operators (Di Serafino et al., 2022). Accordingly, this means an effective identification of the sources of error in emergency ultrasound requires skilled operators as much as advanced technology.

Some errors in emergency room ultrasonography frequently result in situations characterized by major errors with potentially severe outcomes. The primary causes of these diagnostic errors are due to the fact that diagnosticians or physicians are usually expected to decide very fast on a patient with scanty information. Sometimes patients are either under the influence of drugs, alcohol, and uncooperative because of unconsciousness, which increases the chances of error. According to de Casasola et al (2022), the rate of missed diagnoses is proportional to the degree that errors remain captured in trauma incident registries as well as reports; therefore, there are frequent descriptions of missed or delayed diagnosis. In principle, this error may often result in higher mortality and morbidity rates because of missed diagnoses. Sabour (2020) claims that the majority of the diagnostic errors are related to missed or delayed diagnoses.

During ultrasonography in emergency departments, mistakes or errors are mainly classified under three broad categories: patient influences, environmental factors, and technical errors. Pinto et al (2013) argue that environmental factors such as inappropriate investigations as well as overcrowding in emergency rooms can result in errors in diagnosis as well as management of these high-risk environments. Patients admitted to emergency rooms tend to require unexpected examinations, such as fasting status and bladder distention. According to Di Serafino et al (2022), patients often refuse to cooperate because of pain, discomfort, and uneasiness caused by the probe pressure. Thus, misinterpretation of the obtained images is common, and diagnostic imaging modalities are prone to misdiagnosis.

According to de Serafino et al (2022), the operator's technical skills that are linked to their training, experience and skills include the use of the diagnostic capabilities of the department, having the knowledge to pinpoint what is amiss. Another key source of influence on errors within such departments has to do with competence in interpreting findings and images

using the knowledge of physiology as well as pathological changes of the scrutinized organs or tissues. According to Dhamankar et al (2020), the actual number of devices and operators dedicated to the departments of radiology across health care institutions determines the impacts such operations and systems have on emergency ultrasound diagnoses as well as reports. Because of its widespread use, ultrasonography is usually mistakenly considered to be some sort of relatively simple procedure. Most of the technical operator errors are associated with interpretational doubts, which require supplementary diagnostic imaging procedures, thus leading to diagnostic delays, increased healthcare costs, and medico-legal disputes. Also, these errors are associated with the lack of sufficient knowledge by sonographers, mostly due to inadequate training. According to Oglat et al (2020), during the application of this knowledge, a number of implementation errors can occur, which must be properly addressed to have diagnostic performance accuracy as well as correct diagnosis of illness.

Among the different sources of errors that are detected in emergency ultrasounds, interpretation errors are the most common. Di Serafino et al (2022) argue that the interpretation errors remain influenced by chest abnormalities with little and no clinical context, poor-quality artifacts, anatomical variants, and ultrasonography setting errors.

Common image artifacts in ultrasonography frequently render it difficult to interpret and make a proper diagnosis of the condition of the patient. These artifacts, as usual, translate into errors in reading the images generated or acquired. According to Mayo et al (2022), they arise from physical limitations in the different ultrasound modes. They range from speed displacement effects, mirror imaging effects, adaptation of images artifacts, side lobe artifacts, and anisotropy as well as reverberation and diffraction artifacts. For example, it is these reflecting surfaces occurring within the receiving beams but outside the primary ultrasound beam echoes which cause the side lobe artifacts. In the bladder or gallbladder, ultrasonography is witnessed at the bottom of the ladder, in the reported pseudo-mud property, which may be fixed through proper configuration of the ultrasonography image, use of multiple scans (Pinto et al. 2016).

In most cases where mistakes of interpretation occur, mainly with chest ultrasonography, patient-linked artefacts have an influence in the interpretation of the image. According Newitt (2020), the ultrasonography techniques remain utilized to identify different chest problems. Ultrasonography techniques are utilized to discover a variety of chest disorders (Newitt, 2020). Pinto et al (2016) claim that patient-linked artifacts include subcutaneous emphysema fibrotic interstitial lung disease, and pathologies that modify the subpleural space's the air content (e.g., emphysema or atelectasis), frequently affect the interpretation of lung disorders through ultrasonography. The misinterpretations are especially problematic in acute situations such as emergency departments, and they are influenced by age of the patient. Bialek and Jakubowski (2017) found that lung ultrasonography techniques have inherent limitations and rely on A-lines or B-lines, which require clinical data for accurate interpretation.

Other types of errors in ultrasonography include setting errors. To prevent such an error from occurring, one must understand the mechanics of the equipment and how it works. Kim et al. (2021) recommend using a checklist approach to present the correct system settings and Doppler parameters to ensure optimal image quality during ultrasonography diagnostics.

Other causes of error in emergency ultrasonography are anatomical differences and structures that might make picture interpretation challenging. According to Rachuri et al. (2017), pseudo-collections of peritoneal, pericardial, pleural, and retroperitoneal fluids might be harmful, especially during emergencies. Koster and van der Horst (2017) relate anatomical variances to pseudo-pneumothorax, which can occur due to apnea or a lack of lung sliding, making diagnosis challenging in emergency situations. Other comparable disorders include Rouleau phenomena, hypertrophied diaphragmatic pillars, as well as bladder pseudo-masses, which are typically random. According to Rebours et al (2022), emergency conditions are usually caused by severe injuries and accidents, which sometimes might complicate interpretations and urges for further diagnostic confirmations to avoid over-treatment or interpretative uncertainties.

These will increase the complexity of examination and increase the wait time for medico-legal disputes. Anatomical variants can lead to errors in emergency ultrasonography, thus making diagnosis complicated by misinterpretation. For instance, a splenic hematoma could be misinterpreted as a fluid-distended gastric fundus on a CT image. The crescent-shaped hypoechoic area may be misinterpreted as a hematoma between the spleen as well as the left hemidiaphragm. Sabour (2020) describes this anatomical variant as enlargement of

the left hepatic lobe with distinct splenic kissing. Similarly, longitudinal ultrasonography of the inguinal canal of the patient, indicated differences in interpretation when compared to the color Doppler scan, where the former will show inguinal canal blockage, the latter would reveal right epididymitis with funiculitis.

Another class of mistake in emergency ultrasonography is that of underestimation. Such an error can result from overconfidence in diagnosis, which may be a result of superficial or inadequate experience, faulty clinical approach, and erroneous expertise. Inadequate ultrasonography reports and poor image quality are normally the major causes of the underestimation errors in most cases. Azizi et al (2020) claim that this categorically creates the need for comprehensive documentation of the ultrasound results for safeguard against any future medico-legal litigation. Accurate as well as detailed reports are required for the delineation of pathological changes detected and giving timely, relevant responses in clear terms to the most pertinent clinical questions.

In the ultrasonography of gynecology measurements as well as obstetrics, the obstetric measurements are mostly subjected to errors of misdiagnosis and interpretation. Jachetti et al (2021) argue that the practice of obstetric ultrasonography is linked to quite great medico-legal risks, mainly considering missed detectable fetal abnormality that significantly increase medical malpractice indemnities. Pregnancy ultrasound examinations generally include a detailed structural survey to avoid missing fetal anomalies, and, when the sonographic examination is considered less than optimal, repetition may be required, often in its entirety. Subtle fetal abnormalities are sometimes missed by general radiologists, who may then claim immunity from malpractice lawsuits on grounds that they are not specialists in sonography.

New cutting-edge medical as well as technological developments are critical to the creation of numerous medical improvements. Chambers et al., 2017) claim that AI (Artificial intelligence) is a novel section of computer science, which is concerned with the human process of learning, adapting, and solving complicated problems. Deep learning & machine learning approaches are common among the fields of artificial intelligence used in medical imaging. These comprise of algorithms capable of performing prediction and decision-making tasks in the absence of clear programmed regulations. According to Jachetti et al (2021), deep learning, a subset of machine learning, is defined as multi-layered neural networks that automatically extract characteristics without performing the high-level tasks and requiring prior labels. Machine learning algorithms use repeated statistical learning to enhance model performance over time, allowing for pattern detection and classification in huge datasets. Milkau et al. (2018) propose implementing and developing AI models in the ultrasound sector to improve empowerment. Empowerment focuses on clinical and radiological process to reduce ultrasound errors caused by operator, scanner, as well as patient-dependent factors. Seyedhosseini et al (2017) argue that AI in ultrasonography can help novice users' complete accurate tests, leading to better clinical decisions in the radiology sector.

Current evidence shows that AI algorithms can improve image resolution as well as quality. Also, AI systems are applied to some ultrasonography image-based tasks such as abnormality detection, assessment of prognosis, disease classification, as well as image segmentation. These applications extend into areas like abdomen, heart, pelvis, musculoskeletal systems, thyroid, obstetrics and gynecology, and breast, among others. According to Duarte et al., 2022), the outlook for artificial intelligence in ultrasonography remains promising and shall require further research.

## CONCLUSION:

Considering the uncountable possibilities of technical faults and misinterpretations that may arise while ultrasonography is being conducted in emergency departments, the ultrasonography images' misinterpretation ought to be considered against the diagnosis risks, thus affecting patient safety as well as the delivered healthcare. The etiology of these errors is multifactorial and depends on various factors such as patient factors, environmental factors, and technical factors, errors in interpretation influenced by poor clinical correlation, anatomical variants, setting errors, and intrinsic ultrasonography artifacts. These factors ought to be taken into consideration when carrying out emergency ultrasonography. Recent developments in medical technological advancement and artificial intelligence can also be adapted in reducing the chances of errors in ultrasonography.

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