

Diagnostic Ultrasound Performance Testing & Accreditation

Common perceptions of ultrasound (US) performance measurement and quality control (QC) often include the notions that: (1) US QC is technically challenging and time consuming; (2) Expensive test objects are needed; (3) Available subjective tests have limited sensitivity; (4) US QC may be unnecessary, since on-board scanner diagnostics can identify all important equipment problems. The goal of this presentation is to review US performance measurement methods, show that QC can be accomplished in the clinical environment with only a reasonable expenditure of resources, and demonstrate that US QC and acceptance testing are effective and worthwhile for detecting equipment faults.

US performance testing methods have long been studied and reported. A very useful benchmark publication is "Real-time B-mode ultrasound quality control test procedures, a Report of AAPM Ultrasound Task Group No. 1.", by Goodsitt et al, in 1998. Here a comprehensive list of tests was documented, including mechanical inspection, display monitor setup and fidelity, image uniformity, maximum depth of penetration (DOP), hard copy fidelity, distance accuracy, anechoic object imaging, axial resolution, lateral resolution, slice thickness or elevational focus, ring down or dead zone, and film sensitometry. Although manual and subjective assessment methods were described, the development and use of computer-based analysis was recommended. No single standard ultrasound test phantom is endorsed, but numerous commercial phantoms are available with adequate acoustic properties and test targets that allow all common tests to be performed. Basic methods and test objects will be reviewed.

Computer-based analysis methods have since been reported by numerous authors, including algorithms for assessing axial, lateral, and elevational spatial resolution, contrast resolution, depth of penetration and SNR, uniformity, dead zone, and target detectability. These algorithms all operate on one or more US phantom images. Also, a non-image-based US transducer testing tool which measures the electrical and acoustic properties of each transducer element is commercially available. Our experience implementing and using these image-based methods as well as a transducer test device in the Mayo ultrasound practice will be reviewed, emphasizing the advantages and disadvantages of these approaches.

Accreditation of imaging practices is a well-accepted approach to demonstrating and maintaining high levels of quality in all aspects of the clinical practice. Performance testing of ultrasound imaging equipment is commonly required by bodies accrediting clinical ultrasound practices. Other common requirements involve physician and sonographer or technologist qualifications, exam protocols, and quality of sample exams. The requirements of the American College of Radiology, American Institute of Ultrasound in Medicine and the Intersocietal Accreditation Commission accreditation programs will be reviewed, especially as they pertain to equipment performance testing.

Finally, practical recommendations for clinical US performance testing will be offered, as will topics for future development in this area.

LEARNING OBJECTIVES

After hearing this presentation, the audience member will...

1. Be able to list commonly measured scanner performance characteristics
2. Be familiar with subjective and objective performance testing methods
3. Understand the design of an efficient and effective ultrasound QC program
4. Have basic knowledge concerning ultrasound practice accreditation