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Various state and federal courts across the country have dealt with the standard for the admissibility of expert testimony and the qualifications of the individual who proffers the testimony. While any one can seek to be an expert witness, courts have control of admissibility and thus govern who ultimately offers testimony and the qualifications of the expert witnesses. Various jurisdictions have had to deal with the admissibility of scientific evidence when it comes to fingerprints, systolic blood pressure deception tests, lie detectors, voice identification, and voice stress analysis. Some of those tests were based upon other medical or medically developed principals. This article will focus on the standards that have been created for the qualifications of an expert, the admissibility of expert testimony and how some parties have tried to meet the various jurisdictional criteria.

Prior to 1993, there were several standards of admissibility that were applied to certain scientific evidence. The *Frye*[1] test originated from the District of Columbia Court of Appeals in a decision rejecting the admissibility of a blood pressure deception test. Today there is a similar issue with regard to the use of the fMRI (functional Magnetic Resonance Imaging) test which was originally developed to determine brain function and is now being attempted to be used to determine deception. Since *Frye*, the United States issued a ruling in *Daubert v. Merrell Dow Pharmaceuticals , Inc.*,[2] which held that the Federal Rules of Evidence, specifically Rule 702, govern the admissibility of scientific evidence. *Daubert* was followed by *Joiner*,[3] *Kumho*,[4] and *United States v. Scheffer*[5] (involving polygraph testing), which raised the bar for expert testimony.

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1. Frye v. United States, 54 App. D.C. 46, 47, 293 F. 103, 104 (1923).
2. Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 597 (1993).
3. General Electric v. Joiner, 522 U.S. 136, 137 (1997).
4. Kumho Tire v. Carmichael, 526 U.S. 137, 158 (1999).
5. United States v. Scheffer, 523 U.S. 303, 317 (1998).

This paper will attempt to review the perils and pitfalls that still remain and how science consistently presents similar situations that must be addressed.

A prior issue was raised regarding the acceptability of PET scan or SPECT scan results when used for different types of interpretations such as tumors compared to traumatic brain injury. A PET scan is a relatively simple procedure and involves the introduction of radioactive isotopes that are attached to a tagged compound. Brain function is analyzed by measuring how each area of the brain demonstrates the uptake of the isotope and may appear as a different color on an image. The scan was originally developed for what was thought to be certain types of tissue scanning but was later adopted by some for scanning for traumatic brain injuries. A SPECT scan is performed using a gamma camera from multiple angles and a computer is later used to manipulate the results yielding a 3-D data set. Using a different radiotracer than normal, some have been able to use exametazime (HMAPO) to make a neuropsychiatric diagnosis. This diagnosis would certainly be based on different criteria from those established by the Diagnostic & Statistical Manual, now known as DSM IV. A new version, DSM V is now in planning and consultation, but to this author's knowledge, neither DSM IV nor plans for DSM V involve the use of imaging studies as criteria for determination of a psychiatric or neuropsychiatric diagnosis. Therefore, one must look to see whether or not there are two separately recognized schools for making the diagnosis and whether either school is not valid or out of date. One must also look at the sensitivity and selectivity for clinical exams such as mental testing and determine if the results are reproducible with a high enough degree of confidence. In order to increase the confidence level one must make clinical and pathological correlations and this allows for some subjective input on the part of the clinician.

Another issue that has to be addressed is the use of the software that is used to read and interpret various types of radiographic or other medical tests. There is now software available that interprets mammograms, x-rays, CTs and PET scans amongst other medical tests. Who is to be the "expert" if the software was written in another country but used in various institutions around the world? What if the software was used for a test other than what it was developed for? Still another issue is the use of the software with other "markers" or isotopes that were not meant to be used with the software which can create an "off-labeling" situation or the ability to use the test for something that it was not originally designed for.

Another illustration can be shown with worldwide acceptance by both *Daubert* and *Frye* although no national modular accreditation program was ever in effect until 2008. In 1984, the FONAR Corporation received FDA approval for its first MRI scanner. In 1991, the fMRI was developed independently by the University of Minnesota's Center for Magnetic

Resonance Research. While accreditation standards had previously been in place, it was not until 2006 that the American College of Radiology (ACR) approved a resolution that the MRI accreditation program be redesigned into a modular program which best meets the needs of the MRI practice. At that time it was determined that Breast MRI be left under breast imaging and modules were set up for MR Body, MR Head, MR Angiography (MRA), MR Spine, MR Musculoskeletal and MR Cardiac and that program finally launched in 2008. The modular program rolled out 24 years after the first MRI was licensed.

The fMRI was developed based on increased blood flow that accompanies neural activity in the brain. The resulting local reduction in deoxyhemoglobin is therefore called an endogenous contrast enhancing agent or paramagnet. The main advantages of fMRI as a technique to image brain activity relates to a specific task or sensory type process and includes the shortness of the scan time, the in-plane resolution of the image and the fact that the individual undergoing the scan does not require injections of radioactive isotopes. Of particular importance is the fact that particular imaging methods and procedures vary from center to center because various groups have developed their own methods and standards. This is especially true of those seeking to use fMRI for lie detection. fMRI is currently in use at various medical centers to study such conditions as neglect syndromes, cerebella dysfunction, neuro-oncology and similar conditions. Medical centers have used the fMRI to examine the anatomy of the brain and to assess the effects of stroke, degenerative disease, or trauma on brain function and brain mapping in an effort to determine which part of the brain handles what functions. Some of the centers are still investigational while others have established their own protocols and are using fMRI in their facilities.

The criteria established by *Daubert* and its progeny have articulated four basic criteria. They are: general acceptability, established standards controlling the technique's operation and accuracy, a known or potentially known rate of error, and the testability of the procedure. Can a radiologist who might testify as to the applicability of those standards be challenged because he did not do original research work in that area, or should his testimony be allowed because he relies on computer interpretation or it is generally accepted even though he is not familiar with how the software works? In other words, what level of research must an expert be familiar with in order to testify? This has now become important in the use of the fMRI in the area of lie detection.

The court in *Frye* said that the admission of the technique and the purpose for which it was being used was dependant on its acceptance in the scientific community. Various courts including numerous state courts followed *Frye* but their standard for acceptance varied based upon the

judicial forum. *Daubert v. Merrell Dow Pharmaceuticals* derived a test for the reliability of scientific evidence from Rule 702. The court held that in order to qualify as scientific knowledge, an inference or assertion must be derived by scientific method. The court basically stated that the requirements for an expert's testimony must pertain to the scientific knowledge base and establish a standard of evidentiary reliability.

Unanswered questions remain after the advent of the *Frye* test, including: at what point is the principle of "sufficiently established" determined; at what point is a "general acceptance" reached; and what is the definition of "particular field in which it belongs?" While the *Frye* test is not applicable in federal courts, it is applicable in various state courts which still follow *Frye*. This allows for inconsistent results between *Frye* and *Daubert* jurisdictions. Federal courts follow *Daubert*, some state courts follow *Daubert*, and still others follow *Frye*. This creates even more confusion when courts ascertain a standard for admissibility or determine the criteria an expert witness or scientific process must meet. If one or two scientists want to use a test for a certain determination and they testify that the results can be repeated, do they represent the "scientific community?"

Recently, certain individuals and one or two companies have attempted to use the fMRI for purposes never before thought possible. They are seeking to use a medical test developed for brain mapping and neurological function as a lie detector test. For approximately $5,000 a company will scan an individual's brain, using an fMRI, to determine if that individual is telling the truth. The fMRI is used to measure changes in blood flow to different areas over time. Many fMRI studies have concluded that a few key areas of the brain are more active during deception than truth telling. Those areas include the anterior cingulate cortex and the left dorsolateral area as well as the right anterior prefrontal cortices. Cephos Corporation and No Lie MRI are two companies in the field. Early in 2008, No Lie MRI and a defense team were preparing to get the results of the test introduced in a criminal case in California. The defense team was going to argue that "the relevant scientific community" is a narrow group consisting only of scientists who research and develop fMRI based lie detection procedures with fMRI equipment; in other words, only those scientists who had put the fMRI to another use. In addition to the limitation of the definition of "the relevant scientific community," a very interesting medical issue is raised. The *Daubert* standards previously cited raised an even higher bar. Shortly before trial, the defense attorneys decided not to use the test as part of the evidence they were going to present, and, therefore, a case of first impression by any court has yet to come.

What if the test is being used for lie detection but an underlying medical issue is discovered? There was no licensed physician who ordered the test to whom the results could be reported. Since the test is not being used as a

medical test, the issue of obtaining medical consent and HIPAA consent are not relevant and would not be met later down the road. If the findings indicated a positive medical finding, under what conditions could the information be disclosed and to whom would these ethical issues be raised?

As demonstrated in this article, there are numerous unanswered questions waiting to be addressed by various courts before any resolution can come forward.