Forensic science has played an important role in criminal prosecutions in the United States and around the world for hundreds of years. Some of these methods, such as fingerprint analysis, have endured and continue to be refined and relied upon. Others, like serology and hair analysis, were frequently used, but were later determined to be unreliable. One of the most prominent examples of forensic science in criminal trials is DNA analysis. DNA evidence became a mainstay of criminal prosecutions in the 1980s, following the development of PCR. Today, the tests most frequently used are PCR-STR (polymerase chain reactions – short tandem repeats, which measures DNA at 13 core STR loci), y-STR (measures DNA on the y-chromosome only; works best in mixed male-female samples that are dominated by female DNA and involve no sperm), and mtDNA (mitochondrial DNA - best for samples with little or no nuclear DNA; all males and females in a maternal line have the same mtDNA, which limits mtDNA's applicability somewhat). Test results obtained through PCR-STR can be uploaded to and referenced against CODIS (a national DNA database created by the FBI that allows states to share information), while y-STR and mtDNA results cannot.

For evidence to be considered at trial, it must be admissible under the rules of evidence. Two standards are relevant when trial courts assess the admissibility of novel scientific evidence: the *Frye* standard, which was one of the legal system's first efforts at developing a coherent test for the admissibility of scientific evidence, and the more recent *Daubert* standard. In *Daubert v. Merrell Dow Pharmaceuticals* (1993), the Supreme Court ruled that Federal Rule of Evidence 702 superseded the *Frye* standard in federal court, and provided a new standard governing the admissibility of novel evidence and expert testimony. While many state courts have adopted the *Daubert* standard, at least seven states, including California, New York, Illinois, and Florida, refuse to abandon their own formulations of the *Frye* standard. The *Daubert* standard requires trial judges to make a preliminary assessment of whether an expert's scientific testimony is based on scientifically valid reasoning or methodology that can be applied to the facts at issue, and provides a non-exclusive checklist for them to use in making that determination. The relevant factors to be considered when assessing the validity of a methodology are: (1) whether the theory or technique in question can be and has been tested; (2) whether it has been subjected to peer review and publication; (3) its known or potential error rate; (4) the existence and maintenance of standards controlling its operation; and (5) whether it has attracted widespread acceptance within a relevant scientific community.

One new methodology that recently went through *Frye* and *Daubert* hearings was TrueAllele, a probabilistic genotyping algorithm that identifies contributors to mixed DNA samples that would be impossible to analyze using traditional DNA testing methods. TrueAllele has faced criticism because it is not an open-source program, raising concerns that issues with its algorithms may go unnoticed or be difficult to prove. However, TrueAllele has been ruled admissible in state courts in California, Indiana, Ohio, Louisiana, Massachusetts, New York, Pennsylvania, South Carolina, and Washington, as well as internationally in Australia and Northern Ireland.

Relevant Questions/Topics

- Crime lab vs. research lab – differences in standards, practices, workloads, pressures, day-to-day conditions?
    - Related: contamination/degradation protocols; how do you tell if a sample is contaminated (and how do you, as a prosecutor or a defense attorney, approach that)
    - Control over evidence – pure scientists get to literally make/grow their own samples, near-total control; crime-scene techs are operating under dramatically different conditions.
- Standard of evidence – how can you reconcile scientific uncertainty with the beyond a reasonable doubt requirement?
- How do you recognize and address bad science? Bite marks, serology, hair comparison. What role does the scientific community play here? (Ex: shaken baby – doctors publicly reversing their previous positions)
- Is the process too conservative (preventing the introduction of new, cutting-edge methodology) or too liberal (putting defendants' rights at risk because of science that may be unreliable or still developing)?
- Explainability vs. accuracy – for example, TrueAllele may offer enhanced accuracy; but will it be possible to explain its results to a jury of laypeople, and will attorneys understand it well enough to challenge those results?
    - Related: role of expert witnesses – how do you pick them, how do you prep them?
    - Communicating with expert witnesses in the trial context – (basically cross vs. direct)
    - How do you make sure your jury is understanding what your expert is telling them (or interpreting your expert's testimony the way you want them to)?
- Discovery – evidentiary hearings, sharing evidence (but only what you *have to* share and no more) vs. peer review, open access