


Next Generation Sequencing in the Courtroom: An Attorney's Perspective



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Kern County | District Attorney

- **Kern County Pop.:** 923,155
- **County Seat:** Bakersfield
- **Elected District Attorney:**
 - Hon. Cynthia J. Zimmer
- **Deputy DA's:** 70

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KCDA Homicide Unit

Chief Trial Deputy

Homicide Unit: 8 assigned attorneys.

Prosecuting all Kern County homicides; including gang, prison, family violence, and child death homicides.

Active Prosecutions: 130 + total homicides

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Kern Regional Crime Lab

- The **Forensic Science Division** of the Kern District Attorney's Office.
- 5 out of 58 counties in CA have a crime lab as part of the DA Office.
- Primary customer agencies are Kern County law enforcement agencies. Active in forensic research, including recent probabilistic genotyping implementation.
- Receives approximately 7,000 total requests per year, the DNA unit receives 700 request for service.
- **KRCL DNA Unit:**
 - Completes biological screening, kinship analysis, and DNA analysis
 - DNA testing in approximately 85% of homicide cases.

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NGS | Next Generation Sequencing

- **KRCL decision to purchase NGS equipment [2018]:**
 - Outdated 3130 Genetic Analyzer. Sequencing would allow the lab to be at the forefront of technology.
 - Local increase in homicides, sex assaults, and overall violent crime.
 - Limitations of current testing methods. Low level sample precluded subsequent testing.
 - Volume of complex mixtures, low level samples, degraded samples, and cold case testing requests.
 - Familial Searching MOU requires Y-STRs.
 - Local Law enforcement interest in genetic genealogy.
 - NGS allowed provision of investigative leads for unsolved cases.
- **MiSeq FGx purchase a KRCL decision.**

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NGS Next Generation Sequencing

- **Initial Reaction:**
 - Why???? Lack of understanding why the lab was making the change.
 - Comfort with present testing methods and its courtroom presentation.
 - Concern over criminalist time needed to validate sequencing with the pending DNA workload and backlog.
- **Initial Courtroom | Evidentiary Concerns:**
 - Mode of presentation to jury.
 - Additional attorney training required.
 - Increased genetic data and discovery issues.
 - Validation and any subsequent Kelly-Frye court hearings.
 - Anticipated defense attorney challenges.

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Learned Benefits of Next Generation Sequencing:

NGS Benefits

Higher resolution data with degraded DNA samples.

Improved suspect identification between degraded autosomal STRs vs. identity DNPs.

Y-STR testing completed with all samples.

Additional data allowing for improved criminalist contributor assumptions in complex mixtures.

Sequencing of autosomal STR alleles (isoalleles).

Improved Data: helps solve cases, provide investigative leads, evidence of guilt or exonerate the innocent.

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NGS | Benefits to Investigations

Isoallele | Sequence Information

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Autosomal STR Locus Information

Locus	Genotype	Alleles
D13S317	12, 10.18	12, 10.18
D15S11	12, 10.18	12, 10.18
D18S51	12, 10.18	12, 10.18
D19S433	12, 10.18	12, 10.18
D2S1338	12, 10.18	12, 10.18
D3S1358	12, 10.18	12, 10.18
D5S818	12, 10.18	12, 10.18
D7S822	12, 10.18	12, 10.18
D8S1179	12, 10.18	12, 10.18
D9S1122	12, 10.18	12, 10.18
D10S1248	12, 10.18	12, 10.18
TH01	6, 6	6, 6
HLA	15, 56	15, 56
D12S391	15, 20	15, 20
D16S317	15, 13	15, 13
PenicE	10, 14	10, 14
DH8S539	9, 9	9, 9
D17S1331	11, 12	11, 12
D18S51	12, 18	12, 18
D19S433	13, 15	13, 15
D2S1338	14, 14	14, 14
D21S11	23, 30	23, 30
Plen40	10, 14	10, 14
D22S1045	15, 16	15, 16

D6S1179	13 Yes	3638 TCTATCAGTC
D6S1179	13 Yes	3337 TCTATCAGTC

NGS Jury Trial Exhibits

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NGS | Prosecutor Involvement



Planning for validation: Science based vs. court-based knowledge. Different focus.



Trial presentation: Discussion at an early stage how the match will be presented along with the rarity statistic.



Discovery Issues: Current CE data versus NGS data. What will be considered exculpatory or material? Raw Data? Discovery packets?

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NGS | Collaboration

Education by KRCL:

- Constant contact with KRCL during their validation of Verogen MiSeq FGx, including regular updates.
- Meetings early and often.
- Access to Webinars on the topic.
- Access to the lab and vendor.
- Review of Verogen materials, published validation studies, and materials discussing massive parallel sequencing.

Training by KRCL:

- The lab permitted KCDA Chief to be present during sequencing demonstration. Including library preparation, purification, and review of the test results.
- **All KCDA attorneys:** In person training prior to implementation to give them an understanding of the future of sequencing at the lab.

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NGS Legal Issues

Admissibility – Kelly-Frye Test:

- **First prong:** “Admissibility of expert testimony based on a ‘**new scientific technique**’ requires proof of its reliability – i.e. that the technique is ‘sufficiently established to have gained general acceptance in the particular field to which it belongs.”

• People v. Venegas (1998) 18 Cal.4th 47

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NGS | Legal Issues

Admissibility – Kelly-Frye Test :

• **Second Prong:** "...the witness furnishing such testimony must be properly qualified as an expert to give an opinion on the subject."

• **Third Prong:** "... the proponent of the evidence must demonstrate that correct scientific procedures were used in the particular case."

People v. Kelly (1976) 17 Cal.3d 24, 148

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NGS | Admissibility - Legal

Daubert v. Merrell Dow Pharmaceuticals 509 U.S. 579, 580

Trial Judge considerations:

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.
5. Whether it has attracted widespread acceptance within the scientific community.

Note: "General acceptance" is not a necessary precondition to the admissibility of scientific evidence.

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NGS | Legal Considerations

Legal argument whether sequencing is a new or novel technique:

- Presentation of aspects of DNA analysis that has been approved by California Courts.
- "Kelly/Frye only applies to that limited class of expert testimony which is based, in whole or part, on a technique, process, or theory which is new to science and, even more so, the law."

People v. Stoll (1989) 49 Cal.3d 1136, 1156

Review of Appellate decisions for similar DNA processes:

- Capillary electrophoresis vs. next generation sequencing
- Test kits: necessary chemical, primers, and software.
- Autosomal STRs, Y-STRs, and genetic make-up of DNA.

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NGS | Legal Considerations

- **Case Selection Decision:**
 - Sexual assault or homicide cases with single source or deduced single source crime scene items.
 - The selected cases should not be solely reliant on the NGS testing.
- **Preference:** the selected case has DNA that has been tested previously or concurrently and NGS supplements the testing.
- **Time element:** the selected cases need to be likely to proceed to trial within two to three months.
- **Concern:** any significant delay between the validation being completed, the lab implementing NGS in casework, and our first local admissibility hearing.
- **Gradual Sequencing Implementation – Multiple Admissibility Hearings:**
 - Select initial cases using length-based testing when using NGS in court – no difference to CE.
 - Second set of cases selected for admissibility for SNPs and sequence data.

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NGS | Court Admissibility

Which scientific field is relevant?:

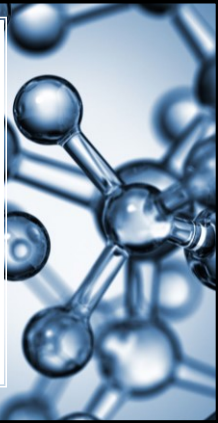
- Criminal forensic community only?
- Medical applications? Biotechnology, Virology, Diagnostic Medicine.

Selection of appropriate admissibility hearing witnesses.

- Local lab expert?
- Sequencing expert?
- Medical expert?

Expert Testimony

- Peer reviewed articles.
- FBI approval for Verogen forensic technology to be uploaded to NDIS.
- Criminal forensic use. International criminal conviction.



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NGS | Discovery

• KCDA – KRCL Attorney Consultation:

- Discovery???
- What is exculpatory or material?
- Provision of certain raw data? All raw data? Excel spreadsheets?
- Compare to prior discovery packets.
- How to provide the approved discovery due to file size.
- Defense requests for data. Stored data vs. discovery data.
- Proprietary information?
- Presentation in court. How to convey to KCDA attorneys what the available information will be for evidentiary use and closing arguments.

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SNPs [Single Nucleotide Polymorphisms]:

- Sufficient basis for use in court?
- Identity SNPs | Phenotype SNPs | Ancestry SNPs.
- Admissibility when physical traits match an eyewitness statement.

Personal Information:

- Prior DNA profile provided nothing about the individual vs. NGS genetic information.
- Phenotype and ancestry data.

NGS

Additional Considerations

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NGS | Data Considerations

Phenotype Data:	Law Enforcement Agency:	Kern Regional Crime Lab:	Anticipating future scientific advances and legislative changes.
<ul style="list-style-type: none"> • Investigative tool. • Phenotype data considerations: (1) what language to use, (2) whether to allow inclusion in probable cause affidavits, (3) statement of strength of the data? • Defense use at trial if phenotype data deviates from the defendant. 	<ul style="list-style-type: none"> • Consent form changes. • Search warrant affidavit changes? 	<ul style="list-style-type: none"> • Local familial database. • Privacy concerns? Local genetic information storage? • Juvenile profile storage vs. adult profiles. 	<ul style="list-style-type: none"> • Forensic Genetic Genealogy

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