Genomics in the Courtroom: The Current Landscape of DNA Technology in Criminal and Civil Litigation

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ADVANCES in genetic technology have led to large and lasting impacts on the law, dating back to the late nineteen-eighties and continuing to today. Recently, at-home genetic testing led to the high-profile arrest and criminal conviction of a seventy-year-old serial killer. That individual terrorized California communities in the sixties and seventies until a familial match in an open-source DNA database narrowed the suspect list, ultimately leading police to the killer.

The impact of new and more-widely available technologies extends beyond criminal law and into civil litigation. As plaintiff and defense counsel employ technological innovations to

support causation and damage claims, counsel and the courts are confronting new issues involving the nature of genetic testing, privacy, and admissibility. As they do so, they are learning the litigation pros and cons of developing this evidence.

This article considers the nature of these impacts. We begin with a short review of the basics of DNA. Next, we look at examples of new DNA technology. Finally, we examine how DNA technology is being used in the courtroom.

I. The (Very) Basics of DNA Sequencing

Deoxyribonucleic acid—DNA for short—functions as the playbook to human development.[1] DNA molecules are made of two twisting, paired strands forming the familiar double-helix. Each strand is composed of a sequence of four different chemical units referred to as the bases — adenine, thymine, guanine, and cytosin. Bases on opposite strands pair in a specific manner – A's pair with T's and C's pair with G's. The sequence of A-T pairings and G-C pairings determines how our DNA "reads" and, in turn, who we are. The full suite of DNA—billions of DNA pairings—comprises the human genome. Specific units of DNA, or genes, create specific proteins, which serve as the building blocks for everything in the human body and direct signals throughout our bodies. Mutated DNA creates abnormal proteins that can lead to diseases such as cancer.

DNA sequencing is the process of determining the order of A, T, G, and C bases in a strand of DNA.[2] Common sequencing processes begin with nucleotides – the building blocks of DNA that consist of a base (an A,G,C or T) together with a molecule of sugar and of phosphoric acid. Scientists "tag" nucleotides chemically and place the tags into a new DNA strand generated from the DNA the analyst wants to analyze. A specific light source activates the chemical "tag", which allows researchers to determine the sequence (the order of A,G,C and T) of the strand of interest. This detailed and laborious process is necessary to ensure accuracy. Once scientists determine the sequence, they use this information to look for variations or mutations in an individual's genes. Harmful variations or mutations can be as simple as a substitution of one base or as vast as the complete absence of thousands of bases.

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[1] National Institute of Health, *A Brief Guide to Genomics*, available at https://www.genome.gov/about-genomics/fact-sheets/A-Brief-Guide-to-Genomics (last visited Dec. 18, 2020).

[2] *Id.*

II. DNA Test Kits and Open-Source Databases: The Advent of At-Home Testing

Companies like 23andMe and Ancestry have brought once-novel and cost-prohibitive genetic tests to the masses.[3] Home test-kits instruct purchasers on extracting saliva samples and sending them off for testing for a variety of purposes, including to determine health risks and genealogy. Companies make these determinations through a process known as genotyping, which zeroes in on specific DNA markers — or variants — that indicate a person's health risks or family history. For example, 23andMe divides its testing services into five categories: Health Predispositions; Wellness; Traits; Carrier Status; and Ancestry.[4]

Ancestry offers similar services.[5] Initially, the company focused on genealogy—allowing users to track family lineage. Ancestry later entered the DNA test-kit industry in order to provide more detailed estimates of lineage, migration patterns, and certain genetic attributes by supplementing the process with an individual's genetic information. Customers can use Ancestry Health to discover personal and family health issues.

Unlike the commercial offerings from Ancestry and 23andMe, open-source databases, such as GEDmatch.com and others, allow individual users to upload their genetic profile to compare with other users.[6] Users must first determine their genetic profile in order to upload that information. Commercial testing kits, including those from 23andMe and Ancestry, allow users to create a DNA profile to upload.[7] Once the profile is in the system, the databases can compare profiles and enable individuals to find distant, or long-lost, relatives. But there is a catch. Open source means what it says, and database companies like GEDmatch.com warn users that their genetic profile might be used for other purposes.[8] More on that below.

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[3] *See e.g.* 23andMe.com.

[4] Samuel A. Garner and Jiyeon Kim, *The Privacy Risks of Direct-to-Consumer Genetic Testing: A Case Study of* 23andMe *and* Ancestry, 96 WASH. U. L. REV. 1219, 1234-1235 (2019).

[5] *Id*.

[6] Nila Bala, *We're Entering a New Phase in Law Enforcement's Use of Consumer Genetic Data*, SLATE.COM (Dec. 19, 2019), available at https://slate.com/technology/2019/12/gedmatch-verogen-genetic-genealogy-law-enforcement.html.

[7] *Id*.

[8] *See* Avi Sek, *The Ingenious and 'Dystopian' DNA Technique Police Used to Hunt the 'Golden State Killer' Suspect*, WASHINGTONPOST.COM (Apr. 28, 2018), available at https://www.washingtonpost.com/news/true-crime/wp/2018/04/27/

III. The Golden State Killer

In April 2018, police arrested Joseph DeAngelo, a seventy-year-old former police officer, at his home in California. Police believed that DeAngelo was the serial killer dubbed the "Golden State Killer." The Golden State Killer had terrorized California in the seventies and eighties by committing a series of horrific sexual assaults and murders.[9] Naturally, arresting a man who had terrorized those communities made national headlines. But the way police identified DeAngelo after decades of trying drove public interest long after his arrest.

Police developed the killer's DNA profile from samples left at different crime scenes, which were preserved until advances in technology allowed scientists to analyze them. Police ran the profile through CODIS—the FBI's DNA database—but didn't get any hits.[10] That meant that the killer had not encountered law enforcement in a manner that lead to collection of his DNA. That is when law enforcement turned to new genetic databases developed for an entirely different purpose. Cold-case investigators used over a half-dozen "open-source" genealogy websites to search for the killer.[11] Unlike the commercial databases discussed above, sites like GEDmatch.com invite individuals to upload DNA profiles in order to match with another user looking for long-lost relatives. As commenters point out, the purpose and methods of open-source databases differ from commercial databases and are readily accessible to criminal investigators.[12]

23andMe and similar companies promise privacy to paying customers who submit samples. Indeed, 23andMe's website has a section dedicated to law enforcement inquiries. The company's "Guide for Law Enforcement" indicates to inquiring officers—and concerned customers—that the company "chooses to use all practical legal and administrative resources to resist requests from law enforcement, and we do not share customer data with any public databases, or with entities that may increase the risk of law

golden-state-killer-dna-website-gedmatch-was-used-to-identify-joseph-deangelo-as-suspect-police-say/.

[9] *Id*.

[10] *Id.*

[11] George M. Dery III, *Can a Distant Relative Allow the Government Access to Your DNA? The Fourth Amendment Implications of Law Enforcement's Genealogical Search for the Golden State Killer and Other Genetic Genealogy Investigations*, 10 HASTINGS SCI. & TECH L.J. 103, 111–112 (2019).

[12] *See id.*

enforcement access."[13] That is not the case for open-source databases, which depend on accessibility and indicate to users that genetic information might be used for "other uses" beyond those intended by the user.[14] Leveraging GEDmatch's open database, investigators used a sample that was particularly rich in genetic information and uploaded it to the site. This led to a long and arduous process as investigators followed a distant familial match through different branches of an extended family tree and cross-referenced information from the case file to narrow the list of suspects to a handful of individuals.[15]

After trimming the list of suspects down to five with help from open-source databases, police returned to old-fashioned detective work. Information gathered during the investigation into the alleged crimes directed officers to DeAngelo.[16] Officers followed DeAngelo to a Hobby Lobby and pulled his DNA from the handle of his car after he parked and went inside.[17] His DNA matched evidence from several assault officers believed the "Golden State Killer" committed. Detectives obtained a second sample from his trash can before arresting DeAngelo in April 2018.

DeAngelo's arrest made national news because of the heinous and terrifying nature of his crimes. But the public and attorneys concerned about the privacy and criminal law implications have had a sustained interest in the investigative methods law enforcement used to narrow the suspect list and break open a long-cold case. While policymakers and privacy advocates will grapple with those issues, criminal defense attorneys must monitor cases like DeAngelo's and others that haven't become national news. As long as consumers continue to use DNA technologies, especially open-source databases, officers can leverage those databases to supplement CODIS.

IV. Medical Causation: Breaking the Causal Chain

Recently developed—and costly—genetic testing can help

[13] 23andMe.com, *Law Enforcement Guide*, available at https://www.23andme.com/law-enforcement-guide/ (last visited Dec. 18, 2020).
[14] Dery, *supra* note 11, at 113.
[15] *Id.* at 114.
[16] *Id.*
[17] Jamie Ducharme, *Investigators Collected the Suspected Golden State Killer's DNA while he Shopped at Hobby Lobby*, TIME.COM (June 2, 2018), available at https://time.com/5299394/golden-state-killer-dna/.

defendants rebut allegations that their products caused cancer or other health issues in a plaintiff. As the risks of an adverse ruling increase, understanding and using the latest technologies to obtain detailed information on a plaintiff's genes will be crucial to mounting an informed defense.

A. Germline and Somatic Mutations

Two types of mutations are relevant to this discussion: germline and somatic mutations. People inherit germline mutations through germ cells. Scientists have committed significant resources to understanding these hereditary mutations, especially those inherited mutations tied to specific diseases. One of the best-known examples is the discovery that linked mutations in the BRCA1 gene to ovarian and breast cancer. This discovery has led individuals to get tested for that gene to determine if they should take preventative measures to avoid developing those cancers.

Somatic mutations are genetic mutations that develop over the course of an individual's lifetime. Somatic mutations can occur without any clear external cause. However, certain environmental exposures can also trigger somatic mutations. In some instances, the cell repair process doesn't repair these mutations, and they can multiply, impacting an individual's health. Unlike germline mutations, these mutations are not passed down to later generations.

B. Genetic Sequencing Methodologies

When considering a defense that involves genetic sequencing, clients and their counsel must make strategic decisions about the type of sequencing to perform. For instance, a defendant may decide to take a broad approach, looking at all known genes. This is referred to as whole genome sequencing (WGS). This approach might provide a breadth of information, but it can be quite costly due to the wide-ranging analysis—called bioinformatics—necessary to sequencing of all 3.2 billion base pairs in the entire human genome. Judges may be less inclined to allow such a broad analysis looking at every potential mutation that could be present in an individual.

Alternatively, a party might decide to pursue whole exome sequencing (WES). WES analyzes only the base pair sequences in the genome—i.e., the part of a gene that causes protein synthesis. On the other hand, WGS provides information about the entire genome, which includes the coding sections as well as the non-coding sections. Experts now believe that the broader WGS approach is preferable to the more targeted WES approach because diseases

like cancer are often caused by a variety of genetic factors instead of a single mutation. The facts of a specific case might command one approach over another.

Finally, a defendant can focus narrowly on a specific set of genes known to increase the risk of certain types of cancers or diseases. This approach is known as a gene panel. For example, if an individual wants to understand her risk of breast or ovarian cancer, it probably is not necessary to evaluate the entire human genome using WGS. Rather using a gene panel approach looking at only the BRCA1 and BRCA 2 genes might provide enough information. The benefit to this targeted approach is clear—it can provide in-depth results on a subset of relevant genes and while being less costly. However, this approach requires an understanding of the factors likely to cause a plaintiff's disease. If there are many different genetic markers and mutations that might affect an individual's predisposition to certain diseases, a thorough analysis can only be so targeted.

There are two DNA sequencing techniques of relevance here: Sanger sequencing, or first-generation sequencing, and Next Generation Sequencing, or NGS. Sanger sequencing (a much older technology) is often viewed as the best available technique—the "gold standard." However, as compared to NGS, Sanger sequencing is much more labor intensive, more costly, and requires more time to complete. One potential avenue for avoiding the heightened costs of Sanger sequencing is to strategically use both methods—NGS to conduct a first level sequencing and Sanger to target specific genomic markers in greater depth.

C. Alternate Causation Versus Susceptibility

One important consideration for both sides looking to use genetic evidence is whether finding a given mutation supports the conclusion that the disease resulted from genetics or demonstrates why the alleged exposure caused the disease in this plaintiff but not others. Whether the plaintiff is the classic "eggshell" plaintiff will likely depend on point of view as well as the other science describing the relationship between the mutation and the disease. Some plaintiffs may, for example, be able to analyze their genetic profile and point to their genetic susceptibility to clear causation hurdles.[18] In other

[18] Kirk Hartley and David Schwartz, *A Lawyer's Guide to Genomics in Toxic Tort Cases: Part I,* LAW360.COM, available at https://www.law360.com/articles/10637

situations, the defense may be able to demonstrate that genetic variations predispose individuals to specific cancers regardless of environmental exposures and establish genetics as the independent cause of plaintiff's disease.[19] These two situations are sometimes distinguished as susceptibility (plaintiff was more susceptible to the exposure's harmful effects) or predisposition (plaintiff was predisposed to develop the condition regardless of environmental exposure), although the distinction is imperfect and will certainly be a matter of dispute between the parties.

In the past, the information needed to make these showings was out of reach in civil litigation due to limited technology and incredible expense. But that is changing. Broad genetic panels remain cost prohibitive, but particularly large cases arguably justify such an expense. In any event, a targeted approach to genetic testing can provide valuable insight at a reasonable cost. The following cases illustrate how counsel might use genetic testing to defend against medical causation claims while identifying potential hurdles during discovery that genetic testing can create.

D. *Guzman v. ExxonMobil Corp.*

Despite the trend in litigation—especially in large cases—away from trial and toward settlement, *Guzman v. ExxonMobil Oil Corp.* is one of the rare cases that made it to trial. The case resulted in a defense verdict, in part because of the DNA evidence Exxon put before the jury.[20]

Ms. Guzman was diagnosed with a form of thyroid cancer at age 30. She alleged that her cancer resulted from prenatal exposure to radioactive material that her father contacted at work. She sued several different companies for tens of millions of dollars in compensatory and punitive damages. Her father worked in a storage facility that housed inactive drilling pipes and other equipment used in offshore drilling. Part of her father's job was to remove build-up from the pipes stored at the facility. Ms. Guzman alleged that the scale contained naturally occurring radioactive material, or NORM. Ms. Guzman pointed to several instances where she was exposed to radioactive scale: her mother would bring her father lunch at the pipe yard while she was pregnant and after she was born; her father would return home after work carrying particles on his

36/a-lawyer-s-guide-to-genomics-in-toxic-tort-cases-part-1.

[19] *See, e.g.,* Guzman v. ExxonMobil Corp. 2013 Jury Verdicts LEXIS 9774; 2013 Jury Verdicts LEXIS 9774 (La. Dist. Ct. Aug. 27, 2013).

[20] *Id*.

body and clothing, which she allegedly inhaled; and other family members who took care of her on occasion when she was a toddler and worked at the same facility.

Ms. Guzman's expert testified that companies in the drilling industry had long known about the risks of exposure to radioactive material. Exxon initially believed that radioactive deposits were limited to a few isolated drilling sites, but later discovered radioactive material at several sites across the country. While that discovery wasn't made until the mid-1980's—after the relevant time period for Ms. Guzman's allegations—Ms. Guzman's expert argued that Exxon should have known about the potential dangers earlier.

Defense counsel attacked Ms. Guzman's expert's assertions vigorously through a battery of experts. The defense put forth experts in pathology, epidemiology, and medical toxicology. The toxicology expert used gene expression testing and genome sequencing to show that Ms. Guzman's DNA did not have the gene signatures you would expect to see if her cancer was caused by radiation exposure. The genetic testing did show that she had a genetic predisposition that made her five times more likely to develop thyroid cancer. This revelation—coupled with the pathology expert's testimony that radiation exposure typically resulted in bone cancers and the epidemiologist's testimony that his research indicating that radiation never caused thyroid cancer—led to a defense verdict.

E. *Hallquist v. E.I. Dupont De Nemours*

Hallquist involved a claim by the spouse of a Dupont employee alleging that benzene he was exposed to while working for Dupont caused her husband's multiple myeloma.[21] According to previous testimony from the decedent, Dupont employees were required to attend mandatory safety trainings. During trainings, benzene was one of the chemicals employees handled. Prior to his death, the decedent testified that he always followed the company's safety protocol, including wearing clothing and safety equipment provided by Dupont when necessary. The testing process involved opening jars containing benzene under a fume hood, inserting a syringe into the jar, and injecting the chemical into a testing machine, which was closed. The

[21] Hallquist, ex rel. Hallquist v. E.I. Dupont De Nemours, No. A-6223-12T2, 2014 N.J. Super. Unpub. LEXIS 2458 (N.J. Super. Ct. App. Div. Oct. 10, 2014).

decedent didn't know how many times he had tested benzene but testified that he knew what that he had been exposed to the fumes and had been present when chemical spills occurred.

Petitioner put forth a physician specializing in internal medicine, and the compensation judge permitted the petitioner's physician to testify to occupational exposures. The physician's testimony was not particularly helpful to the petitioner. He contended that the decedent would have to have been exposed to benzene multiple times a week over a prolonged period for it to have caused the decedent's cancer. On cross-examination, petitioner's expert testified that, although he didn't recall that the decedent had smoked a pack of cigarettes a day for three years in his late teens and early twenties, any negative effects of benzene exposure from smoking would have dissipated by the time his cancer was discovered.

Dupont put forth a toxicology expert to rebut testimony from the decedent and the petitioner's expert. Dupont's expert testified that there were no conclusive studies tying benzene exposure to multiple myeloma. Further, the safety precautions Dupont had in place meant there wasn't evidence sufficient to tie any chemical exposure in Dupont's lab to the decedent's cancer. Finally, Dupont's expert examined the decedent's medical records from the time period he was allegedly exposed. The expert didn't find any sign of altered biomarkers he would expect to find if individual's exposure to benzene caused harmful mutations in the decedent's DNA. Dupont's expert concluded that exposure to benzene during this time period could not have caused the decedent's cancer.

The compensation judge denied the petitioners' claim, finding that Dupont's expert was more credible, and the petitioner had not shown the level of exposure that her expert alleged was necessary to cause the decedent's cancer. The Appellate Division New Jersey Superior Court reviewed the compensation judge's findings and upheld the decision.

F. *Meyers v. Intel Corp.*

Advances in genetic testing only matter if courts are willing to compel plaintiffs to submit to genetic testing. In *Meyers*, a Delaware Superior Court denied Intel's request to compel the infant plaintiff's father to submit to Whole Exome Sequencing.[22] The plaintiffs—the infant and her mother—alleged that Janna and

[22] Meyers v. Intel Corp., No. N11C-07-009, 2015 Del. Super LEXIS 285 (Del. Super. Ct. June 11, 2015).

Robert Meyers' work at Intel exposed them to "hazardous, genotoxic, and reproductively toxic substances," which caused the infant plaintiff's birth defects. Intel argued that there was a thirty-five percent chance that Whole Exome Sequencing would prove that the infant plaintiff's birth defects were not the result of any exposure to a toxic substance, but were caused by genes inherited from his parents. Intel argued that the court had jurisdiction to compel Robert, a non-party, to submit to genetic testing because he submitted to the court's jurisdiction when the plaintiffs requested records on chemicals Janna and Robert were potentially exposed to while working at Intel. The court disagreed, finding that Robert had not consented to its jurisdiction.

The court also found that even if Robert had consented to its jurisdiction, he wasn't a party to the litigation. Delaware's Superior Court Civil Rule 35(a) only allows the court to compel such invasive testing when a party has placed their physical condition in controversy. Intel nevertheless argued that the court had authority to craft its own judicial remedy and order testing. The court declined, holding that "[g]iven this low probability of success, the significant privacy concerns relating to blood draws and genetic testing, the fact that Robert is not a party, and the fact that this Court has no jurisdiction over Robert, the Court finds no basis to compel Robert to submit to genetic testing."[23] Because Intel indicated that it would not seek testing against any of the parties if the court declined its request to compel Robert to submit to testing, the court denied all of Intel's requests.

IV. Conclusion

For several decades, authors have predicted that genetic technology would alter criminal and civil litigation. While there are still practical and legal hurdles preventing widespread use of genetic testing in litigation, those predictions have proven correct. As at-home genetic testing becomes more commonplace, law enforcement will leverage that information in their investigations. In the civil context, genetic sequencing will continue to help plaintiffs prove their claims, but the same technology will allow defendants to rebut allegations that their actions caused plaintiff's alleged harm. As technology improves and courts accept the role genetic technology can play in certain cases, there will be new opportunities to use this technology in both criminal and civil litigation.

[23] *Id.* at *7.