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# Advancements in Technology to Solve Cold Cases

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## Abstract

The purpose of this paper is to highlight the crisis of cold case investigations and discuss the advancements being made in this area over the last four decades. Technology such as CCTV cameras, DNA Phenotyping, and Genetic Genealogy have allowed many cases to be reopened but there are still not enough resources or funds to close the immense number of unsolved cases. There are also ethical concerns being addressed to allow for this technology to continue to be applicable. In some instances, it takes a combination of preexisting technology and new applications to work around previous barriers in investigations. Despite the progress that has been made, research and resources remain a priority for the goal of closing cold cases.



## Keywords

cold case, DNA phenotyping, genetic genealogy, ethics, funding

# Advancements in Technology to Solve Cold Cases

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**Abstract**

The purpose of this paper is to highlight the crisis of cold case investigations and discuss the advancements being made in this area over the last four decades. Technology such as CCTV cameras, DNA Phenotyping, and Genetic Genealogy have allowed many cases to be reopened but there are still not enough resources or funds to close the immense number of unsolved cases. There are also ethical concerns being addressed to allow for this technology to continue to be applicable. In some instances, it takes a combination of preexisting technology and new applications to work around previous barriers in investigations. Despite the progress that has been made, research and resources remain a priority for the goal of closing cold cases.

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## Advancements in Technology to Solve Cold Cases

In the United States alone, there are estimated to be around 250,000 murders still unsolved. This statistic only includes homicides. It does not touch on other unsolved crimes or even missing person cases. After some time, many cases are deemed "cold cases." Without leads, they have been set aside, put in storage, or thrown out completely. The justice system has a huge issue with cold cases. The sheer amount of them is only part of the problem. What does it mean for a case to go "cold" and how long does this take? Would it be surprising to learn that there is no exact timeframe when a case can be declared cold? Would it also be shocking to read that many cases run out of leads relatively quickly after they start? After only 72 hours, many cases are already well on their way to being declared cold.

However, things are starting to change. In the past 40 years, significant progress has been made to allow the revisiting of cold cases. Cameras document our every move. Social media allows society to connect with each other all across the globe and gain insight into other people's lives. DNA technology now exists, which has allowed forensics to evolve significantly. There are ethical concerns with some of this technology. However, this is actively being addressed to continue using the technology for the benefits it can provide to investigations. At times, it may take a combination of older forensic applications with newer advancements to close a case. Investigators may also need to take the most abundant evidence and study it in new ways. On top of this, funding and resources are critical. None of these advancements could be made without money and the people who perform the research and investigations. A tremendous amount of cold cases are still unsolved today, but advancements in technology, dedicated resources, and increased funding can make a big impact on decreasing these numbers.

### Using Technology to Solve Cold Cases

One of the major factors in clearing cold cases is the implementation and advancements in technology. This does not just include what could be called “forensic” technology. In general, the fact that more technology exists today than 40 years ago has increased the chances of cases being cleared. For example, there are currently CCTV cameras, numerous social media platforms, and mass amounts of cyber security. While all this technology may seem invasive at times, there are significant benefits to being watched and monitored. There is a case out of Oakley, California, where a woman named Alexis Gabe had been declared missing since January 2022. Using CCTV footage and text messages, authorities were able to build a trail of Alexis’ movements before she disappeared. Recently, some of her remains were found. The remains were relatively far from her hometown. Her case was widely covered by news agencies and posted all over social media. These outlets allow the public to become involved in searches and updates. They also allow for more of a chance to receive tips. If more people are aware, then there is more potential for new information to be found.

**The Emergence of DNA Technology**

Forensic technology has also come a long way from what was available decades ago. One of the most significant advances in the field is DNA testing. DNA has always existed, but several cases date back decades to when there was not even technology made to test it. In an article for the National Institute of Justice, Phil Bulman said:

> Since 2005, NIJ has awarded more than $73 million to more than 100 state and local law enforcement agencies through its Solving Cold Cases with DNA competitive grant program. This funding has allowed the agencies to review more than 119,000 cases. The funding has also facilitated the entry of almost 4,000 DNA profiles into the FBI's

> Combined DNA Index System, yielding more than 1,400 hits. (Bulman, 2014, sec. 3, para. 1)

In 14 years, more than 119,000 cold cases were reviewed using DNA technology. That is an incredible accomplishment. This goes to show how many of these cases exist. The National Institute of Justice has done significant research into Y-chromosomes and short tandem repeats because the information gleaned from them is incredibly valuable. It is said that:

> Y-chromosome DNA testing examines the male-specific portion of biological evidence. This can be especially important in cases in which a small amount of male DNA is recovered in the presence of a large amount of female DNA, such as in sexual assault evidence. (Bulman, 2014, sec. 3)

There is not always a lot of DNA available to test, especially from the perpetrator. This research provides crucial information to make the most of these small samples of (male) DNA. Also, the implementation of DNA databases where individual profiles are saved allows investigators to refer back to them at any time. These profiles are compared with each other or to new profiles to generate potential matches to suspects. DNA evidence can be used in investigations in numerous ways. Having DNA evidence and profiles to test and refer to can be the turning point in cold case investigations. However, there are times when these profiles and databases are not enough. As explained, once the individual profiles are uploaded to a database, investigators look for a match to that profile. What happens when there is no match? The perpetrator may not be in the system, and a new roadblock lies ahead. These profiles are still very valuable, but they may not always be the expected break in a case. In recent years, new avenues to analyze and match DNA have continued to emerge in the forensics field in order to find ways around the setbacks and generate new leads.

DNA analysis and techniques have been crucial to cold case investigations. Matching a DNA profile to someone could crack cases wide open, but other times there is still not enough to find the perpetrator. For this reason and more, researchers have dedicated an immense amount of time and resources to continually develop new ways to utilize DNA evidence. One such technique is DNA phenotyping. DNA phenotyping or Forensic DNA Phenotyping is a tool that allows investigators to predict the physical appearance of an unidentified individual. This technology utilizes single nucleotide polymorphisms found in DNA. Forensic DNA Phenotyping can be described in this manner:

> In an attempt to obtain information about the physical features of individuals from DNA extracted from biological material, such as blood drops, hair strands, or small body fragments, the scientific community has intensively researched the association between genetic markers and physical traits. (Marano and Fridman, 2019, p. 2)

This research has been able to predict numerous physical features of an individual. These include eye color, hair color, skin color, age, and height. This technology also has the capability to predict facial features, ancestry, and hair loss. When other leads in the case have been exhausted, Forensic DNA Phenotyping has provided a new avenue for investigators to narrow down suspects. It has also been suggested that this technology may be more reliable than typical witnesses. It is said that "In essence, FDP outcomes can serve as "biological witness," and may potentially provide even more accurate information than human eyewitnesses do, who are known to be unreliable" (Kayser, 2015, p. 34). While Forensic DNA Phenotyping is still being researched and developed, the capability of replacing investigators' reliance on faulty human witnesses is extremely valuable. Thus, the further this field can be developed, the better. Humans do not always remember things correctly and are exceedingly susceptible to suggestion and

influence. Other witnesses or even law enforcement officers may lead a witness to inaccurately describe the perpetrator. In order to correctly identify the person who committed the crime, the most accurate physical description is necessary. DNA phenotyping has the potential to be the most accurate when a physical description is the best possible lead.

**Introduction to Forensic Genealogy**

Another prominent addition to forensic DNA applications is Forensic Genetic Genealogy. The new developments in Forensic Genetic Genealogy, also known as Investigative Genetic Genealogy, are largely due to voluntary genetic testing done by the public. It has become increasingly popular to get one's DNA tested to learn about family ancestry by purchasing kits that can be sent to a company that will provide online results. According to Greytak, Moore, and Armentrout:

> Unlike traditional forensic DNA analysis, which uses autosomal short tandem repeats (STRs) to generate an identity profile from~20 loci, genetic genealogy uses hundreds of thousands of single nucleotide polymorphisms (SNPs) spread across the autosome. Participants in genetic genealogy have had their DNA tested by a direct-to-consumer (DTC) genetic testing company, such as 23andMe or AncestryDNA, which use microarrays to genotype up to~1 million SNPs. DTC companies obtain DNA from spit kits or cheek swabs and thus always have a large amount of high-quality single-source DNA to work with. Forensic DNA samples, on the other hand, often only have a small amount of degraded DNA, which may be mixed with DNA from one or more other individuals. (Greytak et al., 2019, p. 103)

Similar to DNA phenotyping, this technology analyzes single nucleotide polymorphisms found within the DNA sample. The profiles obtained from the examination of SNPs are put into a

database that law enforcement can search and utilize during investigations. Law enforcement is looking for a match between their unknown individual and a relative of a user who submitted a DNA sample. This technology led to the recent discovery of the identity of the Golden State Killer.

**Ethical Concerns of Genetic Genealogy**

As described, Forensic Genetic Genealogy is incredibly valuable for criminal investigations. This technology played an important role in getting many cold cases solved. The Golden State Killer was apprehended by utilizing a genealogy database and finding one of his relatives. However, some ethical and privacy concerns have emerged regarding the use of this information. Not all companies made it known to their users that their data was shared with law enforcement. Some individuals don't want to be connected to a criminal. In her article, Glynn says:

> While the impact FGG has had in resolving hundreds of cases in a few short years cannot be denied, to ensure its continued success, it is essential that it is used responsibly, ethically, and with sound scientific practices. In addition, appropriate forensic, investigative, and criminal procedure standards must be followed throughout, with the ultimate goal of protecting public safety and individual privacy at the forefront. (Glynn, 2022, p. 1395)

Companies now have to explicitly make it known if their data is shared with law enforcement. Many allow individuals to decide whether to participate in this sharing or not. Some even give the option to make the data public. A large portion of these companies keep their genealogy databases private, while others require court orders to search. Others, like GEDmatch, explicitly tell consumers that their data is public and can be searched and used to generate potential

matches in cases. Due to the concerns expressed, Forensic Genetic Genealogy is often reserved for special cases and circumstances, being used as a last resort. Privacy concerns are still an active issue, and the use of the technology for investigative purposes is being regulated.

**Combining Old and New**

New advances in technology have been a primary factor in clearing cold cases. However, there are instances where these new techniques are not enough. Some cases take a combination of older forensic applications and new implementations. In one particular case out of Canada, it took three forensic techniques to generate the identity of remains from a cold case that dated back to 1968. Researchers utilized anthropological, mtDNA, and bomb-pulse analyses. Each one of these analyses yielded different information, like pieces of a puzzle. Once all of the pieces were put together, the truth was finally revealed. An article was written about the research involved in this cold case. According to the authors:

> Craniometrics, skeletal ossification, and dental formation indicated an age-at-death of 4.4 ± 1 year. Radiocarbon analysis of enamel from two teeth indicated a year of birth between 1958 and 1962. Forensic DNA analysis indicated the child was a male, and the obtained mitochondrial profile matched a living maternal relative to the presumed missing child. These multidisciplinary analyses resulted in a legal identification 41 years after the discovery of the remains, highlighting the enormous potential of combining radiocarbon analysis with anthropological and mtDNA analyses in producing confident personal identifications for forensic cold cases dating to within the last 60 years. (Speller et al., 2012, p. 1354)

The first pieces of the puzzle were the child's age when they died and their year of birth. The next one was their sex. Lastly, a relative was found by matching their DNA to a sample from the

cranium. The child was finally identified after researchers combined previously developed techniques with modern forensic technology and implementations. Based on these results, the authors believe the methods utilized show promise for applications in other cold cases.

Another similar example involves trace evidence. Trace evidence has been collected at crime scenes and during investigations for many years. It is not a new practice. However, this type of evidence may have more potential to resolve cold cases than previously believed. A laboratory in Western Australia compared over 4400 textile fibers for one specific case. They were able to use this trace evidence to identify a serial killer. They created a database of these fibers to sort them and find the ones needed to connect multiple crimes. The members of the lab described their research in this way:

> Textile fiber evidence was critical in this investigation, as it was the only form of trace evidence that provided links between all three offences (being the sexual assault and two homicides). In the absence of DNA evidence for one of the homicide victims, the recovered fibers were vital in establishing the offences of this investigation as serial killings. (Powell et al., 2021, p. 9)

These fibers connected crimes that could not previously be related to one another. While there was suspicion of this, the work done by this lab confirmed it. They could not rely on new forensic DNA analysis in this case. They used what was available and looked at it in a new way. The database they created provided the means for the fibers to be narrowed down. Three crimes were then connected, and a serial killer was eventually convicted. References like these could be extremely valuable in investigations if no other evidence generates big enough leads. It could even confirm leads that were not fully sought out.

**Dedicated Resources and Funding**

The exact number of cold cases that exist today is unknown. However, as stated early on, the amount of unsolved homicide cases is thought to be around 250,000. This means that the number of all cold cases is considerably more than this. Unfortunately, the resources needed to completely resolve these cases are currently unavailable. In an article from the National Institute of Justice, it is said:

> Every day across the U.S., investigations slow or stop completely, and cases go "cold." Police agencies often lack the manpower, equipment and funding to support units dedicated to investigating and analyzing these cold cases. Homicide and sexual assault units are backlogged with active cases. Consequently, cold cases rarely get the attention they deserve. (Heurich, 2008, sec. 1, para. 3)

There is already a backlog within current investigative units. Those individuals do not have time to investigate cold cases due to already existing casework. This is part of the reason why cold cases were not a priority for many years. Yet, funding from outside sources has enabled law enforcement to dedicate resources to solving cold cases. One such example was mentioned previously. The National Institution of Justice initiated the Solving Cold Cases with DNA competitive grant program (Bulman, 2014). This funding does not only go towards manpower and equipment, as Heurich describes. It is also needed to further develop the technological implementations and create the databases used to clear cases. Resources and funding are necessary for research to continue and for improvements to be made in forensic technology.

## Conclusion

While time has passed and seemingly left many cases in the dark, this has allowed society to become more advanced. CCTV cameras and social media track our activity. DNA analysis

provides a way to identify perpetrators by matching DNA profiles contained in databases. DNA phenotyping is used to predict the physical features of unknown individuals. Forensic Genetic Genealogy allows investigators to compare DNA profiles to profiles within genealogy databases. Ethical concerns exist over the use of this technology, but regulations have been made in order to continue its application to investigations. Forensic Genetic Genealogy has been used to identify serial killers by matching the once-unknown profile to a relative who provided a DNA sample to a genealogy company. Also, more resources and funding are being dedicated to unsolved crimes. Without this, research could not be continued to advance and improve forensic technology. There also would not be enough investigators who had time to focus on cold cases. These cold cases have just been waiting for someone to pick them back up and apply the new advances that have been made. Even though forensics and forensic investigation have come so far, this does not guarantee that these cases will be solved. Unfortunately, some unknowns may always stay that way. However, as we allocate resources, we can take another look at a case in hopes of finally getting it cleared and getting answers. Those involved in the case, such as family or friends, deserve to know the truth, and the forensics discipline currently has the best chance to do this in today's modernized society.

## References

Bulman, P. (2014, March 3). Solving cold cases with dna: The boston strangler case. National Institute of Justice. https://nij.ojp.gov/topics/articles/solving-cold-cases-dna-boston-strangler case

Davis, R. C., & Jensen, C. J., & Burgette, L., & Burnett, K. (2014). Working smarter on cold cases: Identifying factors associated with successful cold case investigations. Journal of Forensic Sciences, 59(2), 376-382. https://doi.org/10.1111/1556-4029.12384

Glynn, C. L. (2022). Bridging disciplines to form a new one: The emergence of forensic genetic genealogy. Genes, 13(8), 1381–1396. https://doi.org/10.3390/genes13081381

Greytak, E. M., & Moore, C., & Armentrout, S. L. (2019). Genetic genealogy for cold case and active investigations. Forensic Science International, 299, 103-113. https://doi.org/10.1016/j.forsciint.2019.03.039

Heurich, C. (2008, July 14). Cold cases: Resources for agencies, resolution for families. National Institute of Justice. https://nij.ojp.gov/topics/articles/cold-cases-resources-agencies-resolution-families

Kayser, M. (2015). Forensic dna phenotyping: Predicting human appearance from crime scene material for investigative purposes. Forensic Science International: Genetics, 18, 33-48. https://doi.org/10.1016/j.fsigen.2015.02.003

KTVU FOX 2. (2022, August 4). 'Shocking and upsetting': Alexis gabe's family shown timeline of daughter's death. https://www.ktvu.com/news/shocking-and-upsetting-alexis-gabes-family-shown-timelineof daughters-death

Marano, L. A., & Fridman, C. (2019). DNA phenotyping: Current application in forensic science. Research and Reports in Forensic Medical Science, 9, 1-8. https://doi.org/10.2147/RRFMS.S164090

Powell, R., & Collins, P., & Horsley, G., & John Coumbaros, J., & van Bronswijk, W. (2021). Enhancing the evidential value of textile fibres part 2: Application of a database-driven fiber comparison strategy to a cold-case investigation. Forensic Science International, 325, 1-10. https://doi.org/10.1016/j.forsciint.2021.110894

Speller, C. F., & Spalding, K. L., & Buchholz, B. A., & Hildebrand, D., & Moore, J., & Mathewes,

R., & Skinner, M. F., & Yang, D. Y. (2012). Personal identification of cold case remains through combined contribution from anthropological, mtDNA, and bomb-pulse dating analyses. Journal of Forensic Sciences, 57(5), 1354-1360.

U.S. Department of Justice Office of Justice Programs. (2019, July 10). The crisis of cold cases. https://www.ojp.gov/archives/ojp-blogs/2019/crisis-cold-cases

Yee, G. (2022, November 4). Partial remains of missing Bay Area woman found in Amador County. Los Angeles Times. https://www.latimes.com/california/story/2022-11-04/alexis-gabe-missing-bay-area-woman-remains-found