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# New research has potential to speed up forensic analysis in sexual assault cases

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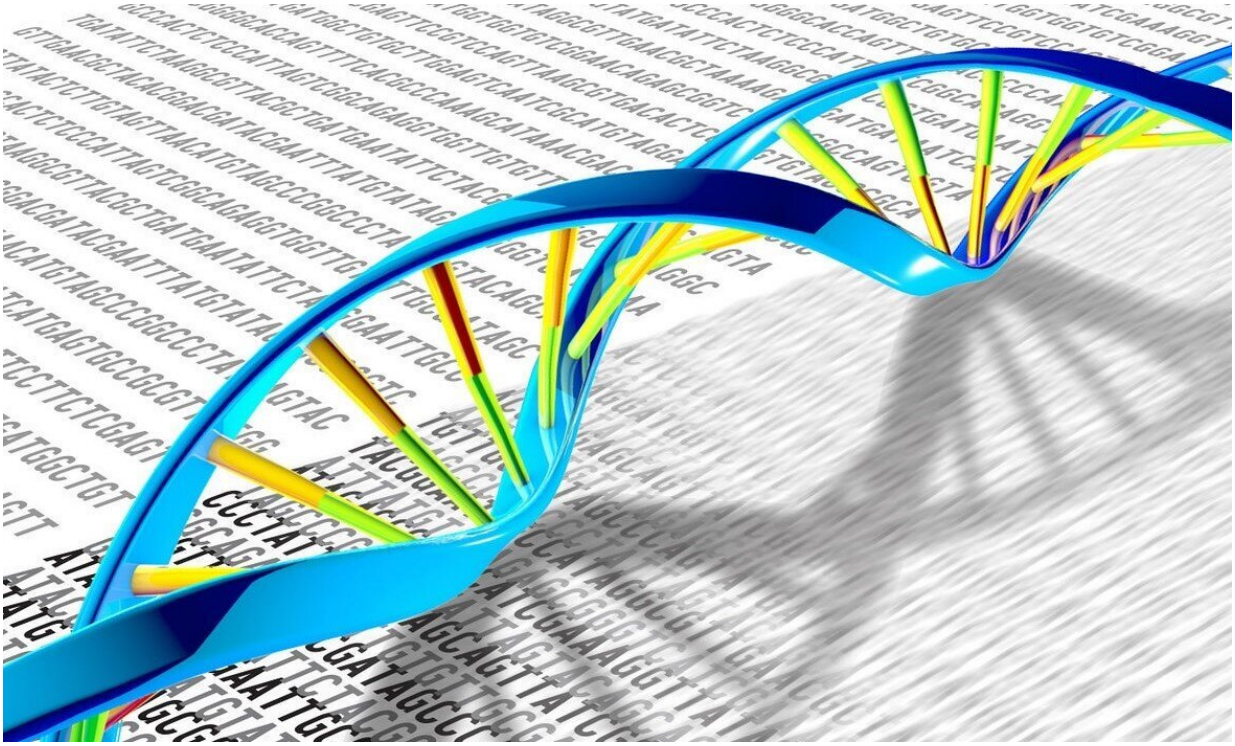

DNA, which has a double-helix structure, can have many genetic mutations and variations. Credit: NIH

A team of researchers has developed a radical new technique for analyzing evidence in sexual assault cases. The new approach could streamline the forensics pipeline and reduce delays in the processing of DNA evidence.

The research is described in a paper published in the journal *Advanced Science*.

There are almost half a million sexual assaults in Canada every year with many more going unreported. The new approach could mitigate one of the reasons victims are reluctant to report assaults: the perception that analysis of forensic evidence is too slow.

"For this research, we read reports and surveys that asked victims why they weren't reporting assaults," says Mohamed Elsayed. "And the most common answer was that they didn't have confidence in the justice system—and that lack of confidence was partly because of how long the process takes."

The lead author is Elsayed, who worked on this project as part of his Ph.D. in Biomedical Engineering and who is now a postdoctoral fellow in the Department of Chemistry at the University of Toronto (U of T).

His U of T co-authors include Professor Aaron Wheeler from the Department of Chemistry, the Institute of Biomedical Engineering at U of T, and the Center for Research and Applications in Fluidic Technologies, and Leticia Bodo, a member of Innis College and a master's student in the Department of Chemistry. All three are also affiliated with the Donnelly Center for Cellular and Biomolecular Research.

Additional co-authors of the study include researchers from the Department of Forensic Science, University of Toronto Mississauga; Ontario's Center of Forensic Sciences (CFS); and the ANDE Corporation.

"CFS and ANDE were critical contributors at every step of the project," says Wheeler. "I'm also grateful to NSERC for having the foresight to

establish the 'Alliance Society' program which has a mission to 'address a societal challenge that will result in new natural sciences and engineering knowledge and societal impact.'"

Processing forensic evidence in sexual assault cases is a highly technical, multi-step process. Typically, DNA evidence is first collected from the victim, then sent to a well-equipped forensic laboratory for analysis by a skilled technician. Once there, the sample is first processed to isolate the assailant's DNA from the victim's; analysis of the assailant's DNA can then be conducted and used to identify a suspect.

The entire process can take days, weeks or longer. Most of that time is taken up with transporting the evidence to the lab; also, once at the lab, the speed with which the sample is analyzed depends on the number of other cases requiring analysis.

The researchers focused on the first step—that of separating the DNA of two individuals from a single sample. Currently, this can only be done manually by trained and experienced experts in a lab; i.e. there is no automated solution.

What Elsayed and his collaborators have developed is a process for separating two individuals' DNA employing a process called differential digestion technique using digital microfluidics. The new approach mitigates the current logistical and technical challenges.

The researchers simplified the process by reducing the number of manual steps needed to isolate the assailant's DNA from 13 to five. "Also, because micro-fluidic processes tend to be faster, we expect that one of the eventual benefits will be shortening the overall time needed," says Elsayed.

What's more, the new approach could lead to a mobile solution that

doesn't require a lab. For example, testing could be done at a hospital where a victim would typically be taken in a sexual assault case—thereby eliminating the time necessary for the sample to reach the lab and circumventing the lab's queue.

The new technique is compatible with the technology known as Rapid DNA Analysis, already in use for the second step of identifying an individual from their DNA. According to the authors, the long term goal would be to integrate the two technologies to make the process even more streamlined.

There are many challenges to overcome before the new technique is operational and deployed. But Elsayed is confident those challenges will be solved and has turned his efforts toward making it commercially viable and widely accessible.

"Our plan is to develop an instrument that will do in five minutes what currently takes 45," says Elsayed. "And to run many more samples than previously. Once we do that, the next step would be to introduce the technology to forensic labs and hospitals. It will take years but the potential is very exciting."

**More information:** Toward Analysis at the Point of Need: A Digital Microfluidic Approach to Processing Multi-Source Sexual Assault Samples, *Advanced Science* (2024). DOI: 10.1002/advs.202405712

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