

Cancer treatment: personalised blood tests can better detect DNA from tumours in the body – new research

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Cancerous tumours release DNA that can be found in the bloodstream. Credit: [Andrey Popov/ Shutterstock](#)

Many cancers, especially in earlier stage disease, are treated by removing

the tumor. But even after the tumor has been removed, there's still a chance that cancer cells remain in the body and the cancer can come back. Currently, patients undergo regular check-ups, scans, and blood tests so that doctors can monitor their status and make decisions about any further treatments that may be needed.

But increasingly, doctors have begun basing these treatment decisions around genomic information from the person's tumor DNA. Each person's DNA is unique and, even more so, each tumor is genetically unique. By sequencing a person's tumor sample or biopsy, doctors can begin to understand what DNA changes have taken place and caused the [cancer](#) to grow. This method allows them to choose a treatment better suited to the patient, in a personalized way.

[Our latest research](#) takes this concept one step further. We found that it was possible to very sensitively detect tumor DNA in a person's [blood](#) using personalized blood tests. This new method may be used to plan treatment for [patients](#) to help prevent cancer from coming back.

Past research has shown that in patients with cancer, cancerous tumors release DNA which can be [found in their bloodstream](#). We call this circulating tumor DNA. Given that cancer DNA contains mutations—which makes it distinct from other DNA molecules found in the blood—this provides an exciting opportunity for new approaches to cancer monitoring through blood tests.

However, detecting circulating tumor DNA in the bloodstream can often be like searching for a needle in a haystack. In patients with early-stage cancer, or after their tumor has been removed, the concentration of cancer-derived DNA in the blood can be very low, making it challenging to detect with methods that are currently used for clinical testing.

In our recent study, [published in *Science Translational Medicine*](#), we

show that circulating tumor DNA can be detected with very [high sensitivity](#) in the blood when we compare it to a profile of the tumor's genome. This allows us to know exactly which mutations to look for in the bloodstream, in a way that is personalized to each patient.

Some tumors can have [hundreds or many thousands of mutations](#). Each patient's list of mutations provides multiple different targets for cancer detection in blood, allowing us to effectively search for many different circulating tumor DNA molecules. We developed a computational method that looks through many DNA fragments in the blood based on a patient's tumor mutation profile. It can carefully scan many DNA molecules from the blood to find signals from tumor mutations.

We found that through this personalized sequencing approach we could detect as little as one or a few mutation-carrying DNA fragments that came from the tumor out of a million DNA fragments in the blood. This method can lead to approximately ten-fold greater sensitivity compared to previous methods.

We used this method to study blood samples from patients with both early and advanced-stage cancers of different types, including melanoma, lung and breast cancer. Patients with early-stage disease had low concentrations of cancer DNA in their blood, as did patients following surgery.

Patients with brain or renal tumors appeared to have lower concentrations of cancer DNA in their blood than patients with other types of cancers. These tumor types seem to release fewer DNA molecules into the bloodstream, though the reasons for this are still unclear. Despite these low levels, we also showed that our approach could detect them with higher sensitivity than other methods.

Personalized blood tests

These types of sensitive, personalized blood tests might be useful for following up cancer patients after they have had surgery. This is because after surgery some patients may have some [cancer cells](#) remaining in their body—which could mean that their cancer might be more likely to relapse.

These patients may have extremely low levels of circulating tumor DNA in their blood. Being able to more accurately identify those patients at high risk of relapse—or detect disease relapse earlier—could help decide which patients may need additional treatment after surgery. This hypothesis will still need to be tested in future trials.

Because our method searches for many mutations, instead of just one, it can help detect signals even in small volumes of blood. So we wondered if this highly sensitive method might even be used to [test](#) as little as a single droplet of blood. Being able to do this would not only reduce testing costs, but could enable entirely new approaches for cancer monitoring.

We found that when we analyzed sequencing data from the equivalent of a single drop of blood, our analysis method was still able to measure the levels of tumor-derived DNA in blood, although not quite at the same level of sensitivity. Combined with our recent demonstration of methods to sequence DNA from [dried blood spots](#), we suggest that it might be possible to monitor cancer levels in the blood from pin-prick blood samples. This might in the future even be done at home and may enable more frequent monitoring of a patient's disease between clinic visits. It could also help broaden access to cancer diagnostics for those further away from specialist cancer centers.

In recent years, personalized cancer blood tests used to detect tumor DNA—sometimes called "liquid biopsies"—have made major strides. Now, companies are beginning to offer [personalized tests for research](#)

[studies](#). In a clinical setting, blood-based cancer profiling has been approved for use [where a tumor sample is not available](#).

Tumor sequencing and personalized blood tests go hand in hand: together, they allow physicians to monitor very small tumors with greater sensitivity. These highly sensitive personalized cancer tests are an emerging area of medicine—and are likely here to stay.

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