

11,000-year-old living dog cancer reveals its secrets

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Simba, a 4-year-old domestic dog from Buyubi Village in Tanzania, exhibits symptoms of canine transmissible venereal tumor. Credit: Anna Czupryna

Scientists have sequenced the genome of the world's oldest continuously surviving cancer, a transmissible genital cancer that affects dogs. This cancer, which causes grotesque genital tumours in dogs around the world, first arose in a single dog that lived about 11,000 years ago. The

cancer survived after the death of this dog by the transfer of its cancer cells to other dogs during mating.

The [genome](#) of this 11,000-year-old [cancer](#) carries about two million mutations – many more mutations than are found in most human cancers, the majority of which have between 1,000 and 5,000 mutations. The team used one type of mutation, known to accumulate steadily over time as a "molecular clock", to estimate that the cancer first arose 11,000 years ago.

"The genome of this remarkable long-lived cancer has demonstrated that, given the right conditions, cancers can continue to survive for more than 10,000 years despite the accumulation of millions of mutations", says Dr Elizabeth Murchison, first author from the Wellcome Trust Sanger Institute and the University of Cambridge.

The genome of the transmissible dog cancer still harbours the genetic variants of the individual dog that first gave rise to the cancer 11,000 years ago. Analysis of these genetic variants revealed that this dog may have resembled an Alaskan Malamute or Husky. It probably had a short, straight coat that was coloured either grey/brown or black. Its genetic sequence could not determine if this dog was a male or a female, but did indicate that it was a relatively inbred individual.

"We do not know why this particular individual gave rise to a transmissible cancer," says Dr Murchison, "But it is fascinating to look back in time and reconstruct the identity of this ancient dog whose genome is still alive today in the cells of the cancer that it spawned."

Transmissible dog cancer is a common disease found in [dogs](#) around the world today. The genome sequence has helped scientists to further understand how this disease has spread.

"The patterns of genetic variants in tumours from different continents suggested that the cancer existed in one isolated population of dogs for most of its history," says Dr Murchison. "It spread around the world within the last 500 years, possibly carried by dogs accompanying seafarers on their global explorations during the dawn of the age of exploration."

Transmissible cancers are extremely rare in nature. Cancers, in humans and animals, arise when a single cell in the body acquires mutations that cause it to produce more copies of itself. Cancer cells often spread to different parts of the body in a process known as metastasis. However, it is very rare for [cancer cells](#) to leave the bodies of their original hosts and to spread to other individuals. Apart from the dog transmissible cancer, the only other known naturally occurring transmissible cancer is an aggressive transmissible facial cancer in Tasmanian devils that is spread by biting.

"The genome of the transmissible dog cancer will help us to understand the processes that allow cancers to become transmissible," says Professor Sir Mike Stratton, senior author and Director of the Sanger Institute.

"Although transmissible cancers are very rare, we should be prepared in case such a disease emerged in humans or other animals. Furthermore, studying the evolution of this ancient cancer can help us to understand factors driving cancer evolution more generally."

More information: Elizabeth P. Murchison, et al. (2014)

'Transmissible dog cancer genome reveals the origin and history of an ancient cell lineage' Advanced online publication in *Science*, 23 January 2014. [DOI: 10.1126/science.1247167](https://doi.org/10.1126/science.1247167)

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