CANDIE – the oldest dog on the planet

Tumour cells have spread between dogs globally for the last 11,000 years and all are directly linked to the first dog's original tumour, writes Dr David Duffy, director of Wildlife Rehabilitation Ireland, and an assistant professor of Wildlife Disease Genomics at the Whitney Laboratory for Marine Bioscience at the University of Florida

Meet CANDIE. She likes to travel, and, as the oldest living dog on the planet, has visited every continent except Antarctica. It takes a great deal of time to become so well-travelled, especially for a dog. So, how old is CANDIE? It might be hard to believe, but she is over 11,000 years old! Having first walked the earth around the time human hunter-gatherers first domesticated dogs, she is still regularly to be found on streets all around the world.

But CANDIE's extreme age isn't her only outstanding feature: she has lived so long that she has even figured out how to be in multiple places at once, a very useful skill for any intrepid traveller. CANDIE figured out how to clone herself long ago and, while she is now all but immortal, there are plenty of scientists, vets and dog owners hell bent on putting an end to her existence.

So, what exactly is the price of CANDIE's immortality and why has it turned so many against her? To achieve her extreme longevity and cloning abilities, she had to forego the life she knew. CANDIE had to give up her body and is now relying on mobile life-support to sustain each of her clones. CANDIE's body might be gone, but her intact cells and genome live on. She had to transition from being a free-living dog to becoming a parasite. Those life-support machines she relies on are other, younger dogs and her cells continue to spread globally from individual to individual.

CANDIE has become a virulent cancer, her cells spreading from dog to dog, reliant on invading the host dog's tissue to survive, drawing nourishment from their poor unsuspecting victims. While her cells continue to grow and divide, she will never again be a free-living dog. CANDIE is, in fact, an abbreviation of CANine venereal DIseasE. All of these global tumours are directly linked to CANDIE's original tumour and not to the host dogs' own cells.

WHAT IS CANINE VENEREAL DISEASE

Canine venereal disease is a transmissible tumour, in which the cells from the original CANDIE spread from dog to dog during sexual contact, giving rise to tumours. Most cancers consist of a body's own cells becoming cancerous and leading to tumour growth. However, transmissible cancers occur when cancerous cells from a different individual are transmitted to and invade a new host, growing tumours which are genetically distinct from the new host.

Canine venereal disease tumours consist not of the host individual's cells, but of the cells from a dog (CANDIE) that originally lived thousands of years ago. Like a regular cancer, the cells from the original CANDIE derived from that dog's own transformed cells. However, they later became transmissible and, before she died, CANDIE's tumour cells then spread to other dogs through sexual contact, giving rise to tumours, and they have continued to spread between dogs globally for the last 11,000 years. All of these global tumours are directly linked to CANDIE's original tumour and not to the host dogs' own cells.

IDENTIFICATION

Researchers were able to identify the approximate time when the tumour cells first diverged from dogs and wolves by analysing tumour genomes from infected dogs from across the globe. They could also pinpoint when the last common ancestor of all the strains currently circulating the globe existed, approximately 500 years ago (about the time of the recent human European expansion).

Research tells us that animal populations with limited genetic diversity may be particularly susceptible to these cancers. Thus, European explorers, settlers and colonisers are thought to have spread the disease globally, by bringing their companion and working dogs with them. Genetic analysis has also confirmed that the original CANDIE from which the tumour arose was a female, although the tumours infect both male and female dogs as well as other canines (eg. wolves and coyotes). Genomic analysis even revealed the colour of the long-deceased CANDIE's body to be black.

Transmissible cancers should not be confused with the distinct and more common pathogen-induced tumours whereby a pathogen induces host cells to transform and become cancerous, such as the human papilloma virus (HPV) and cervical and throat cancers. Transmissible cancers, where the animal's own cells become cancerous and are capable of spreading to other individuals, are thought to be a much rarer event, and in these cases the tumours themselves are the infectious agents.

TRANSMISSIBLE CANCERS

There are only three known instances of such transmissible cancers in mammals: the dog tumour; a Tasmanian devil facial tumour disease; and a Syrian hamster contagious reticulum cell sarcoma. The Tasmanian devil disease is spread by biting. While it is a much younger disease than canine venereal disease, having arisen less than 20 years ago, the tumours are already threatening the wild Tasmanian devil hosts with extinction. Interestingly, in that short time not one but two different individual devils have given rise to unique transmissible cancers, each with a separate genome arising from the original devil. Transmissible cancers have also recently been discovered in clams, causing huge problems for North American clam fisheries which are being decimated by transmissible tumour disease outbreaks. Importantly, transmissible cancer research tells us that

animal populations with limited genetic diversity, such as early domesticated dogs and the island population of Tasmanian devils, may be particularly susceptible to the emergence and spread of these cancers. One has to hope that such transmissible cancers do not become more widespread as humans continue to decimate animal population numbers globally and genetic diversity in myriad species is rapidly reduced.

TREATMENT

What does modern science hold for CANDIE? For infected dogs lucky enough to receive veterinary care, the good news is that this transmissible tumour usually responds well to surgery, chemotherapy and radiation therapy. In addition to better treatments to remove the tumour cells from infected dogs, new scientific breakthroughs could be employed to resurrect this unfortunate individual. It is fascinating (though also somewhat disturbing) to consider that advances in animal cloning technologies mean that it might be possible to clone CANDIE's genome back into a dog embryo. Like Dolly the sheep, the first mammal ever cloned back in the 1990s, this embryo could be carried to term by a surrogate mother, reincarnating CANDIE in dog form once again. This takes us into ethically difficult territory, although for the more optimistic dog lovers an analogy with the Phoenix may be more apt, with Candie being reborn from the ashes of the disease that most likely killed her.

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Animal-assisted therapy – helping fibromyalgia patients and their canine companions

A new study has found that people with fibromyalgia, a chronic centralised pain-sensitivity disorder with no known cure, experienced a more positive emotional-physiologic state after a single session with therapy dog. The recently published study, Better Together, a collaboration between the Purina Institute and the Mayo Clinic, also found that that animal-assisted activity sessions positively impacted the therapy dogs working to help the patients. Despite the widespread use of therapy dogs in clinical settings, there is a lack of understanding of the impact of animal-assisted activity sessions on the emotional state of the dogs. In addition to interacting with patients of all ages in varying physical and emotional states as part of their work, therapy dogs are exposed to novel environments that may include new sights, sounds and textures that require ongoing focus and adaptation. The study focused on 19 therapy dogs' wellbeing during animal-assisted activities, by evaluating their heart rate and heart rate variability, salivary cortisol and oxytocin, and ear temperatures. The dogs – all members of the Mayo Clinic Caring Canines Programme, and varying in breed, age and size – did not show signs of stress and may have been in a more relaxed state at the end of the session. For most parameters, there were no changes in the dogs, signaling contentment; however, for those that did change, they pointed to a more positive emotional and physiological state, such as a significantly lower heart rate, at the end of the session. This signals the dogs were not only good at their jobs, but in many cases, enjoyed the work they were doing with patients.

The National Fibromyalgia Association in the US estimates that 10 million Americans and between 3-6% percent of the world population suffers from fibromyalgia.

While fibromyalgia has some effective treatment strategies, most individuals live with chronic symptoms and look for non-conventional treatments in search of relief. For 221 patients, each enrolled in the Mayo Clinic Fibromyalgia Treatment Programme, an outpatient programme staffed by physicians from the Mayo Clinic Division of General Internal Medicine, the Better Together study provided reprieve for those in the treatment group and hope for those in the control group.

The Better Together study found that patients in the treatment group were in a more positive emotional-physiologic state as a result of the animal-assisted activity session compared to the control group. People who interacted with therapy dogs saw their oxytocin levels increase significantly, while their heart rates decreased. They reported fewer negative emotions and more positive emotions. The results suggest a 20-minute therapy dog visit can significantly and positively impact the physical and mental health of patients with fibromyalgia.

The Better Together study is the first one to utilise physiologic parameters to provide scientific evidence that animal-assisted activities is a valid option for the management of fibromyalgia. The authors of the study believe that animal-assisted activity should become a standard treatment strategy to help patients manage this chronic condition.