SNIFFING OUT CANCER

Claire Guest, Co-founder of Medical Detection Dogs, explains how canines could have an important role in discovering disease.

The association between humans and dogs is long and close. Throughout history, dogs have fulfilled a whole range of different functions and the number and diversity is continually expanding. While traditionally dogs have been trained to hunt, herd and guard, more recently canine roles have grown to a range of medical support and disease-detection tasks.

As medical usage expands, it is imperative that the value of these dogs is objectively assessed, their potential capabilities are optimised and we use these abilities to further our understanding of the diseases in question.

Medical Detection Dogs (MDD) is the world leader at training dogs for this purpose, pioneering both medical assistance and disease detection. The charity is committed to carrying out empirical research to improve training and to inform future medical technologies.

To further this aim, MDD is currently working on a range of NHS-approved clinical trials, exploring dogs' ability to detect cancers – with a promising urological cancer trial ongoing, and a colorectal cancer project in progress. MDD is also researching the volatile detection of the malaria parasite, Parkinson's disease and specific bacterias.

The other arm of MDD, Medical Alert Assistance Dogs uses olfactory alerting ability for day-to-day support for people living with chronic conditions.

Our work

There is growing evidence that elevated levels of a "signature" of volatile organic compounds (VOCs) are associated with disease growth. Our research has shown dogs can be trained to detect these odours. MDD has been at the forefront of canine olfaction work for 15 years and was responsible for the first study of canine detection of bladder cancer, published in the *BMJ* in 2004. Our 2014 research indicated that dogs are capable of detecting odours down to parts per trillion – the equivalent of a teaspoon of sugar in two Olympic-size swimming pools.

Potential

We are on the threshold of delivering an accurate, rapid and non-invasive test to diagnose cancer and other diseases at an early stage, tests that would be offered to clinicians to use alongside existing diagnostic methods.

While we all "know" what coffee smells like, this complex odour which contains over 100 component molecules, would be impossible to describe to anyone who has never smelt it. How can the dogs communicate to technology what the "cancery" smell is?

Together with the Open University, we are developing new technology that enables our dogs to communicate their degree of

certainty when screening a sample. Bio-detection dogs work on a carousel or stand system that consists of metal pads installed on top of sample tubes, which the dog sniffs. If disease is present, the dog indicates this to their handler by sitting in front of the sample. The new technology incorporates a sensor that records the level of pressure the dog exerts whilst sniffing. With training, dogs will apply greater pressure on the pad when they are certain the disease is present.

Therefore, pressure indicates the level of certainty that the dog has. Capturing this data provides us with pressure readouts and will be vital to developing a future screening method, educating experts about the strength of the biomarkers that the dog uses to make his decision.

Future

In a ground-breaking collaboration with the world-famous Massachusetts Institute of Technology (MIT), we are working to develop advanced technologies which will harness the power of the dog's nose in a handheld bio-electronic nose.

Dr Andreas Mershin, Quantum Physicist at the MIT Center for Bits and Atoms, in Cambridge, Massachusetts, was inspired by our study showing dogs could sniff out cancer and plans to use their olfactory ability to develop an easy-to-use electronic nose that can be brought into every doctor's surgery. Dr Mershin is relying on our cancer detection dogs, to teach his prototype device, which uses the latest artificial intelligence (AI) technology, to recognise the odour of prostate cancer.

The device, no bigger than a mobile phone, has been developed to the point where its sensitivity matches the power of a dog's nose – it too can detect parts per trillion – but it is unable to replicate the dog's powers of cognition, which allows them to spot a "cancery smell" even though no two humans' cancer smells exactly alike. Harnessing new AI technology, the machine will "learn" to detect this "cancery smell" rather than

BIO-DETECTION RESEARCH AREAS

Urological cancers
- Prostate cancer is the most common cancer in men.
- Over 42,000 men are diagnosed with prostate cancer every year – that's more than 110 men every day.
- Every hour one man dies from prostate cancer – that's more than 10,500 men every year.
- One in eight men will get prostate cancer in their lifetime.
- Over 330,000 men are living with and after prostate cancer.
- MDD research is demonstrating that dogs can detect urological cancer VOCs earlier and with greater accuracy than current test methods.

Breast cancer
- Breast cancer is the most common cancer in the UK.
- Breast cancer is the name given to cancers that have first developed in breast tissue, but there are many different types.
- Around 50,000 women are still diagnosed with breast cancer each year.
- More than 80% of women with breast cancer are still alive five years after diagnosis.
- Around 12,000 women die of the disease each year. An MDD proof-of-principle study is underway into whether breast cancer can be detected on a breath sample. The research will be important in helping inform future testing and research into breast cancer.

Other diseases
In addition to urological cancers and breast cancer, MDD is currently exploring the possibility that the dogs can detect a number of other cancers and diseases, including:
- Lung cancer
- Bowel cancer
- Animal cancers
- Malaria
- Parkinson's disease.

rely on being programmed with every possible molecular combination.

Microbiome

There is growing evidence of the role of the microbiome in human health. Changes or damage that occur to our microbiome can result in significant deterioration in health. Research could provide information that alters the future of diagnostics and treatments for many diseases.

Our data indicates that dogs can assess the human microbiome by odour and we believe that dogs can detect individual changes. Our dogs will accelerate the knowledge of the role of the microbiome in human health and will assist in answering crucial questions about its influence on disease process, diagnostics and recovery.

Understanding the microbiome (human, animal and environmental) may be just as important to our future as the human genome. It influences all major health conditions, including cancer, neurology and immunity and we believe will play a crucial part in future diagnostics.

MDD is a fantastic example of how humans and dogs can work together to save lives. The canine model, "active searching" may well remain the mode of choice for some disease, such as malaria at airports, whilst the expertise developed will result in a team of canine and electronic experts that could produce bio-electronic noses for other diseases, bringing the power of the dog's nose into every doctor's consulting room.

We believe that dogs are capable of detecting all disease. Our vision for the future is to harness the power of canine olfaction, to speed the early diagnosis of cancer, neurological conditions, such as Parkinson's and motor neuron disease, enabling medical research to discover more effective treatments and, hopefully, cures. **BMS**