The Science Behind ONE Medicine

humanimal trust

ONE Medicine, caring for humans and animals

Humanimal Trust:

The Science Behind One Medicine

Here at Humanimal Trust we are driven by a clear goal: human and animal healthcare advancing hand in hand. We want to see vets, doctors and scientists collaborate and share data to ensure that all humans and animals benefit from sustainable and equal medical progress, but not at the expense of an animal's life. We believe cross-disciplinary collaboration can bring about transformative advances in healthcare, improving medical knowledge and treatment for humans and animals alike.

This is One Medicine.

To make this a reality, Humanimal Trust creates opportunities for doctors, vets and researchers to come together and share knowledge, in person and through the Humanimal Hub, an interactive online space where human and veterinary medical professionals and research scientists can meet and collaborate. We facilitate and fund research

that helps establish a powerful evidence base for One Medicine. We only fund studies that examine spontaneous and naturally-occurring disease in animals, and only if it is in the animal's best interests to do so. In doing so, our goal is to help humans and animals, in a culture of mutual reciprocity. We do not fund research that uses experimental animals.

Whilst we believe One Medicine has transformative potential across all medical areas where humans and animals share physiological and genetic similarities, our research is currently focused on five key areas of intervention, specifically:

- Infection and antibiotic resistance
- Cancer
- Spinal disease
- Musculoskeletal disease
- Regenerative medicine

Infection Control and Antibiotic Resistance

Pathogens not only affect humans and animals, they also transmit back and forth across the species barrier[1,2]. The treatment of these pathogens is managed in similar and in some cases, identical ways between species; e.g. by using the same antibiotics. However, widespread use of antibiotics in humans and animals has resulted in an increase in antibiotic resistance[3]. As a major global issue across all species[4-6], we believe that the most promising solutions to antibiotic resistance will arise through studying animal and human infection together.

Progress in cross-disciplinary collaboration is already underway, with treatment protocols for infection already being shared between fields. For example, the use of sponges impregnated with the antibiotic gentamicin to treat infection in the joints of canine patients[7] has directly contributed to best practice guidelines in the treatment of human infection[8]. Naturally occurring infections, such as biofilms that form on implants[9] and canine models of periprosthetic infection have also proven to be important models for advising clinical management of human disease and as a means of greater clinical understanding[10-12]. The knowledge gained from examining infections in dogs in these cases clearly demonstrates the potential of human and veterinary medicine fields working together.

Cancer

Cancer affects humans and animals alike, with significant similarities in disease development and treatment across species, often with identical chemotherapeutic drugs used in humans and dogs[13]. Physiologically, there are striking similarities between various dog and human tumours[14]. For example, in osteosarcoma, a form of bone cancer, 265 genes are shared between humans and dogs[15] and placed side by side under the microscope, an osteosarcoma tissue sample from a human and one from a dog would be difficult to tell apart[13,16-18]. In fact, cancer tissues can be more similar between species than healthy vs. cancerous tissue in the same species.

With so many remarkable similarities, there is much to be learnt by studying human and dog cancer development in parallel, both for understanding disease progression but also intervention options. Accurate recording of data such as treatment pathways, histopathological results, genetic analysis of tumours and clinical outcomes will allow us to further our understanding of cancer progression beyond what we can achieve by studying one species in isolation - ultimately improving the lives of all.

Spinal Disease

Dogs and humans are affected by a similar range of spinal disease conditions. Much like us, dogs frequently suffer from degenerative disease of the spine[18-21]. The treatments currently available to help patients, including disc replacement and decompression surgeries are directly comparable across the two species[22-24]. These clinical similarities create an obvious opportunity for cross-disciplinary collaboration. However, research in human spinal surgery still remains heavily reliant on purpose-bred laboratory animal models despite evidence that naturally-occurring systems of disease are preferable[27]. Naturally-occurring spinal disease replicates normal conditions: there is greater natural variation amongst study populations; there is a natural time delay between

injury and treatment which better reflects the progress of the disease; and the assessment of successful treatment response is better[23]. Not only will collaborative studies have the potential to inform better treatment outcomes for humans and animals alike, they will also contribute significantly towards innovative research practice in both fields of medicine.

Humanimal Trust has identified spinal research as an ideal discipline for demonstrating One Medicine for all, moving away from a human-benefit bias. We are actively involved in developing improved surgical interventions for animal patients whilst contributing to mutual medical understanding.

Musculoskeletal Disease

A heavy burden has been placed on animal species in the development of new therapies to treat musculoskeletal disease - disease affecting bones, joints, ligaments, tendons and muscles. Dogs in particular are the most widely-used model species in orthopaedic research[25,26]. There are striking similarities between bone structure and physiology in dogs and humans[27,28]; for example, the bones of dogs are more similar to those of humans in terms of measurable protein and mineral content when compared to any other species (excluding non-human primates)[29].

The parallels extend beyond anatomy and physiology to the cellular mechanisms of growth and repair[30,31] and therefore therapeutic use of these similarities can expand into clinical practice. For example, bone-morphogenic-protein-2 (BMP2), a protein at the forefront of novel regenerative therapies in human orthopaedic surgery, shares 100% structural similarity in humans, mice, rats and dogs[32] and has been successfully used therapeutically in dogs[33-38].

Studies investigating the formation of bone and joint disease in dogs already contribute significantly to our understanding of human disease. We want to go beyond this, to establish a culture of reciprocity, where collaboration flows both ways and data gathered from human patients is then retrospectively applied to inform veterinary interventions. This two-way collaboration is already a reality, in fact a first generation of human artificial limb implants was informed by studies of skin growth on deer antlers[39]. Conversely, the data generated from human patients in studies such as these can feedback to veterinary interventions - a true vision of One Medicine.

Regenerative Medicine

Regenerative medicine helps to restore tissues and organs affected by trauma or disease by stimulating the body's own repair mechanisms to heal and regenerate. This field has the potential to significantly impact the lives of all affected by disease, be they human or animal. Key to regenerative medicine are mesenchymal stem cells (MSCs)[40–42], undifferentiated adult cells that can be isolated from human and animal sources and are capable of multiplying and transforming themselves into different cell types. Given that MSCs are capable of transformation into bone, fat or cartilage - their therapeutic potential is immense.

MSCs share common genetic markers across species[43] with comparable *in vivo* and *in vitro* traits demonstrated between mice, rats, rabbits, dogs, sheep and horses[44–46]. These similarities have also been demonstrated in clinical trials; results published in 2017 using MSCs in the treatment of osteoarthritis and osteochondral disease in dogs[47,48] and in humans[49,50] found comparable outcomes, providing proof of principle for further trials and improved care for both. Similarities in the behaviour and development of stem cells between species, combined with similarities in the progression, treatment and clinical follow-up of many human and animal diseases make it clear that regenerative medicine is a field ripe for a cross disciplinary approach.

Our Goal

We want a world where both humans and animals have better opportunities to benefit equitably from medical progress because vets, doctors and researchers routinely collaborate and share. We want medical and veterinary medicine to move away from using purpose-bred laboratory animal models which cause unnecessary suffering and are not predictive of real-life outcomes for patients. Instead, we will focus our efforts, time and money on real-life studies in real-life veterinary patients who need help. It is our intent that with One Medicine, animal testing will become obsolete. In the meantime, we support the principles of the NC3Rs: Reduction, Refinement and Replacement

of animal testing, and we advocate a missing 4th R: Reciprocity, whereby animals benefit from the medical advancements that they contributed to in the first place.

Here at Humanimal Trust we believe that the journey of one is the journey of all. With the help of our supporters, we drive collaboration between vets, doctors and researchers so that all humans and animals benefit from sustainable and equal medical progress, but not at the expense of an animal's life. This is One Medicine, where medical progress means progress for all.

For further details of how you can support our work and join our campaign, please visit **www.humanimaltrust.org.uk** or email us via **info@humanimaltrust.org.uk**

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Join the One Medicine Network

The One Medicine Network is an online group hosted on LinkedIn, where those working in human and animal medicine can meet, collaborate, initiate and share knowledge and research, driving forward closer cooperation for the benefit of humans and animals.

What is the One Medicine Network for?

- Meet, discuss matters affecting human and animal health, share knowledge and collaborate
- Visit a market place of ideas and inspiration
- Find professional 'matches' with those sharing similar interests, challenges or ideas
- Set up an online meeting or debate
- Start a working relationship
- Share research in progress; promote research opportunities
- Offer or seek funding
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- Engage the next generation of scientists, doctors, vets and researchers
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