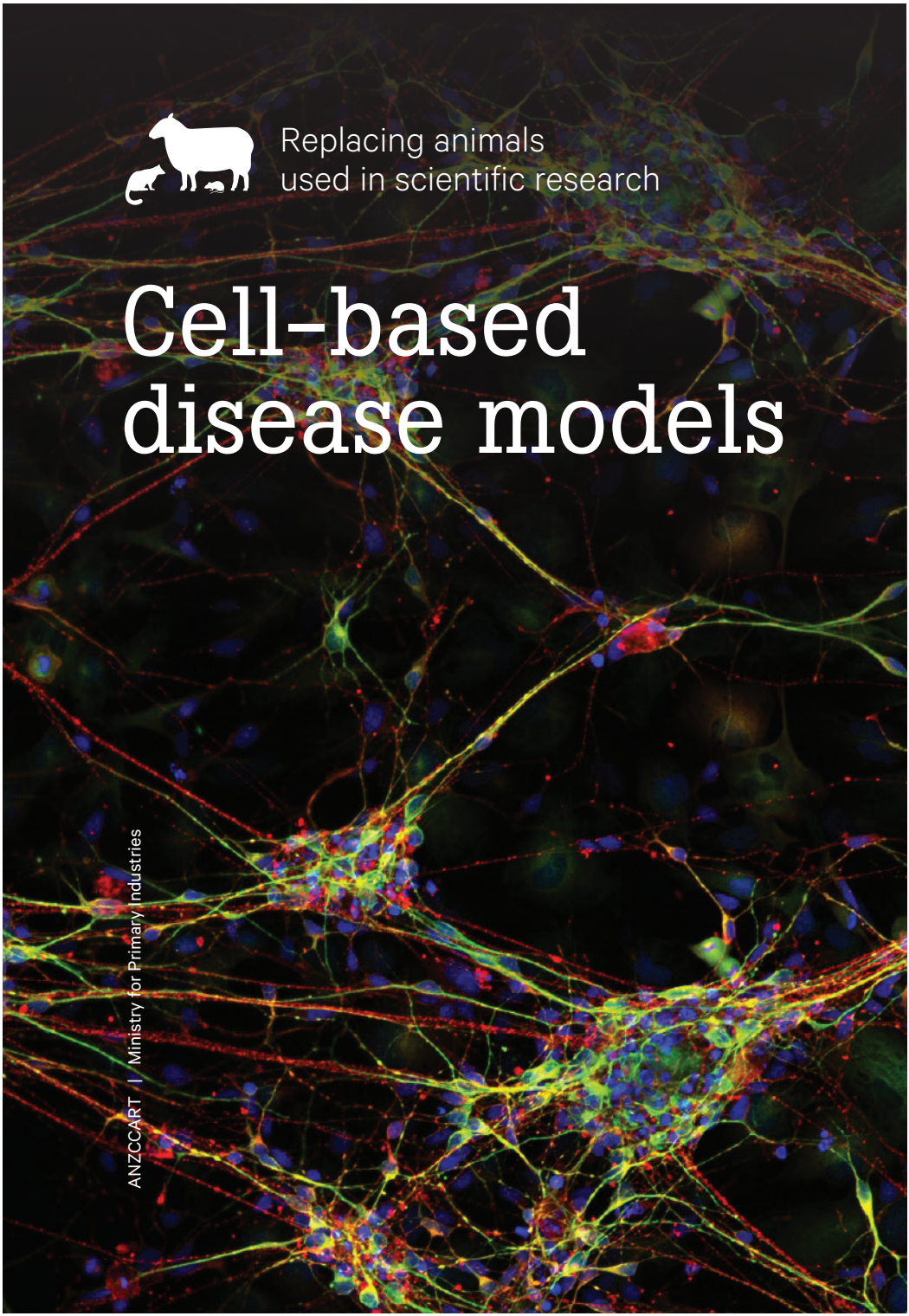
Replacing animals
used in scientific research

Cell-based disease models



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Replacing animals used in scientific research

Scientists are busy developing some really exciting high-tech methods to replace the use of many animals in scientific research and teaching, like organs-on-a-chip, advanced animal mannequins and computer assisted learning.

replacement: *where possible, replacing animal use with alternative techniques*

What problem are scientists trying to solve?

Cardiovascular disease and neurological diseases are important causes of death in New Zealand. To help improve the treatment of these diseases, researchers are working to find and develop new drugs, but this relies on the use of animals to test whether a drug will be safe and effective before it is tested on human patients. Populations of animals (usually mice) are bred with a condition that replicates the target disease (an animal model), and the effects of the new drugs are then measured on treating the condition in the animal.

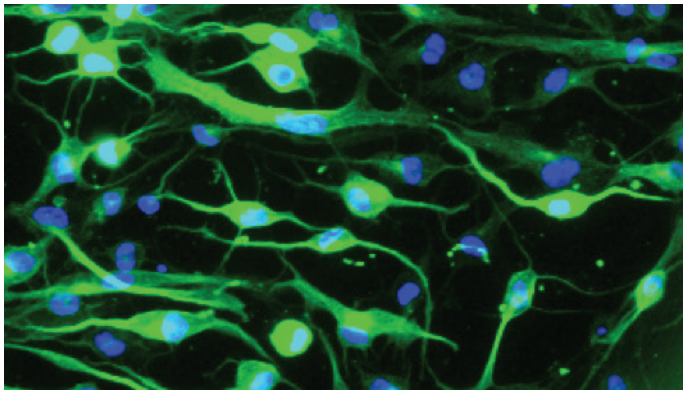
The solution

Using the patient's own cell tissues *in vitro*

Instead of using animals to test the effectiveness and safety of new drugs, drugs can be tested using the patient's own cells and tissues that have been grown in a laboratory vessel. Techniques that occur in a laboratory vessel or other controlled experimental environment rather than within a living organism are called *in vitro* techniques.

How is it done?

Using human cell reprogramming technologies, mature cells such as skin or blood, can be taken from patients and genetically transformed back to the state of embryonic stem cell. These cells can then be used to generate any tissue or organ cell type found in the human body. This means that scientists can study the disease in cells and tissues specific to the patient's own genetic makeup.



The cells shown here are human brain cells (green = brain cell; blue = nucleus of cell) that have been reprogrammed from human skin.

Advantages

- Treatments are tested on the patient's own cells, rather than on animals whose symptoms of the disease may not be generated through the same mechanisms as that in humans, or which may not reproduce all the features seen in human patients.
- Reprogrammed patient cell lines include the genes and genetic modifiers which can play an important role in how human diseases work.
- The use of cell-based disease models in laboratory vessels increases the efficiency of drug screening and toxicology as they can be scaled up easily for automated high-throughput testing.
- It is still a requirement for new medicines to be safety-tested in animals, but using disease-relevant live human tissue systems means that treatments that are not specific or effective enough do not make it to the animal testing stage.

Disadvantages

- Cell reprogramming technology and the development of cell-based human disease models is still in its infancy.
- There is experimenter resistance to moving away from traditional models of experimental design.

References

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Induced Pluripotent Stem Cells as a Disease Modeling and Drug Screening platform. Ebert, A. D., Liang, P. & Wu, J. C. *Journal of Cardiovascular pharmacology*, 60(4), 408 (2012).

Modeling human disease using organotypic cultures. Schweiger, P. J. & Jensen, K. B. *Current Opinion in Cell Biology* 43, 22–29, (2016).

Helpful links

www.youtube.com/watch?v=-QyPV0vwLO0

www.health.govt.nz/our-work/diseases-and-conditions/cardiovascular-disease

www.health.govt.nz/your-health/conditions-and-treatments/diseases-and-illnesses/cancer

For further information

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