Impetus Project Report

Investigating time-scales to replace animals in biomedical research

Fund for the Replacement of Animals in Medical Experiments

FRAME

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CONTENTS PAGE

IMPETUS PROJECT BACKGROUND

At FRAME, we often ask how we can make the biggest strides towards a world in which human-based methods, and not animals, are the first choice for human biology, disease, and drug research.

As a charity, we have a history of working with animal researchers, alternative methodologies researchers, and those working in industry, to better understand the areas in which the main opportunities and challenges lie.

In **2021, there were 3.06 million scientific procedures carried out on animals in Great Britain** – 1.73 million for experimental purposes, and 1.33 million for the creation and breeding of genetically altered animals.

Of the 1.73 million experimental procedures:
- **882,300** were for the **purpose of basic research.**
- **467,100** were for the **purpose of applied research.**
- **363,300** were for **regulatory purposes.**

There is no exact figure for the number of animals used in science worldwide per year, due to the lack of a universal recording system, however the RSPCA estimate the figure to be around 100 million, as of 2021.

In recent years there have been many developments in the area of replacement, including the growth in the number of individuals and organisations working on aspects of the issue. 3Rs centres exist in many countries and work diligently to replace the use of animals in research where possible. Researchers are constantly developing, trialling, and validating new human-based methods and models.

There are many areas that need work, however, there is little coordination or overview of how much progress is actually being made towards an animal-free biomedical research system. It is important to consider whether some areas are being overlooked, particularly in basic biological and medical research, which are not governed by guidelines in the same way as regulatory testing of chemicals and medicines. For example, are there research areas where a combination of available alternatives could, with a joined-up approach and collaboration, replace animals today? In areas where animal research remains necessary, as there are no viable alternatives on the horizon, **what is needed to bring replacement one step closer?**

PROJECT AIMS

The aim of this project was to seek views from experts within industry and academia, to answer two key questions.

1. **What are the areas of biomedical research or testing where animals are currently used, but could be replaced in the short term (5-10 years)?**

2. **What are the areas of biomedical research or testing where replacement looks unlikely in the long term (20+ years)?**

These questions will allow us to identify where the most impact could be made towards the replacement of animals in the short and long term.

METHODS

Contact list

We complied a contact list of 197 people. Each person was selected as an expert within the fields of animal research, 3Rs research, and industry. We also invited 5 academic research institutions and 3 scientific organisations to share with their staff and take part. The survey was also shared on social media platforms including Twitter and LinkedIn, and in the FRAME e-shot newsletters.

Questionnaire

The survey was conducted via an online questionnaire, consisting of 5 core questions. The questionnaire was open to responses from 16th September 2021 to 29th October 2021. Respondents were invited to leave their contact details if they wished to take part in an expert working panel, however this was optional. Otherwise, all responses were anonymous.

SURVEY DEMOGRAPHICS

Location

Of 197 surveys sent out, we received a total of 25 completed survey responses. Of these respondents, 10 resided in the UK (40%), 3 in Denmark (12%), 2 in Italy (8%), 2 in Germany (8%), 2 in the USA (8%), 1 in Canada (4%), 1 in Norway (4%), 1 in India (4%), 1 in Portugal (4%), 1 in Slovakia (4%), and 1 in France (4%) (Figure 1).

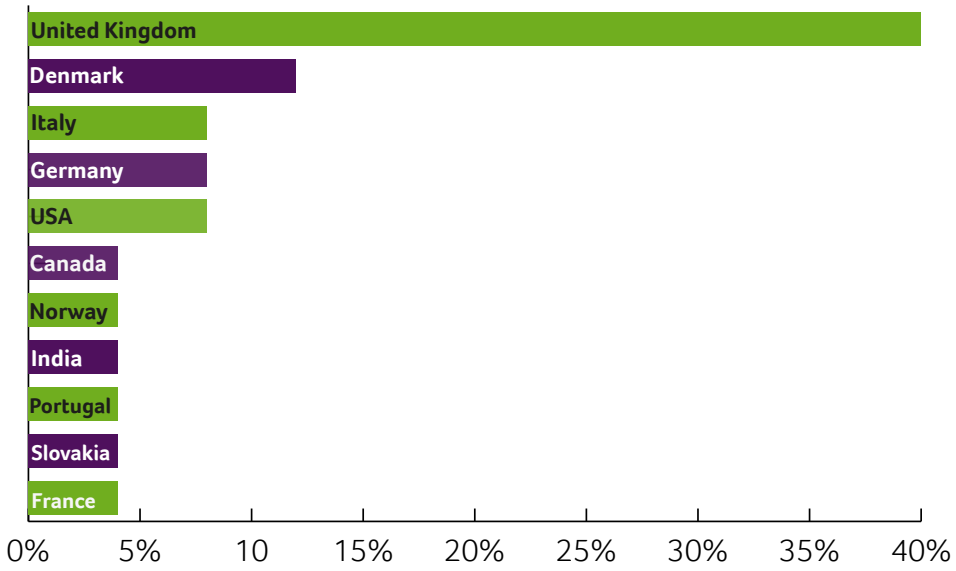

Figure 1 - demographic data of respondents

Years in research

15 (60%) respondents had worked in research for 21+ years, 5 (20%) respondents for 11-20 years, 2 (8%) respondents for 5-10 years, and 3 (12%) did not work directly in research (Figure 2). Of those who worked in research, 15 (71.43%) worked in basic research, 13 (61.9%) worked in applied/translational research, and 8 (38.1%) worked in regulatory toxicology. 12 (48%) respondents stated that they worked in more than one area of research.

Of those who did not work directly in research, their sources of knowledge included training as a medical doctor, training as a biologist, working in science policy, attending 3Rs conferences, being a member of animal ethics committees, and studying peer-reviewed articles.

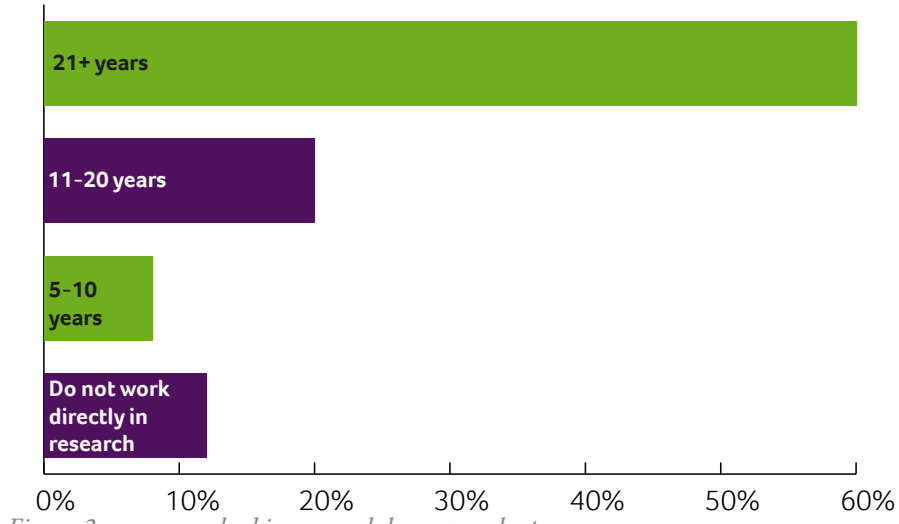

Figure 2 - years worked in research by respondents

RESULTS: SHORT TERM

Question 1: What are the areas of biomedical research or testing where animals are currently used but could be replaced in the short term (5-10 years), and why? What would be required to achieve replacement in these areas?

21.4% Toxicology and toxicity testing
14.3% Drug development
11.9% Cancer research
4.8% Serum use
4.8% Basic research
4.8% Vaccine research
2.4% Skin sensitivity testing
2.4% Cardiovascular research
2.4% Pharmacokinetics
2.4% Virology
2.4% Medical device testing
2.4% Neurodegeneration
2.4% Anti-serum production
2.4% Antibody production
2.4% Idiopathic pulmonary fibrosis
2.4% Psychoactive substances
2.4% Heart failure
2.4% Diabetes
2.4% Organ specific disease experiments
2.4% Cell and molecular level research
2.4% Education
2.4% No area likely

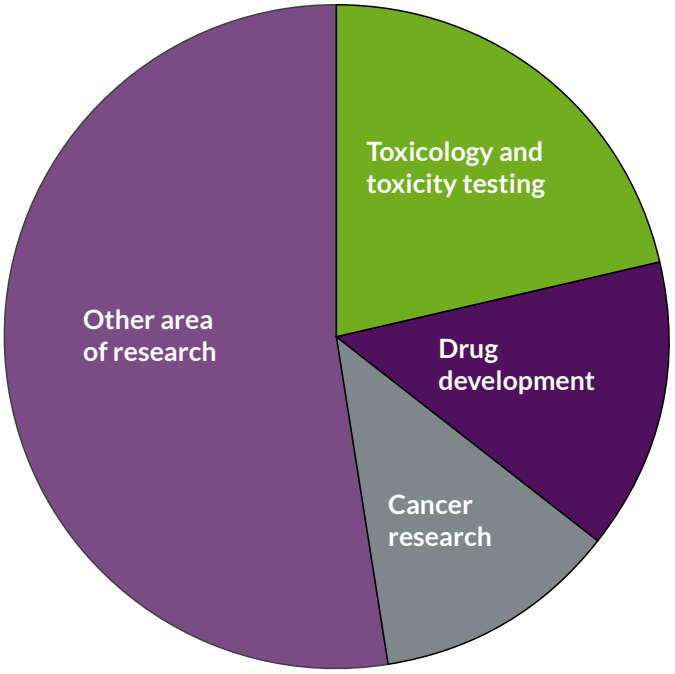

Figure 3 - Areas of research according to the respondents in which replacement looks likely in the short term

Respondents were asked to provide up to two areas of research or testing that could be replaced in the next 5-10 years, resulting in 42 individual responses and 22 areas (Figure 3).

The most common area respondents identified was toxicology and toxicity testing, with 9 individual responses (21.4%). This was followed by drug development with 6 responses (14.3%) and cancer research with 5 responses (11.9%). 1 (2.4%) response stated that there were no areas of research that would see wholesale replacement in this time frame. The remaining responses are summarised in table 1.

RESULTS: SHORT TERM

Toxicology and toxicity testing

Toxicology and toxicity testing was highlighted in 9 (21.4%) responses, which can be separated into subcategories:

- **2 (4.8%)** responses identified **general regulatory testing.**
- **2 (4.8%)** responses identified **neurotoxicity testing.**
- **1 (2.4%)** response identified **acute toxicity studies.**
- **1 (2.4%)** response identified **lung toxicity testing.**
- **1 (2.4%)** response identified **chemical toxicity testing.**
- **1 (2.4%)** response identified **cardiotoxicity testing.**
- **1 (2.4%)** response identified **liver toxicity testing.**

Despite highlighting several different areas of toxicology and toxicity testing, many of the reasons given for why this was an area where replacement was possible in the short term, were largely the same or similar. **Respondents agreed that "the science behind NAMs (New Approach Methodologies) in this area already largely exists", and in most cases, is fairly well known.** There was a general consensus that the mechanisms behind these areas of research are well understood, even for the more complex organs. For those subcategories where the knowledge is currently lacking, respondents agreed that there is "ongoing, active development into alternative testing strategies", that will likely be in place within the next 10 years. For example, in the US, the EPA (Environmental Protection Agency) announced in 2019 that it plans to phase out all chemical safety testing on mammalian species by 2035.

With regards to NAMs in specific subcategories, respondents who identified neurotoxicity testing stated that "a steady state has been reached in this area, where animal tests can only provide minor benefits to research" and that new alternatives that are being developed will replace these animal models in the short term. Respondents who identified liver toxicity testing stated that hepatocytes created through induced pluripotent stem cells (iPSC) (reprogramming cells back to an embryonic like state that allows for the unlimited development of other cell types), have the potential to replace rodents, whilst being fully reproducible.

To achieve replacement in liver toxicity testing, respondents highlight issues both ethical, scientific, and economic. Ethically, issues surrounding the sourcing of human tissues as an alternative to using animals were raised. Economically, more funding needs to be directed into developing and validating NAMs in this area of research. This would not only make NAMs more effective and efficient, but also make them more accessible. The lack of funding links directly to the scientific issues raised, as the research cannot take place without funding.

RESULTS: SHORT TERM

Drug development

Drug development was highlighted in 6 (14.3%) individual responses.

Respondents identified several reasons why animals in drug development could be replaced in the short term. **The overarching view is that animal studies into drug development have limited human relevance, and there is evidence that using animal models can be misleading and leads to potential drug candidates being wrongly rejected, or deemed safe when they may in fact be the opposite.** It is a commonly cited statistic that around 90% of drugs that pass animal trials fail to reach market, due to a failure of preclinical tests to accurately predict their outcome in humans among other factors.

Another reason identified throughout the survey was that there is "sufficient scientific evidence that the current animal tests in this area can be replaced by NAMs". Examples provided were human tissue models that provide similar or better results, modelling using computational biology, mathematics, or AI (Artificial Intelligence), and using a large panel of drug candidates in which human clinical data is available. Respondents believed this would lead to a reduction in the number of drug candidates rejected or accepted for incorrect reasons.

The final reason identified was that "some countries no longer require drugs to be tested in animal models by law". This is not to say that it is banned in these countries, but rather **non-animal methods can be accepted in place of animal data, which will allow these countries to move away from their reliance on animal models in this area.**

Legally there are a number of factors that would need to change in order to replace animals in drug development in the short term. Respondents identified that legislation in countries that require tests on animal models would need to update their legislation and regulation to accept non-animal data as valid.

RESULTS: SHORT TERM

Cancer research

Cancer research was an area highlighted in 5 (11.9%) individual responses.

Respondents highlighted two main reasons as to why cancer research is an area where replacement looks likely in the next 5-10 years: The high failure rate and frequent irrelevance of animal models in this type of research, and the increasing number of NAMs that are becoming available. Examples of NAMs given within the responses were using 3D cell cultures and cell interactions to virtually construct a human, and using freshly isolated human tumour cells.

To achieve replacement in this area, respondents stated that more data from NAMs is needed to build confidence in these methods and ensure they are equally or more effective than the current animal models. Issues regarding the production of micro-organoids in sufficient enough numbers were also raised as a factor that would need to be addressed.

No areas of replacement

Out of the 42 individual responses, 1 (2.4%) response stated that no areas of replacement look likely within the short-term time frame of 5-10 years. The respondent highlighted that extensive work is being undertaken to replace specific regulatory tests with NAMs across the globe, and we will likely see these adopted in the short term. However, despite animal tests being unable to support efficient regulatory work due to their variability, wholesale replacement is unlikely in the next 5-10 years.

RESULTS: SHORT TERM

Table 1 - Summary of the areas identified by respondents where replacement is likely in 5-10 years, that were less common. Reasons for highlighting these areas and what would be required to achieve replacement also summarised.

Area of research	Number of responses	Why is this an area where animals are likely to be replaced in the short term?	What is required to achieve replacement?
Serum use in preclinical research	2 (4.8%)	Easily substituted components for any research activity	Further scientific uptake of currently available alternatives, and lower the cost
Basic research	2 (4.8%)	No legal requirement to use animals Involves large numbers of genetically modified mice which could be replaced with cryopreservation, as well as breeding on demand rather than maintenance	Mindsets need to change early Less paperwork required to obtain human surgical waste Look into costs of cryopreservation, as they should outweigh the costs for maintaining breeding colonies
Vaccine research	2 (4.8%)	Sufficient scientific evidence that current animal tests can be replaced Some countries no longer require animal data by law	Update legislation in countries that require animal tests to accept non-animal data More reliable in vitro models that can be validated and accepted into relevant legislation
Skin sensitivity testing	1 (2.4%)	Artificial/reconstructed skin models offer accurate data	No response given
Cardiovascular research	1 (2.4%)	3D cell cultures and interactions between different cell types which can be used to virtually reconstruct a human	No response given
Pharmacokinetics	1 (2.4%)	In vitro and in silico tools can offer a big picture without animal studies	No response given
Virology	1 (2.4%)	Human tissue models available which show similar or better results	No response given
Medical device testing	1 (2.4%)	Alternatives already accepted in other regulations that can be transferred to medical devices	No response given
Neurodegeneration	1 (2.4%)	High failure rate in animal models Increasing number of NAMs	Need more data that further builds confidence in NAMs in this area
Anti-serum production	1 (2.4%)	Mechanisms are well known	Establish cell lines that can produce the same quality products
Antibody production	1 (2.4%)	Easily substituted components	Further scientific uptake of currently available alternatives Lower the cost of alternatives to make them more appealing

RESULTS: SHORT TERM

Area of research	Number of responses	Why is this an area where animals are likely to be replaced in the short term?	What is required to achieve replacement?
Idiopathic pulmonary fibrosis	1 (2.4%)	Bleomycin induced lung fibrosis has a defined cause and does not represent idiopathic disease	No response given
Psychoactive substances	1 (2.4%)	Current inability to translate an animal's psychological response to what might be experienced by a human Human volunteers could be utilised following stringent approval and	More dedicated funding and more training on non-animal methods Incentives to enable researchers to move away from animals, including reassurance for early career researchers that their career will not be stunted by a dedication to non-animal methods
Heart failure	1 (2.4%)	Already have access to human bioma	No response given
Diabetes	1 (2.4%)	Already have access to human bioma	No response given
Organ specific disease experiments	1 (2.4%)	Organ on a chip technologies are advanced for lungs, livers, eyes, and skin, and provide more predictive results than animals	More dedicated funding and more training on non-animal methods. Incentives to enable researchers to move away from animals, including reassurance for early career researchers that their career will not be stunted by a dedication to non-animal methods Initiatives to enhance public awareness/understanding of science to gain public trust in non-animal technologies Increased education for regulators about non-animal advances to ensure they can be more confident in accepting results obtained from non-animal models
Cell and molecular level research on human conditions	1 (2.4%)	Information available on misleading character of animals Availability of advanced human cell cultures	No response given
Education	1 (2.4%)	Many realistic models, computer simulations, and audio-visual aids available as an alternative to using animals	No response given

RESULTS: LONG TERM

Question Two: What are the areas of biomedical research or testing where replacement looks unlikely in the long term (20+ years)?

22.2% Toxicology and toxicity testing
11.1% Behavioural studies
8.3% Cancer research
8.3% Basic research
5.5% Vaccine research
5.5% Drug development
5.5% Immunology
2.8% Biocompatibility testing
2.8% Developmental biology
2.8% Mammalian genetics
2.8% Veterinary research
2.8% Complex diseases
2.8% Pathology
2.8% Pain research
2.8% Ageing research
2.8% Embryology
2.8% Transmissible Spongiform Encephalopathy research
2.8% No area unlikely

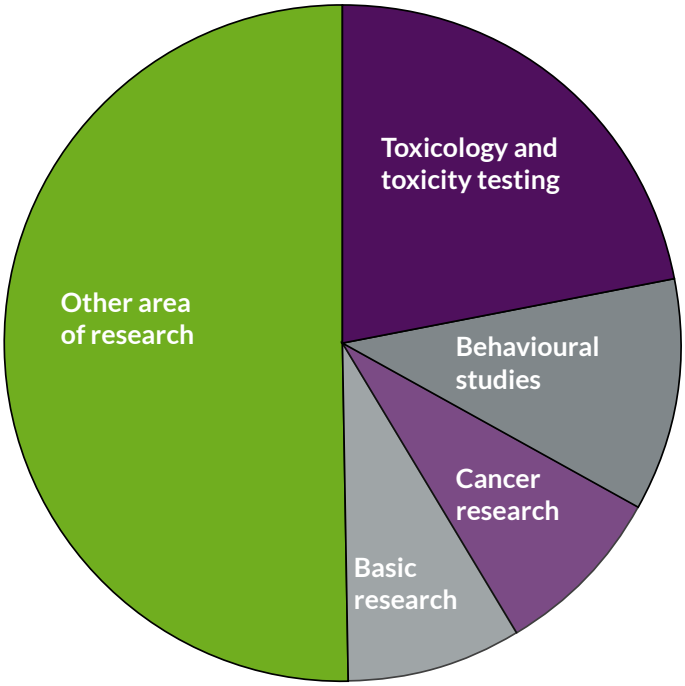

Figure 4 - Areas of research according to the respondents in which replacement looks unlikely in the long term

Respondents were asked to provide up to two areas of research or testing that are unlikely to be replaced in 20+ years, resulting in 36 individual responses and 19 areas (Figure 4). **The most common area respondents identified as an area where replacement was unlikely in this time frame, was toxicology and toxicity testing**, with 8 individual responses (22.2%). This was followed by behavioural studies, with 4 responses (11.1%), cancer research with 3 responses (8.3%), and basic research with 3 responses (8.3%). 1 (2.7%) response stated that there were no areas of research where replacement would be unlikely in the long term.

RESULTS: LONG TERM

Toxicology and toxicity testing

Toxicology and toxicity testing was identified in 8 (22.2%) individual responses, which can be separated into 4 subcategories:

- **4 (11.1%)** responses identified **general toxicology and toxicity testing**
- **2 (5.5%)** responses identified **reproductive toxicity testing**
- **1 (2.7%)** response identified **immunotoxicity testing**
- **1 (2.7%)** response identified **chronic toxicity testing**

Whilst several different subcategories of toxicology and toxicity testing were highlighted, **the overarching reason remained the same: the science is incredibly complex and causes issues when using non-animal models.** The "lack of 'whole-body' alternative systems" and "the inability to find all possible mechanisms for an alternative" creates a barrier for researchers. In areas like reproductive toxicity, "it is difficult to mimic a full reproductive cycle in vitro", causing researchers to rely heavily on animal models. Similarly, in immunotoxicity testing, a variety of cells and complex cell interactions play a part, and **there is currently no 'gold-standard' covering all aspects of immunotoxicity in a reliable, human relevant way.**

Respondents also provided explanations that were less focused on the science behind using animal models. **It is currently "cheaper and legally safe to use animal models" in toxicology and toxicity testing, and there is "no obligation to find replacements in this area".** Respondents also stated that vested interest groups, including researchers, industry professionals and regulatory bodies are unlikely to change their habits anytime soon without external incentives and sanctions. Using animal models has been the norm for a long time. **Researchers that use animal models in this field will likely have only been taught how to use animals,** rather than human relevant alternatives, and relied on them throughout their entire careers.

RESULTS: LONG TERM

Behavioural studies

Behavioural studies were identified in 4 (11.1%) individual responses.

The nature of behavioural studies was the main focus of these responses, with respondents stating that **behaviour is a "complex phenomenon with an emotional and hormonal quotient" which cannot be replicated in vitro**. It was also highlighted that cells do not behave and therefore cannot mimic how an animal model would behave in the same study.

Behavioural studies receive little attention in the world of human relevant methods and rely heavily on the use of animals. There currently is not a human relevant equivalent that would produce the same, or better, results than using animals. 1 respondent identified clinical human behavioural testing as an alternative but explained that this is unlikely to be taken up by a research community that currently conducts their studies within a laboratory setting.

RESULTS: LONG TERM

Cancer research

Cancer research was identified in 3 (8.3%) individual responses, with each respondent highlighting a different reason as to why animal use is unlikely to be replaced in the long term.

One respondent stated that "the proof for molecular studies in human and cancer genetics is currently in vivo", whether this be in humans or animals. This is very unlikely to change within the 20-year time frame. Whilst this respondent did state that these studies could be carried out in humans or animals, there are more ethical and legal issues surrounding the use of humans in these types of studies, as opposed to using animals. Another respondent also highlighted issues surrounding this, stating that "there is a limit to what can be done in human clinical studies" for cancer research. The third respondent explained that there is currently "no suitable alternative that allows the progress of cancer to be studied at a whole organism level", which is provided when using an animal model.

Basic research

Basic research was highlighted in 3 (8.3%) responses. Basic research is also known as fundamental research and is conducted, primarily, to expand knowledge of a subject area. The most common areas of focus for basic research using animals are the immune system, nervous system, and cancer.

A recurring theme throughout the response is the reliance on animal models in basic research. Respondents stated that within this area there is a lack of willingness to switch to alternative approaches, and "vested interest groups are unlikely to change their habits". Political will from academia and research institutions may also cause a delay in the uptake of alternative methods due to the habitual use of animal models.

Respondents explained that often in basic research, there is a need to study reactions in the whole animal, which is difficult to replicate in NAMs. Furthermore, "most NAMs are currently very specific for each mechanism or pathway". Whilst this is useful for replacing animals in those specific tests, it is unhelpful when the study is exploratory and the disease mechanisms or pathways are not yet known.

No areas of replacement unlikely

Out of the 36 individual responses, 1 (2.8%) response stated there were no areas where replacement will not be achieved within the long-term timeframe of 20+ years. The respondent highlighted that such a change would, however, require concerted effort and a solid commitment from all stakeholders.

RESULTS: LONG TERM

Table 2 - Summary of areas identified by respondents where replacement looks unlikely in the long term, that were less common. Reasons for highlighting these areas also summarised

Area of research	Number of responses	Why is this an area of research where replacement looks unlikely in the long term?
Vaccine research	2 (5.5%)	Need to collect safety data in a whole organism for drugs and biologicals for human use
Drug development	2 (5.5%)	No obligation on pharma to find replacements in this area. Cheaper and legally safe to use animals Vast majority of new drugs require systemic analysis in an animal model to achieve regulatory approval for clinical trials
Immunology	2 (5.5%)	Sheer complexity of the immune system renders not using animal models impossible, at least at some point Need a whole immune system
Biocompatibility testing	1 (2.8%)	Lack of a whole-body alternative system
Developmental biology	1 (2.8%)	Requires complex interactions between a variety of tissues and organs Despite advances in organ on chip technologies, there is still a long way from truly replicating multi-organ systems in a lab
Mammalian genetics	1 (2.8%)	The proof for molecular studies in genetics is in vivo - either in man or in animals, and this will not change within the next 20 years
Veterinary research	1(2.8%)	No response given
Complex diseases	1(2.8%)	Multi-organ in vitro models are difficult to build and maintain for the extended periods needed for disease studies
Pathology	1 (2.8%)	Difficult to mimic pathological events affecting multiple organs outside an animal model
Pain research	1(2.8%)	Require complex interactions between a variety of tissues and organs Despite advances in organ on chip technologies, still a long way from truly replicating multi-organ systems in a lab
Ageing research	1 (2.8%)	The host-term nature of in vitro is not compatible with this form of research Often start from stem cells of dedifferentiated lines which do not represent an aged organism
Embryology	1 (2.8%)	Zebrafish models are commonly used to study the effects of various genes on developmental process, and this would be difficult to replicate without them as a model
TSE research	1 (2.8%)	Need the biological/chemical interactions that take place in a live animal

CONCLUSION

One of the biggest takeaways from the results of the survey is the contradictory views regarding toxicology and toxicity testing. Toxicology and toxicity testing was identified 9 (21.4%) times as an area where animals are currently used but could be replaced in the short term (5-10 years), and 8 (22.2%) times as an area where replacement looks unlikely in the long term (20+ years). In both questions it was the most identified area.

The responses that identified toxicology and toxicity testing as an area where replacement is likely tended to focus on the alternative methods that already exist and are used within this area of research. It was also highlighted that whilst suitable alternatives do not currently exist in all areas of toxicology and toxicity testing, there is plenty of ongoing development into alternative testing strategies, and these are likely to exist within the timeframe provided in the questions. On the other hand, responses that identified toxicology and toxicity testing as areas where replacement is unlikely in the long term tended to focus on the fact that the knowledge is lacking and is unlikely to improve in 20+ years. So the main source of disagreement appears to be around the likely pace of development and uptake of additional NAMs; however, it was also noted that vested interest groups are unlikely to change their habits, and that most researchers have relied on animals throughout their careers, making the field often inherently resistant to change. The attitudes of regulators will play a pivotal role here.

Cancer research was also an area which was identified as both likely to be replaced in the short term (5 responses, 11.9%), and unlikely to be replaced in the long term (3 responses, 8.3%). The responses that highlighted this area as likely to be replaced stated that **animal models have a high failure rate and NAMs are becoming increasingly available**. They also stated that more data will be required to build confidence in these methods, which will increase as NAMs become more available. On the opposing side, respondents that highlighted cancer research as an area that would be unlikely to replace animals stated that animal models are necessary as this is where the bulk of existing knowledge lies, noting a heavy historic reliance on animal models.

Drug development was the second most identified area where replacement is possible in the short term (6 responses, 14.3%), however unlike toxicology/toxicity and cancer research, only 2 (5.5%) responses stated that replacing animals was unlikely. As previously stated, it is a commonly cited statistic that 90% of drugs that pass animal trials fail to reach market due to a failure of preclinical tests to predict their outcome among other factors. Reasons provided for drug development being unlikely to be replaced consisted of there being no obligation to find replacements in this area, and new drugs requiring animal models for regulatory approval. However, **if there is evidence that animals do not predict the outcome effectively or efficiently, there is every obligation to find suitable replacements and change the regulations to accept non-animal data**.

RECOMMENDATIONS

Where can the most impact be made?

In most areas, particularly toxicology and toxicity testing, and cancer research as the two biggest and contradictory responses, the current science and a heavy reliance on animal models in research seem to be the main barrier in furthering the uptake of alternative methods. This can also be said for drug development.

1) Funding

Further and more directed funding into these areas would allow development of NAMs to increase. This would allow NAMs to become more accessible, and potentially reduce the reliance on animals in these areas. Furthermore, **more funding would allow for dedicated work into the subcategories within these areas that currently have no alternatives** – reproductive toxicity testing for example. If all areas of toxicology and toxicity testing are to be replaced by NAMs in 5-10 years, funding is crucial.

2) Education

Reducing reliance on animals is difficult when many researchers have worked with animals their whole careers. **However, education and training in NAMs as early as possible in an academic setting is crucial so the next generation of researchers feel confident enough to engage in NAMs rather than animal models**. This will go hand in hand with NAMs becoming more accessible.

3) Regulation

As mentioned with regards to drug development, regulatory changes are crucial to advance the uptake of non-animal methods. Whilst animal data is still accepted, and in most cases required, by regulatory bodies, animal models will continue to be first choice in these areas. Regulatory bodies must start accepting non-animal data, and preferably as a first or sole choice.

Next steps

The next step in this project will be a roundtable discussion with those respondents that volunteered to take part. This will open the discussion and provide further detail into the areas identified within the survey. This will allow us to identify one or two key focus areas where substantial impact can be made towards the replacement of animals. The second stage of the project will bring together the information from this report and the roundtable discussion to form a roadmap for the key focus area(s) outlining a plan for achieving the identified changes.

About FRAME

This report was funded and compiled by FRAME. The report's main authors were Jessie Hellier and Celean Camp.

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FRAME exists to further the replacement of laboratory animals in any kind of medical or scientific procedure.

For more than 50 years we have actively funded and promoted alternatives to animal testing. FRAME is an independent charity, funded by corporate and individual donations, and legacies. FRAME was set up to promote and assist research into new techniques and valid scientific substitutes to replace animal research in medical, biological and pharmaceutical research. Since the inception of the charity, FRAME is proud to have worked with influential figures in the Government, industry and academia to bring change across many areas of animal testing and continues to do so today.

FRAME has always supported the 3Rs (Replacement, Reduction & Refinement) as the most effective way to bring an end to the use of animals in laboratories. Today we are still dedicated to the development of new and valid methods that will replace the need for laboratory animals in medical and scientific research, education, and testing.

Fund for the Replacement of Animals in Medical Experiments (FRAME) is a charitable incorporated organisation with registration number: 1176266.