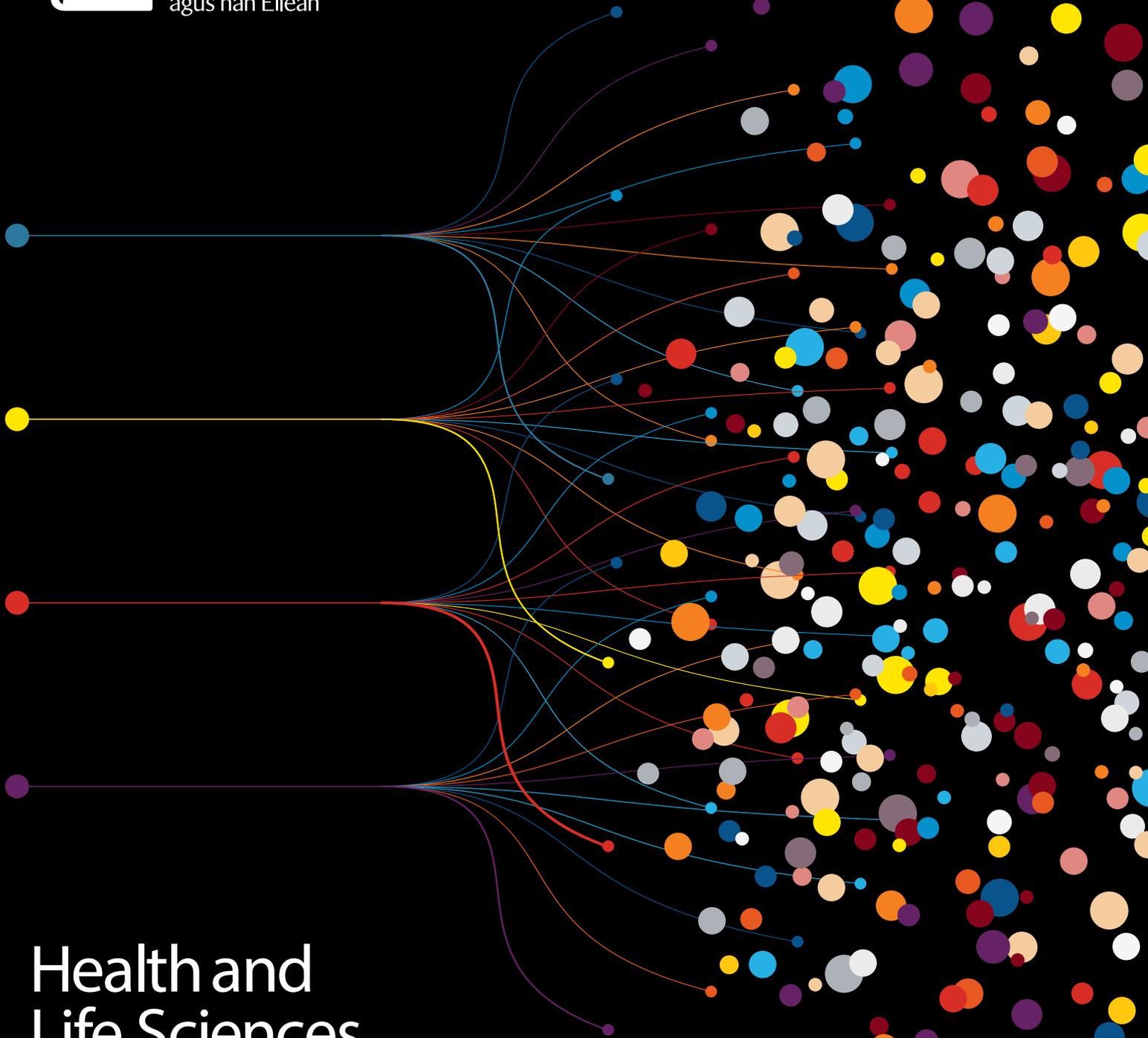




University of the
Highlands and Islands
Oilthigh na Gàidhealtachd
agus nan Eilean



Health and Life Sciences Innovation Project Portfolio

University of the Highlands and Islands

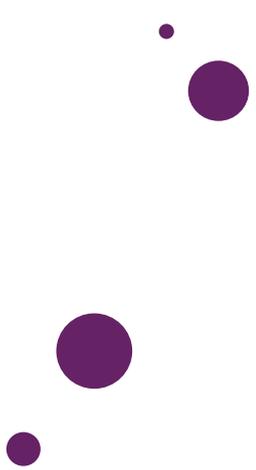




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We support innovation, development and implementation of health and life science technologies, products and services with local significance and global relevance.

INTRODUCTION

We are delighted to provide this portfolio of innovative health and life science projects supported through the University of the Highlands and Islands School of Health, Social Care, and Life Sciences.

The Highlands and Islands face major challenges in delivering affordable, safe and effective care to a population with increasingly complex medical needs. The university has adopted a strategic approach to supporting health and life science projects with both local significance and global relevance. Major themes include facilitating the movement of patients from hospital to home, increasing patient engagement by addressing holistic care needs and promoting disease prevention through adopting a healthy lifestyle.

Projects are linked to our regional demography and geography and focus on existing strengths in active health, digital health, behaviour science, and rural health and wellbeing. A key aim is to expand the range and scope of the regional life sciences sector by providing the infrastructure and personnel to improve care provision, secure inward investment and create new education and employment opportunities.

We are working with our partners to innovate, develop and implement new health and life science technologies, products, services and businesses. Highlights include successful clinical, commercial and academic collaborations, new healthcare and life science products and services, and clinical service delivery improvements. In 2022, we will open a new innovation facility to support commercially relevant health and life sciences projects. This open innovation facility will be highly accessible and play a significant role in delivering health and life science opportunities throughout the north of Scotland.

If you would like more information about our work, please email innovation@uhi.ac.uk

● Dr Adam Giangreco
Director of Health and
Life Sciences Innovation



● Professor Ian Megson
Head, Institute of Health
Research and Innovation



The Highlands and Islands have a long history of health and life science innovation spanning more than 100 years.



● 1913
Launch of the Highlands and Islands medical service, forerunner to today's NHS.

● 1965
Establishment of the Highlands and Islands Development Board (now Highlands and Islands Enterprise). Today HIE continues to serve as a key partner for regional life science innovation.

● 1995
Founding of Inverness Medical, global leader in diabetes monitoring (now LifeScan).

● 2001
University of the Highlands and Islands is awarded higher education institution status, enabling increased academic-commercial partnerships.



● 2007

Opening of the Centre for Health Science in Inverness. The Centre is home to the Institute of Health Research and Innovation as well as numerous life science companies.

● 2017

Funding from the UK Government as part of the Inverness and Highland City-Region Deal enables new clinical, academic and commercial partnerships in healthcare and life sciences.

● 2022

Planned completion of the Inverness Campus health innovation laboratories. These will provide a resource for clinical, academic and commercial partners to develop innovative new technologies in health and life science.

FACTS AND FIGURES

125



£9m



1200+



52



£9m Inverness and Highland City-Region Deal funding committed from the UK Government to support health and life science innovation

125 current and completed health and life science projects since 2015

More than 1200m² dedicated health and life sciences space

52 successful commercial partnerships with UK and international companies since 2015



62 collaborations with universities across the globe (2015-today)



69% of University of the Highlands and Islands health research deemed internationally excellent or world leading (2014 UK REF)



£30m in new research grant income generated since 2015



More than 50 research active academics and clinician scientists

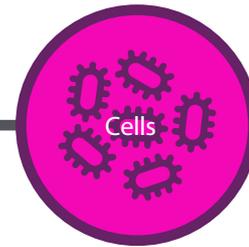
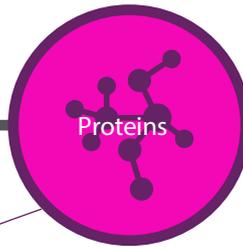
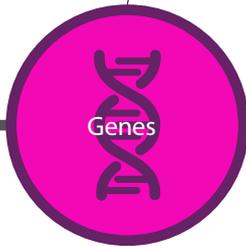
RESEARCH STRENGTHS

Health and life science research covers a range of disciplines that impact human health, from genes through to environment and infrastructure.

MOLECULAR GENETICS

Dr Antonia Pritchard

Antonia studies the genetics, genomics and immunological response to diseases such as cancer. She helps understand which changes in DNA make people more likely to develop these conditions, how genetics and genomics can help predict who is at risk, and identify whether these changes influence immune responses and treatment outcomes.



PRECISION IMMUNOLOGY

Prof Jun Wei

Jun investigates the immunogenetic mechanisms of human diseases, with a focus on schizophrenia and cancer. His recent work has identified natural antibodies present in around 10% of individuals that can be isolated, purified and used as a precision diagnostic and therapy for certain types of liver cancer.



ACTIVE HEALTH AND PHYSIOLOGY

Dr Dan Crabtree

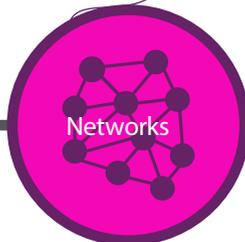
Dan examines the effects of dietary interventions and physical activity on human metabolic health. His main objective is to combine the university's existing research strengths with his own expertise in human nutrition and physical activity to deliver novel healthcare innovations.



DIGITAL HEALTH

Dr Mark Grindle

Mark investigates the potential for digital health technologies to improve people's health and wellbeing. He is interested in the power of digital, audio-visual and interactive storytelling to influence human behaviour towards positive outcomes related to health.



REMOTE AND RURAL HEALTH

Prof Annetta Smith and Prof Sandra MacRury

Sandra and Annetta's remote and rural health interests include delivering world class patient access, experience, and clinical outcomes throughout the Highlands and Islands. Work is focused on understanding how interactions amongst users, healthcare professionals and existing and emergent technologies can impact chronic diseases such as diabetes.



RESEARCH STRENGTHS

NOVEL BIOCHEMISTRY

Dr James Cobley

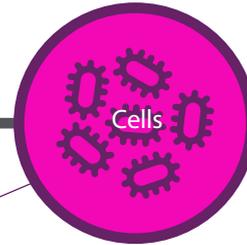
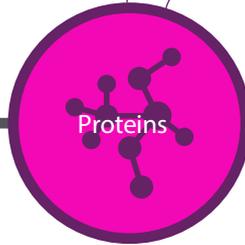
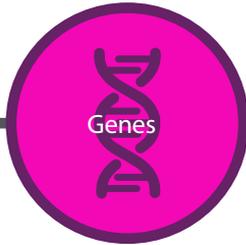
James studies redox biochemistry and has an interest in how the production and metabolism of reactive oxygen species like hydrogen peroxide impact development. James is applying this work towards developing new tools for the diagnosis and treatment of human disease.



MEDICAL NANOTECHNOLOGY

Prof Alistair Kean

Alistair's background in applied physics allows him to work with materials on an atomic and molecular scale to deliver novel health and life science innovations with practical, real world impact. These include antimicrobial materials and biofunctional surface coatings that modify cellular proteins and processes.



FREE RADICAL BIOLOGY

Prof Ian Megson

Ian's interests include the interaction of free radicals, nitric oxide and oxidant species in the cellular processes that underlie heart disease and other conditions. His work is focused on the role and potential benefits of nitric oxide donor drugs as vasodilators, anti-platelet agents and anti-inflammatory agents.



BEHAVIOUR SCIENCE

Prof Gill Hubbard and Dr Leah Macaden

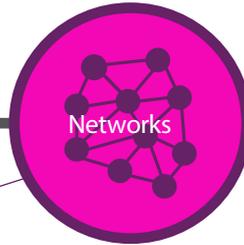
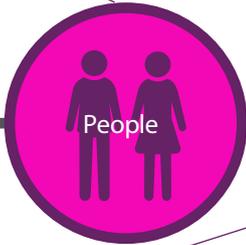
Gill and Leah are interested in behaviour change to improve health. Their expertise is the design, implementation, and evaluation of new services and technologies. They have particular interests in dementia care, teenage health behaviours, pre and rehabilitation, and physical activity interventions.



PHYSICAL ACTIVITY BEHAVIOUR

Prof Trish Gorely

Trish's interests are in psychological and behavioural aspects of physical activity, sedentary behaviour and health. Her work focuses on understanding how these behaviours correlate with and influence the design of successful behaviour change interventions.



USER-LED DESIGN

Dr Sarah-Anne Munoz

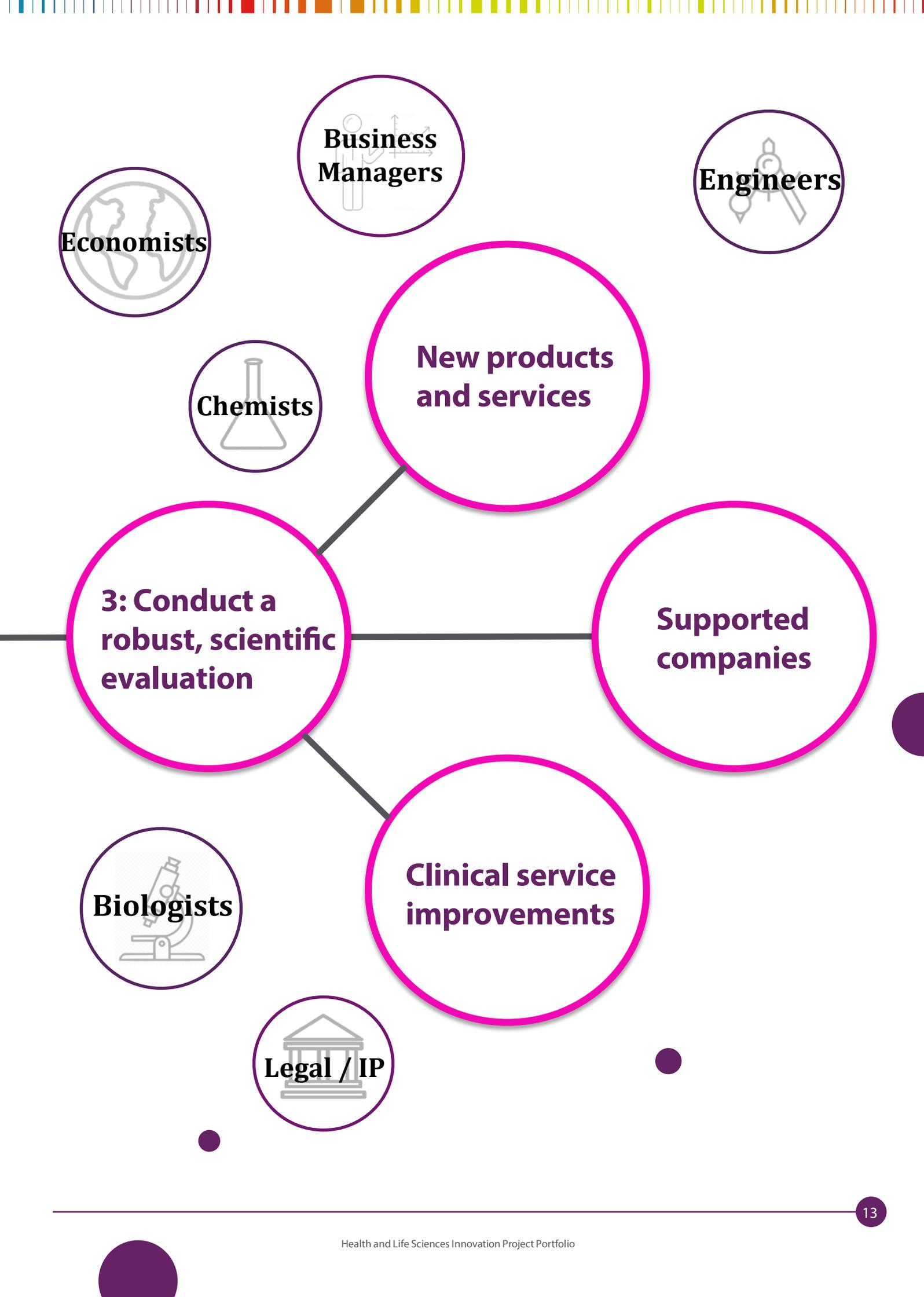
Sarah-Anne's research involves the use of participatory, qualitative methods to guide the co-production and user-led design of healthcare services and technologies. Her work particularly focuses on community engagement within remote and rural populations and the role of green and blue spaces in promoting health and wellbeing.



OUR APPROACH

We take a practical, 'needs lead' approach to health research and innovation, considering opportunities holistically amongst key stakeholders to generate new products and services, supported companies, and clinical service improvements.





Economists

**Business
Managers**

Engineers

Chemists

**New products
and services**

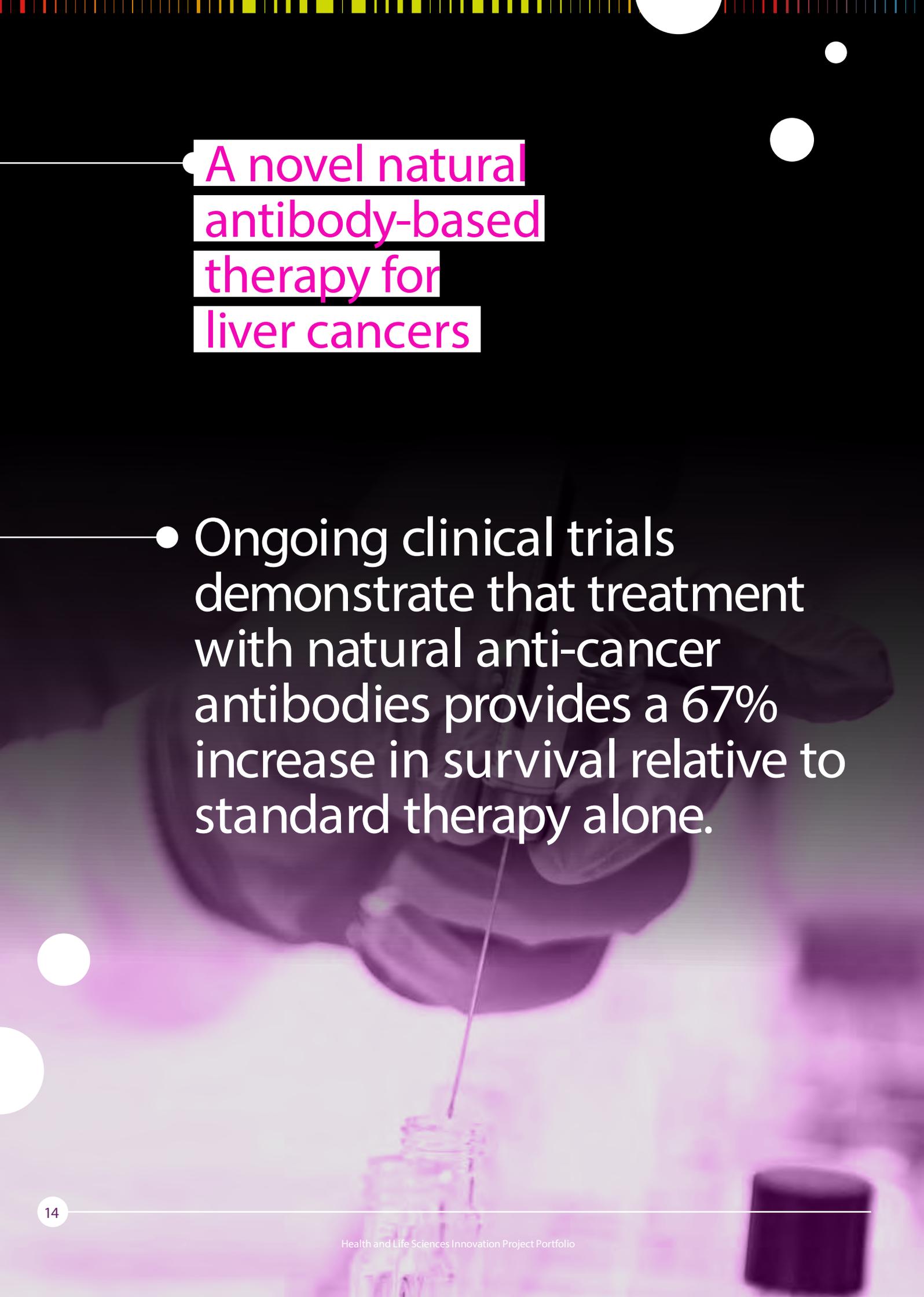
**3: Conduct a
robust, scientific
evaluation**

**Supported
companies**

Biologists

**Clinical service
improvements**

Legal / IP



A novel natural
antibody-based
therapy for
liver cancers

- Ongoing clinical trials demonstrate that treatment with natural anti-cancer antibodies provides a 67% increase in survival relative to standard therapy alone.

CASE STUDY

● Innovation overview

Liver cancer is amongst the most common tumours worldwide, with approximately 800,000 new cases diagnosed each year. Most people are diagnosed with advanced disease, which typically carries a mere 9% five-year survival rate. There is an urgent need to identify new technologies to improve liver cancer treatment and improve patient outcomes.

University of the Highlands and Islands research recently identified a novel role for naturally occurring antibodies in treating liver and other cancers. Specifically, *in vitro* studies established that natural antibodies present in plasma isolated from healthy donors can deliver increased tumour killing activity.

This project will establish the clinical utility of screening anticancer antibodies in plasma and developing natural antibody-based therapies to treat advanced liver cancer. This involves screening healthy donor blood samples for the presence of natural anti-cancer antibodies. Once identified, samples with high levels of natural antibodies will be purified and pooled for use as a novel therapy in ongoing clinical trials taking place in China.

● Objectives

- Perform large scale blood sample screening and plasma enrichment for natural anti-cancer antibodies.
- Secure intellectual property licenses to enable natural antibody clinical trials.
- Evaluate and publish results of these studies as appropriate.

● Potential impacts and outcomes

This project has established a new type of cancer therapy based on the identification, purification and delivery of natural anti-cancer antibodies. Successful demonstration of this technology in ongoing trials would have significant clinical and economic implications.

● External partner:

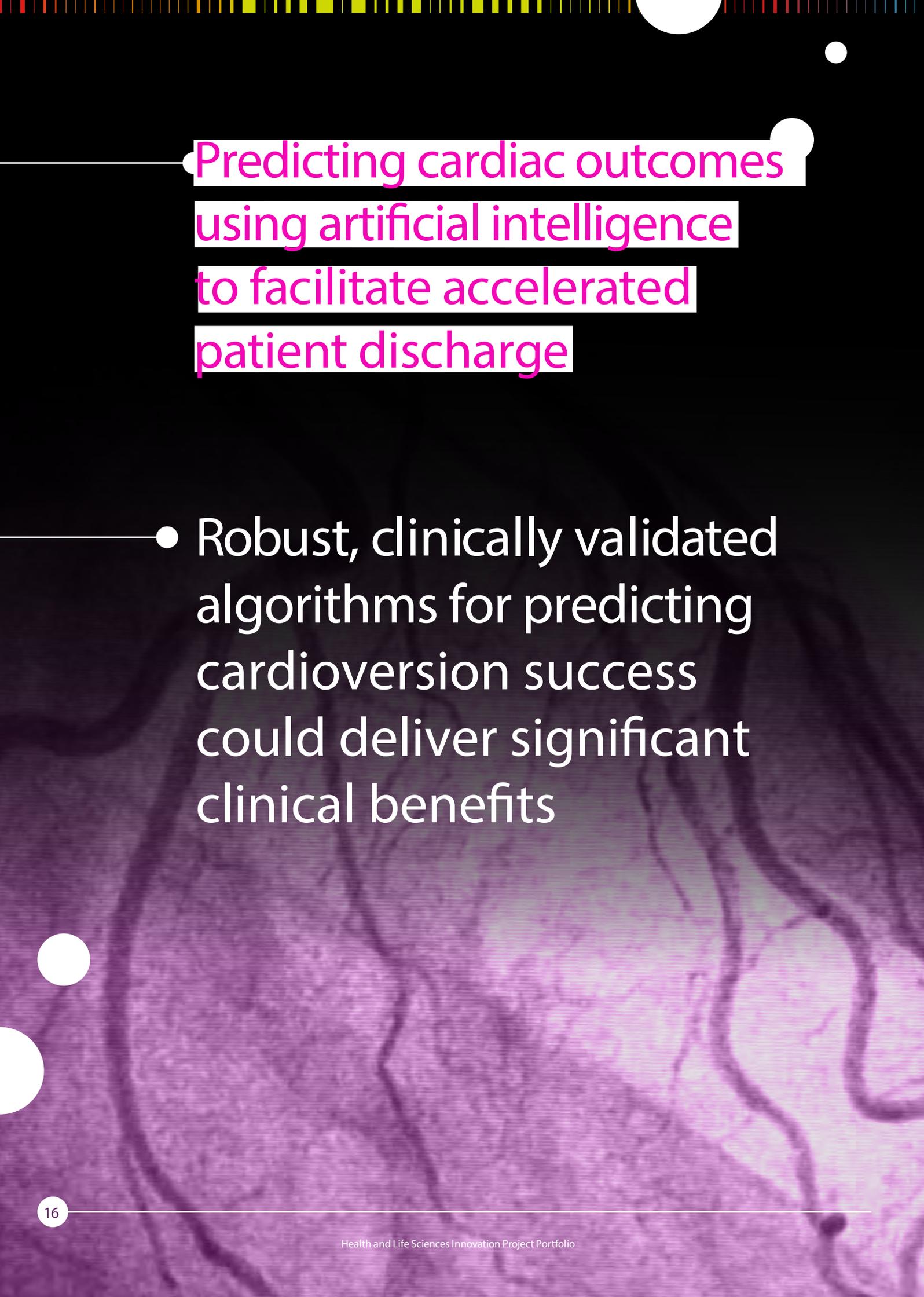
● QHB Ltd.



● University lead:

● Prof Jun Wei,
Professor of Genetics and Immunology





Predicting cardiac outcomes
using artificial intelligence
to facilitate accelerated
patient discharge

- Robust, clinically validated algorithms for predicting cardioversion success could deliver significant clinical benefits

CASE STUDY

● Innovation overview

Atrial fibrillation (AF) is a common heart condition, causing an abnormally fast heart rate and irregular rhythm, which can lead to significant morbidity and mortality. Treatment options include drugs and/or electrocardioversion (ECV). Although mortality can be significantly reduced with ECV, it is only successful in 30% of patients. The procedure also carries risk, and is expensive to carry out. Consequently, there is an urgent need to predict which patients with AF are most suitable for treatment using ECV.

This project will gather data including ECGs, age, gender, comorbidities, medications and outcomes. TTP will analyse and interpret the data, using this to determine any factors that may influence AF outcomes post ECV. TTP will also use the data to rapidly prototype and train machine-learning algorithms for clinical prediction and risk scoring.

● Objectives

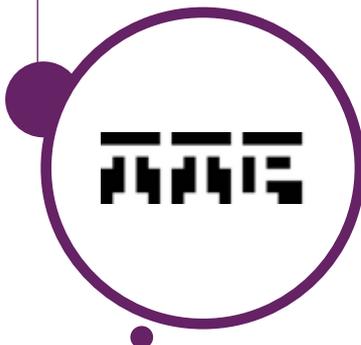
- Assess the technical feasibility and ideal use scenarios for remote cardiac monitoring.
- Establish stratification protocols to identify an 'ideal patient profile' for the use of cardiac monitors in remote and rural settings.
- Develop a digital algorithm to enable the identification of patients suitable for electrocardioversion.

● Potential impacts and outcomes

Predicting ECV success has the potential to improve patient experience, promote increased patient mobility and deliver significant cost savings. The algorithms that will be developed therefore represent a potentially valuable new commercial product.

● External partner:

● TTP plc



● University lead:

● Prof Steve Leslie,
Professor of Cardiology and Consultant
Cardiologist (NHS Highland)





Validating
decontamination
systems to help reduce
hospital-acquired
infection

- Hospital acquired infections following surgery impact over 250,000 patients and cost the NHS in excess of £1 billion each year.

CASE STUDY

● Innovation overview

Ineffective decontamination of surgical instruments is considered a major cause of hospital-acquired infection which affects up to 10% of patients, is responsible for 5,000 deaths and costs the NHS in excess of £1 billion each year. Despite this, there is little data on the efficacy of decontamination systems and a lack of standardised validation practices. The need for independent, standardised monitoring is therefore essential to improve patient outcomes and reduce costs.

This proposal will compare novel Aseptium decontamination technologies and washing systems in use throughout the NHS. Researchers within the University of the Highlands and Islands will perform independent cleaning efficiency analysis to detect surgical contamination products using advanced instrumentation including liquid chromatography-tandem mass spectrometry.

● Objectives

- Comparison of Aseptium technologies (uSonic cleaning systems, VeriTest process challenge devices) and existing NHS systems.
- Identification of contaminants resistant to standard washing procedures.

● Potential impacts and outcomes

This project will promote collaboration amongst Inverness Campus stakeholders, highlight regional healthcare innovation activity and support Aseptium marketing and business development activities. It may also help determine the efficacy of decontamination systems used by the NHS, potentially resulting in reduced hospital acquired infections.

● External partner:

● Aseptium Ltd.



● University lead:

● Prof Phil Whitfield,
Head of Lipidomics Research



Establishing a canine cancer registry to improve disease prevention and care

- The cancer therapeutics market for animals is expanding by 10% each year with annual global sales exceeding \$350 million.

CASE STUDY

● Innovation overview

The cancer therapeutics market for animals is undergoing rapid expansion with annual spending now exceeding \$350 million. This growth is driven by consumer demand, increased animal lifespans and expansion of pedigree breeding. Cancer registries help identify factors that influence the health and wellbeing of companion and working animals by enabling the identification of common risk factors and clinical diagnostic tests.

This cancer registry, the first of its kind in Scotland, is a collaboration involving Scotland's Rural College, the University of the Highlands and Islands, Scottish Veterinary Referrals and VPG Histology. The project will collect veterinary data and samples including DNA, tissue and bodily fluids, to help identify trends in canine cancer incidence, geographic distribution and survival. Veterinary practices across Scotland will be encouraged to participate and share data of animals under their care.

● Objectives

- Establish feasibility for collection and submission of data to a canine cancer registry.
- Coordinate the practicalities of large electronic dataset handling and data security.
- Provide guidance regarding the collection, storage and analysis of veterinary samples and data.

● Potential impacts and outcomes

Establishing this cancer registry will provide an important evidence base that could be used to improve care and to drive cancer prevention. Animal cancer registries have also been used to inform and influence human health and wellbeing, by helping to identify common risk factors and shared early warning signs.

● External partner:

● Scotland's Rural College, Scottish Vet Referrals, VPG Histology



● University Lead:

● Dr Antonia Pritchard,
Senior lecturer, Genomics
and Immunology





User-led design of a digital health technology for improving dementia care

- The number of people living with dementia doubles every 20 years, with annual global costs now exceeding \$1 trillion.

CASE STUDY

● Innovation overview

Evidence suggests that cognitive decline in people with dementia is slower if they can be supported to live in their own homes as independently as possible. At home, most dementia care is provided by families and unpaid carers who often lack adequate support and understanding of condition management. Cognihealth have recently developed CogniCare, a novel digital health technology for improving at home dementia care delivery.

A user-led design process involving patients, carers, clinicians, nurse consultants and dementia advisors will help the development of features that strengthen the CogniCare system. The focus will be on enhancing carers' competence and confidence in identifying symptoms and changes that need to be monitored to reduce unnecessary hospitalisation, enable early intervention, and facilitate improved disease self-management.

● Objectives

- Collect and evaluate stakeholder data from patients, carers and healthcare professionals.
- Use collected data to inform the design of new features on the CogniCare digital platform.
- Evaluate and publish results of these studies as appropriate.

● Potential impacts and outcomes

This user-led design project will support the design of new features of the CogniCare platform for improving the care of patients with dementia. Results will help evidence the benefits of offering this technology through the NHS.

● External partner:

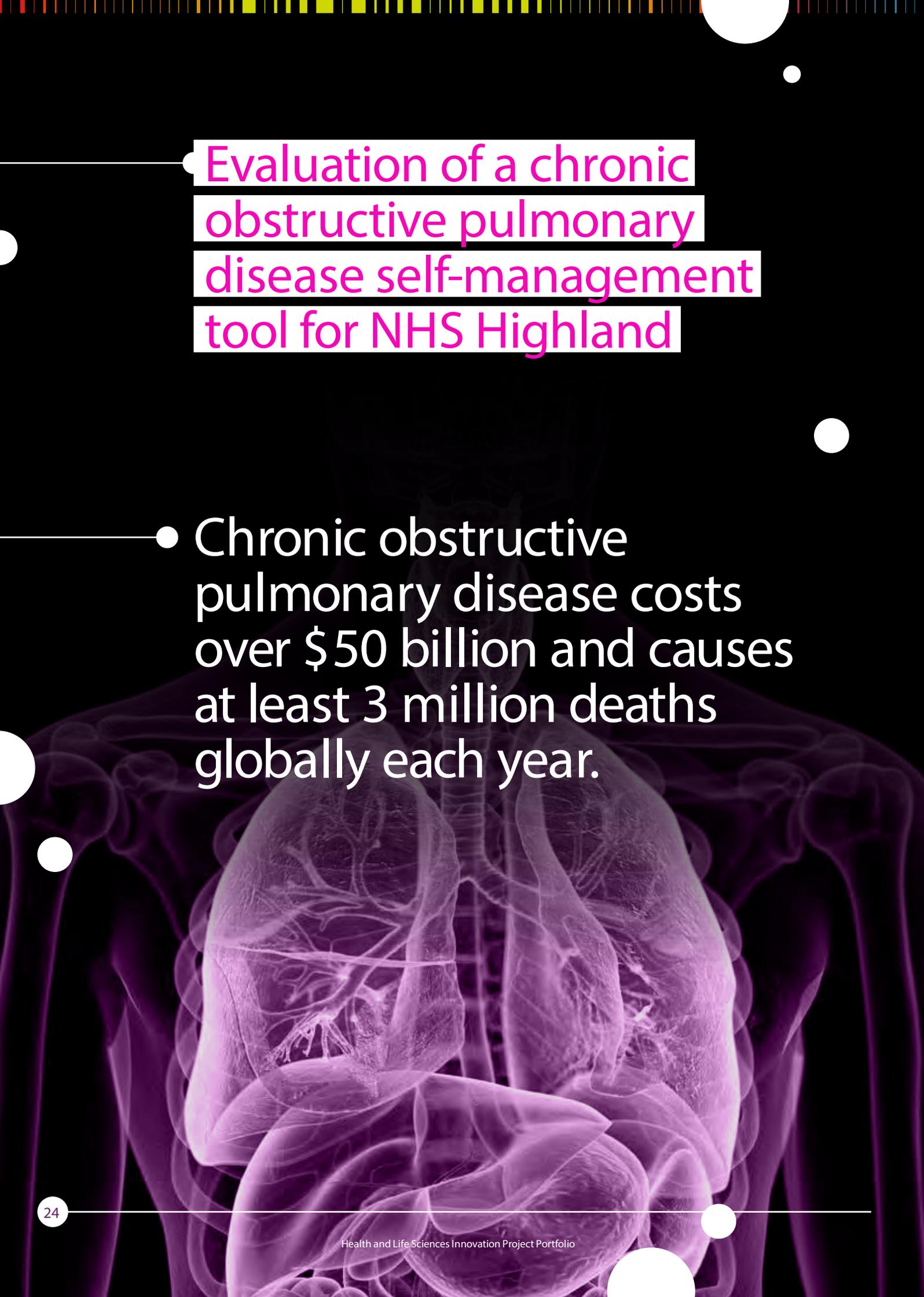
● Cognihealth Ltd.



● University lead:

● Dr Leah Macaden,
Reader, Nursing





Evaluation of a chronic obstructive pulmonary disease self-management tool for NHS Highland

- Chronic obstructive pulmonary disease costs over \$50 billion and causes at least 3 million deaths globally each year.

CASE STUDY

● Innovation overview

Annual NHS costs for chronic obstructive pulmonary disease (COPD) exceed £1.9 billion. Most of this cost is derived from unplanned inpatient admissions following acute disease exacerbation. The myCOPD platform is a patient self-management tool that empowers users to manage their disease more effectively by reducing inhaler errors, increasing medication compliance and providing structured education and guidance.

NHS Highland has secured test of change funding to evaluate the myCOPD platform and has approached the University of the Highlands and Islands for assistance in data collection, evaluation, and health economics modelling to support subsequent health board procurement.

● Objectives

- Evaluate the clinical and economic impact of myCOPD during the test of change.
- Provide a cost-benefit model and analysis to facilitate downstream procurement decisions.

● Potential impacts and outcomes

This project will evaluate the health and economic benefits of the myCOPD digital health platform. Results will be used to evaluate the cost effectiveness of this intervention as well as its impact on overall patient health and wellbeing.

● External partner:

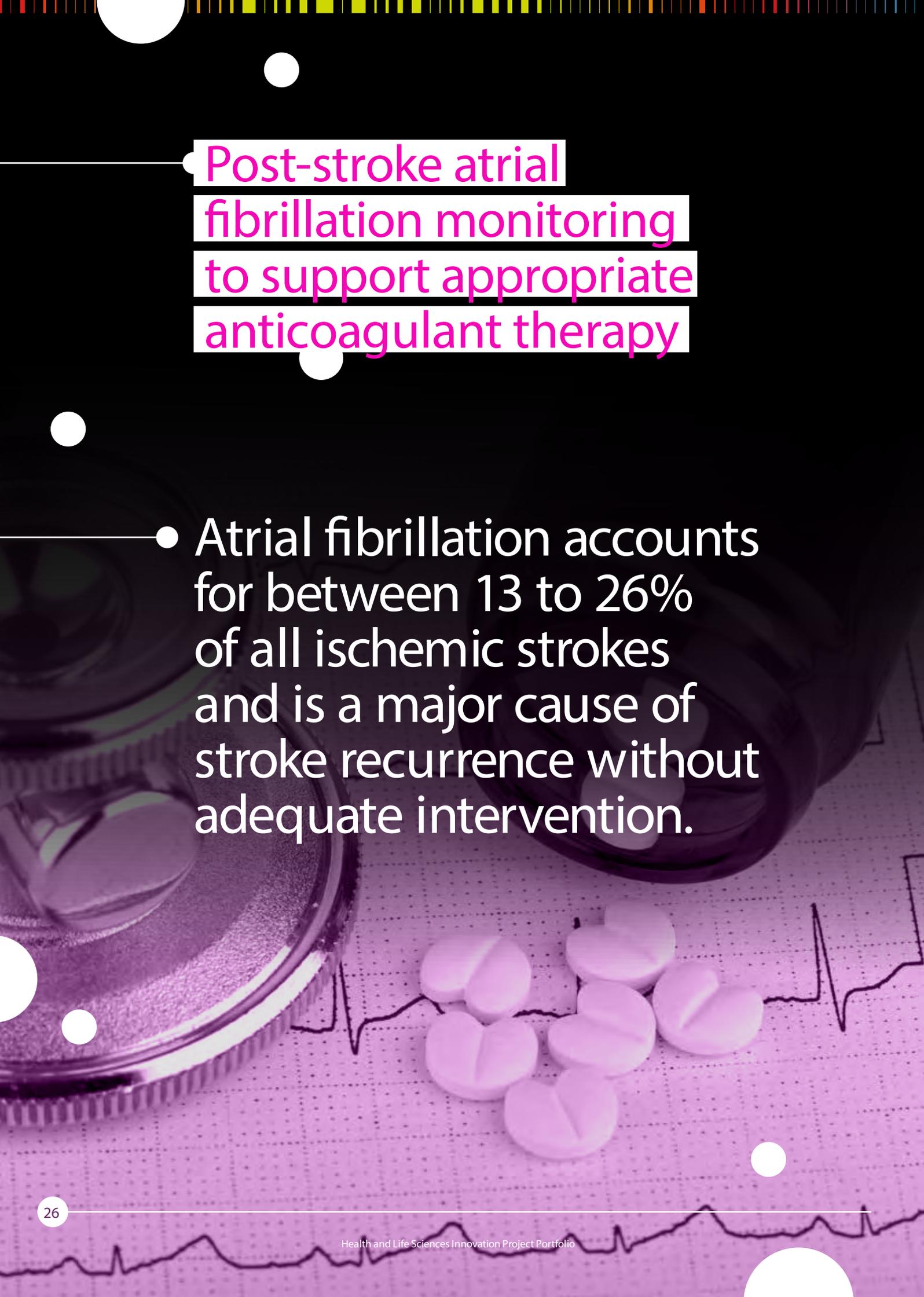
● mymhealth Ltd.



● University Lead:

● Dr Beth Sage,
Honorary Senior Lecturer and Consultant
in Respiratory Medicine (NHS Highland)





**Post-stroke atrial
fibrillation monitoring
to support appropriate
anticoagulant therapy**

- Atrial fibrillation accounts for between 13 to 26% of all ischemic strokes and is a major cause of stroke recurrence without adequate intervention.

CASE STUDY

● Innovation overview

Ischemic stroke is the leading cause of adult disability in the developed world and the third leading cause of patient mortality. In patients who have had a stroke, atrial fibrillation greatly increases the chance of a further stroke and is associated with poor prognosis and increased stroke severity. Oral anticoagulants reduce this risk of recurrent stroke in patients with atrial fibrillation and it is therefore critically important to treat these patients appropriately.

The aim of this project is to evaluate atrial fibrillation monitoring technology to improve patient outcomes following stroke. Patients will be offered screening which has not been available before. Based on existing literature, it is expected that 20% of patients will be identified as having atrial fibrillation and therefore offered oral anticoagulation. We anticipate that appropriate oral anticoagulant prescribing may reduce the risk of recurrent stroke by approximately 60%, improving clinical outcomes and reducing healthcare costs.

● Objectives

- Establish post-stroke monitoring protocols at the Highland stroke unit.
- Perform monitoring and ensure that patients who are eligible for anticoagulation have this appropriately prescribed.
- Evaluate clinical outcomes and patient satisfaction metrics.

● Potential impacts and outcomes

Adoption of atrial fibrillation testing and appropriate oral anticoagulant prescribing has the potential to reduce the risk of recurrent stroke. This will improve patient outcomes, reduce NHS costs and improve compliance with UK national screening guidelines.

● External partner:

● Daiichi-Sankyo, Ltd.



● University lead:

● Prof Steve Leslie,
Professor of Cardiology and
Consultant cardiologist (NHS Highland)





• Collaborative design of a digital toolkit for children and young people with additional support needs

- Providing support to children and young people with additional care needs is essential for improving their long term outcomes.

CASE STUDY

● Innovation overview

Approximately 19% of all children and young people in the Highlands experience life-limiting mental or physical health conditions, responsibility as young carers, or significant adversity including mental and physical abuse. Providing them with appropriate support is essential to mitigate against the long-term impact of such experiences, with research clearly demonstrating that such adversity is a key factor in developing detrimental conditions later in life.

This project works collaboratively with children and young people with additional support needs to design, develop, and deliver a new digital toolkit that empowers users with a balance of both self-management and professional support mechanisms. The long term aim of this work is to improve psychosocial outcomes amongst children and young people, thereby reducing the incidence and cost of long term condition management.

● Objectives

- Collaborative design and development of a digital support toolkit for and by children and young people with additional support needs
- Establish feasibility of the toolkit for improving psychosocial outcomes and reducing long term care needs

● Potential impacts and outcomes

The long term aim of this work is to improve psychosocial outcomes amongst children and young people with additional care needs, thereby reducing the incidence and cost of long term condition management. If successful this project has the potential to be applied across Scotland, the UK, and internationally.

● External partner:

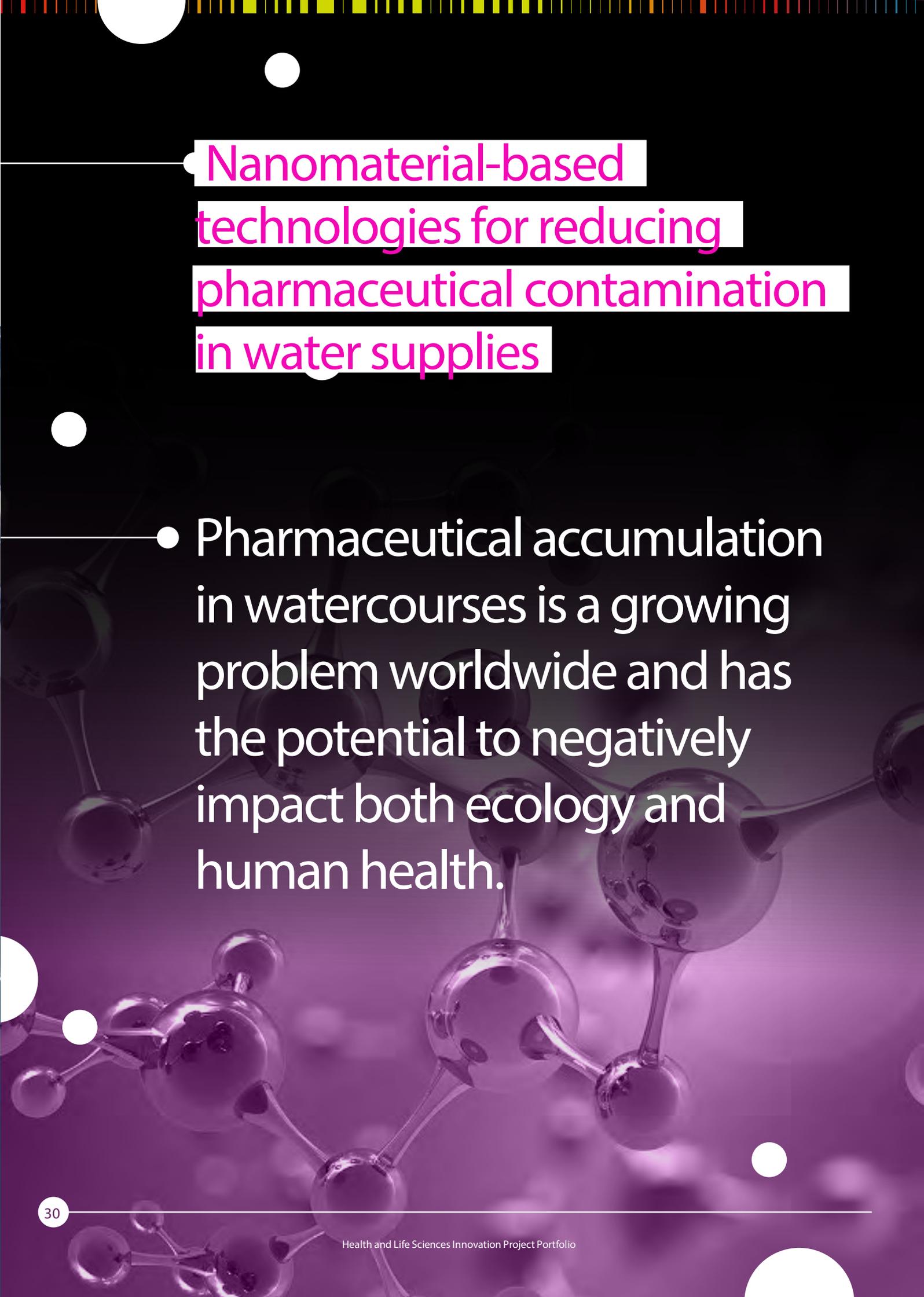
● Highland Children and Young People's Forum



● University lead:

● Dr Mark Grindle
Senior lecturer, digital health technologies





Nanomaterial-based technologies for reducing pharmaceutical contamination in water supplies

- Pharmaceutical accumulation in watercourses is a growing problem worldwide and has the potential to negatively impact both ecology and human health.

CASE STUDY

● Innovation overview

This project aims to develop technologies for removing contaminant pharmaceuticals from hospital effluent in order to reduce their impact on environmental and human health.

Using a novel nanostructured material, microporous hollow fibres will be functionalised to filter, capture, and/or 'break down' pharmaceutical contaminants. Nanomaterial coatings provide the filter an extremely high surface area allowing high capacity and throughput. Construction of test rigs is currently underway to quantify filter efficacy and optimise design. This pilot study is the foundation for a wide range of nanomaterial based applications at the interface of medicine, chemistry, and nanotechnology.

● Objectives

- Develop a nanomaterial-based filter technology for removing pharmaceutical contaminants from water
- Generate proof of concept efficacy and specificity data regarding nanomaterial-based filtration technologies

● Potential impacts and outcomes

Development of nanomaterial-based technologies capable of reducing pharmaceutical contamination of water supplies has the potential to significantly improve human, animal, and environmental health in the UK and worldwide.

● External partner:

● PolyCat UK



POLYCAT UK

● University lead:

● Prof Alistair Kean
Professor of Medical
Nanotechnology



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