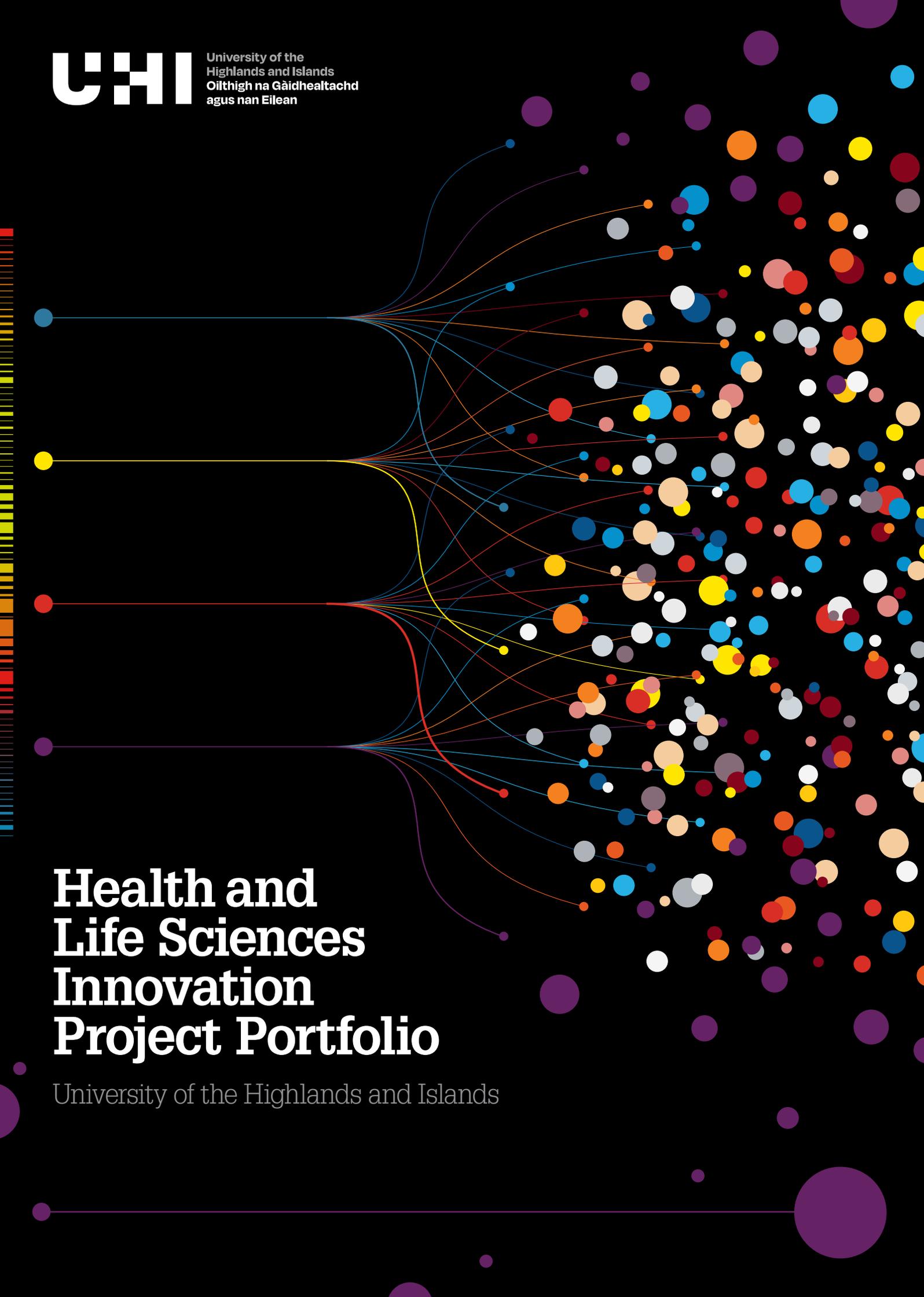




University of the  
Highlands and Islands  
Oilthigh na Gàidhealtachd  
agus nan Eilean

An abstract graphic on a black background. On the left, a vertical bar contains horizontal lines of varying lengths and colors (blue, yellow, red, purple). From these lines, numerous thin, curved lines of the same colors extend towards the right, where they connect to a dense field of multi-colored dots (blue, yellow, red, purple, white, orange, grey).

# Health and Life Sciences Innovation Project Portfolio

University of the Highlands and Islands



## CONTENTS

- 3 Introduction**
  - 4 Historical perspective**
  - 6 Facts and Figures**
  - 8 Research strengths**
  - 12 Our approach**
- 

### Case studies

- 14** A novel natural antibody-based therapy for liver cancers.
  - 16** Developing natural plastics alternatives using a circular economy approach.
  - 18** Validating decontamination systems to help reduce hospital-acquired infection.
  - 20** User-led design of a digital health technology for improving dementia care.
  - 22** Evaluation of a chronic obstructive pulmonary disease self-management tool for remote and rural populations.
  - 24** Post-stroke atrial fibrillation monitoring to support appropriate anticoagulant therapy.
  - 26** Using digital health technology to address unmet orthopaedic patient needs.
  - 28** Nanomaterial-based technologies for reducing pharmaceutical contamination in water supplies.
  - 30** Predicting cardiac outcomes using artificial intelligence to facilitate accelerated patient discharge.
- 

### 32 Get involved

**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 UHI 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, active 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, licensed IP assets, and clinical service delivery improvements. In 2022, we will open a new innovation centre to support additional commercially relevant health and life sciences activities. 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](mailto: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 sciences 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

UHI 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 UHI School of Health, Social Care, and Life Sciences 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.

● 2019

UHI is awarded the Scottish Council for the Development of Industry Award for Excellence in Research and Innovation.

● 2022

Completion of the Inverness Campus health innovation centre. This facility will provide a resource for clinical, academic and commercial partners to develop innovative new technologies in health and life science.



• £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 1200m<sup>2</sup> 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)



• 70% of University of the Highlands and Islands health research deemed internationally excellent or world leading (2021 UK REF)



• £20m in new research income generated since 2015



• Over 50 research scientists and clinicians

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.



● **ACTIVE HEALTH AND PHYSIOLOGY**

● **Dr Dan Crabtree**

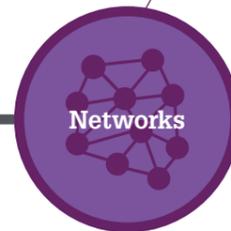
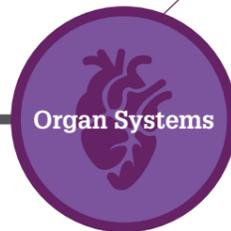
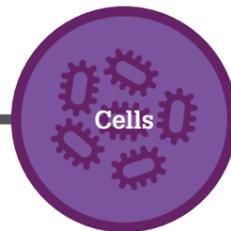
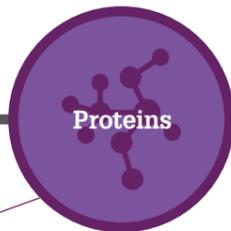
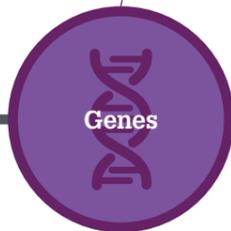
Dan examines the effects of dietary interventions and physical activity on human metabolic health. His main objective is to combine the university's existing research strengths with his own expertise in human nutrition and physical activity interventions to deliver novel healthcare innovations.



● **DIGITAL HEALTH**

● **Dr Mark Grindle**

Mark investigates the potential for digital health technologies to improve people's health and wellbeing. His focus is on the therapeutic power of digital, audio-visual and interactive storytelling to influence human behaviour towards positive outcomes and behaviour change.



● **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.



● **REMOTE AND RURAL HEALTH**

● **Prof Sandra MacRury**

Sandra'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.



## NOVEL BIOCHEMISTRY

### Dr James Cobley

James studies redox biochemistry and has an interest in how the production and metabolism of mitochondrial reactive oxygen species like superoxide and 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.



## BEHAVIOUR SCIENCE

### Prof Gill Hubbard and Dr Leah Macaden

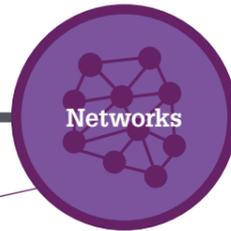
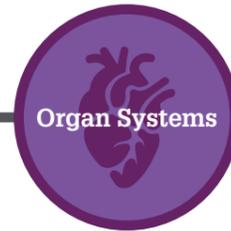
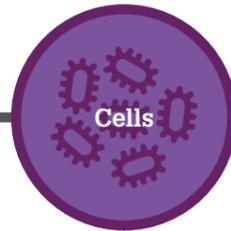
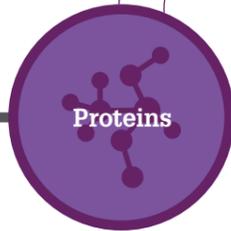
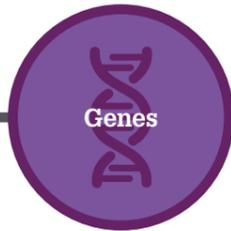
Gill and Leah are interested in behaviour change to improve health. Their expertise is the design, implementation, and evaluation of new services and technologies. They have particular interests in dementia care, teenage health behaviours, pre and rehabilitation, and physical activity interventions.



## PHYSICAL ACTIVITY BEHAVIOUR

### Prof Trish Gorely

Trish's interests are in psychological and behavioural aspects of physical activity, sedentary behaviour and health. Her work is focused on health outcomes, physical activity and sedentary behaviour measurement, understanding the correlates of these behaviours and the design and evaluation of behaviour change interventions.



## 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.



## USER-LED DESIGN

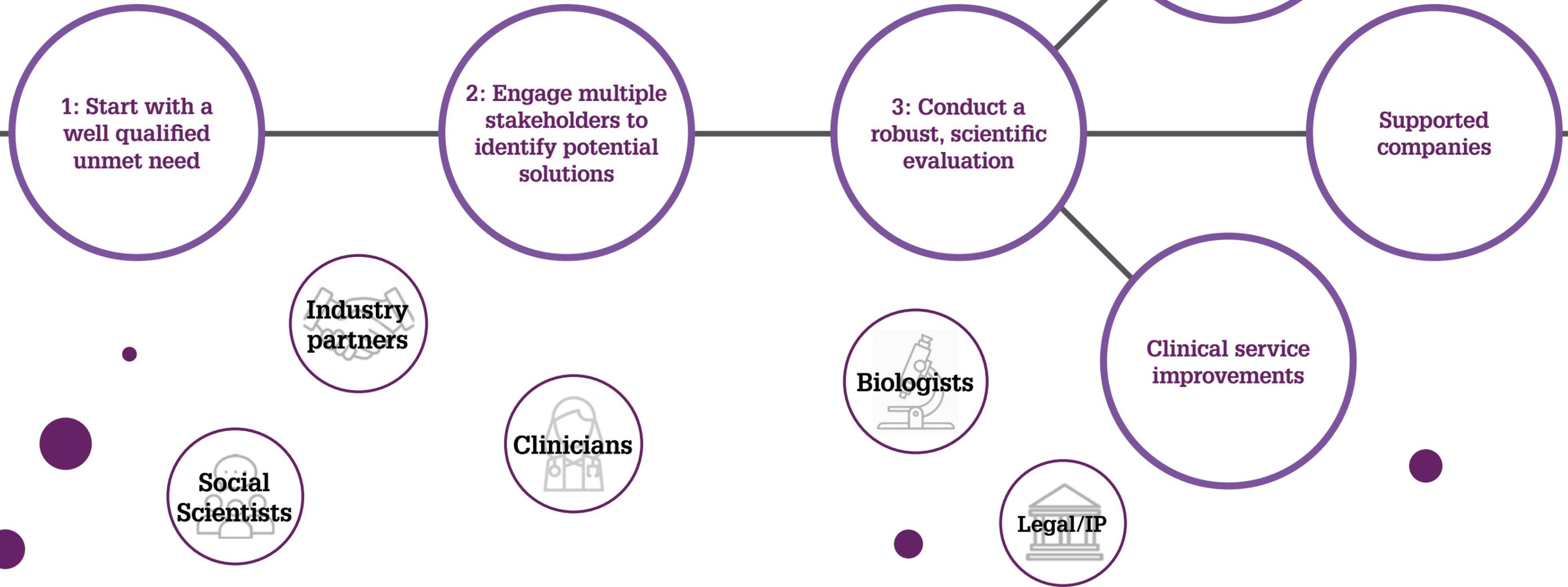
### Dr Sarah-Anne Munoz

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 alongside key stakeholders to generate new products and services, supported companies, and clinical service improvements.



# A novel natural antibody-based therapy for liver cancers.

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

## CASE STUDY

### • Overview

Liver cancers are 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 and treatments to improve diagnosis and overall patient outcomes.

UHI 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 established the utility of screening anticancer antibodies in plasma and developing natural antibody-based therapies to treat advanced liver cancer. This involved licensing our technology to Qingdao Hailanshen Biotechnology (QHB) Ltd who screened healthy donor blood samples for the presence of natural anti-cancer antibodies. Samples with high antibody levels were purified, pooled, and used in ongoing Chinese clinical trials.

### • Objectives

- Perform large scale blood sample screening and plasma enrichment for natural anti-cancer antibodies
- Secure IP licenses to enable natural antibody clinical trials

### • Impacts and outcomes

This project established a potential new cancer therapy involving identification, purification, and delivery of natural anti-cancer antibodies. The partnership and licensing agreement with QHB Ltd was recognised as one of 3 national finalists for the 2019 Praxis Auril 'KE Deal of the Year' in recognition of its potential global importance.



### • External partner:

• Qingdao Hailanshen Biotechnology (QHB) Ltd



### • University lead:

• Prof Jun Wei,  
Professor of Genetics and Immunology



# Developing natural plastics alternatives using a circular economy approach.

- Over 100 million metric tons of plastic waste are created each year, driving a global ecological emergency.

## CASE STUDY

### Overview

Plastic use has increased worldwide since 1960, with over 100 million metric tons of waste created each year. Serious concerns regarding this plastic waste include the negative impacts of microplastics on agriculture and marine life, local environmental contamination following plastic degradation, and deaths to animals caused by plastic entanglement or ingestion. This is an urgent, global ecological emergency that needs addressing.

CuanTec, a Scottish biotech company, has established an innovative, environmentally friendly process to produce the world's first chitin-based plastic alternative extracted from shellfish waste that would otherwise be discarded. This novel material has the potential to replace petrochemical derived plastics in a range of goods, is entirely biodegradable, and might additionally extend the shelf life of food products due to its natural antimicrobial properties.

The UHI mass spectrometry facility helped characterise the materials produced by CuanTec to verify their product safety profile. This collaboration, funded by IBioIC, will support further development, IP generation, and subsequent product regulatory approval. This will allow CuanTec to access additional routes to market and establish a novel manufacturing approach within the circular economy, leading to reductions in plastic use and waste generation.

### Objectives

- Develop a process to quantify potential allergens in CuanTec products using chemical analysis
- Establish parameters and methods needed to consistently produce allergen-free materials

### Impacts and outcomes

This project enabled CuanTec to assess the safety profile and potential route to market for chitin-based plastic alternatives.

### External partner:

CuanTec Ltd.



### University lead:

Dr Angelique Stalmach,  
Head of mass spectrometry



# Validating decontamination systems to help reduce hospital-acquired infection.

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

## CASE STUDY

### Overview

Ineffective surgical instrument decontamination is a major cause of hospital acquired infection that affects up to 10% of patients, is responsible for 5000 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 practises. The need for independent, standardised monitoring is therefore essential to improve patient outcomes and reduce healthcare costs.

This project assessed the efficiency of Aseptium decontamination technologies. UHI researchers used mass spectrometry analysis to detect surgical contamination products pre and post cleaning and provided these results to Aseptium.

### Objectives

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

### Impacts and outcomes

This work increased local stakeholder collaboration activities and supported Aseptium's business development activities.

The project was featured as an 'Innovative Collaboration' finalist at the 2019 Scottish Life Sciences Awards.



### External partner:

Aseptium Ltd.



### University lead:

Prof Phil Whitfield,  
Head of Lipidomics Research



# 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

### ● 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, collaborative design process involving patients, carers, clinicians, nurse consultants and dementia advisors was employed to help the development of the CogniCare system. The focus was 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

### ● Impacts and outcomes

This user-led design project supported the inclusion 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. This collaboration was recently featured as a national case study by Interface.



### ● External partner:

● Cognihealth Ltd.



### ● University lead:

● Dr Leah Macaden,  
Division of Nursing and Midwifery



# Evaluation of a chronic obstructive pulmonary disease self-management tool for remote and rural populations.

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

## CASE STUDY

### • Innovation overview

Chronic obstructive pulmonary disease (COPD) is a common, costly, and incurable respiratory disease affecting 1.2 million people in the United Kingdom alone. Acute COPD exacerbations requiring hospitalization place significant demands on health services, and the incidence of COPD in poor, remote, and rural populations is up to twice that of cities.

The mymhealth myCOPD platform is a digital health self-management technology designed to improve COPD outcomes and mitigate demands on health services. In this study, we evaluated myCOPD use and its clinical effectiveness at reducing hospitalizations, inpatient bed days, and other NHS resource use amongst our predominantly remote and rural Highland population.

### • Objectives

- Establish the benefits of myCOPD in a real world evaluation.
- Provide a clinical and health economic analysis of myCOPD to facilitate downstream procurement decisions

### • Impacts and outcomes

Our results suggest that neither age, wealth, nor geographical location represent barriers to using myCOPD. This finding may help mitigate perceived risks of increased health inequalities associated with the use of digital health technologies.

Although myCOPD did not reduce demands on health services or direct healthcare costs our results did show that highly engaged patients may derive benefits.

This study was featured in a recent NICE evaluation of myCOPD.

**NICE** National Institute for Health and Care Excellence

### • 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

### Overview

Ischemic stroke is the leading cause of adult disability in the developed world and third leading cause of patient mortality. In people 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 people with atrial fibrillation and it is therefore critically important to identify and treat them appropriately.

This collaboration with Daiichi Sankyo assessed the clinical impact of prolonged atrial fibrillation monitoring using wearable R-TEST monitoring technology. Atrial fibrillation was detected in 8% of patients, all of whom were offered appropriate oral anticoagulation. Health economic modelling predicted that adoption of R-TEST technology had a high probability of demonstrating net clinical and economic benefits.

### Objectives

- Establish improved post-stroke monitoring protocols for NHS Highland
- Ensure that patients who would benefit from anticoagulation therapy have this appropriately prescribed

### Impacts and outcomes

Adoption of R-TEST based atrial fibrillation monitoring and appropriate oral anticoagulation has reduced the risk of recurrent stroke for patients and represents a net health economic benefit for NHS Highland.

This partnership project was recognised at the 2022 Healthcare Service Journal Awards for Healthcare Excellence.



### External partner:

Daiichi-Sankyo, Ltd.



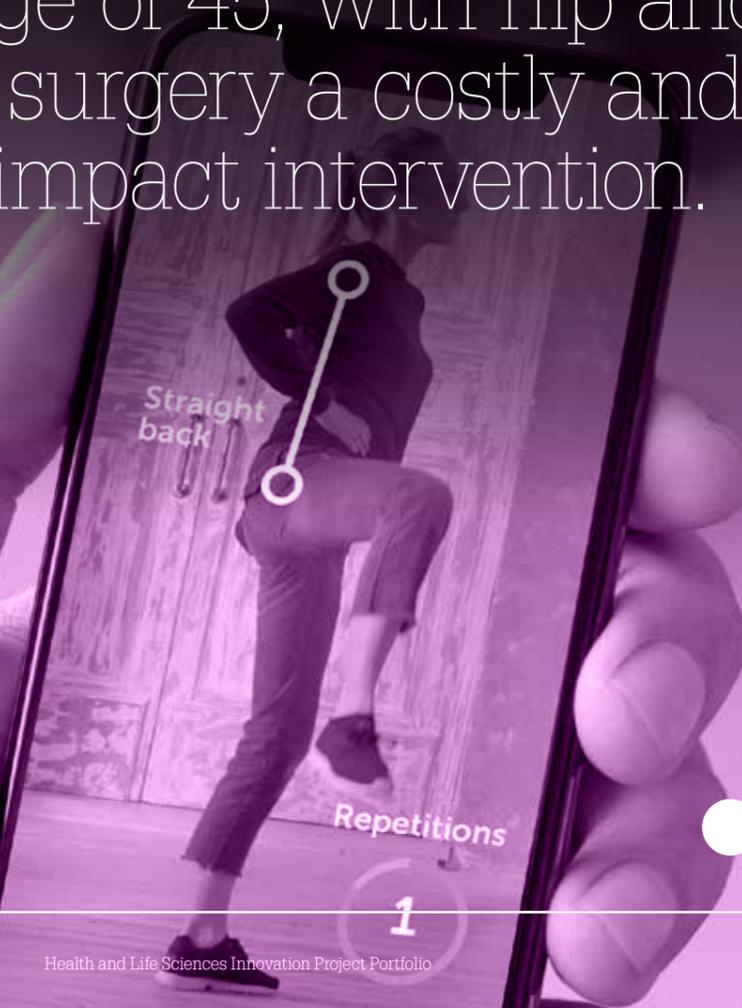
### University lead:

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



# Using digital health technology to address unmet orthopaedic patient needs.

- Osteoarthritis impacts about a third of people over the age of 45, with hip and knee surgery a costly and high impact intervention.



## CASE STUDY

### • Overview

Osteoarthritis is the most common type of arthritis in the UK, causing painful joints and often requiring high cost, high impact hip and knee surgery.

UHI and NHS Highland are evaluating if Joint Academy, a digital treatment app developed in Sweden, can help patients awaiting their knee and hip operations. The app connects patients with a registered physiotherapist, provides information about chronic joint pain and encourages users to undertake tailored exercises to help reduce pain and restore movement.

Previous studies of Joint Academy found that some patients using the treatment decide they no longer need surgery. Trials also showed reductions in post-operation recovery times for regular users.

### • Objectives

- Evaluate the feasibility of an online and digital health intervention for osteoarthritis patients awaiting routine hip or knee replacement surgery
- Identify factors driving patient enrolment and engagement with the Joint Academy digital health technology

### • Impacts and outcomes

Establish direct and indirect measures of Joint Academy clinical impact, including patient reported outcomes, sit to stand ability, and decision to undertake or opt-out of hip and knee replacement surgery.

Develop an economic viability assessment based on participant engagement and clinical efficacy data.

### • External partner:

• Joint Academy



### • University lead:

• Prof Trish Gorely  
Division of Nursing and Midwifery



# 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

### • 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

### • 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



### • University lead:

• Prof Alistair Kean  
Professor of Medical  
Nanotechnology



# Predicting cardiac outcomes using artificial intelligence to facilitate accelerated patient discharge.

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

## CASE STUDY

### • 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

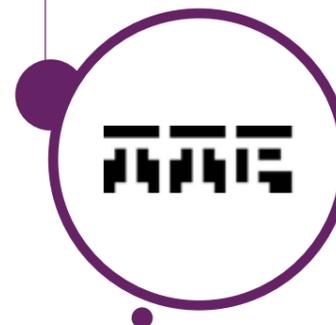
- Assess the technical feasibility and ideal use scenarios for algorithm-based cardiac monitoring.
- Develop a digital algorithm to enable the identification of patients suitable for electrocardioversion.

### • Impacts and outcomes

Predicting ECV success has the potential to improve post percutaneous coronary intervention has the potential to improve patient experience, 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)





We need your help to deliver research and innovation that creates new products and services, promotes economic growth, and transforms health and social care outcomes throughout the Highlands and Islands.

Your donation will support promising, clinically important research, enable researchers to develop their innovative ideas, and encourage students and staff to build commercially viable health and life sciences products, services, and businesses.

**£1,000**  
could support a student in health and life sciences training

**£5,000**  
could support an initial health innovation feasibility study

**£15,000**  
could help develop a promising technology from concept to prototype

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**UHI is a registered Scottish charity no.  
SC022228**

**Funding support**



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