Innovate UK

## Results of Competition: Precision Medicine - Impacting Through Innovative Technology - FS

## Competition Code: 1709_HLS_PM_FS

## Total available funding is £6m

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

| Participant organisation names | Project title | Proposed project costs | Proposed project grant |
|---|---|---|---|
| **TORR SCIENTIFIC LIMITED**<br><br>Imperial College London | BioPAD: Biosensors for Personalised Antimicrobial Dosing | £55,072<br><br>£44,919 | £38,550<br><br>£44,919 |
| **Project description - provided by applicants** | | | |
| There is a growing problem of antibiotic resistance. As well as researching new drugs, it is essential that we manage our current drugs effectively to be able to continue to treat infections and enable surgery. There is good evidence that many patients receive the wrong dose, and in any case individuals differ between one another and during the course of an episode of illness. We have developed a relatively painless blood-free method of measuring antibiotics just below the surface of the skin- the microneedle array. These devices can be used to control perfusion pumps or monitor a patient's individual response to antibiotics. The dose of drug can then be tweaked to obtain the most effective and safest dose. The next step is to develop methods for manufacturing large numbers of the microneedle array. This will speed up testing on healthy humans and ultimately enable incorporation of the sensors into systems for delivering individualised drug treatments in hospitals, clinics and in the community. | | | |

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| **CAMBRIDGE RESPIRATORY INNOVATIONS LIMITED** | Commercial Opportunities for Pulmonary Diagnosis (COPD) | £98,815 | £69,170 |

| Project description - provided by applicants |
| --- |
| Innovate UK has awarded a feasibility research grant to Cambridge Respiratory Innovations Limited, of Swavesey, Cambridgeshire. Currently a clinician needs to use a range of medical devices, from peak-flow meters through spirometers and pulse oximeters to scans and x-rays, to diagnose a respiratory condition. The most commonly used devices to diagnose asthma, COPD and other chronic respiratory diseases are spirometers and peak-flow meters. Both devices are difficult for patients to use, rely on forced expiratory manoeuvres, are technique dependent and measure a respiratory proxy. Adults in respiratory distress and children cannot use these devices. Cambridge Respiratory Innovations Limited (CRiL) has developed an innovative epitaxially-grown III-V LED-based CO2 sensor which is faster, more accurate and more consistent than any existing incandescent or florescent CO2 sensor. It is not affected by condensation in the breath and is a fraction of the cost. CRiL has developed it specifically to measure the CO2 waveform shape in normal tidal breathing to use in low-cost personal respiratory monitors. Tidal breathing CO2 (TBCO2) waveform shape analysis is an established but under-used biomarker for respiratory conditions. Whilst medical devices that measure exhaled CO2 (capnometers) are commonplace in the operating theatre, devices that measure tidal breathing CO2 are not used in any form of respiratory diagnosis at the moment. This project focuses on the research, development and adoption issues that the N-Tidal diagnostic concept will need to address and the likelihood of success in commercialisation in the primary and secondary care medical communities. The objectives of this project are to clarify the value proposition of the concept to help healthcare providers and other customers to understand the attractiveness of the N-Tidal diagnostic device. This includes determining: * patient and end user needs * the required changes to patient pathways * commissioning and procurement options * health economics * adoption drivers The main areas of focus of the research will be the users' needs, the value proposition, the health economics and the clinical evidence required for successful commercialisation. The primary output from this study will be a validated and fully-costed development plan. This commercialisation feasibility study will identify whether there are any commercial, economic or evidence impediments which hinder the adoption of the N-Tidal respiratory diagnostic device based on tidal breathing CO2 measurement. |

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| **M-SQUARED LASERS LIMITED** | Therapeutic Drug Monitoring in the Community | £99,746 | £59,848 |

**Project description - provided by applicants**

About 30-60% of drugs are administered without clinical benefits, amounting to around £393bn per annum wasted globally. Patients have inherently varied responses to drug concentrations influenced by genetic background, metabolism, adherence to treatment plans and drug--drug interactions. Therapeutic drug monitoring (TDM) is the measurement of the concentration of drugs in biological fluids at timed intervals in order to maintain a relatively constant concentration of the medication. TDM is used for drugs that have a narrow therapeutic window with severe consequences from toxicity by over dosing or from not reaching therapeutic levels by under dosing. Currently TDM analysis use time consuming, costly methods such as High Performance Liquid Chromatography that require specialised personnel and dedicated laboratories. Recently an optical spectroscopy method has been demonstrated to identify and quantify drugs and their metabolites down to nanomolar concentrations. The aim of this project is to develop a system to be used for TDM at the point of care. The system would be rapid, easily administered by non-experts, low cost and can be used any time of day, as often as needed.

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| **ADAPTIX LIMITED** | 3D orthopaedic imaging from a low cost, portable, low dose X-ray device | £99,478 | £69,635 |

**Project description - provided by applicants**

This project will deliver a proof of concept for a ground-breaking medical imaging system for hands and feet. Fractures of these are common but the current imaging methods are unsatisfactory. Standard X-rays only give a 2D view (i.e. a shadow) of these complex 3D joints and subtle fractures or problems can be missed. CT and MRI scanners produce 3D images but are expensive, time-consuming and often immovable, and CT scans involve a relatively high radiation dose. Our proposed product will provide 3D images from a low cost, low dose, portable device. No current device on the market offers this. Adaptix will achieve this by fundamentally changing how X-rays are made. Conventional X-ray tubes haven't changed significantly in a century whilst televisions have changed from CRT tubes to flat screens and bulbs from filaments to arrays of LEDs. Adaptix's innovative technology makes a similar technological leap for X-ray sources. Instead of a single, high-power source of X-rays, we use solid state technology to create an array of many emitters arranged in a lightweight flat panel with low power consumption. The panel illuminates the patient from a variety of angles so can use parallax information to derive 3D information (a technique called tomosynthesis), in the same way that having more than one eye gives us depth perception. This is done at a radiation dose much less than CT. This project will take Adaptix's core technology and refine its use for imaging hands and feet. This will involve modifying the X-ray source to optimize its performance for these and elaborating requirements and designs with orthopaedic doctors. These outputs will confirm that the technology is viable and that the product will meet the market needs.

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| **PLATINA BIOMEDICAL TECHNOLOGIES LIMITED** | Application of Clinical Biomarkers for the Development of Multimodal Imaging Agents | £97,422 | £68,195 |

| Project description - provided by applicants |
| --- |
| Incorrect assignment of cancer stage in advanced-cancer-patients is responsible for the incorrect choice of first-line cancer therapy leading to increased-mortality(1.5-2x) and lowered-survival (less than 12 months) in as-many-as 25% of all patients diagnosed with cancer in the UK. Contrast-enhanced MR and CT imaging are the most common imaging modalities for cancer imaging and staging across all treatment regimes. Current MR/CT imaging contrast imaging agents do not possess required specificity and sensitivity and therefore cannot distinguish between cancer sub-stages, resulting in an inaccurate and imprecise estimation of cancer stage. The project develops novel" i.e. patient-specific, MR/CT imaging-sensitive and side-effects-free imaging agents. The imaging agents are composed of multifunctional nanoparticles and cancer biomarker targeting ligands. The nanoparticles are biologically compatible and capable of optimizing contrast in MR and CT imaging. Most importantly, the nanoparticle agents specifically bind to cancer cells, therefore, are required in 4-10x lower dosage relative to existing MR/CT imaging contrast agents to optimize tumour contrast, thus causing minimum inconvenience and adverse effects in patients. The imaging agents will not only reduce the time and frequency of patient's clinical visits but also reduce the overall cost of cancer treatment by increasing overall cancer treatment efficacy by minimizing revision surgeries, imaging sessions and related-inefficiencies. Therefore the personalized imaging agents will promote sustainable healthcare by enabling cancer patient's access to adequate and cost-effective healthcare." |

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| **BOND DIGITAL HEALTH LTD** | A digital solution for patient-centred management of Chronic Obstructive Pulmonary Disease [METIS] | £97,976 | £68,583 |

| Project description - provided by applicants |
| --- |
| Chronic Obstructive Pulmonary Disease (COPD) is a common, progressively disabling disease characterised by airflow obstruction in the lung and commonly associated with smokers. The World Health Organisation (WHO) estimated that over 384 million people were affected worldwide in 2010, with 65 million people estimated to have moderate to severe disease. The economic burden of COPD is huge, costing £4bn p.a. to the UK alone. Bond Digital Health is developing a wearable technology called Metis, which integrates with the company's existing software developments, providing a digital solution to the white space" void that currently exists between patient visits with their doctor. This void can be a few days or as long as 6 months, during which the clinician has to rely on anecdotal evidence and at best, inaccurate paper diaries. These are often referred to by clinicians as "car park diaries" as that is where the information is often entered, moments before the consultation . Metis integrates hardware and software solutions to address this issue. The device provides "at a distance" listening to the patients' lungs and heart enabling their health care practitioner to monitor COPD sufferers released from care. It will equip the practitioner with independent, accurate analysis of the patient's data providing valuable, comprehensive insights and evidence-based care. Metis is essentially a digital stethoscope consisting of 1 to 5 patches which adhere to a patient's torso. These patches contain a processing chip, audio capture device and Bluetooth, allowing lung sounds to be collected and transmitted to a smart phone, which are then processed by a central analytical system and stored in a secure cloud database for clinicians to access 24/7\." |

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| **PHYSIOMICS PLC** | Prostate Cancer Chemotherapy Precision Dosing APP | £97,307 | £68,115 |
| **Project description - provided by applicants** | | | |
| Precision medicine heralds a new era of cancer care where each patient receives the right drug at the right dose and time specific to their needs. However, the practice of precision dosing is hampered by a lack of smart dosing algorithms. The choice of chemotherapy dose in the clinical practice is predominantly based on Body Surface Area (BSA) which is derived from a population based analysis. This can lead to under or over dosing a significant number of cancer patients; hence there is currently no reliable process for defining the optimal dosing regimen on an individual patient basis. Focusing on prostate cancer in this feasibility study, our goal is to develop a demonstrator for Precision Dosing within oncology. It will integrate a diverse range of drug, tumour and patient data curently monitored in curent clinical pratice in order to better design dosing regimen, optimise patient care path, and ultimately deliver improved cancer care. To achieve our goal we will integrate existing tools (clinical PK/PD efficacy and toxicity models) to build this novel predictive platform. Also in collaboration with the Oxford AHSN we will build a business plan for implementation within the NHS (Route to Market"). This will serve as a basis of a development plan to take forward the proposed Precision Dosing APP demonstrator into a fully commercial version." | | | |

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| **GLG PHARMA (UK) LTD** | Feasibility study for rapid and improved drug combination selection in paediatric brain tumours | £99,998 | £69,998 |

| Project description - provided by applicants |
| --- |
| GLG Pharma UK (GLG) has a technology portfolio applicable to the personalised treatment of brain tumours. GLG Pharma, LLC (US parent company) has a series of repurposed compounds and more than 50 patented new chemical entities (NCEs) that are STAT3 inhibitors. The exclusive licence for STAT3 inhibitors for brain tumour indications is being transferred to GLG in the UK. GLG's small molecule library targets inhibition of dysfunctional STAT3\. Its drug candidates are licensed from the Moffitt Cancer Center & Research Institute, Tampa, FL and optioned from the Dana Farber Cancer Institute in Boston, MA. The molecular target for the drug is dysfunctional constitutively activated STAT3 (p-STAT3), a signalling protein that is essential to cell growth. In diseased cells, dysfunctional STAT3 signalling leads to cells that multiply out of control. STAT3 inhibitors target the dysfunctional STAT3 signalling. GLG is working in the personalised medicine space for oncology. It has therefore added the application of genomics to better profile and rapidly identify responders to its STAT3 inhibitors, in weeks rather than months, potentially providing critically earlier interventions, particularly in paediatric brain tumours. The company is seeking to forge a new market in personalised cancer care through use of its proprietary human genome technology-driven tumour cell capture platform (Genomic-PDx") with its proprietary anticancer small molecule library. Patient derived tumour cells are screened _ex-vivo_ against this library to identify drug combinations (STAT3 inhibitor plus one or more anticancer therapies) most appropriate for the patient's tumour type, tumour heterogeneity, tumour genetics and somatic genetics, and in so doing, maximise therapeutic benefit. Genomics tools guide the process and provide metrics and companion diagnostics for standardisation and subsequent drug approvals. GLG considers every patient tumour as unique, requiring a unique treatment, in contrast to the relatively ineffective and old one-tumour/one-drug/one approval model. GLG's treatment will cover all the following tumours mentioned below that have constitutively activated STAT3 (p-STAT3), the target of GLG's STAT3 inhibitors: DIPG (diffuse intrinsic pontine glioma), High grade gliomas (HGG), Anaplastic Oligodendroglioma, Anaplastic Astrocytoma, Glioblastoma(GBM), Primary CNC Lymphoma, Medulloblastoma, Meningioma, Paediatric Ependymoma, Metastatic Brain Tumours, Metastatic Spine Tumours, Chordoma. Subject to tissue availability GLG aims initially to focus on DIPG. Other paediatric tumours could also be studied at the same time, again subject to tissue availability from the UK Children's Cancer and Leukaemia Group Tissue Bank, and will be followed by glioblastoma and other adult brain tumours." |

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| **ARETE MEDICAL TECHNOLOGIES LTD** | Business Feasibility and Strategy for Precision Respiratory Diagnostic Device | £97,480 | £68,236 |
| **Project description - provided by applicants** | | | |
| This feasibility study project is to understand and develop business strategies for an innovative diagnostic device for chronic respiratory diseases, such as asthma and COPD. We are developing our device to help doctors make precision medicine decisions. This will help people with respiratory diseases find effective treatments faster and more accurately. Improvements are expected to the overall cost, usability, and access for the device. With our software-driven approach, personalised medicine approaches to diseases like asthma and COPD become possible. By helping to personalise treatment decisions, quality of life, patient outcomes, and overall costs to the health system will be improved. This study will investigate different use cases and market opportunities for our device. We will develop our business and product development plans to meet clinical needs and grow our UK-based startup business. We will be engaging with patients, charities, doctors, academics, and other health-related professionals to understand their needs and values. | | | |

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| **TRANSFORMATIVE AI LIMITED** | CardioAI - Sudden Cardiac Arrest Prediction Feasibility | £98,328 | £68,829 |

**Project description - provided by applicants**

At Transformative AI, we are transforming the emergency medicine paradigm from rapid response to personalised preparation and prevention. Our proof-of-concept algorithm, CardioAI, analyses high-risk patients' telemetry data to predict when a patient is at imminent risk of a ventricular tachyarrhythmia, causing Sudden Cardiac Arrest (SCA). Our software then provides an alert, allowing healthcare providers to take proactive steps that will improve outcomes if and when SCA strikes. For example, preparing to defibrillate so that an electrical shock can be delivered immediately upon SCA onset. Avoiding delays in defibrillation prevents prolonged cessation of blood flow to the brain, thereby optimising the chance of neurologically intact survival. Following an alert, medical teams can focus on identifying and correcting reversible triggers of SCA, such as high potassium and low blood sugars. For some patients, such actions hold the power to prevent imminent arrhythmias from striking altogether, which would both save additional lives and further increase the cost-effectiveness of our technology. Research published in the New England Journal of Medicine showed that early defibrillation is strongly associated with improved outcomes. By solving the problem of delayed defibrillation alone, we could improve survival by 21 percent for in-hospital cardiac arrests, which translates to 5,000 lives per year in the UK.

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| **GOLD STANDARD PHANTOMS LIMITED** | Automatic calibration of quantitative imaging biomarkers for increased precision in prostate cancer detection | £99,779 | £69,845 |

| Project description - provided by applicants |
| --- |
| Prostate cancer is the **most common cancer** in men affecting 1/6 of all men. In 2013, over **47,000 men** were diagnosed with prostate cancer in the UK, with 90% of early detected disease not requiring any intervention. Currently, prostate cancer diagnostics can be localised, for the first time, using **advanced magnetic resonance imaging (MRI) methods**. This has enabled radiologists to start using MRI first before sending the patients to get a biopsy, therefore reducing healthcare costs. Yet the use of these specialised MRI methods is not accurate at 100% and **many patients need unnecessary biopsies**. In addition, there is a remaining risk for patients to be diagnosed too late at this current state. Therefore, there is an unmet need to **improve the consistency of diagnosis of patients using advanced MRI methods**, so that the medical guidelines used by the NHS, which currently promote active surveillance of such cases, could start advocating for such methods to be used to reassess disease over time, as even partial removal of the prostate is associated with devastating decrease in quality of life for most patients. Herein, we outline development of an automatic calibration software for standardisation of so-called diffusion imaging, the **most important tool** used for detection of early changes in prostate cancer. A feasibility study for the use of such a software will be undertaken concurrently with the in-house development of a new type of device specifically designed to be scanned together with the patient to guarantee **reproducibility of measured parameters** using MRI on the same scanner over time or interchangeably compared between scanners. We hope that such devices, dubbed Within Image Calibration Devices" (WICADs), will completely transform the way radiology is currently practiced and help establish **widespread deployment of advanced MRI techniques** towards automated or assisted diagnosis leading to improved treatment implementation on an individual patient basis. The choice of prostate cancer as a first implementation of our product is very important as a so-called precision medicine approach is already in use, which aims at operating on patients only when truly necessary, in order to improve **their quality of life**." |

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| **RELATIVE HEALTH LIMITED** | D-TWO-H: Dynamic Time Warping for the Optimisation of Hypertension | £97,902 | £68,531 |

| Project description - provided by applicants |
| --- |
| It is well recognized that ambulatory blood pressure (BP) monitoring by means of wearable sensors has the potential to enable new levels of health-related vigilance and medical care in a number of novel settings, including, for example, controlling chronic hypertension and monitoring in-patients during convalescence. However, a significant challenge to realizing true non-invasive blood pressure (NIBP) measurement remains the problem of accounting for the unknown tension in the underlying arterial wall: If one simply measures pressure external to an artery (for instance, on the overlying skin), one is measuring the balance of intra-arterial pressure and the rapidly varying arterial wall tension. Ideal NIBP methods solve the problem of estimating intra-arterial wall pressures independently of the arterial wall tension. Yet, there is no optimal solution to truly wearable NIBP measurement. The ideal wearable device would be lightweight, easy-to-apply, non-invasive, small, unobtrusive, and as close to imperceptible as a regular wrist-watch. The fundamental assumption in Machine Learning is that analytical solutions can be built by studying past data models. Machine Learning supports that kind of data analysis that learns from previous data models, trends, patterns, and builds automated, algorithmic systems based on that study. As Machine Learning relies solely on pre-built algorithms for making data-driven analysis and predictions, it claims to replace data analytics and prediction tasks carried out by humans. In Machine Learning, the algorithms have the capability to study and learn from past data, and then simulate the human decision-making process by using predictive analysis and decision trees. Dynamic Time Warping is a temporal operator Machine Learning Algorithm architecture that specialises in finding the optimal match between two given sequences (e.g. time series) with certain restrictions. The sequences are warped" non-linearly in the time dimension to determine a measure of their similarity independent of certain non-linear variations in the time dimension. This sequence alignment method is often used in time series classification. Although DTW measures a distance-like quantity between two given sequences, it doesn't guarantee the triangle inequality to hold. D-TWO-H looks to use a uniquely configured Machine Learning Algorithm to identify trends between optical sensor samples and thus develop a map of arterial performance which can thus allow a user to calculate a value for trending Blood Pressure. It is hoped that these works will enable the resolution of a continuous Blood Pressure as a metric that can be acquired by consumer health wearable devices." |

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