Irish Coronavirus Sequencing Consortium - Tracking the genetics of the COVID-19 virus in Ireland

Lead Researchers: Professor Paul Cotter, Teagasc and APC Microbiome Ireland
Funded by: Science Foundation Ireland, Enterprise Ireland and IDA Ireland
Funding amount: €378,716

In Summary

The virus that causes COVID-19, SARS-CoV-2, contains genetic information that can change over time. If we can 'read' those changes, we will have a better map of how the virus spreads across regions. Being able to determine the genetic makeup of the viruses circulating in Ireland will also support efforts to respond to clusters of infections as they arise and minimise the spread of the virus. Collecting the sequences of the viruses in Ireland will also mean we can pick up on important new changes that could affect the ability of the virus to cause disease or to evade treatments or vaccines.

SFI is to fund a National Coronavirus Sequencing Consortium that will read and analyse the genetic makeup of the SARS-CoV-2 virus in patient samples in Ireland. The data about the genetic sequences of the viruses will be freely available, allowing epidemiologists to monitor trends in Ireland and internationally, and to watch for for changes in the virus that could have an impact the development and delivery of treatments and vaccines.

The Problem

The virus that causes COVID-19 contains RNA that can change slightly over time. Unless we track those changes comprehensively in Ireland, we won't have a clear picture of how strains of the virus are spreading, nor will we be able to spot changes in the virus that could affect how it causes disease, or how we could develop treatments of vaccines against it.

The Project

SFI will fund a consortium led by the Teagasc/APC Microbiome Ireland Sequencing Centre at Moorepark with partners University College Cork, Cork University Hospital, the National Virus Reference Laboratory, University College Dublin, Beaumont hospital, Genomics Medicine Ireland, Trinity College Dublin/St James's Hospital, University of Limerick (UL)/University Hospital Limerick, the National University of Ireland, Galway and Maynooth University. This consortium will 'read' the RNA sequence of viruses isolated from samples of patients who have lab-confirmed infections of COVID-19 and make the sequence information freely available for analysis.

The Outcomes

We will know more about the genetic makeup of COVID-19 viruses circulating in Ireland

The information generated by the project will allow experts to monitor genetic changes in the virus and quickly spot developments that could affect human health and treatment or vaccination against COVID-19

Professor Paul Cotter, a Principal Investigator with APC Microbiome Ireland and VistaMilk, SFI Research Centres at Teagasc, says: "*The Irish Coronavirus Sequencing Consortium has been made possible due to the remarkable enthusiasm and commitment from very many clinicians and researchers across the country. By continuing to work together, we can provide key insights into viral spread and how it is evolving over time. I'd like to in particular thank my colleague, Dr Fiona Crispie, for her key role in establishing this Consortium*"

Equipment to make it easier and safer for patients with COVID-19 to breathe

Lead Researchers: Professor Martin O'Halloran and Professor John Laffey, NUI Galway
Funded by: Science Foundation Ireland, Enterprise Ireland and IDA Ireland
Funding amount: €205,667

In Summary

The virus that causes COVID-19 attacks the airways and lungs, which means that people who are ill with the virus can have trouble breathing.

There are pieces of equipment to help these patients, including machines to assist their breathing, and tubes to deliver a flow of oxygen into their nose. Because of COVID-19 though, such equipment is in short supply, and in the case of high-flow oxygen, it may put the attending healthcare workers at greater risk of being exposed to the virus.

A new project led by NUI Galway called INSPIRE will develop new and easy-to-manufacture equipment to help support patients with airway problems while minimising the risk to healthcare workers.

The Problem

Patients with COVID-19 who are severely ill often need help to breathe, but equipment to do this is in short supply, and some may increase the risk of the virus spreading to healthcare workers.

The Project

The INSPIRE project led by NUI Galway will develop a CPAP/BiPAP Hood that can help patients to breathe and that will be easy to manufacture and reuse, and comfortable for patients to use for long periods.

For patients receiving high-flow oxygen therapy, the project will also develop a vacuum-assisted face guard that will collect infectious droplets coming from the patient's nose or mouth during treatment, reducing the infection risk for healthcare workers.

The initiative will involve an interdisciplinary team of academic researchers, MedTech engineers, frontline healthcare professionals and industry working together to develop these technologies.

The Outcomes

- By developing breathing-support equipment that is easy to manufacture and safe to use for patients with COVID-19, the project will reduce risk of infection to front-line healthcare staff and may help reduce the demand on more invasive, mechanical ventilators for patients.

Dr Martin O'Halloran, Director of the Translational Medical Device Laboratory at NUI Galway, says:

“This project shows what can be achieved when industry, academia and the HSE come together with a common goal of saving lives during the COVID-19 crisis. Uniquely, the Inspire team is composed of several founders of Irish MedTech companies, a team of NUI Galway researchers, and clinicians and healthcare workers from UHG. The glue holding this diverse team together is a shared commitment to making a real and tangible impact on patient care.”

UCD to create a secure, reliable supply of critical reagents for COVID-19 testing

Lead Researchers: Professor Virginie Gautier, Professor Patrick Mallon, and Professor Gil Lee
Funded by: Science Foundation Ireland, Enterprise Ireland and IDA Ireland
Funding amount: € 540,263

In Summary

Testing people for COVID-19 infection helps to diagnose patients, who can then isolate and receive treatment as needed. High rates of testing across the country will also be key in enabling Ireland to safely navigate its way out of the pandemic. Sampling involves taking a sample from the back of the nose and throat with a swab, and put that sample through a lab test (PCR) to see if the virus is present. However, testing has been disrupted by an unreliable supply of the high-quality reagents, solutions and chemicals needed. With SFI funding, a project led by University College Dublin will develop and supply necessary reagents and materials for SARS-cov-2 testing to hospitals in the Ireland East Hospital Group. The local and reliable supply will help enable the country to meet its testing requirements and will provide important information for clinicians, planners and policy-makers.

The Problem

To detect the SARS-CoV-2 virus, which causes COVID-19 infection, a very small number of RNA viral genomes must be isolated from the nasal swab. This is a stereotypical needle in the haystack problem where there are a very small number of viruses in among tens of thousands of much larger cells. The key is to use magnetic nanoparticles to capture the RNA from the complicated soup that makes up the virus lysate, which includes proteins, lipids and other cellular components, and then use a powerful magnet to move and thus separate the magnetic nanoparticles. This allows a series of solutions to be used to rinse the RNA-nanoparticle complex and then release the RNA it into a buffer that can be used for reverse transcription and quantitative detection with the polymerase chain reaction (PCR).

The Project

A project led by a multi-disciplinary team of infectious disease clinician, molecular virologist and nanotechnologists at University College Dublin. Using test samples from patients enrolled in the All Ireland Infectious Diseases Cohort, we will test and make key reagents and supply them to the Ireland East Hospital Group, to ensure a timely and adequate supply of in vitro diagnostics. That will include Lysis buffer, which inactivates and bursts open the virus, superparamagnetic nanoparticles, rare-earth magnet arrays, and specific ‘probes’ to detect virus RNA.

The Outcomes

- Making reagents and materials “in-house” for SARS-CoV-2 virus testing will provide a secure and local supply for the Ireland East Hospital Group.
- The project will immediately provide reagents and materials to enable 40,000 tests for COVID-19 infection to hospitals in the East of Ireland.

- Over time, the project will develop the capacity to deliver reagents and materials to enable 15,000 tests per day.

Professor Gil Lee, Stokes Full Professor of Physical Chemistry at UCD, says:

"There are two types of tests that can be used to detect the virus that causes COVID-19. The rapid antibody tests have been available to the public and are used to confirm the symptoms of the disease. Nucleic acid (NA) tests have only been used in hospitals up to this time. The NA test is the gold standard because it allows the virus to be detected more reliably and in individuals who do not show symptoms, so called, Super Carriers.

"This award will allow a world-class, multi-disciplinary team of biomedical researchers to develop a local source of nanoparticles, buffers and advanced magnet separation devices to ensure that the RNA genome of the SARS-CoV-2 virus can be isolated and detected to support the Irish healthcare system. Unlike the systems currently in place in Ireland, this system is not automated which means that it is more flexible and not tied to a specific piece of plastic or reagent. It will allow teams of clinical scientists to provide up to 15% of Ireland's NA diagnostics.

"We would like to thank the SFI for their generous support for this work and their vision to support basic research in our laboratories over the last 10 years. We would also like to thank Amgen Ireland, Alpha Precision, and Magnostics for making it possible for us to rapidly prototype the V-REK system."

A data platform for emergency services and managing COVID-19

Lead Researchers: Professor Tim McCarthy, Maynooth University
Funded by: Science Foundation Ireland, Enterprise Ireland and IDA Ireland
Funding amount: €402,323

In Summary

Emergency services need timely and relevant data to respond to crises, including the COVID-19 pandemic. A Science Foundation Ireland-funded project led by Maynooth University will use information from satellites, drones and other sources to derive activity metrics relating to human movement and interaction in public-spaces. The platform will be developed ethically to protect data privacy and ensure GDPR compliance, and it will be designed to used to reduce risk, promote safety and minimise spread of COVID-9 infection.

The Problem

COVID-19 infections can spread between humans who are in close contact, so Ireland has brought in physical and social distancing measures to protect public health. Failing to adhere to those measures could result in more widespread infection, suffering and death from COVID-19

The Project

A project led by Maynooth University will establish a drone co-ordination and operations centre, and will develop a platform to collate and analyse data from diverse sources relating to human activity. The system will be able to detect where activities could potentially pose a risk to public health relating to the spread of COVID-19 and inform emergency services.

The Outcomes

The decision-support data platform developed in this project will help central government agencies, local authorities and organisations to manage general movement, social distancing and human-interactions in cities, towns and public spaces

Dr Tim McCarthy, an Associate Professor at the Department of Computer Science in Maynooth University, says: “The overall aim here is to research and adapt latest Robotics and Machine Learning techniques to devise a set of geospatial metrics on how public amenity sites are used in order to support Local Authorities and Government Agencies in loosening-up Covid-19 social-distancing restrictions and help kick-start the gradual, responsible return to normal every day life.”

Finding the signals to quickly identify patients at risk of severe disease in COVID-19

Lead Researchers: Dr. Ignacio Martin-Loeches, Trinity College Dublin
Funded by: Science Foundation Ireland, Enterprise Ireland and IDA Ireland
Funding amount: €192,566

In Summary

When someone is infected with the virus that causes COVID-19, it can sometimes result in severe illness. Being able to tell quickly who is at risk of becoming very sick with the virus would mean that those patients could be quickly prioritised for treatment.

A study led by Trinity College Dublin will analyse samples from patients infected with the COVID-19 virus and measure aspects of their immune responses. By comparing these responses to the level of illness that the patients develop, the researchers will identify immune 'signatures' in patients that could signal a higher risk of becoming very sick with COVID-19. The project will also help us to better understand how our immune systems respond to the virus and will thereby inform potentially better ways to treat the disease and develop strategies for immunity.

The Problem

Some patients become very sick when they infected with the COVID-19 virus, and this can lead to severe injury to the body and death. We don't know how to identify these patients early so they can get the appropriate level of medical attention quickly. We also don't know how their immune response is involved in more severe illness.

The Project

The project, led by Trinity College Dublin, will look at various molecular signals and antibodies in samples from patients who have been infected with the COVID-19 virus, and see how those molecular signals relate to the severity of disease and symptoms that the patients have. This will allow them to identify the early molecular signals associated with more severe symptoms, and to see if there is a link between symptoms and the levels of antibody a person produces to the virus.

The Outcomes

By understanding more about how the immune system responds to in infection with the COVID-19 virus, we will know more about how that response could cause more severe symptoms and this will help inform ways to intervene

By figuring out the early molecular markers that suggest a patient is at high risk of developing severe disease in COVID0-19, clinicians should be able to quickly identify at-risk patients while they are in the early stages of infection prioritise them for more intensive medical care. This will help to reduce the numbers of patients experiencing severe forms of the disease

Getting better picture of the antibodies that patients with differing levels of disease produce will help to inform strategies to build immunity in the population at large

Dr. Ignacio Martin-Loeches, Vice-Chair of Intensive Care Medicine at Trinity College Dublin, says "*I am very grateful for SFI to have funded a clinical Doctor working in the first line to understand the disease better with cutting edge technology*."