Impact Through Collaboration – problem solving by accessing knowledge from other domains.

The Irish Centre for High-End Computing (ICHEC) and The Biomedical Diagnostic institute (BDI) came together to solve a technology roadblock in interpreting new data derived from an advanced diagnostic for platelet function. Platelets are blood particles that clump together and cause heart attacks. The BDI device uses a sophisticated imaging and computer platform to measure how platelets behave in a system that mimics a damaged artery. The BDI investigators needed to know how to interpret that data to define when platelets were "sticky" and thus an individual was at increased risk of a heart attack. Professor Dermot Kenny (RCSI) leads the research programme, Functional Diagnostics in Platelet Biology, in the Biomedical Diagnostics Institute (BDI). He is a cardiologist and expert in thrombosis (the formation of blood clots). He approached ICHEC to address this challenge.

As providers of Platform technologies, ICHEC both facilitates and participates in many research activities. The active involvement of ICHEC staff in scientific research is particularly important in bridging the gap between increasingly-complex numerical and ICT techniques, and researchers from different communities.

In association with Prof. Kenny and researchers from the BDI in DCU, ICHEC automated and optimised a time-consuming, manual analysis pipeline in the operation of a prototype medical device.

The device measures the '*stickiness*' of platelets which varies among healthy individuals and is increased in patients with cardiovascular disease. This stickiness can be reduced by medications such as aspirin, but there are no tests on the market that define platelet stickiness accurately. Using this device, time consuming conventional diagnostics that give very little clinically relevant information have been superseded by new high speed data generated to profile platelet behaviour that is indicative of an increased risk profile for cardiovascular disease.

ICHEC used their experience in astrophysics, where an algorithm had been previously developed to pick out and identify galaxies (shapes) against a background of stars (single points) in telescope images. They applied this to pick out platelet aggregation (shapes) against a background of single platelets (single points) and thus measure the extent of platelet aggregation in blood flow.

ICHEC also leveraged its data analytics expertise and introduced machine learning techniques, previously used for demand forecasting and fraud detection, into the diagnostics pipeline. The work has greatly improved the diagnostics capability of the prototype medical device and demonstrates the benefits of an effective cross-disciplinary collaboration.

TIP

The value to your work of knowledge and expertise from other fields can be considerable. You need to find the right people and this case shows the value of organisations and centres which contain a wide range of experience and expertise in technology solutions.

TIP

'The language of clinicians, engineers, scientists, computer experts etc is fundamentally a different language. After two years working with ICHEC we are starting to understand their language and vice versa. If these linguistic differences are not overcome the probability of any translational research being effective is very low. It is only by working together on a research project that this occurs' – Prof Dermot Kenny, RCSI.

Apart from enhancing diagnostics capability, ICHEC also optimised and automated a labour-intensive and error-prone computer analysis protocol as part of its collaboration. It developed a platform that enables the device operator to easily upload the raw data acquired by the medical device and obtain the key analytical results in a few minutes per experiment, rather than hours or days it took previously in batches. Another advantage of this technology is it has enabled the prototype medical device to be deployed at multiple physical locations by centralising the analysis on an ICHEC-hosted server. This has ensured consistency and standardisation of the protocol, which has also assisted in the calibration of equipment at different sites.

The workflow optimisation and automation work has enabled the trial of the prototype medical device on a much larger sample of donors/patients with greatly reduced turn-around time to results. The efficient, centralised analysis was a key factor in the roll-out of the device to a new site, the clinical research centre of the Royal College of Surgeons in Ireland. At present the device is being used to test samples from a range of patients both with and at risk for cardiovascular disease. The collaborative research of BDI and ICHEC has made a giant stride in progressing a medical device from a laboratory prototype to its usage in near patient care and developing a novel clinically relevant diagnostic device.

IMPACT: The impacts from this research and collaboration are far reaching. The development of the technology, borrowing ideas from fields such as astrophysics and machine learning, to its application in the prevention of heart attacks and strokes has clearly improved an existing device currently in use. Testing of the device is on-going but it has the potential to revolutionise this diagnostic in the health industry through radically faster turn-around time on patient results and its near patient care use.