



# CHIC

Northern Ireland Connected  
Health Innovation Centre

## 20 / 21

## Highlights of the year

### PUBLICATIONS

**14** academic publications

### COMPANIES

**34** member companies

### PROJECTS

**14** active industry-led projects  
& **2** pre-projects

### EVENTS

**2** key events  
in collaboration with HSC

**75%** of projects completed this year have progressed to licencing or further projects  
(some funded externally)

### SPEND

**£671,462** total project spend in year

### HOURS

**15,500** research hours

# Welcome

**Our health systems, businesses and society have undergone a dramatic and rapid transformation since the COVID-19 pandemic took hold in early 2020. The healthcare sector responded at pace, with some services being transformed more in the last 12 months than in the last decade. This CHIC 2020-21 Annual Report provides an overview of how, through our ability to be agile and flexible, we were able to realign our work and resources and adapt so that we could contribute to, support and in some instances, lead activity as part of the pandemic response.**

The COVID-19 pandemic has brought physical and mental suffering to many members of our community and everyone has been affected in some way. The collective response has been a shining light in what otherwise is a very dark outlook and particularly in the areas of connected health and innovation we have seen amazing responses and developments. Key emerging trends include:

- Wholesale refactoring of primary care delivery including the **adoption of telehealth**. Through the use of virtual digital visits with clinicians, remote condition monitoring and increased community use of wearables and rapid testing and diagnostics many people have continued to receive exceptional levels of care.
- Increased **awareness of the ageing sector** of our community, both in care homes and their own home when dealing with things like social isolation, mobility and fragility.
- Exponential rise in **collaboration, cooperation and innovation** across society sectors to meet the challenges of COVID-19 head on – be it pivoting to PPE manufacture, developing ventilators or testing vaccine usability.
- Highlight of the **importance of health data** – from the original John Hopkins global tracking of COVID spread, to localised modelling of each intervention and relaxation of restrictions.

Many of these themes have been subjects of the CHIC research strategy and it is clear that these will continue to be of importance. National and global opportunities arising out of COVID-19 have led to strong venture capital investments, mergers and acquisitions and government expenditure in the sector.

This report summarises and highlights CHIC activities and performance over the year July 2020 – June 2021. Despite restrictions project numbers and spend have risen this year, global benchmarking continues to be strong and a number of key projects which concluded this year have led directly to the next stage of commercialisation.

**David Branagh**  
Centre Director



# CHIC – Transforming Healthcare through Business Research

Connected health technologies are part of the answer to increasing the quality of life for aging populations and reducing healthcare costs. The NI Connected Health Innovation Centre (CHIC) was formed in 2013 to create business-led research focused on the Connected Health market. We promote economic growth by bringing together universities, research institutes and innovative businesses to carry out strategic collaborative research in areas with a direct industrial focus. CHIC is open to any company based in Northern Ireland or internationally, that wants to collaborate in applied research relevant to them at a reduced cost.

## The Strategic Objectives of CHIC research are:

- To deliver impact - though transforming healthcare, improving patient outcomes and facilitating healthy aging
- To deliver economic benefit for our member companies and the region
- To engage local industry in collaborative academic research and extend capabilities of local companies and researchers
- To advance the published knowledge-base on connected health research
- To pave the way for a self-sustaining CHIC operating model
- To develop a collection of research outputs which can be easily deployed / commercialised

## Research guiding principles:

- Alignment with global research themes including sustainable development goals.
- Alignment with local member industry need (both existing and future spin-outs)
- Clear healthcare and technology alignment and strong potential for significant impact
- Alignment with existing CHIC research capability and expertise

## CHIC Research Subjects:

### A) Research Themes

Health where we live (Smart Living)  
Point of care and self-care technologies (Medical Sensors & Diagnostics)  
Cross cutting themes of connectivity, analytics, AI (ML) and Living Lab

### B) Areas of Research Excellence – Medical Sensors, Internet of (Medical) Things, Living Lab, Data Analytics and Behavioural Science

### C) Research agenda Impact Domains - Cardiovascular Disease, Community Based Health Care and Smart Ageing.

CHIC research builds the scientific foundation for the commercial development of health improvements. CHIC is a research-rich environment where excellent research is produced and where excellent care and associated business models are developed from CHIC research.

# Air quality monitoring can improve respiratory outcomes

Monitoring air quality can aid the self-management of respiratory conditions

Air quality has become a major factor in people suffering from respiratory conditions and finding ways to manage this is critical. Accounting for the most emergency admissions for children in Northern Ireland under the age of 6, asthma care costs the UK health service at least £1.1 billion per year according to Asthma UK.

By identifying the contributors to medical issues and the impact of air quality on people, money that has been traditionally spent treating respiratory issues will be reduced.



This project was designed to develop and trial an app solution to monitor air quality for self-management of respiratory conditions. In a society that regularly uses health monitoring devices, people could monitor vital signs that are impacting their respiratory health negatively.

By using the app as a digital health diary, not only is the air quality assessed by peers, but automated interventions will prompt individuals to make immediate and long-term lifestyle changes which will ultimately benefit their health. Participants can record:

- Their symptoms
- Their perceived health changes
- Their medication adherence like using an inhaler to help with their asthma.

With this data, recommendations can be made to whether additional sensors are needed and will be able to broadcast the gathered data around perceived air quality to other users who may be suffering from respiratory conditions.

This technology ensures that those who want to self-manage their respiratory condition are given the tools to do so and reduces pressure on the overstretched health services in Northern Ireland.

**Dr Colm Hayden, the CTO of Anaeko, believes that membership to CHIC allows companies to “develop new digital technologies that transform patient care” which encourages economic growth within Northern Ireland.**





# Low-cost home tests could prevent hospitalisations

Using quantitative lateral flow devices for diagnosis of respiratory illnesses.

Chronic Obstructive Pulmonary Disease, otherwise known as COPD, is the third leading cause of death in 2020 throughout the globe. With respiratory issues on the rise, the forecast shows that its growth has reached 4% annually.

Several respiratory diseases, from COPD to Cystic Fibrosis all are accompanied by Neutrophil Elastase (NE) activity. NE is an informative biomarker to monitor respiratory disease activity as it is one of the leading causes of lung tissue damage. This predictor of loss of lung function causes patients to have repeated cycles of inflammation and infection.



Current technologies do not accurately measure the severity of the respiratory disease so this project focused for the development of a highly specific quantitative Lateral Flow Device for Neutrophil Elastase.

It is important to highlight that the ProteaseTag<sup>®</sup> detects the active form of a protease. The development of this quantitative NE Lateral Flow Device will uniquely inform the respiratory consultants on the active, latent, degraded or inhibited forms of the enzyme. According to respiratory consultants the following can then be recommended:

- Important information alongside lung function data
- Extent of the lungs' exacerbation
- An accurate prescription of medication.

With hospitalisation costs of between £3,000 to £20,000 per exacerbation, the use of the quantitative NEATstik<sup>®</sup> to monitor patients from the comfort of their homes allows for early diagnosis and intervention, and significantly reduced costs.

According to Dr David Ribeiro, CEO of ProAxis, "This exciting collaboration [with CHIC] will support the further development of NEATstik<sup>®</sup>". This will identify people at future risk of exacerbation from their conditions taking strain off the health service and saving money in an area that is fiscally demanding.



# Solving non-human health problems can lead to rapid human innovation

Developing an Equine Health and Fitness Monitoring System.

In elite equine events where the margins for success are so fine, trainers and riders looking for top level performances need no longer rely on talent, ability or gut instinct alone. Top level performances need to be strategically engineered but this is almost impossible due to a lack of real-time feedback from the horse and waning knowledge and skillset from staff. This lack of knowledge has led to 45% of horses being injured in training.

Current products that are designed to retain data do not offer any prescriptive or analysed feedback – just raw data which cannot be interpreted. Traditional tools like vet visits, whiteboards, excel spreadsheets, and notebooks are often used which don't empower the trainer or the horse as individual performance development cannot be analysed.

Developing technologies for non-humans could lead to rapid innovation in human treatment. By analysis of horse performance, this could be used by elite athletes in the future to monitor their health and improve their performance.



This project created a tendon boot which acted as a sensor, sending data collected to the cloud for analysis and interpretation which will determine the fitness and wellbeing of the horse. Creating this tendon boot has led to an innovative and intuitive sports platform – Stable Innovations tendon boot optimises the fitness of equine athletes by providing their trainers and/or riders with a structured tool engineered for relaying the following information:

· Health · Ability · Performance

This leads to rapid development in maintaining horses' health with faster detection of sub-clinical lameness occurring. With data, faster clinical decisions can be made as there is a clear history for each horse's health.

Not only are there benefits for the horse, but there will also be economic benefits. With equestrianism totaling €1.05 billion for Ireland alone, this technology will create more employment and higher incomes for trainers as they are winning more frequently.

This will also translate into job creation in the Equine industry as Equine Data scientists are sought after to interpret the data. Animal models have often been used to prototype and test new diagnostics and this could translate into technologies for humans in the future.



# Remote Detection of Mastitis via NIR techniques

Development of a Mastitis test by the measurement of analytes in liquids using Near Infra-Red Spectroscopy.

Mastitis is the inflammation of the mammary gland and udder tissue and is a major endemic disease of dairy cattle. There are 264 million milking cows in the world, all of whom can develop mastitis. Between 25% and 50% of these cows develop mastitis annually. Producing nearly 600 million tonnes of milk every year, mastitis can affect the quality of the milk.

It is the costliest disease in the dairy industry as it reduces milk production. Costing the global dairy industry between \$19.7 and \$32 billion US dollars per year, using technology to recognise cows with mastitis could not only improve profit margins but also help with the standard of the milk. Through solving non-human health issues, human health is also improved. This is through better quality milk – rich in calcium and other minerals that promote a healthy lifestyle.



This project introduced the use of a NIR spectroscopy device to detect mastitis. Otherwise known as Near-infrared spectroscopy, it is a spectroscopic method that uses the near-infrared region of the electromagnetic spectrum. Used in medical and physiological diagnostics as well as research, it has been found to detect differences in milk with and without mastitis.

Using NIR spectroscopy devices allows for mastitis to be detected quickly. NIR signatures are found in the fat, lactose, and protein of cow's milk, and it is then possible to determine the composition of milk. This easy-to-use device can be linked to the dairy computer systems to ensure that farmers are given all the information they require to produce good quality milk.

Not only does this benefit farmers in delivering good quality milk, but it also ensures that the general public are receiving nutrient rich dairy products which have massive health benefits. This technology can also have human impact as it could lead to further developments in understanding and diagnosing infection properly and swiftly in human cases.



# Digital interventions for elderly care

Event correlation and ADL analysis to enable pro-active care of the elderly.

Through the Coronavirus pandemic, elderly and other vulnerable people have found themselves shielding from external contacts as much as possible. With an ageing population who suffer from multiple chronic conditions, there is mounted pressure on the health system to cater to issues suffered by the elderly.

With most people to remain in their communities and homes for as long as possible technology can facilitate this to make it easier for those to access care. Offering a technology or digital health innovation that could disrupt the current market in Homecare and Supported Living could offer a highly quantifiable and cost-effective solution which improves the outcomes for patients in general.

Kraydel

RFproximity

PulseAI

After many years of reactive action, care is slowly moving towards preventative action meaning that reliable information and trends on patient's physical and mental wellbeing is essential. Working with project partners, the project focused on building systems that convert data from sensors around the home to garner this information.

Using sensors to monitor a person's Activities of Daily living (ADL), problems can be identified immediately and deviations will be noticed from an individual's normal habits or routine.

The sensor data can be used to indicate opportunities for proactive care. Machine Learning (ML) tools can be applied to the accumulated ADL combined with other data, so that trends in behaviour, and deviations from norms can be identified.

Significant impacts for elderly and vulnerable people include reducing risk and care costs. These benefits will not only help those who require care but will also increase confidence of loved ones and carers, who will be able to see problems and deal with them accordingly.



Impact Study 6

# The power of data in speeding a post-COVID return to health

Healthy Kidz data analytics service for promoting physical activity in children.

Due to COVID-19, there has been an increased level of inactivity in homes across the country. Research has also shown that low-income families have to travel relatively long distances, often on foot, to reach shops that sell nutritious food.

Now coupled with inactivity, low-income households are at significantly increased risk from obesity and associated metabolic diseases such as diabetes and non-alcoholic fatty liver disease.

Evidence shows that sleep and moderate-to-vigorous physical activity are associated with improving risk for chronic diseases. More recently, light physical activity which simply consists of the activities of daily living has also been shown to have a positive effect on health.



This project focused on increasing physical activity in school aged children through the development of an app with Healthy Kidz. The Healthy Kids app tackles inactivity, providing personalised interventions to promote physical activity and well-being, and to accurately monitor user engagement.

Developed by teachers and coaches who recognised the need for a physical activity intervention within their school population, their goal to get children moving will ultimately lead to lowering obesity and conditions associated with inactivity.

Through creating an automated and personalised physical activity intervention, this data will not only be accessible to the child, but it will be able to inform parents, caregivers, and teachers of the child's engagement and progress.

While using it, there were significant improvements in fitness tests from baseline to post-intervention. Results from the app also show that all fitness measures were statistically significant, and the intervention was equally effective across different schools and in both boys and girls.

**Chris Cousens, Technical Manager from Healthy Kidz and project manager, believes "This exciting collaboration will support the further development of Ed – Tech solutions to promote and increase physical activity for our pupils." This also ensures that obesity-led conditions are reduced which, in turn, takes pressure off an overstretched health service.**

Kevin Creery, CEO Healthy Kidz, believes that, with CHIC's support, they were able to "move further from a lifestyle company to an ED-Tech company and decided to start a new company called Healthy Habits Technology CIC and we would continue to develop our technology."



# CHIC Projects

During this year there were 2 open calls for projects.

**8 potential projects were identified and 8 were approved.**

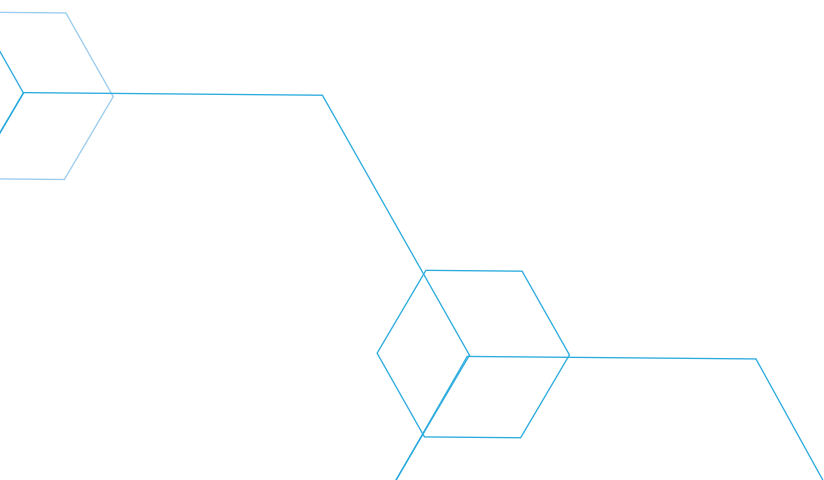
Project	Research Project Name	Collaborating Companies:	Project Budget	Status
10.5*†	Elder Social Engagement Gamification/Nudging	Kraydel Ltd, Liopa, S2ack	£135k	Ongoing
11.1*†	Tissue Classification Methods Review	Cirdan, Causeway Sensors, Direct Conversion	£34k	Complete
11.2*†	Unobtrusive technology for agitation falls and life sign	Lava, it+, CMASS	£214k	Ongoing
11.3*†	Quantitative Lateral Flow Device for Respiratory Illness	ProAxis, Causeway Sensors, CMASS	£192k	Complete
11.4*†	Monitoring air quality for the self-management of respiratory conditions.	Anaeko, Dozen Deal, Well Air	£57k	Complete
11.5*	Equine Health and Fitness Monitoring System	Stable Innovations, Bourne Development, 221 e	£196k	Ongoing
12.1	Event correlation and ADL analysis to enable pro-active care of the elderly	Kraydel, RF Proximity, PulseAI	£181k	Ongoing
12.2*	Development of a Mastitis test by the measurement of analytes in liquids using Near Infra-Red Spectroscopy.	CIGA Healthcare, CMASS, Healthcare Analytics	£110k	Ongoing
12.3	Development of a flexible, low-cost wearable ECG patch for remote cardiac monitoring	Pulse AI, S2ack, Cirdan Imaging	£91k	Ongoing
12.4	Optical reader for plasmonic sensor chip	Causeway Sensors, Cirdan Imaging, CMASS	£124k	Ongoing
12.5*	Data Analysis for Telemetric Sensing in Lower Limb Prostheses	Bioflex Yarns, PST Sensors, Healthcare Analytics	£80k	Ongoing
13.1*	Data Analytics Service for Promote Physical Activity in Children	Healthy Kidz Healthcare Analytics, Health Union Technologies.	£129k	Ongoing
13.2	Hyperspectral (HS) Imaging of Breast Specimens	Cirdan Imaging, Causeway Sensors, Anaeko	£91k	Ongoing
13.3	Machine Learning enhanced diagnosis of Respiratory Illness	ProAxis, Healthcare Analytics, Health Union Technologies	£160k	Ongoing
FF/P	CHIC2 Future Funding and Platform work	Programme Committee Approved work.	£400k	Ongoing

**Key** | \* projects running in this period based on early market opportunities † partnering opportunities with health/government providers

	Research Project Name	Collaborating Companies:	Project Outputs/ publications / Intellectual Assets	Next steps
10.5	Elder Social Engagement Gamification/Nudging	Kraydel Ltd, Liopa, s2ack	Software to calculate metrics and present visualisations of system user interactions in a web-based system. Software to obtain feedback on designs to encourage users to have more social contact	commercial evaluation licence
11.1	Tissue Classification Methods Review	Cirdan, Causeway Sensors, Direct Conversion	In-depth literature review reviewing and analysing methods with potential use for Breast Tissue Classification for Improved Cancer Diagnosis.	led to a follow-on CHIC project
11.3	Quantitative Lateral Flow Device for Respiratory Illness	ProAxis, Causeway Sensors, CMASS	Original electronic reader to analyse a respiratory lateral flow device and produce a digital reading.	subject of a grant for R&D proposal
11.4	Monitoring air quality for the self-management of respiratory conditions.	Anaeko, Dozen Deal, Well Air	Air quality self-monitoring mobile app. Platform for recording data form the mobile app. Database of participant records. Data correlations and insight.	-

## Finance and Key Performance Indicators 20/21

	Budget / target 2020/21	2020/21	2019/20	Note/commentary
<b>Project value delivered</b>	£1,387,722	£852,395 (£671,462 + £180,933)	£615,221 (£583,407+ £31,814)	'delivered' = researcher spend + recorded in-kind contributions from industry
<b>Industry cash contribution</b>	£49,036	£38,248	£ 30,375	Through membership fees and project cash contribution
<b>Industry in-kind contribution</b>	25% of project value (i.e. for a budget of £1,387,722 this equates to £346,930k)	21% (£180,933) in year, with resultant 16% to date over 2019/21.	7% (£31,814) in year	
<b>Leveraged funding</b>	£299,828 (£844,330 over the 3 years of CHIC2)	£170,854	£ 861,116	3-year total target exceeded
<b>Number of projects</b>	5	15 projects running	7 projects running	
<b>Research staff (FTE)</b>	n/a	on average 9.1 FTE researchers over the last 12 months, and 92% utilisation rate for industry-led projects.	on average 5.7 FTE researchers over the last 12 months, and 81% utilisation rate for industry-led projects.	
<b>Academic publications</b>	Minimum of 3 joint academic / business publications	14 CHIC-related publications in this period.	15 CHIC-related publications in this period. 1 with explicit co-authorship of industry partners.	





## Intellectual Property and further Commercialisation

Four projects concluded in the year July 2020 – June 2021. Of these one is subject to commercial evaluation licence, one has led on to another project moving towards commercial development, one is subject of a grant for R&D proposal.

A significant options identification exercise was undertaken during the year to capture any licencing interest and confirm IP position.

## People

The strength of CHIC lies in its core body of academic researchers led by Prof Jim McLaughlin and Prof Chris Nugent. These respected researchers are located in the schools of Computing and Engineering and possess an astounding depth and range of skills. Over the past year one of the CHIC researchers has taken up additional teaching responsibilities as a lecturer and several new researchers have joined CHIC on a full-time basis. We continue to draw from a wide pool of expertise in the related academic faculties as required.

The number of researchers employed by CHIC to undertake project activities was on average 9.1 FTE researchers over the last 12 months, and 92% utilisation rate for industry-led projects. The core staff of Centre Director, Sustainability and Business Engagement Manager and Centre Administrator lead, co-ordinate and support the research projects and centre development.

Four PhD candidates commenced their research in the past year supported by CHIC. Two candidates are situated in Ulster University and two at Queens University Belfast, one example of the cross-institutional collaboration of CHIC.


This year marked the end of the term of office of the chair of CHIC Dr Sinclair Stockman having held the office for over 5 years. Through this time Dr Stockman presided over the CHIC phase 2 successful funding, and the embryonic stages of Centre for Digital Healthcare Technology and we record heartfelt thanks to him.

## CHIC Governance

Four scheduled **Programme Committee** meetings were held during this period. Industry participation was high and several new members were welcomed onto the Programme Committee.

The **Intellectual Property Management Group** met during this period to further develop the IP identification and licencing processes in place at CHIC.

The newly formed **International Advisory Group** held an orientation meeting and the first full meeting spanning 3 equi-distant timezones.



# Centre Benchmarking

Annually CHIC carries out a benchmarking activity against other similar institutions along 3 comparators:

(1) Academic Output, (2) Commercial Relevance, and (3) Health and Clinical Impact.

<b>Academic Output Comparator</b>	Comparison of the level of academic outputs such as patents, publications and academic impact.
<b>Commercial Relevance Comparator</b>	Comparison of the level of engagement, growth of SME's, ability to support new start-ups and engagement with Larger Companies
<b>Health and Clinical Impact Comparator</b>	Comparison of the relevance to healthcare improvement and the ability to accelerate access to Healthcare for the exploration and adoption of new technologies.

The June 2021 comparison showed that CHIC is one of the top two institutions for all measures except for "patients impacted per 100 million £". This corresponds to high performance in both the academic output and industry relevance comparators.

Additional focus on health impact and the measurement / recording of the impact was agreed to expand the CHIC excellence performance across all comparators.

## Conclusion and Outlook

The second year of the CHIC extension (July 2020-June 2021) covered in this report represents a strong progression of industry-led research in the connected health arena at a time when in the impact of the COVID-19 global pandemic has rapidly progressed the uptake of connected health solutions. The suspension of face-to-face research and restrictions on accessing some equipment has had only a minor impact to CHIC projects.

Collaborative projects conducted in this year demonstrate a strong pipeline of research for Northern Ireland companies and cutting-edge research at Ulster University and Queens University Belfast. The PhD enabler scheme, although delayed, will start to drive and inform future projects in the coming years. As more of the current projects complete, we will see more intellectual asset identification and technology transfer agreements into industry to utilise and commercialise the project outputs.

# CHIC Partner Companies



LittleFox



Trackars  
Healthcare





Invest   
Northern  
Ireland

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