SCSP Innovation Fund Case Study

Mari-One

Summary

The purpose of this initiative was to illustrate how smart health monitoring solutions powered by advanced data transport techniques using 5G connectivity could inform and enable local authorities to deliver more targeted digital care solutions in the future whilst managing budgets more effectively.

Mari-One Limited (M-O) implemented an Integrated Digital Care Solution for this pioneering initiative, leveraging medical grade biometric sensors, data aggregation techniques, available 5G connectivity and remote monitoring to focus on the identification of advancing frailty levels in social and adult care communities in North Lanarkshire both inside and outside the home.

This innovative solution supports and promotes the opportunity to extend independent living, allowing residents to monitor or be monitored for vital sign changes whilst going about their daily activities. The M-O solution underscores that by adopting advanced wireless technologies into Smart Care programs across Health and Social care it allows for keeping more residents in need of care to be kept safe, well and socially connected with their care support workers and families. Working alongside North Lanarkshire Adult and Social Care Partnership, our principal objective was to demonstrate the value of sensors and remote monitoring and how they could be applied as part of a wider integrated digital care purposeful on enhancing care delivery and operational efficiency.

M-O spearheaded the collaboration in association with North Lanarkshire Adult and Social Care Partnership services management teams together with data scientists from the University of Strathclyde.

The key output was a first to market digital solution for the remote recording of frailty. By providing a base line summary of vital sign health data that could identify, and alert approved users of potential clinical decline or initial signs of frailty we converged multiple data points in our assessments. Additionally, the solution was designed to prepare for open integration into and interoperability for a wider integrated digital care solution to support local authorities. Once data was aggregated, we delivered a digital health score rating using the Rockwood score index for frailty whilst assessing the needs of an individual.

This solution has proven that digital technologies can change how frailty assessments are conducted whilst helping and preparing local authorities to plan for future demands for adult and social care services based on the individual needs of the residents who may have advancing levels of frailty.

The solution is designed to be modular and can migrate to legacy systems using the appropriate techniques to merge with existing APIs. This is important when considering emerging and digital solutions already deployed across the region, as well as making it versatile for multiple applications and uses.

Watch the Mari-One case study video.

Introduction

Context and Rationale

The shared commitment to assessing frailty within the North Lanarkshire community in the context of our project was reinforced against the backdrop of advancing levels of frailty in Scotland which have been a growing concern for Local Authorities and Healthcare Providers. This is particularly apparent amongst older adults where 10-15% are considered frail, with more being pre-frail. In terms of healthcare service usage, frail individuals often experience higher rates of hospital admission, longer hospital stays, and increased reliance on community health services. The NHS Scotland has been focusing on integrated care approaches to support frail patients, emphasizing early intervention and community-based resources.

Early intervention is important and more local authorities such as North Lanarkshire Adult and Social Care Teams are also advocating that older people should be assessed for the presence of frailty during encounters with health and social care professionals. Gait speed, the timed-up-and-go testing and the PRISMA questionnaire are recommended assessments as well as recording an individual's scoring on the universal standard the Rockwood scoring index, which we prepared to record digitally in our project.

North Lanarkshire Adult and Social Partnership teams have been focussing on innovative approaches to help support frail patients in the community. In tandem, strategic planning teams have underscored the need for emphasizing early intervention and prevention. Focused community-based resources can often produce better outcomes, particularly when it comes to elderly citizens with increased frailty issues. The continuous challenge whilst emphasizing early intervention is to identify those citizens who are pre-frail and where frailty is advancing. Typically, pre-frail or advancing levels of frailty is often confirmed by a GP or occupational therapist using the Rockwood scoring index as one means of assessment. Unfortunately, this is often only captured once frailty issues have been identified after a fall or following a GP assessment or hospital admission. M-O's digital frailty assessment advocates an initiative-taking digital care solution using biometric sensing techniques that can support carers and adult social care teams in advance. Remote health monitoring can provide base line data that informs future referrals to identify pre-fall alerts or increased signs of frailty to GPs or lead occupational therapists as part of an integrated smart care program.

The underlying rationale behind this project considered macro-economic factors in collaboration with North Lanarkshire Adult and Social Care Partnership teams having foresight to explore new innovative techniques. Together we identified the following challenges and factors.

- Consideration of a national program that offers routine population screening for frailty by way of digitally assessing those at risk should be explored to inform future demands for care support to avoid reactive services.
- Demand for care support is rising whilst the financial budgets to service the communities have been reducing.
- Too much care takes place in hospitals and not enough in the community, which is becoming increasingly unsustainable for local authorities across Scotland and the wider UK.
- Challenges remain in providing accessible housing for the projected increase in older people living longer.
- Challenges continue to develop programs that adequately support people, to take responsibility for their own health and well-being outcomes.
- Investment in preventative approaches and anticipatory services is currently insufficient to meaningfully reduce the demand for reactive services.
- Legacy IT systems are often incompatible with new and emerging systems.

Background Statistics / Supporting Data

Currently in the UK there is no national program for extensive training in frailty assessments or frailty recognition programs for health and social care operating staff working to support older people or middle-aged citizens with underlying health conditions. More people across the aged care communities have multiple health conditions making their support and care needs specific and more complex; this coupled with advancing social and adult care costs to support them is rising at the same time causing significant challenges for the future for local authorities. This often leads to reactive solutions to respond to unforeseen demands on their services. Recent statistics on older adult health in Scotland indicate that about 29% of people aged 65 often live with a long-term condition, and around 18% have two or more long-term conditions.

Whilst life expectancy has improved, conversely healthy life expectancy at age 65 is much lower, with around 9.5 years for men and 8.5 years for women. Social factors significantly impact older adult health in Scotland, influencing both physical and mental wellbeing. Key factors include social isolation, which is prevalent among older adults and can lead to increased risks of depression and cognitive decline and advancing levels of frailty with reduced physical activity over time. Economic status also plays a role, as lower income levels can often be associated with poorer health outcomes. Additionally, this increases the demand for access to healthcare

services and community support resources as a crucial requirement for maintaining health and managing chronic conditions for the longer term.

A key driver across all local authorities is to ensure the appropriate use of limited resources in the growing demand for services. In North Lanarkshire there are some key indicators that highlight that total spending on **Total Adult Social Care and Care Homes has increased at a greater rate in 2021/ 22 and 2022/23 than in the wider Scotland or Glasgow City. This is being driven in certain instances by an increased ageing population across North Lanarkshire in particular.**

Expenditure	Region	% Increase in Expenditure between 2021 and 2022/23
Total Adult Social Care	Scotland	10.3%
	Glasgow City	7.0%
	North Lanarkshire	12.9%
Care Homes	Scotland	6.5%
	Glasgow City	2.0%
	North Lanarkshire	6.7%
Care at Home	Scotland	7.5%
	Glasgow City	4.7%
	North Lanarkshire	5.2%

There is an increase in Integrated Adult Health and Social Care spend between 2022/23 and 2023/24 of 3.3%

https://www.northlanarkshire.gov.uk/sites/default/files/2024-10/NLC_Annual_Accounts_2023-24_Audited_0.pdf

North Lanarkshire have seen a steady rise in hospitalization rates amongst 60–65-year-olds indicating increasing levels of illness or chronic conditions which in turn often impact increasing frailty issues as a result. The significant increase of 15% of 75–79-year-olds being admitted to hospital in North Lanarkshire is important to note when we cross reference this figure in comparison to the lower percentage of care at home of services which constitute 5.2 % from local adult and social care budget allocation, which is considerably lower than other parts of Glasgow City and Scotland. **In addition, the population forecasts of North Lanarkshire indicate that by 2040 there will be 71.2 % of residents that will be over the age of 75-79.** This combined with a forecast decline in working age residents means that there will be less people providing social care services in home settings even if the budgets were to increase beyond 5.2% on average.

This critical point highlights the need for urgent action to consider digital health and digital care solutions to help solve a looming crisis in future long-term adult and social care plans for North Lanarkshire. Continued increases in the ageing population, coupled with increasing admissions to inpatient hospital visits, will continue to drive the debate on how to solve the significant issues of on-going sustainable health within an average adult and social care budget of more than £245 million per annum.

https://www.opendata.nhs.scot/dataset/annual-inpatient-and-daycase-activity

Inpatient Admissions in North Lanarkshire by Age Group	% Increase or decrease from 2021/22	% Increase or decrease from 2022/23	% Increase or decrease from 2021/22 to 2023/ 24
60-64 years	2%	0%	2.1%
65-69 years	4%	7%	11.3%
70-74 years	-3%	2%	-1.2%
75-79 years	8%	7%	15.5%
80-84 years	-1%	4%	3.7%
85-89 years	2%	1%	2.8%
90 years and over	4%	-3%	1.0%
Total	2%	3%	5.5%

There has been a 5.5 % increase in over 60-year-old patients Inpatient Admissions in North Lanarkshire from 2021 – 22 to 2023 - 24.

Aims and Objectives

The overall aim of the project is to demonstrate the ability to digitally monitor, continuously and enabled by next generation mobile infrastructures, the activity profile of individuals in the Active 60s community across North Lanarkshire, and to present the data in a form that supports the future planning of resident care interventions. The first phase analysis of the unique monitoring data acquired from a robust, proven wearable platform which has secured FDA approval, will provide evidence of the ability to capture and store multiple streams of individual data from a wearable throughout the day, the foundation for subsequent work programmes to create predictive insights that assist the decisions of care providers in supporting safer, healthier, independent living across North Lanarkshire.

Problem Statement

- The aging population and increased prevalence of chronic health conditions continue to strain local authority budgets.
- Current frailty assessments rely heavily on visual observation, which limits the ability to provide initiative-taking care.
- Increasing the visibility of biometric at the individual citizen level and a demonstration of the ability to acquire data in multiple environments together with evidence of its value in generating insights that inform timely and appropriate interventions will lower the barrier to adoption.

Remote monitoring of vital signs at the individual level.

The primary outcome of the project was to prove the ability to acquire and conduct preliminary analysis on extensive vital signs data derived from personas identified during the test period across North Lanarkshire as the foundation for classifying the level of frailty in an individual citizen. Furthermore, innovative technologies with the potential to assist in addressing the need to solve the ever-increasing challenge of servicing growing levels of frailty that impacts the prolonged independent living were explored.

The classification of frailty using vital signs data.

A digital care solution was explored that supports care workers to identify more accurately those individuals with frailty issues through referencing vital signs data captured using bio-metric sensors. In the first instance, the aim was to provide data insights for assessing levels of activity and posture that can be shared digitally with care teams or lead occupational therapists who will then determine the next level care required to support an individual or potentially signpost a referral note or alert to a GP, local district nurse or medical professional, beyond the social care setting.

Base-Line Digital Care Solution

The solution provides real-time visibility for social care providers as to the mobility profiles impacting members of the community owing to ageing, or chronic health conditions which are often synonymous with increased frailty. The solution offers a foundation to assist in prioritising the most appropriate care support packages for the future. The additional insights will help manage budgets, a key outcome as part of a long-term strategy for embracing digital health solutions that tactically deliver specific support services more effectively.

Local Authority & NHS Scotland Context

- The project aligns with Scotland's goals of promoting independent living and leveraging technology to improve public health outcomes.
- The solution provides a longer-term scalable model for addressing health inequalities and improving the efficiency of social care services.
- Considering the importance of frailty assessments including keeping healthy active 60 + members of the community have supported programs that recognize early intervention and prevention of emerging chronic health conditions as part of the ageing process.
- Providing digital health solutions inside and outside the home allows local authorities to identify early on those individuals through regular assessments may require social and adult care services in the future.
- The project allows innovative new pathways amongst key stakeholders to help identify those most in need of support regarding their ranking on the frailty score index, preventing falls, and reactive services demands that frequently arise which if not met increase the increase in hospital admissions. Which based on evidential based data underscores the need.

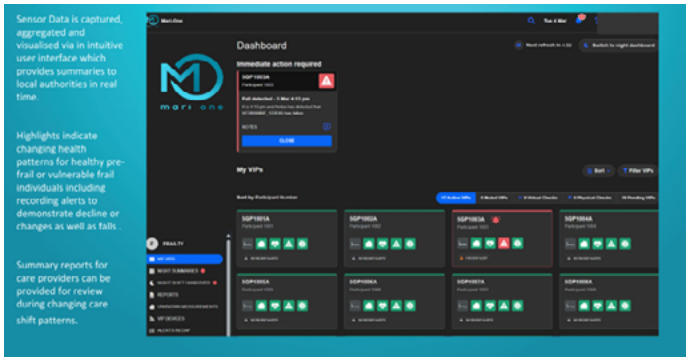
Project Description

The solution utilizes medical grade approved biometric sensors to collect real-time health data, which is currently used in over 42 countries worldwide to record vital signs, from individuals in social and adult care settings inside or outside the home, in hospital or in a post operative care environment. By integrating this data into a robust analytics platform, the project delivered the following:

- Comprehensive digital frailty assessments based on the internationally recognized Rockwood Score with governance applied by qualified lead occupational therapists from NHS Queen Elizabeth Hospital, Glasgow.
- Data visualization tools were designed and developed to inform care planning and resource allocation teams as to benefits of real-time remote health monitoring inside and outside the home including frailty scoring indicators based on each individual participant.
- Predictive analytics to identify at-risk individuals and prioritize interventions was applied in conjunctions with data scientists from University of Strathclyde.

Key features included:

- Open APIs that consider Interoperability with existing systems to streamline workflows.
- Customizable data aggregation and visualization capabilities enhanced with customized reporting as well as opportunities for password protected historical data storage.
- Secure, user-friendly interfaces for local authority and healthcare staff which are modular and customized for each scenario or applications for targeted health outcomes.
- Unique ID numbers were allocated for each participant keeping anonymized data secure for purposes of statistical analysis and further predictive analytics modelling.



Approach

Collaborative Design

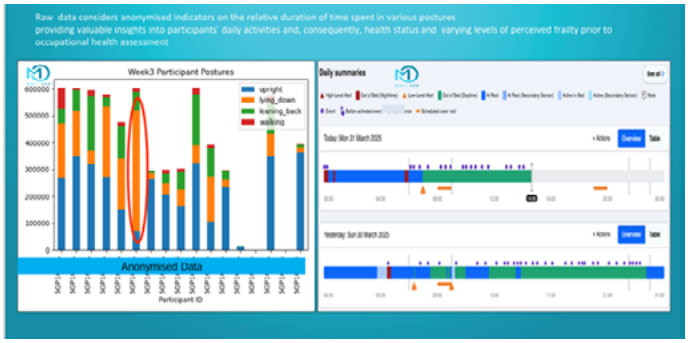
Key Collaborators and Stakeholders

The key stakeholders in the program included **North Lanarkshire Adult and Social Care Partnership** as well as the **University of Strathclyde**. Key roles included helping us define the strategy and preferred approach to collaborating with internal teams with considerable existing workloads. North Lanarkshire Adult and Social care teams helped us identify and recruit the best candidates to participate in the program. Further, Adult and Social care they played a key role in defining the appropriate governance and mentorship necessary to begin engaging key members of the community.

Areas of governance included ensuring data protection and risk assessments were applied, including ensuring individual consent forms for anonymized participants were suitable prior to application of biometric sensors. Engagement with operational delivery teams, social care team leaders, digital care, and IT teams was mandated from the onset to ensure no cross over of conflict of interests with other existing programs and systems. Due to existing strategic partnerships with University of Strathclyde specifically, North Lanarkshire Adult and Social Care Group has experience on the development around R&D Innovation on digital health solution and important factor both in the delivery of project outcomes

but just as importantly on lowering the barriers to adoption of new innovations highlighted in this M-O initiative.

M-O and the University of Strathclyde managed the aggregation and analysis of the vital signs data generated from the IoT platform. The key role was to assist to review and analyse raw data files, the foundation for the correlations between vital signs and key indicators of frailty specifically step count, walking, posture, fall detection, body temperature, heart rate and sleep periods. In addition, data engineers contributed to the optimization techniques for Data Aggregation with MO teams by selecting the best techniques for data cleansing and applying outlier removal if observed as relevant.



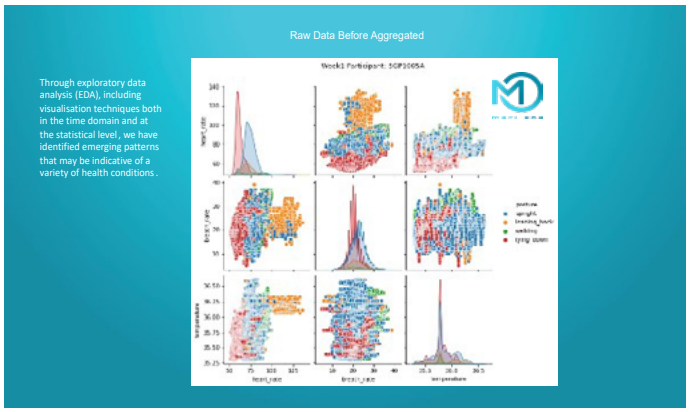
Feature extraction techniques for time-series data were considered, allowing the establishment of base line data visualization, which permitted the ready inspection of multiple data streams of data and in turn, the search for anomalies and outliers.

All partners and stakeholders participated in scheduled regular meetings.

Implementation

Risk Management

- Risk 1 – The most significant risk for the project was to ensure that the most appropriate participants in a timely manner. The potential risks here were that we would not have sufficient volumes of data to assess for a base line of individuals Rockwood scoring index, over a sufficient period. We set about directly engaging face-to-face with participants to secure their participation in educational workshops supported by North Lanarkshire Adult and Social Care teams on a weekly basis. This measure assisted us in the conversion of value-added impact which participants understood directly. Community engagement at the start of the program created a short delay as we relied on stakeholder partners to engage the community on our behalf. This was solved allowing strong collaboration with the community.
- Risk 2 - Dedicated network bandwidth and connectivity. There were no issues with functionality of data capture, but the challenge remained staying connected to 5G networks. Given the lack of availability of 5G adoption in key areas of Glasgow city region, in particular North Lanarkshire, we had to consider advanced wireless sensor techniques to ensure a contingency plan was in place to counteract this risk. We implemented a relay device which allowed for the sensor to connect to the most readily available network to allow for the data to be transmitted via the most suitable data communication infrastructure.
- Risk 3 - Evaluating the raw data before aggregating into a concise and user-friendly interface that would be able to consider the identifiable and emerging health conditions and patterns of each individual before we could cross populate frailty screening. See figure below that illustrates the raw data collected for scientific assessment.



In this concise project, we ascertained that participant data streams, which are provided via the consolidated IoT platform, proved of high quality - a fundamental requirement for downstream pattern recognition via artificial intelligence. We have demonstrated that these data streams could be aggregated and processed at a scale (storage and computational power); this is a crucial consideration for future full scale when this integrated care digital solution is to be deployed on a mass scale. Together, the combination of high-quality data sets and scalable processing provides the necessary prerequisites and robustness for viable deployment.

Evaluation Framework

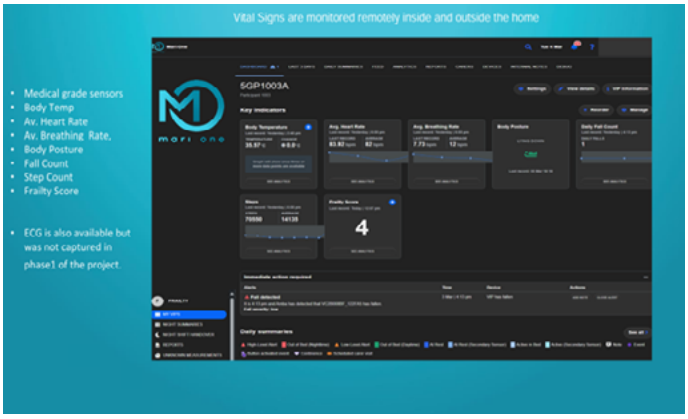
Participant Feedback

Participant feedback was qualitative and quantitative and included completion of a questionnaire. This was issued to all participants in the study that had previously signed consent forms in advance of participation. Equally, we conducted exit interviews with all our stakeholders covering key aspects of the project management of the program in areas such as operational delivery, communication, workshop and onboarding processes, governance, and outcomes. We recorded qualitative feedback from participants and stakeholders on video, for internal purposes and where applicable this was shared

with project teams and stakeholders at Glasgow City Region as required.

Findings Key Insights

- Data-driven frailty assessments enhanced the ability to target future care resources effectively.
- Early identification of advancing frailty scores allows the provision for timely interventions, in the future whilst reducing hospitalizations or short-term A&E admissions which we identified in an increasing issue for frail residents following falls inside and outside the home.
- Customizable dashboards improved user engagement and operational efficiency.



Stakeholder Feedback

- Local authorities valued the actionable insights derived from data aggregation and visualization. They particularly appreciated and acknowledged the active engagement on a weekly basis with the group participants.
- It is important for our stakeholders to consider that all future designs of digital care enabled solutions can be integrated with legacy systems alongside new emerging technologies in the current road map for digital health across North Lanarkshire.
- Stakeholders remain committed to advancing innovation and collaboration with academic partners and technology partners as they continue to advance the digital healthcare agenda that focuses on solving significant issues for ageing populations and citizens with chronic conditions or underlying health conditions associated with advancing frailty issues.
- Social Care teams and senior managers reported increased confidence in how technology could be applied in the future for the ongoing care teams planning and resource allocation.

Key Considerations

Facilitators

- Strong collaboration among project partners ensured seamless integration of technologies.
- Interoperable systems streamlined data sharing and reporting processes.

Barriers

- Winning the hearts and minds of operational teams within adult and social care teams who are already stretched to driving existing programs for home care support for elderly and frail residents within the community.
- Initial digital literacy challenges (biometric sensor application is a new concept) among staff and community participants, this required initial training and support with one-to-one engagement in person offering quick uptake once applied.
- Limited project timeline constrained the depth of data analysis.

Learnings

- Engaging working teams at an operational level to ‘come off task’ to engage and drive new innovations is a challenge, particularly whilst considerable workloads are already in place during a winter period when demand for care services was higher during Nov 24 -Jan 25.
- We would suggest providing greater lead times in future that consider peak times for local authorities’ adult and social care teams and holiday seasons who are required for collaboration.
- Mapping, timing, and planning is critically important with stakeholders, and it is not automatic to assume organizational alignment is always on shared timeframes for implementation of innovative programs.
- Regular feedback from focus groups was essential for refining the user interface and analytics tools, community engagement is critical to the success of deploying innovative technologies that require support and commitment from a senior group community.
- Scalability of the solution requires ongoing collaboration with key stakeholders and community engagement to include cross functional teams for on boarding, training and infrastructure integration whilst addressing legacy and expanding IT systems.

Conclusion

The Integrated Digital Care Solution for frailty assessment demonstrates how biometric data and advanced analytics can transform the future of social and adult care services. By enabling early intervention and efficient resource allocation, the project addresses health inequalities, supports independent living, and optimizes local authority budgets. This scalable model aligns national priorities for digital health and public service efficiency. The solution aides strategic planning teams in addressing the move from reactive services towards proactive planning with real time data that can be applied as required across various scenarios across in a modular and customized way.

Next Steps

- Communicate and share the digital care solution for those local authorities considering new pathways for improving adult and social care teams operating models.
- Engage with local social care management teams seeking additional operational support to assist in planning proactively which reduces the response to the current provision of reactive services.
- Engage local authorities as to the benefits realization in the digital transformation of adult and social care services by illustrating the budgetary impact on new business operating models to include new applications to consider data integration into existing systems.
- Expand technology adoption to additional local authorities and care settings, in the UK and internationally with M-O shared in country partnerships.
- Continue to collaborate with local authority strategic planning teams and stakeholders to explore further innovative pathways for integration to the Scottish Govt- Digital Front Door strategy.
- Help enable North Lanarkshire residents and people in Scotland to interact more effectively with health and social care services by advancing knowledge exchange, and educational programs on the use of digital health and digital care solutions.
- Invest funds to engage collaboration partners to address the roll out of smart care opportunities that support scalability and continuous improvement for the health and wellbeing of the wider GIRFE groups as well as support programs for improved health and wellbeing of adult and social care staff members.

Sustainability Plan

The solution's scalability and interoperability functionality ensure long-term viability. The solution can help reduce pressure on local authority budgets while improving health outcomes by enabling early identification of frailty whilst promoting independent living whilst transforming adult and care services and improving lives. The development and integration of predictive analytics in an extended Phase 2 paves the way for broader adoption, supporting Scotland's vision of digitally enabled, equitable healthcare.

The advancing levels of frailty across Scotland and the UK requires a sustainable solution to help identify the rising levels of support required to deal with residents in the community who will require additional care services. This ongoing problem exists across the wider Glasgow City Region; therefore, we must ensure the solutions delivered in this program can be shared and integrated with national concurrent programs to solve the looming crisis of an ageing population with less available carers. This is important long term due to demographics and the concomitant impact on the resources required to care for frail members of society highlighted by the unambiguous trend that there will be fewer people of working age in North Lanarkshire by 2040 which will require new operating models. Equally by implementing digital healthcare solutions codesigned through collaboration results will help to reduce hospital admissions longer term by encouraging health and well-being programs that consider pre-frail members of society earlier in ageing process.

The M-O smart care solution provides the evidence as to the viability of digital health and care technologies making it possible to record using 5G networks that we can capture human vital signs remotely inside and outside the home dwellings. The capture of a base line summary of vital sign health data over an extended period of time gates the generation of for example, an alert to social care teams or healthcare providers of potential clinical decline or early signs of advancing frailty. The scalability and sustainability of access to remote monitoring health data offers long term benefits to local authorities. In turn this will allow for new innovative patient pathways for those citizens being discharged from hospital to home where vital sign recording is needed to ensure social care teams can proactively plan care packages.

The demand for Smart Care Solutions in the future is inevitable and will in turn require sustained investment in national data communications infrastructures if the benefits are to be realised. This includes the need to accelerate the on-going commercial investment in 5G networks to maximise the data transport techniques we have applied for the M-O smart care system. Equally to advance the wider adoption of digital health and care solutions in the future there will be a continual need to foster thriving 5G ecosystems at a city region level and nationally. This is turn will encourage and enable a

'learning by doing' digital culture demonstrating real world applications of connected technologies that can propel the digital transformation needed in our health and social care services. 5G network infrastructures will in turn drive economic growth in the digital health sector whilst highlight the benefits of digital health and care systems needed to keep citizens safe and well and socially connected to their appropriate care support settings.

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Find out more about the project on the Glasgow City Region website.

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