Connected Health Cities – End of Project Report:

Creating a Trusted Research Environment for Connected Health Cities in the North West Coast

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ABSTRACT:

The model for creating a Learning Healthcare System for the North West Coast Connected Health Cities programme was to first establish a Trusted Research Environment (TRE) hosting anonymised hospital administrative data for the whole region.

This data was made securely and remotely accessible to a team of university-based data scientists working closely with front line NHS teams who played a key role in the development of the codes used to extract the data.

The work focused on providing new analytical tools to enhance the health care system's ability to accurately track emergency care pathways, identify variation in activity, process and outcome and opportunities to improve care.

The methodologies and results were shared with the local health economy, seeking to bring new data-driven approaches to enabling, monitoring and guiding local QI initiatives.

Having established novel analytical approaches to the use of administrative data, we then explored opportunities to enhance the analytical tools through linkage to other datasets including primary care and by exploring alternatives to traditional statistical approaches.

INTRODUCTION:

There is a wealth of data available in the NHS that could be used to improve the delivery of care.

The aim of Connected Health Cities was to develop methods to leverage greater insight from currently available datasets in the NHS to improve three clinical pathways which are a priority for health services in the North West Coast - alcohol-related liver disease, (COPD) and epilepsy.

But patient data is sensitive and can include confidential information such as patients' medical history. To be able to use this data effectively requires appropriate information governance and information security management policies.

So the challenge for CHC was to find the perfect analytics platform for our researchers to store and analyse health data securely.

The environment also had to provide appropriate statistical and geospatial analytical software to enable them to analyse the data.

TREs are highly secure facilities where you can store, analyse and process health data. They are one of the safest, most efficient data analysis resources for researchers working with sensitive data and use a number of strict security controls to prevent unauthorised access and misuse of data.

Plus the TRE infrastructure has the ability to support demanding computer resource requirements, such as multiple processors and large amounts of memory and storage.

AIMES Management Services is a leading commercial data centre based at Liverpool Innovation Park which specialises in cloud technologies for healthcare and was awarded the contract to host the TRE infrastructure for the Connected Health Cities (CHC) project.

AIMES was tasked with creating a super-secure data management e-infrastructure to house the pseudonymised patient data and enable cloud-based collaborative analytics to take place.

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Under the leadership of Professor Dennis Kehoe, the team at AIMES built a TRE specifically for the North West Coast CHC which hosted anonymised hospital administrative data for the whole region.

This data was made securely and remotely accessible to a team of research analysts at the University of Liverpool who used statistical and geospatial analytical software to analyse data on our three clinical pathways.

This enabled the Liverpool Data Lab to analyse the data to develop new, actionable information resources with the potential to improve clinical decision-making, support personalised care and evaluate the impact of service changes whilst ensuring all appropriate information governance was adhered to.

AIMES provided the assurances to the data controllers within the NHS, that the data was held and processed according to Information Governance toolkit processes and ISO 27001 Information Security Management System policies.

New analytical tools and algorithms were developed by the Data Lab to identify cohorts of patients accurately and enhance the health care system's ability to accurately track emergency care pathways, identify variation and its drivers and opportunities for improving care.

Insights were then shared with those delivering care in the North West Coast as part of Learning Health System (LHS) - continuously analysing data which is collected as part of routine care to monitor outcomes, identify improvements in care, and implement changes on the basis of evidence.

METHOD:

CHC's industry project partner AIMES created a Trustworthy Research Environment (TRE), a highly secure data analytics environment.

Utilising strict standards of research, data security and privacy, the TRE is ideal for analysts who are looking to access sensitive data.

It allows the data owner to grant access to duly authorised individuals into a 'walled-garden' which provides analysts with all of the software tools required to analyse and visualise sensitive data in an ISO27001 and IG Toolkit compliant cloud-based e-infrastructure.

The CHC TRE provided access to the N3 – a national broadband network for the NHS which is currently being replaced by The Health and Social Care Network (HSCN).

The TRE comprised two zones, an N3 facing data-provisioning zone (DPZ) and an internet-facing separate analytics zone (AZ).

The DPZ is made up of Database Server, File Server and SFTP Server and this zone is connected to the N3 Network, which is where the Patient Data was ingested.

The AZ is where the file server, publishing server and the VDI Instances sat. The VDI are accessed by secure VPN and 2 form factor authentication. The AZ provides analysts with a virtual desktop, typically comprising 8 cores and 32GB RAM and access to common statistical and geospatial software.

The TRE was centrally managed and standardised for simple usage, utilising a controlled platform and secure access (VPN/GPD), making use of standardised data retention, back-up policies and secure VDI architecture.

The provider is ISO27001 certified and provides ISO27001 data centre services to NHS Trusts and Universities.

It is NHS Information Governance Toolkit Compliant with the highest compliance level at level 3 (100%) and also an accredited and approved NHS N3 aggregator, entrusted by NHS Digital to monitor and maintain the security of organisations connecting to the N3 network on its behalf.

They currently meet the requirements of the Cyber Essentials Scheme and hold a Certificate of Compliance which has been independently assessed and verified by a Government approved external body. The n+1 resilience of the facility provides the highest levels of up-time and ensures continuity of application availability.

To enable the research team to receive data in a structured way, data sets were drawn down from the DSCRO (Data Services for Commissioners Regional Office) using a secure FTP.

They were then collated into a single data management environment and collated. Person-level consistent pseudonymisation and linkage of data were made in the environment.

Over the lifespan of CHC, AIMES improved the TRE to meet the needs of the analytics and clinical teams.

Improving speed of the system was important for analysts working within this environment. In addition, the team developed a visualisation tool to allow a good visual summary of a patient journey for specific care pathways

Collaboration with Imosphere provided additional functionality via the Atmolytics tool which enabled better visualisation of data to clinicians and commissioners.

Inclusion of Atmolytics enabled the generation of actionable insights, measured performance and improved outcomes across the care system and is part of the next-generation self-service analytics platform.

This model can house linked data from across the health, social care and local government, voluntary, commercial and other organisations.

The arrangements are permissive to enable approved health and local government care planners and providers to interrogate and analyse data rapidly.

This shortens the time to answer new questions about service delivery/outcomes, and enable timely monitoring of changes in care pathways.

Opportunities to enhance the analytical tools through linkage to other datasets including primary care and by applying emerging alternatives to traditional statistical approaches (eg. machine learning) were also explored.

IMPACTS:

CHC has clearly demonstrated the capability of the TRE as an ideal data analytics e-infrastructure.

Within the NWC TRE, Learning Healthcare Systems for COPD, epilepsy and alcohol-related liver disease were successfully created providing data visualisation, cohort creation and personalised interventions.

The Learning Health Systems developed for the NWC pathways are now facilitating the improvement of care for patients by turning data into information which is enabling clinicians to better plan, review and adjust the care they offer and develop and monitor new and/or more effective pathways.

Six Trustworthy Research Environments have been embedded within the Data Arks to support data-driven innovation and improvement projects which will directly help patients and save the NHS money.

Records for a population of 9.5m can be accessed through three major linked datasets in the North of England

CHC had a real impact in supporting AIMES to develop reputation and capability in designing and developing new interoperable infrastructure architectures to enable data sharing between university, NHS organisations and others across regions.

The TRE is generating interest from across the country and AIMES has been commissioned to support a range of projects who wish to link data sets in a safe environment.

As well as the NWC, AIMES was instrumental in creating TRES for the other CHC regions, such as North East and North Cumbria as well as other trusts in our region, such as Merseycare NHS Foundation Trust and Liverpool Heart and Chest Hospital NHS Foundation Trust, which are using similar environments improve the pathways for mental health, cardiovascular disease and stroke prevention.

The uptake of TREs is now accelerating across many organisations including acute and tertiary trusts with the number of researchers using them having doubled.

This is being driven by the two complementary forces of data availability and the emergence of advanced analytical techniques as well as a move towards making better use of our data assets. The primary use cases to date which have driven the development of the TRE architecture are Predictive Analytics, Clinical Trials/Screening and Population Health

AIMES now provides TRE infrastructure of this type to over 12 universities and trusts and organisations such as Cancer Research UK, Innovate UK and has become the biggest commercial provider of TREs in the UK.

The CHC programme has been instrumental in the next generation of TRE being developed incorporating Artificial Intelligence and Machine Learning.

TREs also have an important role to play in the roll-out of the emerging Local Health and Care Record Exemplars (LHCRE) and in the adoption of 'Big Data' technologies into the NHS.

The successful development of the TRE and LHS methodology has seen the North West region becoming a hub for development and implementation of this technology.

IMPACTS IN NUMBERS

- A new algorithm was developed to identify emergency admissions due to Chronic Obstructive Pulmonary Disease (COPD). When compared with the national analysis, the NWC algorithm identified 45% more people with COPD currently being provided with NHS care.

- An extra 25% of cases of alcohol-related liver disease were detected when compared with gold-standard review of clinical records resulting in improved monitoring of unplanned admissions and post-discharge events.

- The newly developed algorithms identified an extra 66% of epilepsy-related admissions when compared to just using the primary diagnosis code, now capturing more accurate average length of stay.

CONCLUSION:

The work we have carried out provides a legacy for further academic and educational development, infrastructure development and staff development as well as allowing us to take forward our learning to new initiatives relating to regional digital and infrastructure development (Local Health and Care Records – Share to Care).

Further usage of data analysis techniques, algorithm development and next generation technology, around ARK / AI and Machine Learning will become part of development of expertise and horizon scanning.

"Building the trusted research environment for Connected Health Cities has been a big success.

"This regional data analytics platform is very secure and maintains all the information governance rules laid down by the NHS.

"We are now working on similar secure environments for cancer research and mental health and are looking at two new pathways – cardiovascular and stroke prevention.

"It is a legacy of CHC, bringing together research and hospital communities to create learning health systems which will transform health and social care."

Professor Dennis Kehoe, Chief Executive Office at AIMES Management Services

"The TRE developed and hosted by AIMES has opened up new opportunities for clinical and academic teams to process and analyse NHS datasets adhering to ISO27001 security standards and NHS IG.

The TRE provides safe, secure means for getting NHS data used to inform clinical care directly and has become a true enabler for a Learning Health System."

Professor Mike Pearson, Professor of Clinical Evaluation, University of Liverpool

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