Large Scale Infrastructure for Health Data Analytics

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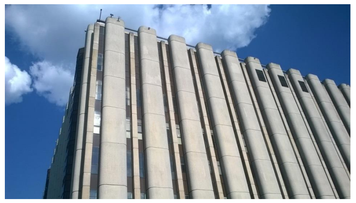
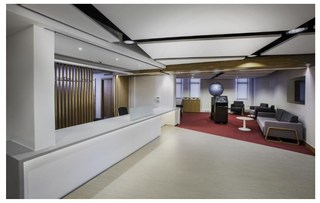
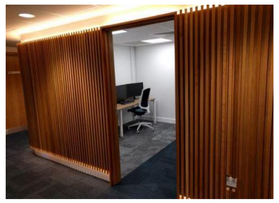
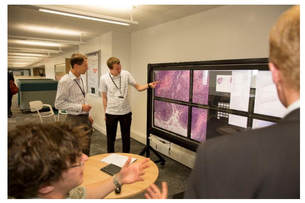



Outline

Growth in e-health systems brings opportunity for data analytics to inform health research on a larger scale [1]. In the UK, 65 million residents have lifelong e-health records that can be examined for patterns of disease and to evaluate interventions in the real world [2]. To date, projects in health data analytics are often run by silo-ed research teams, independently solving similar issues around information governance, data confidentiality, understanding systems and data, and developing new methods.

We describe a way that uses large-scale infrastructure to address the opportunities for data analytics at scale in the UK. It has supported 50 projects in a range of scientific areas and can be seen as an exemplar for the developing field of data analytics.

Context

The UK population (n=65 million) has life-long primary care records with the largest single database system (n=40m) being TPP's SystmOne (www.tpp-uk.com), which has research access via ResearchOne (currently 7m opted in).

UK hospital systems also capture rich genomic, imaging and bio-informatics data. At Leeds Teaching Hospitals NHS Trust (LTHT) for example this covers 3 million patients in systems linked to their Patient Pathway Manager (PPM).

The Leeds Institute for Data Analytics (LIDA) is a £12m investment in data science at the University of Leeds, funded by UK research councils, to develop a partnership with TPP, LTHT and the NHS Health and Social Care Information Centre (HSCIC) (Table 1).

	TPP SystmOne	LTHT systems
EHR source	5,000 UK NHS organisations *incl. GP, community, prisons, social care*	Leeds Teaching Hospitals NHS Trust, Leeds, UK
Period	Life-long records	Episodes of care, 1996 onwards
Patients	40 million	3 million
Data examples	Demographics, diagnosis, referral, pathology, prescription, vaccinations	Diagnosis, prescription, genomic, procedure, laboratory, vital signs

Table 1. Examples of large scale systems in the LIDA partnership

Figure 1. LIDA in the UK Health Landscape

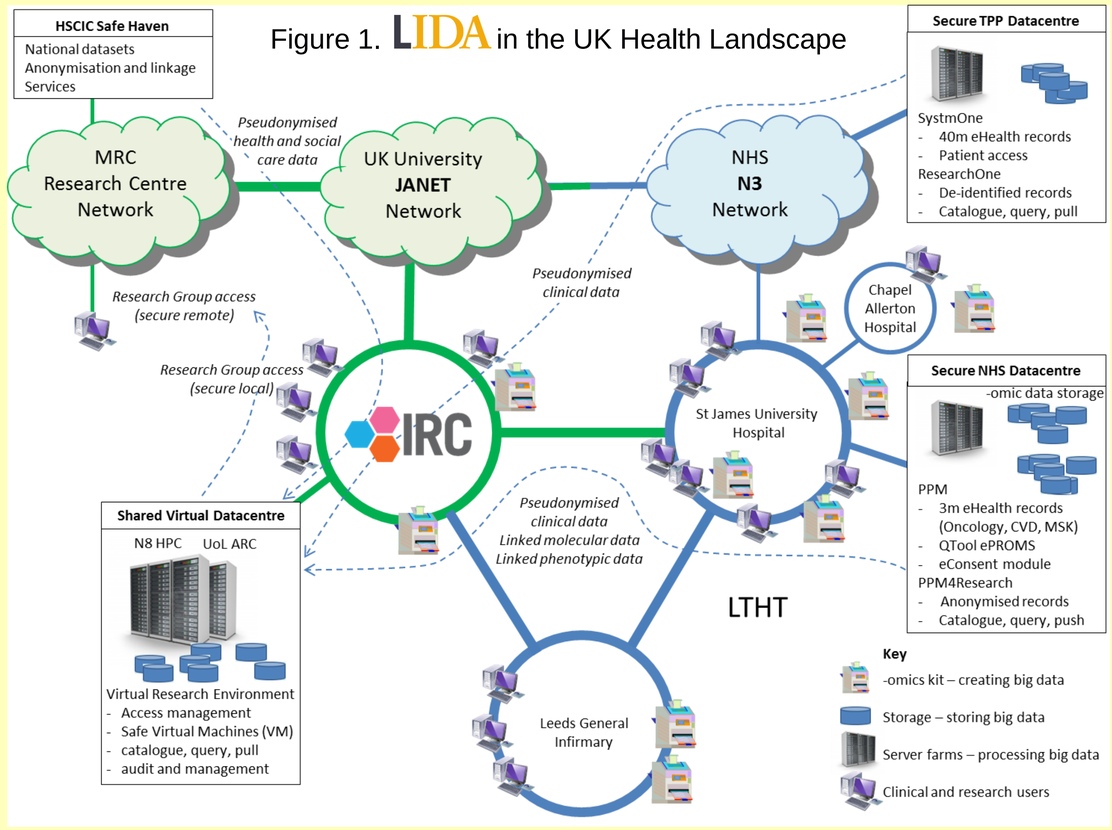


Figure 2. IRC Virtual Research Environment for isolated projects with remote data access

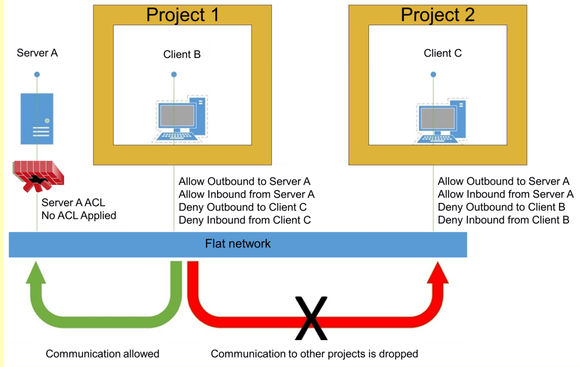
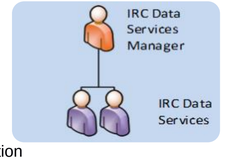


Figure 3. IRC Team Roles

Data Services Manager
- Ensure the IRC provides new services as required
- Own and promote the infrastructure
- Ensure value for money via re-use and exploiting new opportunities
- Operationally responsible for execution of Standard Operating Procedures
- Manage interactions with data providers and University IT
- Technical problem management

Data Services (currently 6)
- Data linkage and risk profiling
- Load and transform data
- Responsible for information governance
- Deliver bespoke software
- Liaise with data providers
- Produce datasets for research and publication
- Assist researchers with data / compute issues
- Support researchers through the whole project lifecycle
- Manage areas of system administration



Aim and Objectives

LIDA aims to improve the pace and quality of big data research through sharing knowledge, tools and equipment.
Its objectives are to:
- Enable large scale data analytics research
- Protect and increase revenue and intellectual property
- Increase the impact and visibility of research
- Improve the researcher experience

LIDA require a large-scale infrastructure to meet this. Therefore the University of Leeds developed the **Integrated Research Campus (IRC): a service for secure and large-scale data analytics.**

IRC

The Integrated Research Campus

- **Computer network** for large-scale data capture, storage and analysis (firewall-protected servers with 700 cores, 4 TB RAM and 2,000 TB storage), plus High Performance Computing (HPC)
- **Links to data services** such as ResearchOne and LTHT's PPM and development of their services, including a Leeds Data Warehouse to merge LTHT systems (Fig 1)
- **'Privacy by design'** information security system (ISO27001 pending)
- **Processes**, templates and guides for common research tasks and tools
- **Data access** via Virtual Research Environments (VRE) tailored to the data, security, software and processing needs of each project and each team member (Fig 2) [3]
- **IRC Data Team** provides support in data science, governance and data handling (Fig 3)
- **Space** for multi-disciplinary co-location includes a PowerWall data visualization suite, collaborative working areas and data 'safe rooms'
- **Cost remuneration** scheme for quick, competitive costing in bids

Outcome

From LIDA's launch in June 2015 it has provided IRC access to 150 associates including clinicians and researchers, in 50 projects, supported by 10 data science interns. For example:

- One study used IBM Watson Content Analytics to develop natural language processing algorithms to identify diagnoses from 50 million clinical reports
- Another pseudonymously links e-health records with environmental, genomic and tumor data in order to identify skin cancer and improve its treatment

The IRC aids research on a large, cost-effective basis and this data is used at scale by multiple research teams. LIDA offers a model for the developing field of data analytics.

References

1. A.B. Jensen, et al., 2014. Temporal disease trajectories condensed from population-wide registry data covering 6.2 million patients. *Nature Communications,* 5: 1-11
2. O. Johnson, et al., 2014. Electronic health records in the UK and USA. *The Lancet*, 384 (9947): 954
3. R. Smith, et al., 2013. "GATEway to the cloud: Case study: A privacy-aware environment for electronic health records research," In: *Proceedings – IEEE 7th SOSE*292-297.