Analysing “Big Data” to Improve Patient Outcomes
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Definitions

(Frost & Sullivan)
“Big Data refers to electronic datasets so large and complex that they are difficult (or impossible) to manage with traditional software and hardware. The volume of all electronic data in the world is staggering. It is estimated that in 2010, medical centers hold almost 1 billion terabytes of data, or almost 2 trillion filing cabinets worth of information.”

(Wikipedia)
“Big data is a broad term for data sets so large or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization, and information privacy. The term often refers simply to the use of predictive analytics or other certain advanced methods to extract value from data, and seldom to a particular size of data set.”
NSW Health and Patient Data 2008-2015

- Statewide initiative to tender for and implement an eMR across all NSW Area Health Service hospitals,
- Functions include Emergency Department management, electronic enterprise-wide Scheduling, Outpatients, Waiting Lists and Operating Theatres, electronic Discharge Summaries and transmission to GPs,
- Integration of Pathology and Radiology ordering and results reporting,
- Current projects including electronic Prescribing, and Intensive Care integrating with the eMR,
- A wealth of information, but with some reporting challenges
Who Uses the EMR?

- Allied Health Professionals
  - e.g. Pharmacists, Physiotherapists
- Nurses and Doctors
- Specialists in their Rooms
- Operating Theatre Staff
- Outpatient Clinic Staff
- Wards, Units, Departments, Clinics, Rooms
- Emergency Room Staff
- Radiologists & Radiographers
- Health Information Managers
- Technicians & Scientific Staff
- Pathology Doctors, Nurses and Scientists
CHALLENGES FACING THE HEALTHCARE SYSTEM

As population ages, chronic disease is becoming more common, requiring new and different models of care to that provided for patients with acute conditions.

The health system is facing increasing levels of demand with more people attending Emergency Departments and more people requiring treatment.

Advances in medical technologies continue to provide new opportunities to provide care differently, and outside hospital walls.

Issues such as access to healthcare and socio-economic disadvantage play a critical role in determining health outcomes in all communities across NSW.

Healthcare costs are increasing requiring new ways of improving value for money and ensuring a sustainable healthcare system for the future, connecting all elements of healthcare delivery inside and outside State public health systems.

Community expectations of the healthcare system continue to increase, necessitating the need to work together in planning and delivering services.

Information technology is changing the way we communicate and providing opportunities to connect care across multiple care providers and treatment settings.

Source: NSW Health June 2014
The problem is that …

• Many of the clinical staff are collecting and entering patient information into the eMR
• But easy access to information to assist in treating the patient is not always achievable
• Some key systems are not always integrated with the eMR e.g. NSLHD Horizon Cardiology, Access and Excel databases
• There is no private hospital and GP data in the eMR
Options Available with Big Data

New Health Sciences Data Sources

- Drug Research
- Social Media
- Patient Records
- Gene Sequencing

- Test Results
- Claims
- Home Monitoring
- Mobile Apps
Kolling Institute’s Research Project

- Environmental scan of health determined a need for greater access of integrated patient information across public and private providers
- Key objective of the submission was to improve the information available during the continuum of care
- Funding submission made and funds acquired
- Project approved and commenced in FY 2014/2015
What does this look like
<table>
<thead>
<tr>
<th>Aims</th>
<th>Progress</th>
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<tbody>
<tr>
<td>Bring together groups who have not traditionally worked together</td>
<td>Meetings with:</td>
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<td></td>
<td>- NSLHD specialists and operational staff in: Head &amp; Neck Cancer, Maternity and Cardiology, Radiologists</td>
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<td></td>
<td>- External: Douglass Hanly Moir, Pathology North, Sydney Ultrasound for Women, Ramsay Healthcare</td>
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<td>- NSW Health, eHealth</td>
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<td>Link health datasets relating to pathology, imaging, genomics,</td>
<td>Currently have datasets collected for all integrated into one database, excluding proteomics and</td>
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<td>proteomics, prescribing, procedures, diagnoses and administration</td>
<td>genomics – for agreed exemplars</td>
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<td>Create a model in which different organisations are comfortable in</td>
<td>Infrastructure (hardware, database, reporting tool) created to support secure sharing of data.</td>
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<td>sharing data with appropriate and proportionate governance</td>
<td>Long term objective to use a “data safe haven”</td>
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<tr>
<td>Aims</td>
<td>Progress</td>
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<tr>
<td>Develop training opportunities for individuals to undertake new</td>
<td>Meeting with Sydney University Medical School regarding opportunities</td>
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<td>research in this emergent research field</td>
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<td>Advance methodological development in cutting-edge inter-disciplinary</td>
<td>Patient data linkage across multiple providers has occurred, and data</td>
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<td>analytical approaches to data manipulation, linkage and analysis</td>
<td>manipulation and analysis by clinicians has commenced</td>
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<td>Contribute to a strategy for a wide and inclusive collaboration</td>
<td>Close relationship formed with eHealth. Use of State-wide Qlik reporting</td>
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<td>between academe, health and industry that can catalyse an</td>
<td>tool is consistent with State strategy.</td>
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<td>internationally competitive NSW-wide Health Informatics Programme</td>
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HIP Progress to Date

• Management and governance framework created
• Clinicians engaged and involved in discussions regarding requirements
• Infrastructure established in a secure environment on NSCCLHD’s servers
• Contracts employed to assist with: project management, programming (extracts and reporting)
• Tools agreed (QlikView, QlikSense) for display of integrated patient information
HIP Progress to Date (2)

- Exemplars agreed to be Obstetric, and Head and Neck cancer patients, increased to include Cardiology
- Extracts taken and integration has occurred across: Cerner’s eMR, McKesson’s Horizon Cardiology, ObstetriX, iPharmacy, Access and Excel databases
- QlikView used to provide dashboards to clinicians of integrated patient information
- Second and third iterations of dashboard design occurring in agreement with clinicians
- Analytics involving Sydney University, and National Language Processing (NLP) for unstructured data
Questions by Management

How many patients are we treating in Cardiology?
And how many patients have received Angiograms, and Stents?
Patients receiving Stents
Patients and Catheterisations
Questions by Clinical Management

How long is it taking to treat patients from Ambulance pick-up, from ballooning etc?
Average time to treat patients
Benefits of Integrated “Big data”

- Integrated patient information accessible in a dashboard format easily understood by clinicians
- Reduces number of unnecessary pathology and radiology tests
- Reduced medication errors, as a result of integrated prescribing databases
- Clear indication where patients are treated, and types of treatment provided
Benefits of Integrated “Big Data”

• Information indicates efficiencies (and inefficiencies) regarding time to treat and by each hospital
• Financial calculations available for number of stents performed by specialist
• Reduction in the patient’s length of stay as a result of all information available in the one place
• Public and private (hospitals, providers) data integrated across public/private hospital campuses
Benefits of Integrated “Big data”

- Patient’s view of integrated public and private hospital information improves coordinated care, morale, and enhanced outcomes
- An ever increasing treasure-trove of patients clinical data – specific patient types or population groupings of patients/conditions
- Foundation for future innovation e.g. Watson Health, genomics
Where are my Patients
Achieving better health outcomes for patients by (source: NSW Health)

- Integrating acute and primary care
- Working with others to meet the patient’s needs
- Harnessing eHealth and mobile technology
Challenges with a Big Data Project

- Where to start
- You don’t know what you don’t know
- Which system is the true source of the data
- Who owns the data, and concerns about privacy, confidentiality
- Data cleansing
- Clinician involvement
Challenges with a Big Data Project (2)

- Scope creep
- Which tools to use – dashboard display, analytics
- Skills availability – both ICT and clinical
- Maintaining a momentum, and then controlling the interest as clinicians start to see the benefits of integrated information
Clinical Feedback

- Clinicians indicating what is **not** required, ie information integrated from Excel databases, and preference for this to come from the eMR
- Need for information relating to how many patients discharged “alive” vs those who were not
Clinical Feedback

- Medications viewed on patients discharged queried by Obs & Gynae staff, now the subject of discussion
- Medications Oncology clinicians interested in integrated data from Cardiology including patients who have experienced heart attacks
- Request for graphed information on the number of patients who were anaemic on admission
- The mapped location of inpatients discharged to be used in planning for educational programs

However, how the integrated information is improving patient outcomes will take some further development and analysis including using natural language processing for unstructured patient information with the discharge summary a useful source of data.
Next Steps

- Data collection is continuing with private providers, GPs, community, integrated care
- Sydney Ultrasound for Women has become part of the project and data is being extracted and integrated
- Discussions occurring with a Sydney Private hospital regarding integration of their patients
- Analytics of unstructured data has commenced
- Data safe haven – options being reviewed
Next Steps

- Operational support – meetings arranged to start discussions regarding potential of introducing the system into operational use
- Further exemplars being added
- Outcomes analysis starting to occur
- QlikSense tool introduced to (1) provide dashboards on mobile tools, and (2) provide access to dashboards to clinical staff
Summarising

- eMR and other patient information systems integrated and displayed using state-agreed tools
- “Big data” patient information has been sourced, integrated and benefits are starting to be realised
- Clinicians showing interest in the opportunities with integrated data across continuum of care
- Importance of integrated patient information across public and private divide appreciated

But this is just the start of a long journey with “big data” and to improve health outcomes