Big data analysis to improve care and patient safety

Emmanuel Jo, Manager, Analytics and Modelling, Health Workforce New Zealand
A simple example of HWNZ Analytic team’s daily work.

Expressing LOVE in analytic way

\[
\left( y - \sqrt{|x|} \right)^2 + x^2 = 8
\]

Developing algorithms/formulas for health data analysis
Many of us living in Big Data environment

- Electronic Health Record
- Registration data for Regulated Health Workforces
- Electronic HR data
- Claims data (payments)
- No problem with computing power (who uses samples?)
  - Replacing survey by big data analysis
- Big data technology is increasingly popular for its accuracy, and evidence base planning
Conceptual diagram of health service, and health workforce data flow in New Zealand

Public/Private Hospitals
Community Pharmacies

Health Workforce

Responsible Authorities

Service data (patient demographics/diagnosis/procedures etc)
Dispensing data (Chemical name, quantity, date, prescriber etc)

Supply demographic/qualification/work information

Issue Annual Practicing Certificate with registration ID

Provide Health Practitioner Index (HPI) for each practitioner

Supply workforce data

Big data analysis using SAS

Claim for payment for delivered services
Payments using HPI

Supply demographic/qualification/work information

Issue Annual Practicing Certificate with registration ID
Identifying patterns

Big Data: extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions

Patterns for patients
  • Health service utilisation (with data linking between patients-health workforce or practice)
  • Health outcome by age, gender, geographic location

Workforce patterns
  • Profession entry
  • Profession exit
  • Working hours
  • Incidents
    By age, gender, geographic location

Source: http://grigory.us/big-data-class.html
Big Data used for improving diabetes patient care in New Zealand

New Zealand Ministry of Health improves diabetes policy planning with SAS®

Diabetes is a chronic disease affecting many around the world. New Zealand’s Ministry of Health sought to more accurately understand the percentage of its population that suffers from the condition. With the help of SAS’ data analysis capabilities, the ministry created a register to accurately predict the prevalence of the condition and help design effective public health policies to support quality clinical improvements.

SAS’ analytical capabilities have been the key tool in developing the VDR to be very accurate and robust, and revealing a true representation of the diabetes population and analysis.

Tracking the population of diabetics

The Ministry of Health, in collaboration with experts from the New Zealand Society for the Study of Diabetes (NZSSD), established a Virtual Diabetes Register (VDR) that combines and filters various sources of health information to more accurately determine how many people are diagnosed with the condition, as well as predicting who is likely to develop it in the future.

DR. Paul Drury, Clinical Director of the Diabetes Auckland Center and Medical Director of NZSSD, Dr. Sandy Dawson, Chief Clinical Advisor, and Emmanuel Jo, Principal Technical Specialist at Health Workforce New Zealand, Ministry of Health, have all been instrumental in the establishing the VDR.

"Previously, we would use national surveys to measure diabetes in the community; however, this proved to be slow, costly and have a high error rate," Jo says. "Now, the quality of data within the VDR is offering the accuracy and immediacy we need.”
Identifying diabetes patients by combining large set of data sets – more than 100 million rows of data

Development of a Virtual Diabetes Register using Information Technology

Virtual Diabetes Registry (VDR)
Use of Virtual Diabetes Register (VDR) feedback loop in New Zealand

Figure 2. Health information flow in relation to diabetes mellitus in New Zealand.
Big data for linking patient and Health Workforce for the whole country

• Which primary care provider has less avoidable hospitalisations
• Which place has less still birth
• Which place has
• Identifying practice patterns
  • What improvement can we make?
  • What if intervention can we introduce
  • What if analysis by changing provider/patient centric plasticity matrix
  • Why?
Large datasets that existed independently

**National Minimum Dataset**
Hospital Events e.g. Ambulatory Sensitive Hospitalisations

**National Health Index**
Patient Demographics

**Community Services Card**
Providers cheaper healthcare costs

**Facility Code Table**
List of health facilities in NZ

**PHO Enrolment Collection**
(PHO enrollees in each General Practice)

**GP Provider List**
Number of doctors in each General Practice

**Medical Council Registration Database**
Doctors qualifications, scope of practice
Identifying patterns using many variables

• Measuring Ambulatory Sensitive (avoidable) hospital admissions for entire New Zealand, and identify patient profile
  • age
  • gender
  • ethnicity
  • deprivation
  • rurality score
  • available number of Doctors, Nurses, Physios, Midwives around patients
  • copayment price
  • primary care practice visiting patterns
  • distance to
### Primary Care Integrated System

4.5 million rows of individual-level data

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#### Table: Patient - General Practice - Workforce Integration

<table>
<thead>
<tr>
<th>Patient ID</th>
<th>Name of General Practice</th>
<th>Number of doctors</th>
<th>Number of enrolees</th>
<th>Number of Māori</th>
<th>Number of Pacific people</th>
<th>Number of European/Other</th>
<th>Number of CSC holders</th>
<th>Average deprivation index</th>
<th>Number of ASH events</th>
<th>Distance to General Practice</th>
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</thead>
<tbody>
<tr>
<td>wNTQ1aqIgG</td>
<td>Practice A</td>
<td>2</td>
<td>1,462</td>
<td>667</td>
<td>527</td>
<td>268</td>
<td>856</td>
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<td>60</td>
<td>2.1 Km</td>
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<tr>
<td>LVIHahOfCM</td>
<td>Practice B</td>
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<td>935</td>
<td>873</td>
<td>1,781</td>
<td>293</td>
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<td>21</td>
<td>2.5 Km</td>
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<tr>
<td>Bev26yQ04J</td>
<td>Practice C</td>
<td>2</td>
<td>1,892</td>
<td>305</td>
<td>472</td>
<td>1,115</td>
<td>172</td>
<td>2</td>
<td>43</td>
<td>3.8 km</td>
</tr>
</tbody>
</table>

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**Diagram:** Map of New Zealand showing the distribution of general practices and patient data.
Distribution of General Practitioners (GP) & Primary Health Care (PHO) enrollees

- Solo GP
- 2 or more GPs

Number of PHO enrollees (high to low)

Next step? look at Solo GPs with age 65+?
MidCentral District Health Board – location of GP practices & infant enrollees with an ASH events
Big data used in regulated workforce projection/planning

https://positivpsychologyprogram.com/affective-forecasting/
Conceptual diagram of workforce simulation

For each scope and any geographical sub group
Emmanuel wins Data Olympics at International Health Workforce Collaborative

Updated on 8 November, 2016 - 14:33

Emmanuel Jo, Principal Technical Specialist, from Workforce Education Intelligence and Planning, HWNZ, People and Transformation, has taken out the top prize at the 'Data Olympics' held as part of the recent International Health Workforce Collaborative (IHWC).

![Emmanuel Jo and HWNZ Board Executive Chair Professor Des Gorman](image)

The 16th Collaborative was held in Washington, DC from 24-28 October 2016 hosted at Association of American Medical Colleges. The invitation only conference, provided delegates with a unique opportunity to discuss key global and local workforce issues in the United States, Canada, the United Kingdom, Australia and New Zealand. This is first time the New Zealand Ministry of Health participated in the IHWC.

Emmanuel gave an outstanding presentation at the Data Olympics and won gold for New Zealand in challenge 1.

The 'Data Olympics' explored three challenges:

- How are you modelling future health workforce supply, accounting for workforce and broader health system changes?
Using Big Data to forecast Midwives in New Zealand

**National All Midwives Workforce by Age Group - Head Count**

- National All Midwives Workforce as at 2016
- 2016 workforce as at 2016
- New/Re-Entries Since 2016 as at 2016

2016 Total: 3023

**National All Midwives Workforce by Age Group - FTE**

- National All Midwives Workforce as at 2016
- 2016 workforce as at 2016
- New/Re-Entries Since 2016 as at 2016

2016 Total FTE: 2490.1

Age group:
- 20-24
- 25-29
- 30-34
- 35-39
- 40-44
- 45-49
- 50-54
- 55-59
- 60-64
- 65-69
- 70-74
- 75+

Number of workforce - HC

Number of workforce - FTE
Using Big Data to forecast Midwives in New Zealand
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Using Big Data to forecast Midwives in New Zealand

![Graph showing the national midwives workforce by age group - head count and FTE. The graphs display the workforce distribution across different age groups for both head count and full-time equivalent (FTE) calculations. The data is compared for the years 2016 and 2020, with a total head count of 3023 in 2016 and 3025 in 2020. The total FTE for 2016 is 2490.1, and for 2020, it is 2484.6.]
Using Big Data to forecast Midwives in New Zealand

National All Midwives Workforce by Age Group - Head Count

- National All Midwives Workforce as at 2016
- 2016 workforce as at 2021
- New/Re-Entries Since 2016 as at 2021

2016 Total: 3023
2021 Total: 3020

National All Midwives Workforce by Age Group - FTE

- National All Midwives Workforce as at 2016
- 2016 workforce as at 2021
- New/Re-Entries Since 2016 as at 2021

2016 Total FTE: 2490.1
2021 Total FTE: 2477.6
Using Big Data to forecast Midwives in New Zealand
Using Big Data to forecast Midwives in New Zealand

National All Midwives Workforce by Age Group - Head Count

- National All Midwives Workforce as at 2016
- 2016 workforce as at 2023
- New/Re-Entries Since 2016 as at 2023

2016 Total: 3023
2023 Total: 3009

National All Midwives Workforce by Age Group - FTE

- National All Midwives Workforce as at 2016
- 2016 workforce as at 2023
- New/Re-Entries Since 2016 as at 2023

2016 Total FTE: 2490.1
2023 Total FTE: 2463.2
Using Big Data to forecast Midwives in New Zealand
Using Big Data to forecast Midwives in New Zealand
Using Big Data to forecast Midwives in New Zealand

![Graph showing the national midwives workforce by age group in New Zealand.](image_url)
National, employment and region specific forecasting

= 43 supply models

National workforce

National DHB workforce

Regional DHB workforce

National LMC workforce

Regional LMC workforce
How the results being used?

• Health workforce plan for patient care and safety (prepare for future shortage or over supply)
  • Changing government policies (immigration rules)
  • Introduction/review of workforce bonding program
  • Share results and working together with colleges, universities, Ministry of Education, Immigration department
Essential environment for productive Big Data analysis

Continues improvements in
• data collection
• analysis system
• analytic human recourses
• developing better analysis techniques
Conclusions

• Good data collection system is essential for using BIG DATA
• Endless user case of Big Data for improving patient care, safety, planning of regulated health workforces development
  • Patient care
  • Workforce care and projection
  • Workforce regulations
  • Improving health policies
  • Establishing system to prevent mistakes (drug prescriptions)
  • Identifying patterns for incidents (medical misadventures) to allow to look at possible improvements (regulation, education etc)