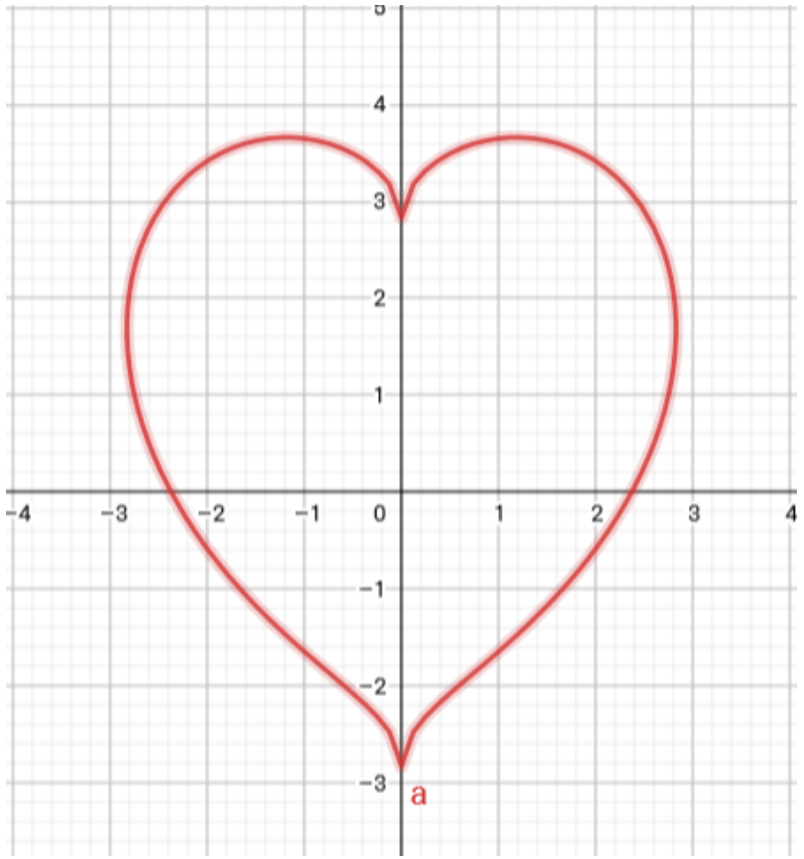
Big data analysis to improve care and patient safety

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

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

Claim for payment for delivered services

Payments using HPI

Provide Health Practitioner Index (HPI) for each practitioner

Supply workforce data

Big data analysis using SAS

Health Workforce

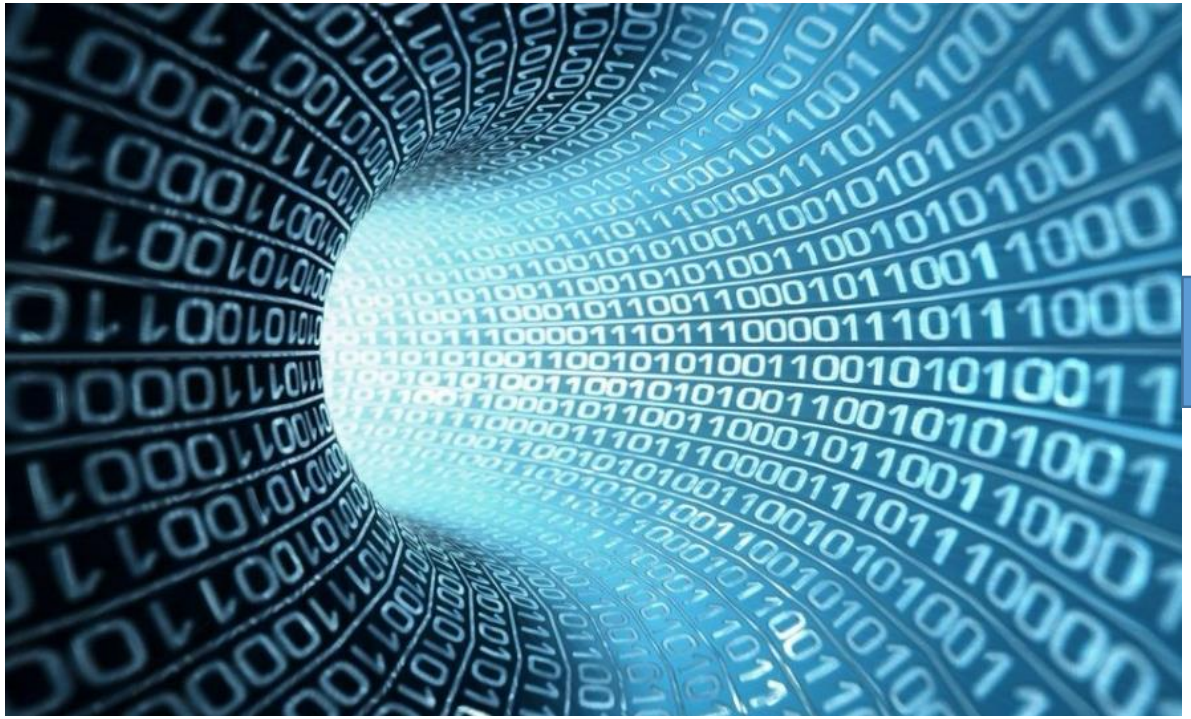
Supply demographic /qualification / work information

Issue Annual Practicing Certificate with registration ID

Responsible Authorities

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



Source: http://grigory.us/big-data-class.html

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

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.

Emmanuel Jo
Principal Technical Specialist at Health Workforce New Zealand, Ministry of Health

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."

Challenge

Information surrounding the number of people in New Zealand with diabetes was considered to be inaccurate; health policies were not as effective as they could be.

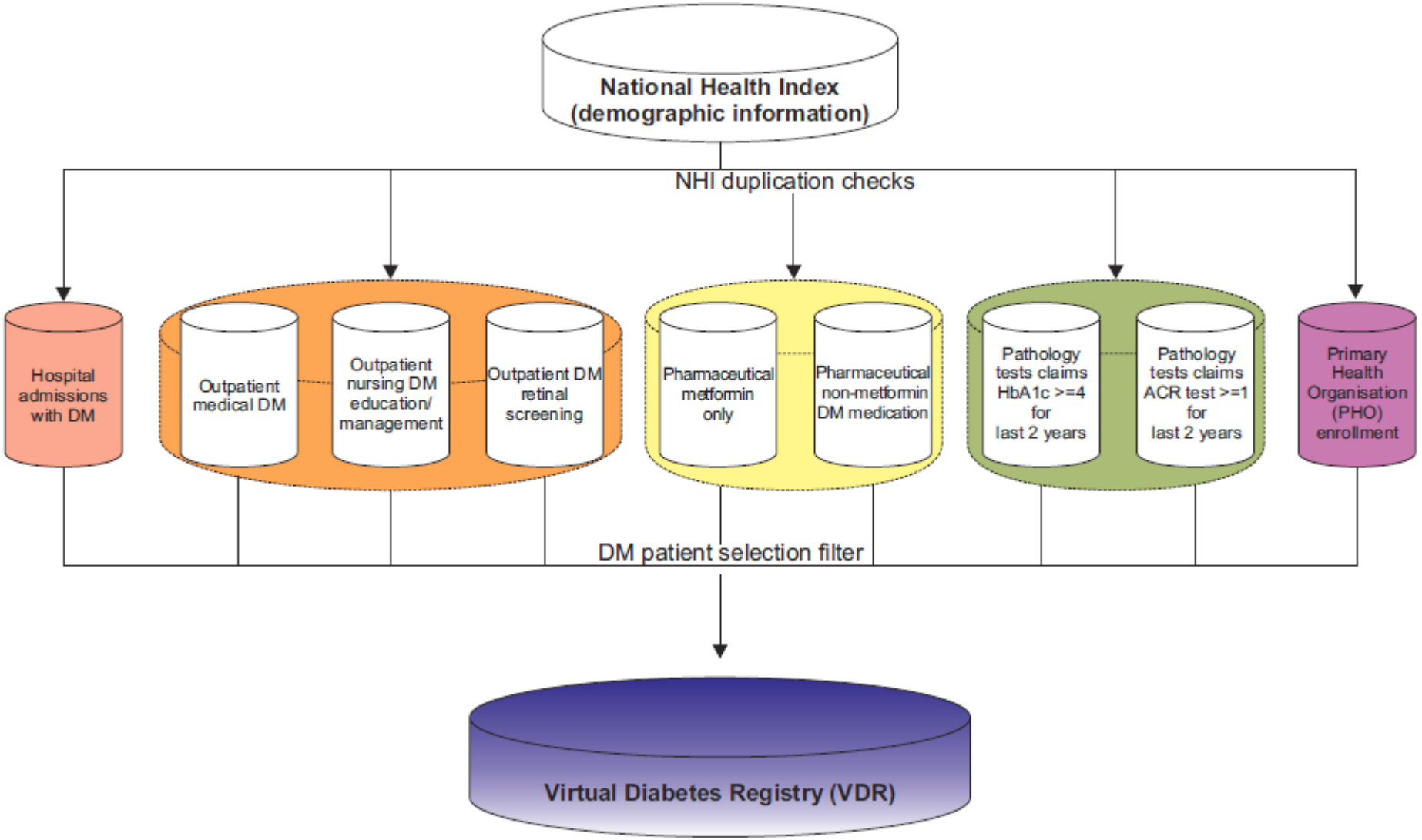
Benefits

- Linked six data sources and integrated those sources with patient's heath number.
- Identified cohorts with increased prevelance rate.
- Can predict who may be at risk to ensure appropriate resources are available.

Identifying diabetes patients by combining large set of data sets – more than 100 million rows of data

HIR Healthcare Informatics Research

Development of a Virtual Diabetes Register using Information Technology



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

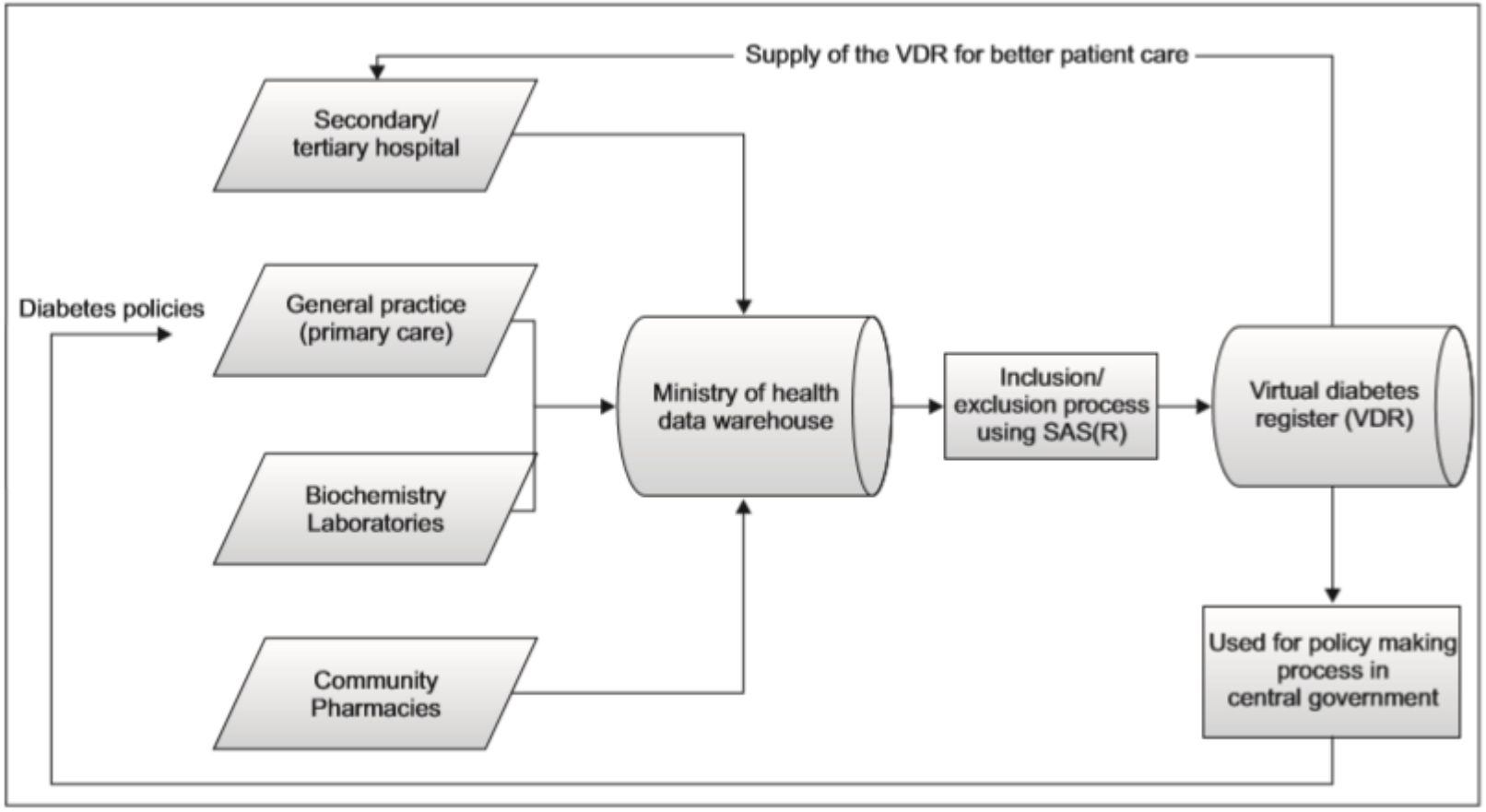


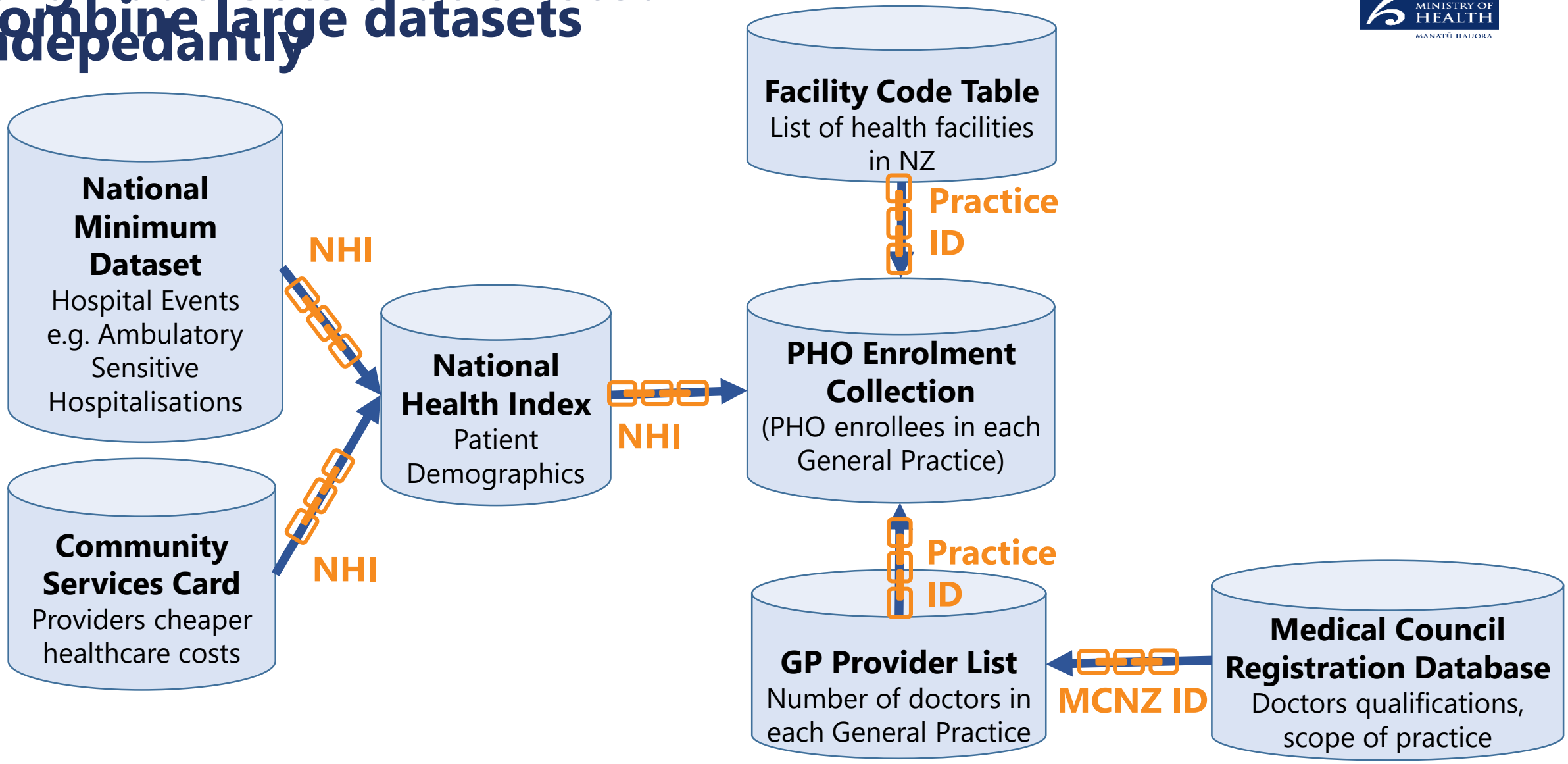
Figure 2. Health information flow in relation to diabetes mellitus in New Zealand.

https://www.e-hir.org/Synapse/Data/PDFData/1088HIR/hir-21-49.pdf

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 Combine large datasets indepedantly



Identifying patterns using many variables

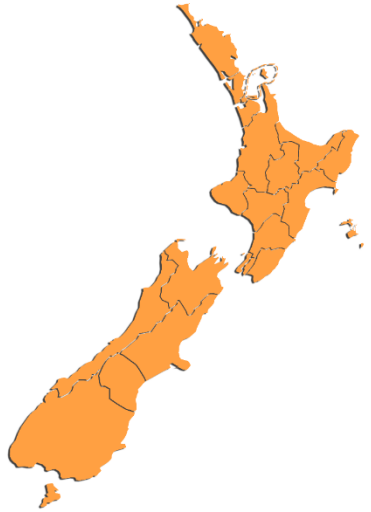
- Measuring Ambulatory Sensitive (avoidable) hospital admissions for entire New Zealand, and identify patient profile
  - age
  - gender
  - ethnicity
  - deprivation
  - rurality score
  - available number of Doctors, Nurses, Physios, Midwives around patients
  - copayment price
  - primary care practice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

Patient ↔ Hospital Event ↔ General Practice ↔ Workforce

Primary Care Integrated System

4.5 million rows of individual-level data

=



Patient	General Practice		Patients							
NHI number	Name of General Practice	Number of doctors	Number of enrolees	Number of Māori	Number of Pacific people	Number of European/Other	Number of CSC holders	Average deprivation index	Number of ASH events	ce to l e
wNTQ1aqlG	Practice A	2	1,462	667	527	268	856	8	60	
LVlHhahOfC M	Practice B	4	3,589	935	873	1,781	293	6	21	
Bev26yQ043	Practice C	2	1,892	305	472	1,115	172	2	43	

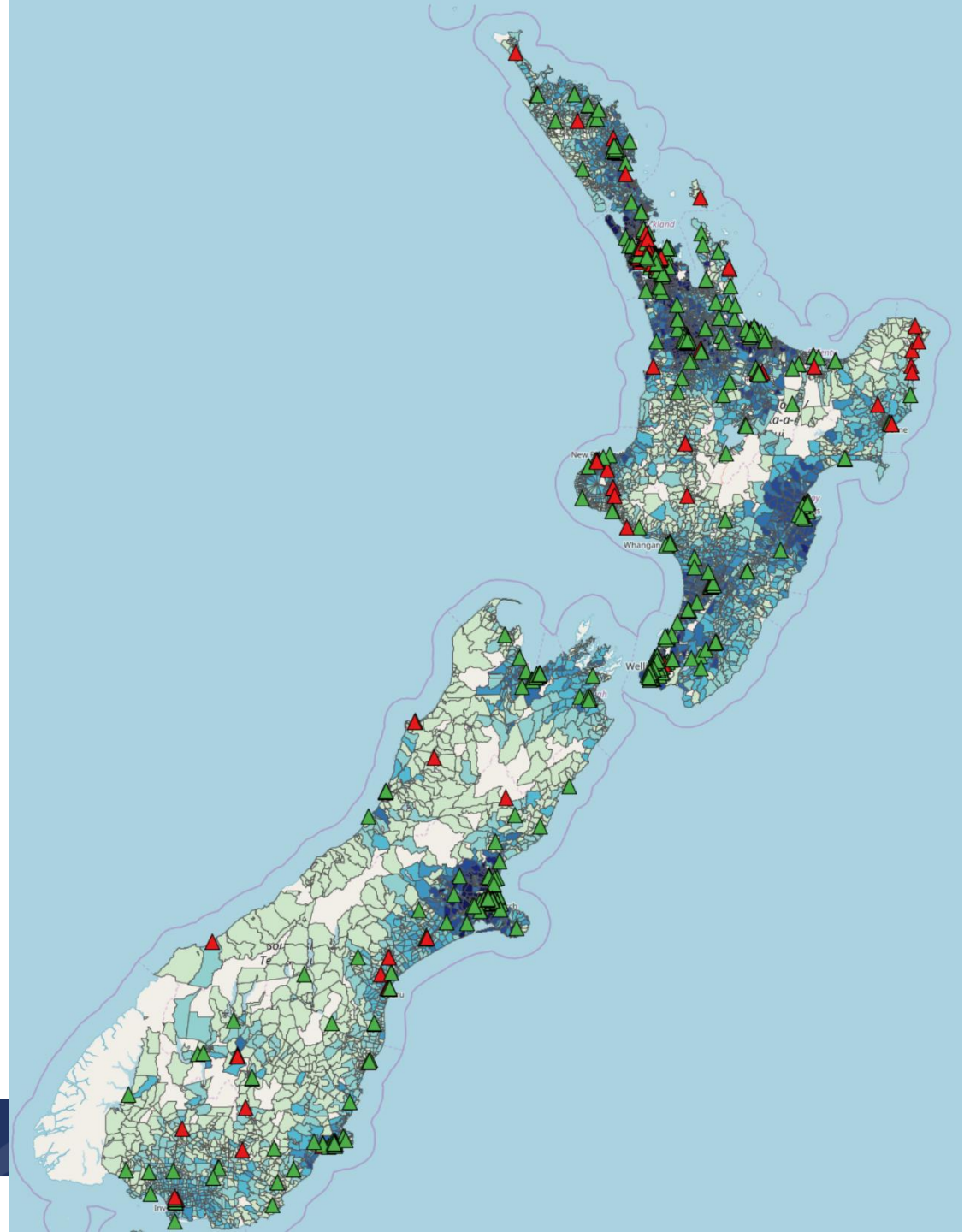
Distribution of General Practitioners (GP) & Primary Health Care (PHO) enrollees

Solo GP

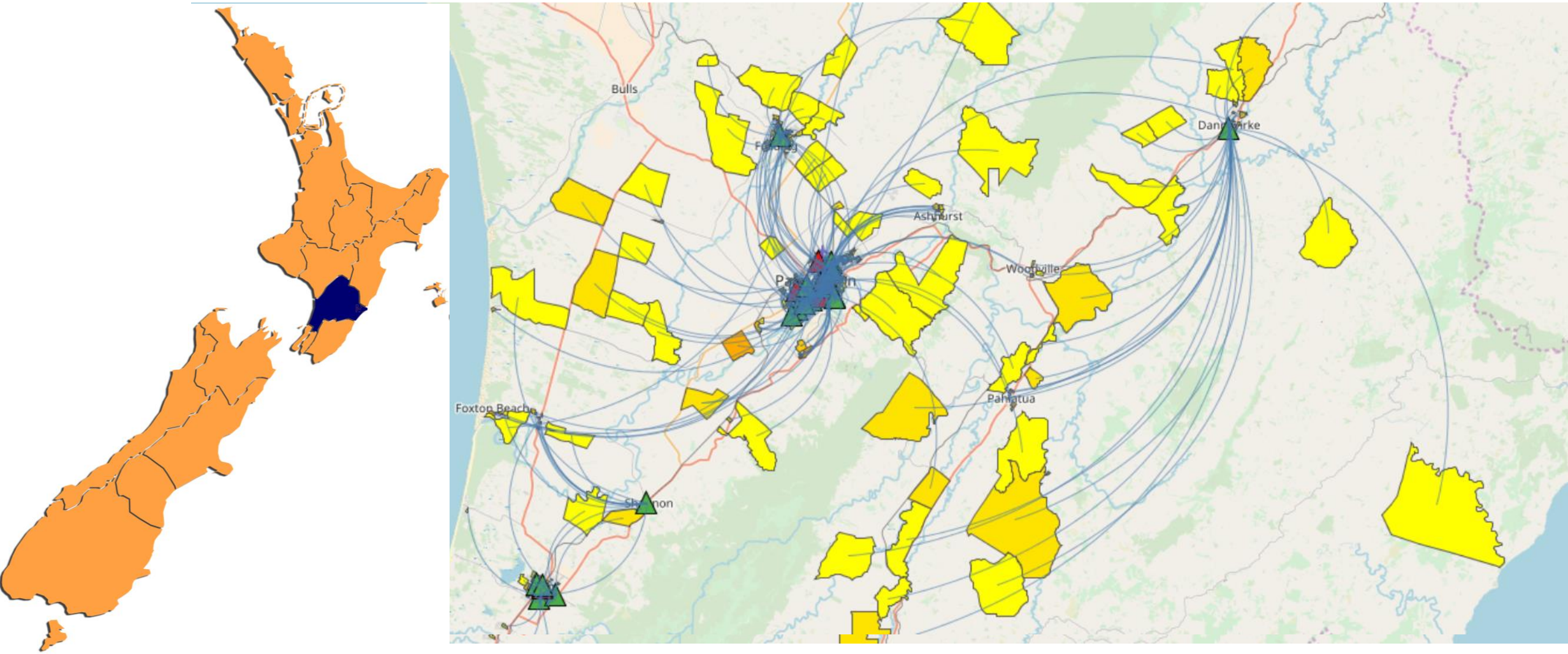
2 or more GPs

Number of PHO enrolees (high to low)

Next step? look at Solo GPs with age 65+?



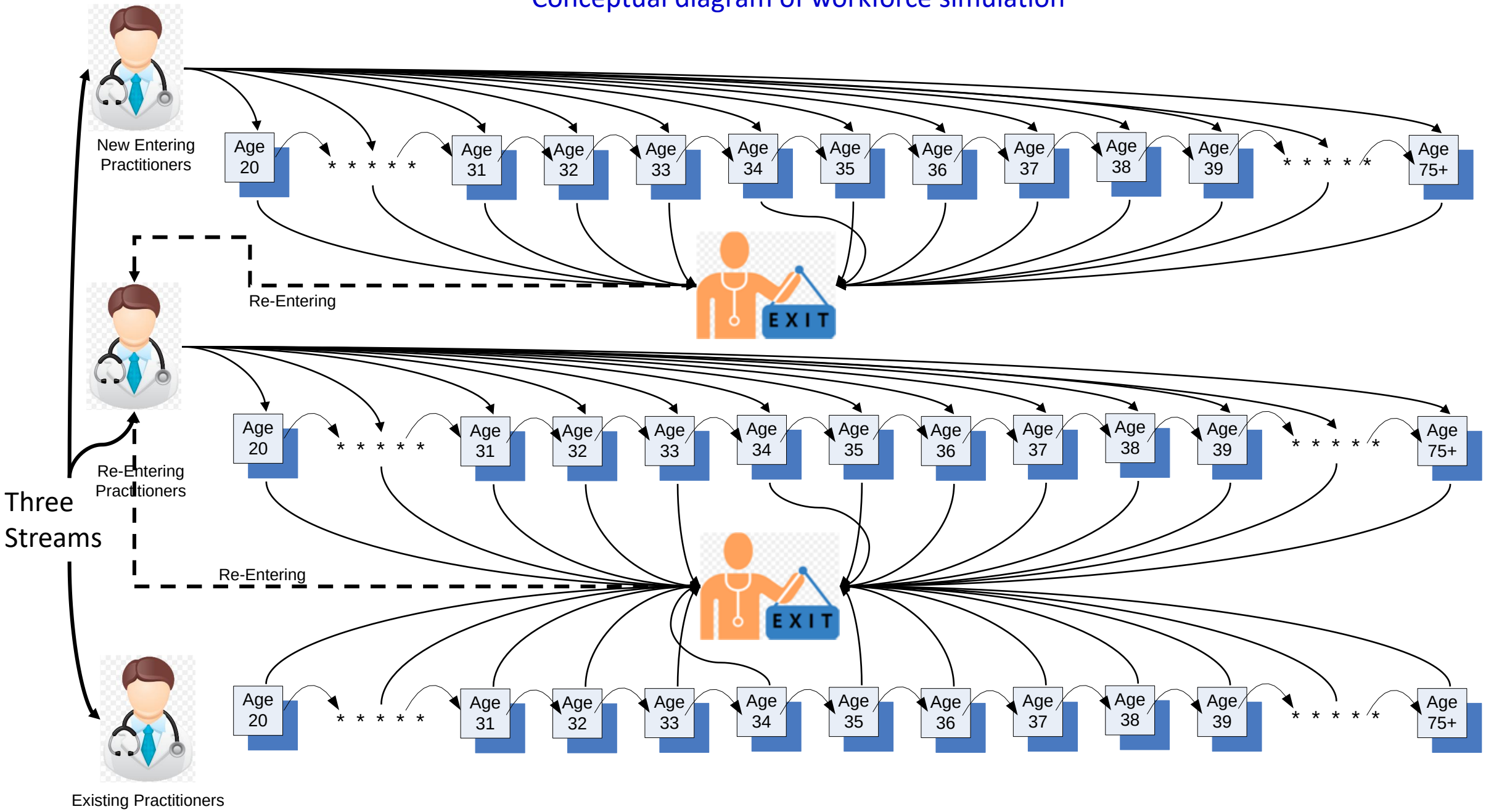
MidCentral District Health Board – location of GP practices & infant enrollees with an ASH events



Big data used in regulated workforce projection/planning

https://positivepsychologyprogram.com/affective-forecasting/

Conceptual diagram of workforce simulation

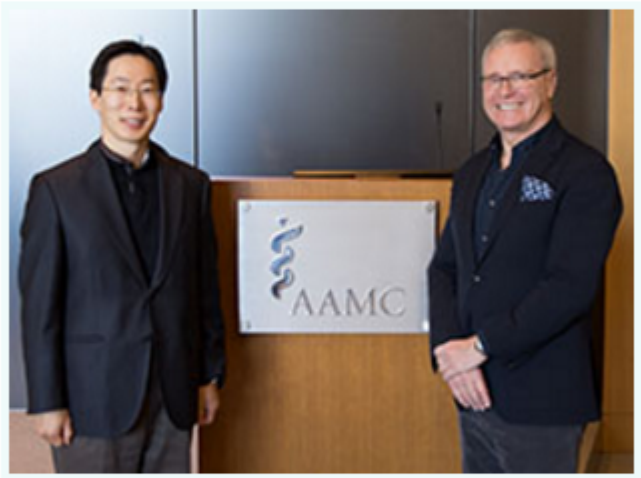


For each scope and any geographical sub group

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).



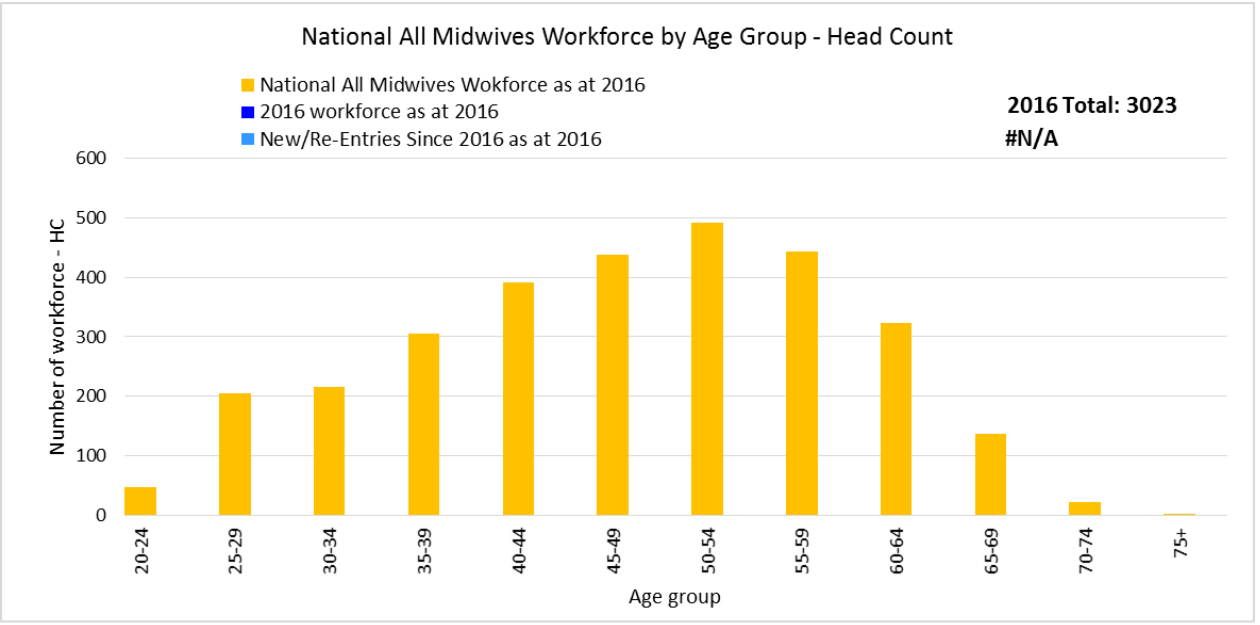
Emmanuel Jo and HWNZ Board Executive Chair Professor Des Gorman

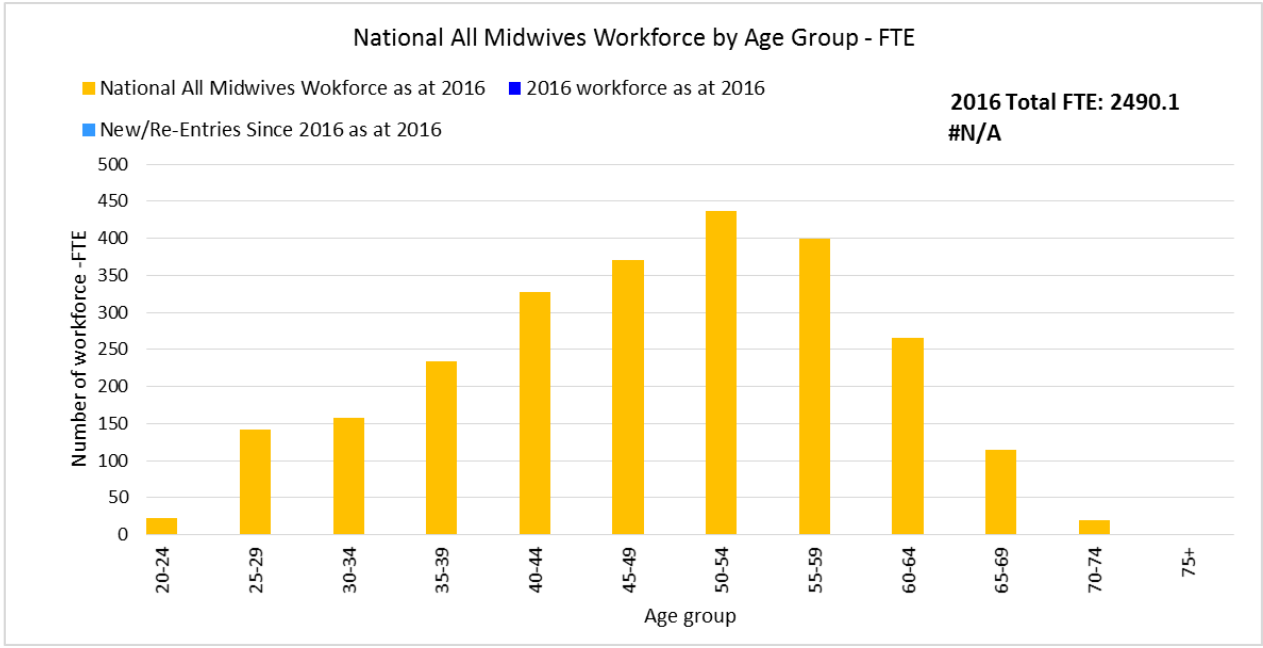
The 16th Collaborative was held in Washington, DC from 24-28 October 2016 hosted at Association of American Medical Colleges. The invitation only conference, provided delegates with a unique opportunity to discuss key global and local workforce issues in the United States, Canada, the United Kingdom, 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:

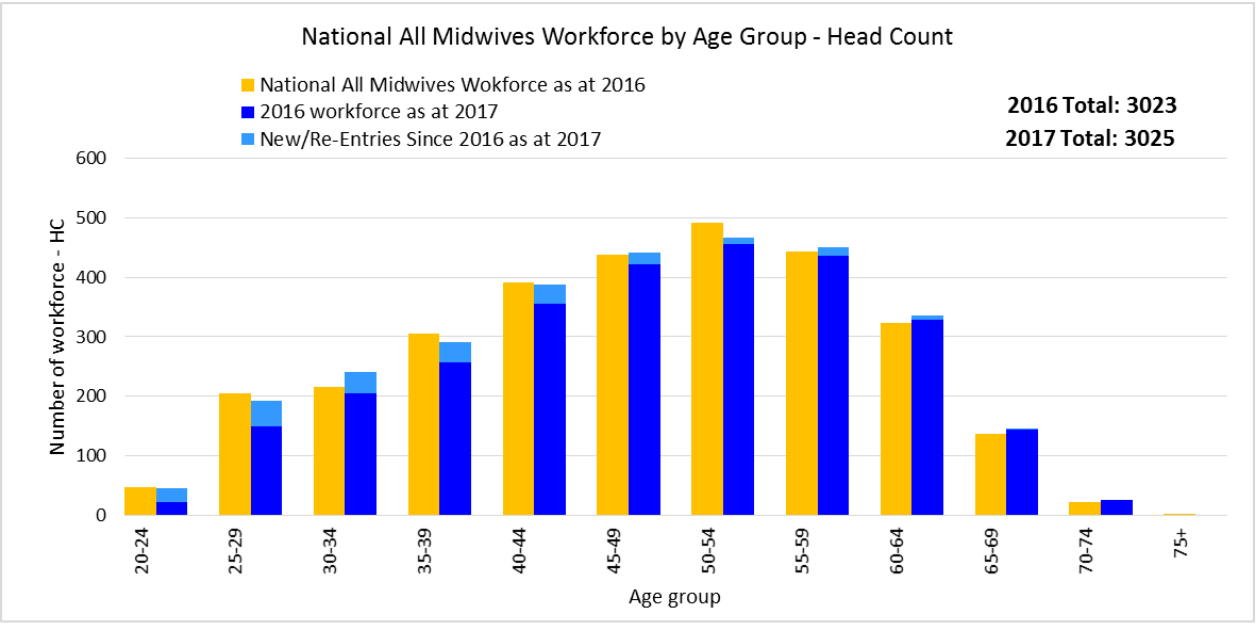
- How are you modelling future health workforce supply, accounting for workforce and broader health system changes?

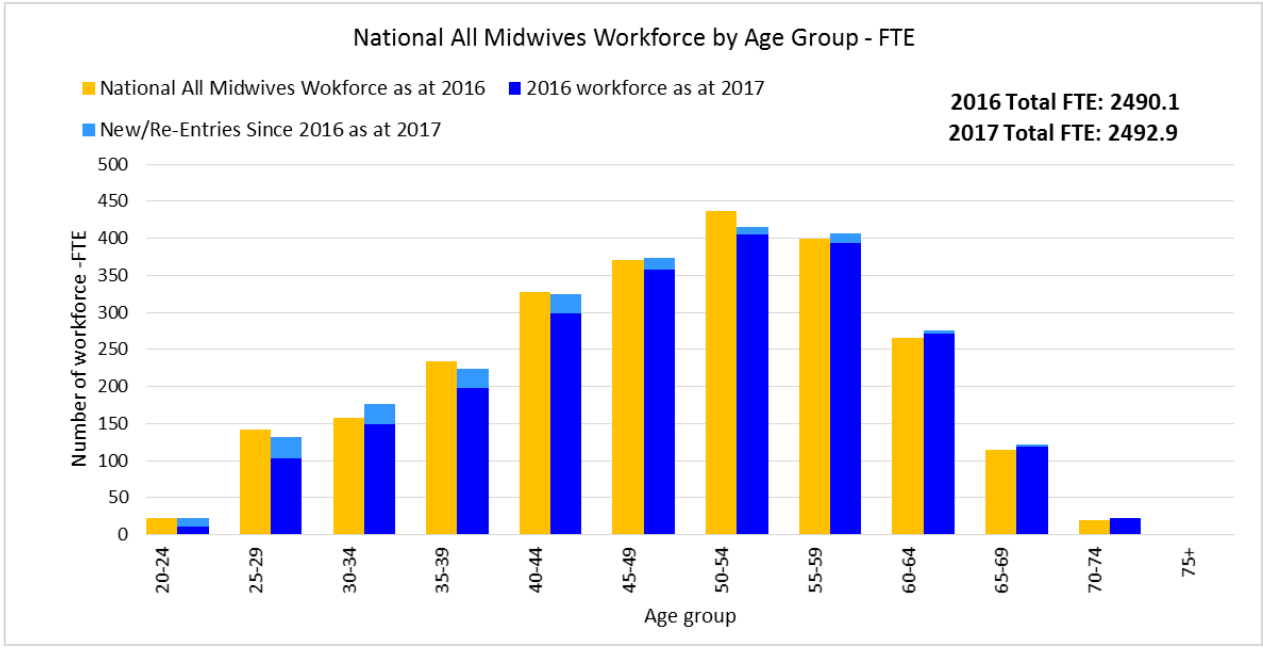
Using Big Data to forecast Midwives in New Zealand



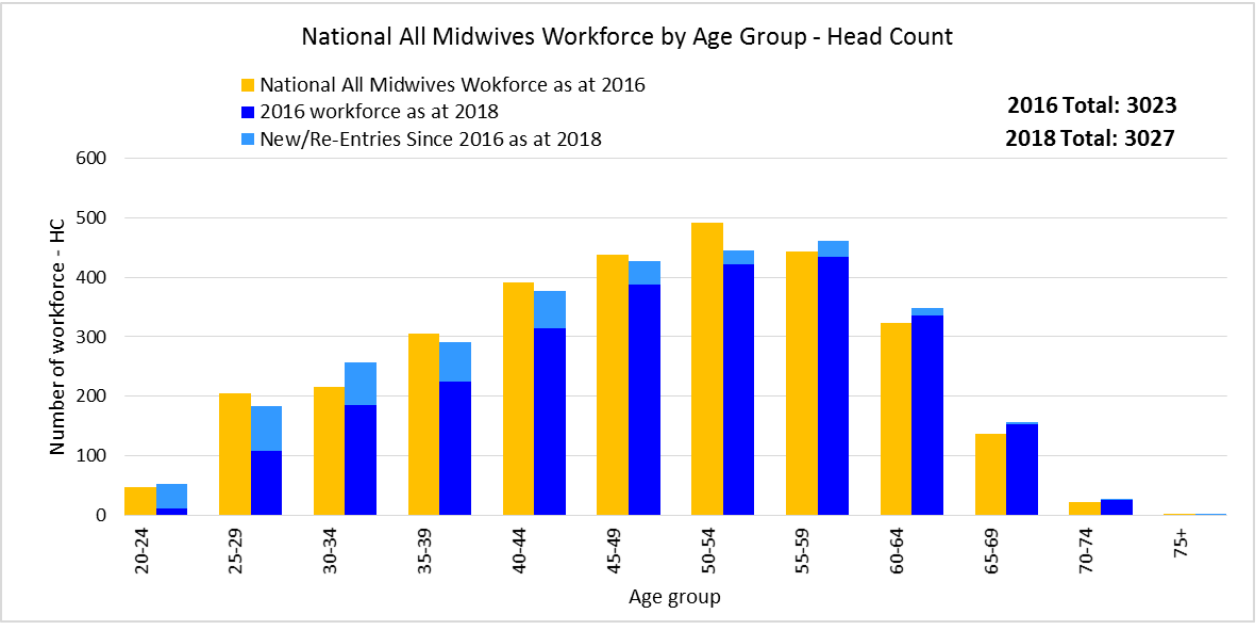


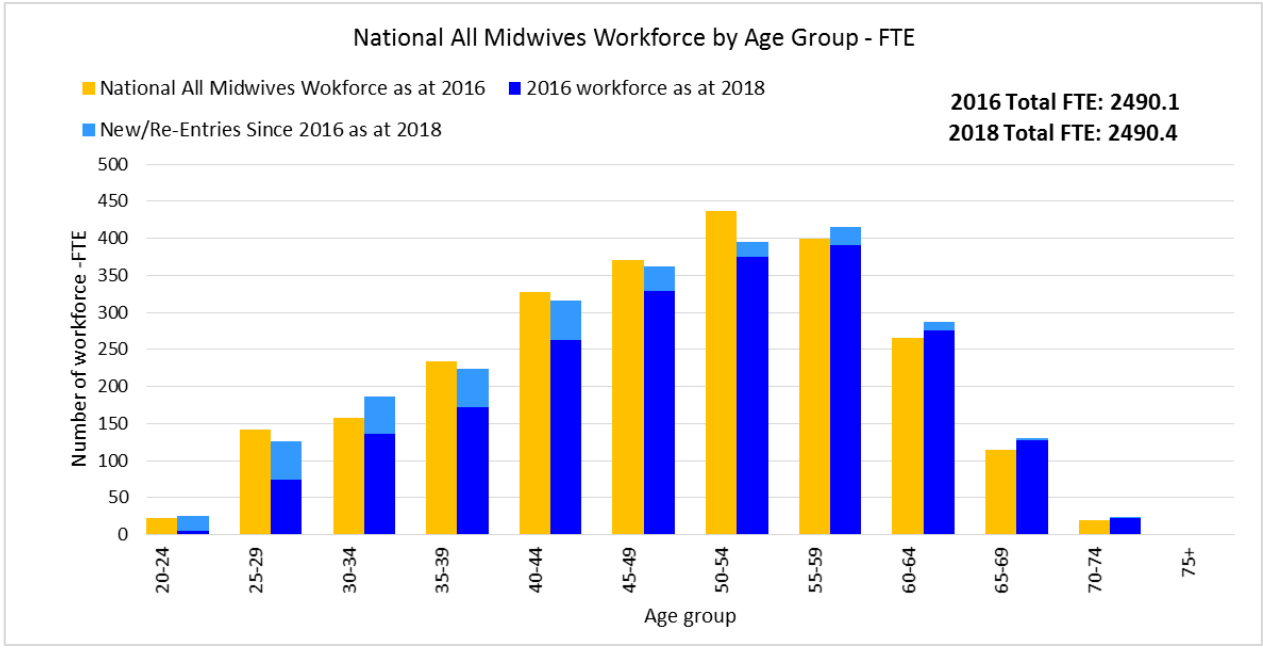
Using Big Data to forecast Midwives in New Zealand



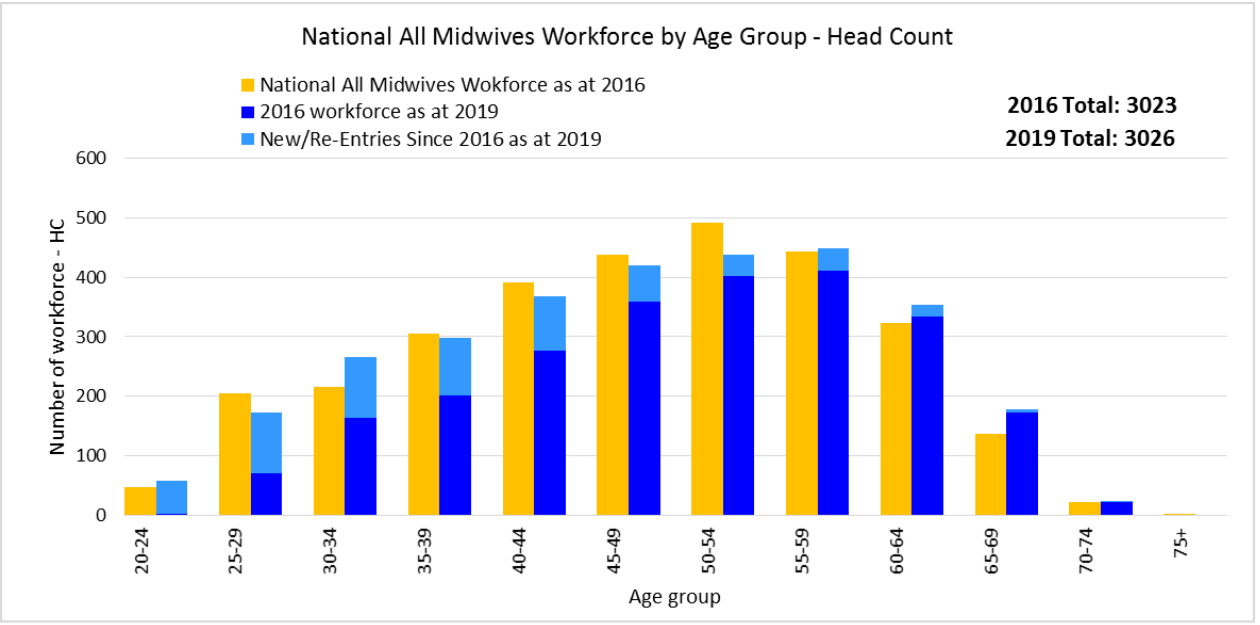


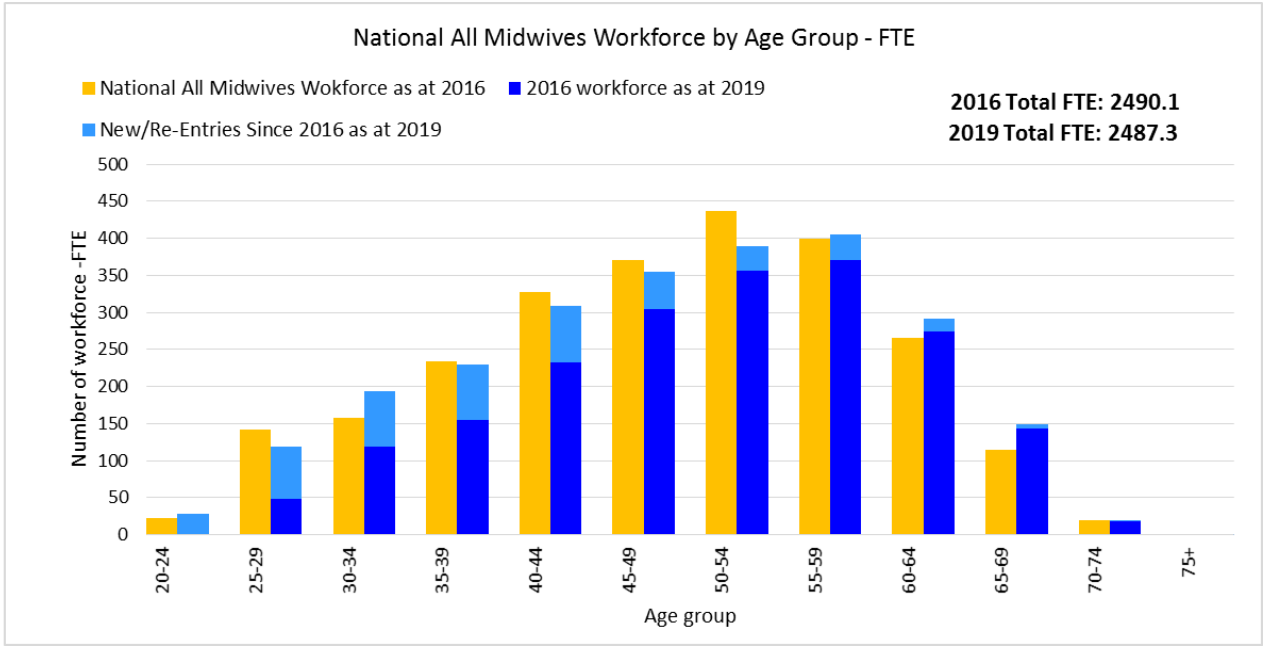
Using Big Data to forecast Midwives in New Zealand



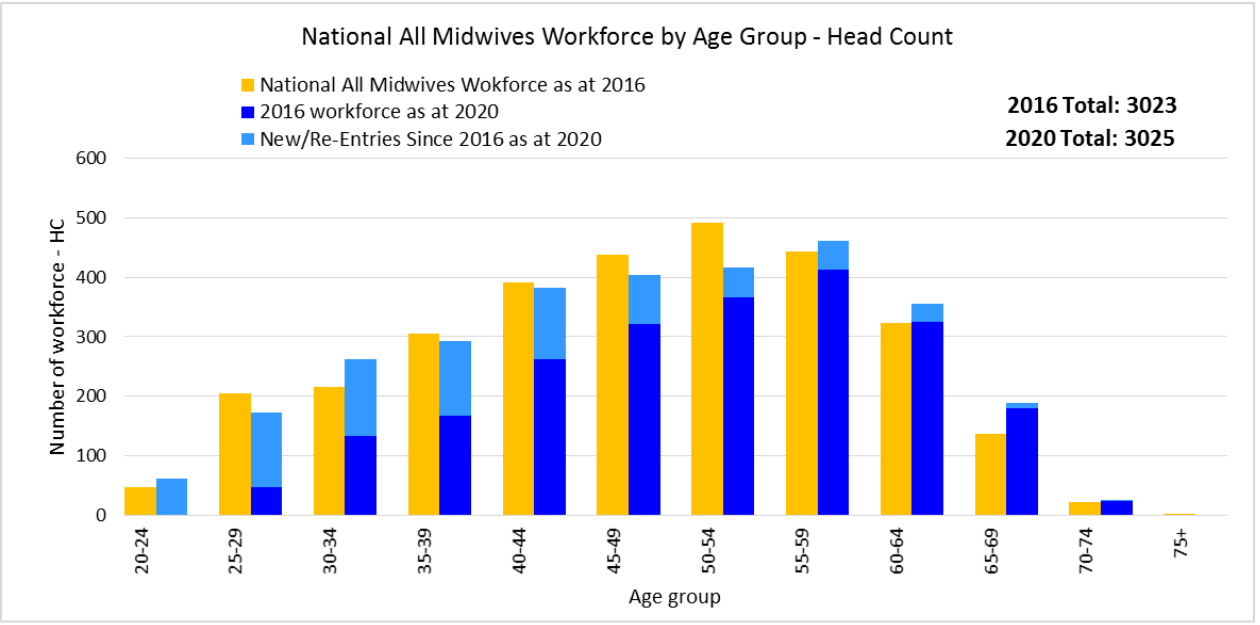


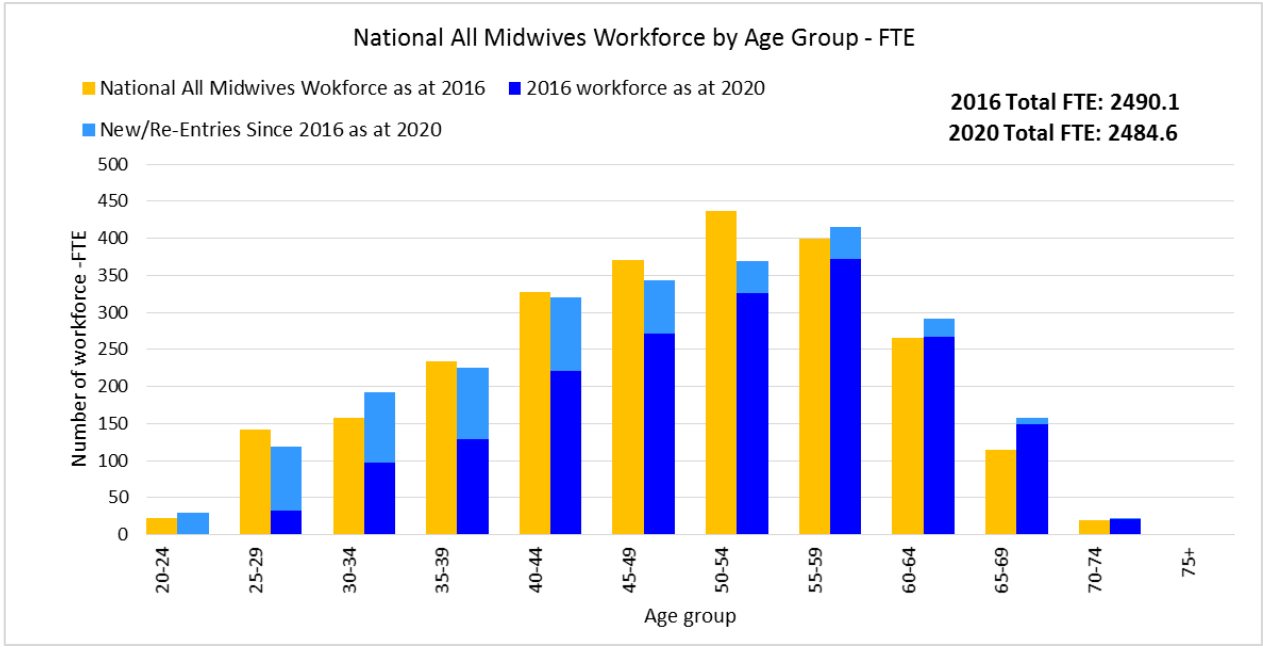
Using Big Data to forecast Midwives in New Zealand



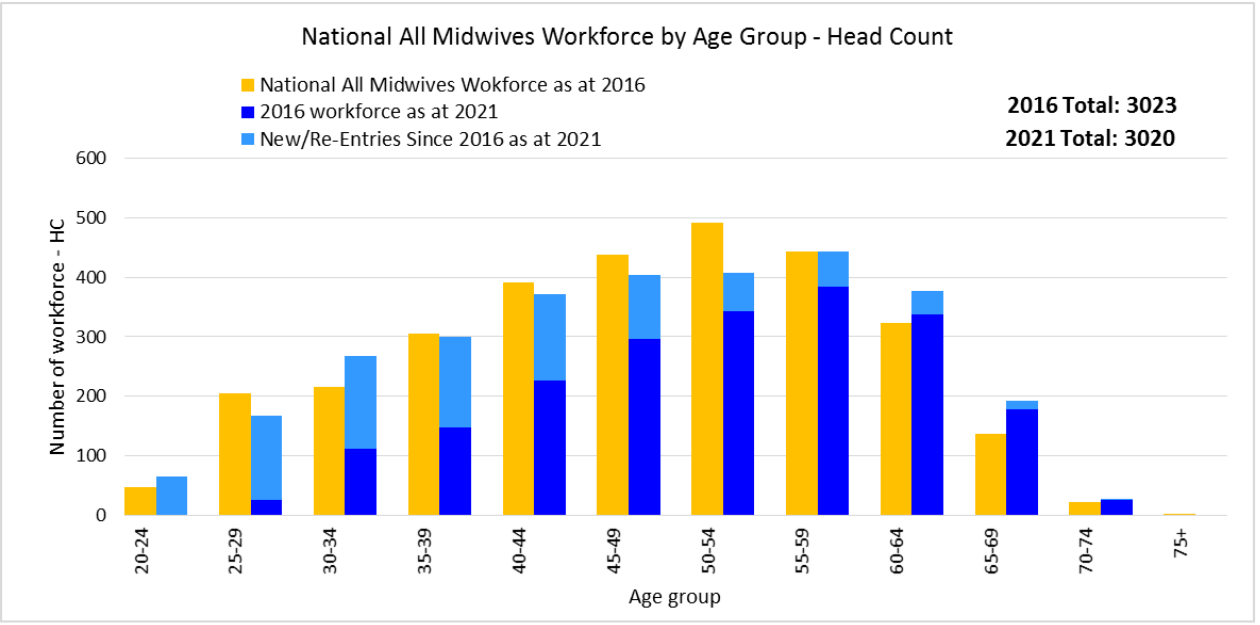


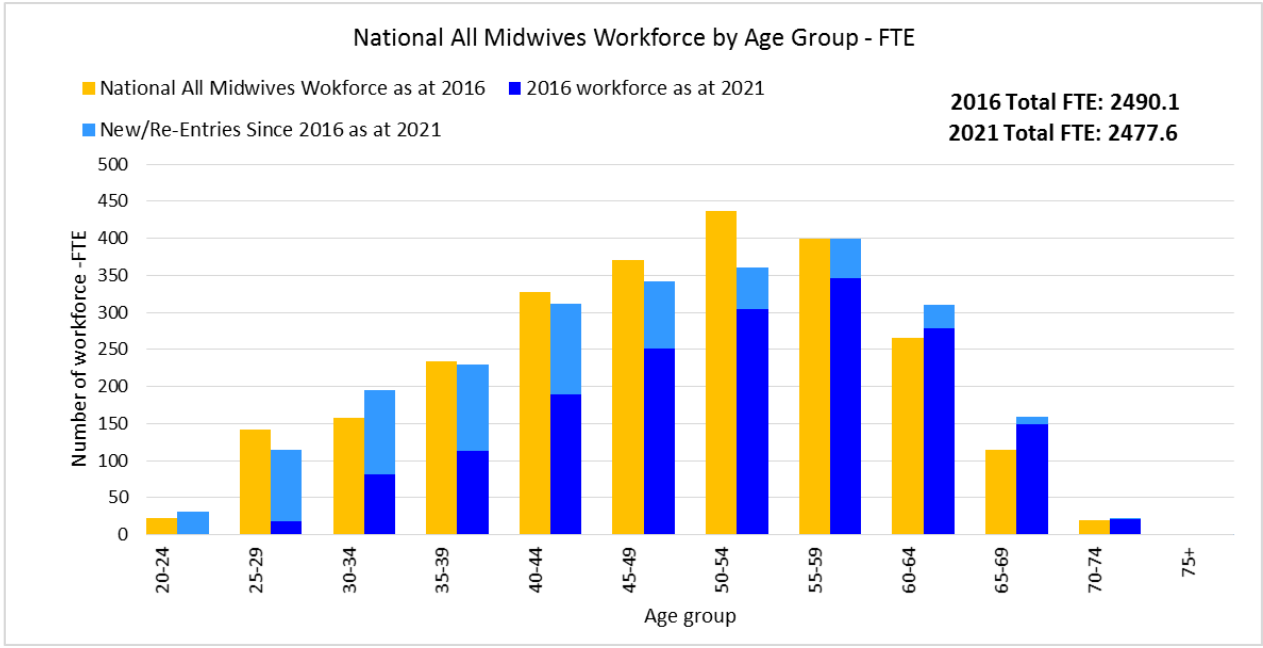
Using Big Data to forecast Midwives in New Zealand



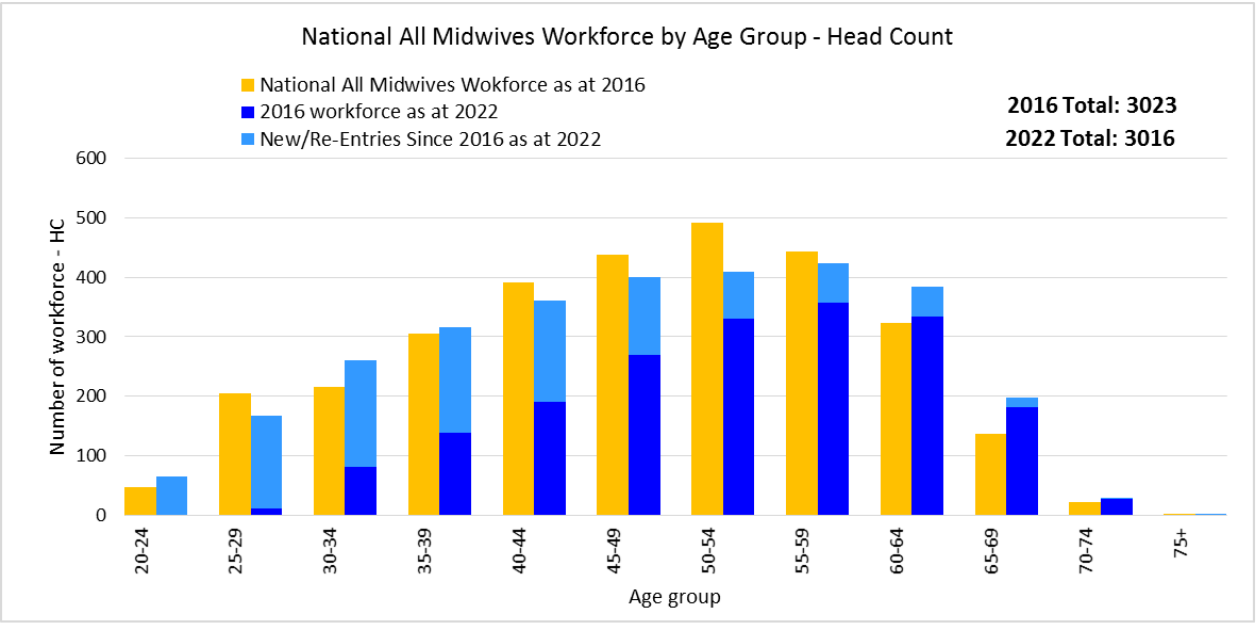


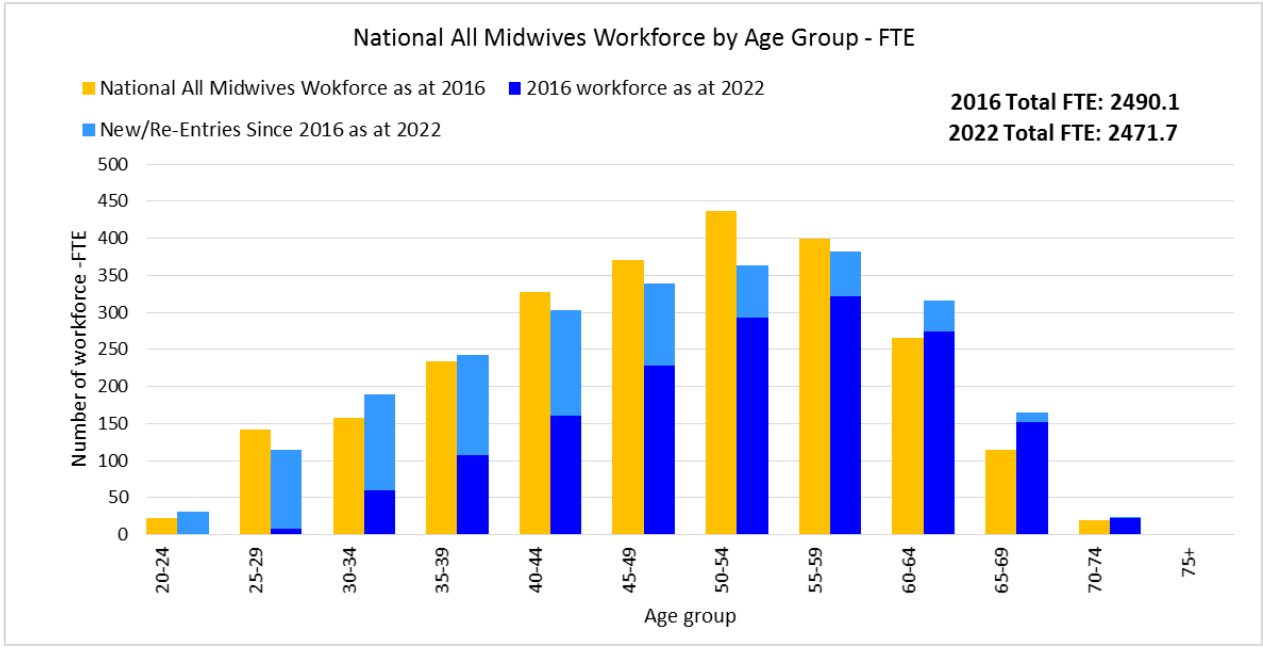
Using Big Data to forecast Midwives in New Zealand



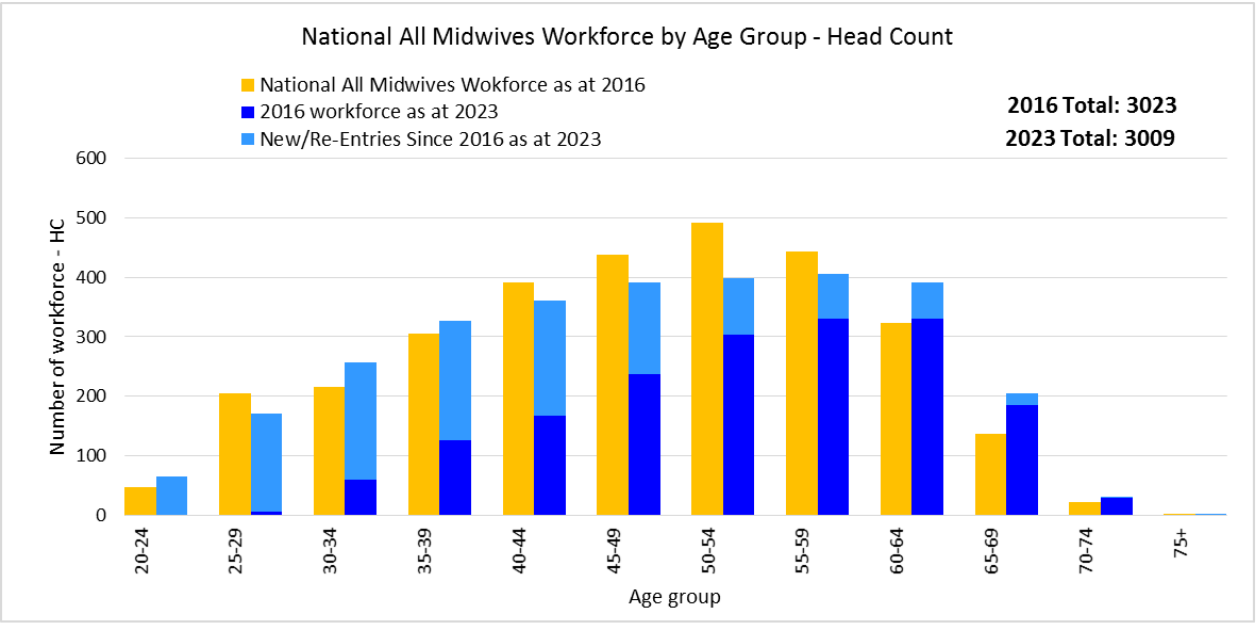


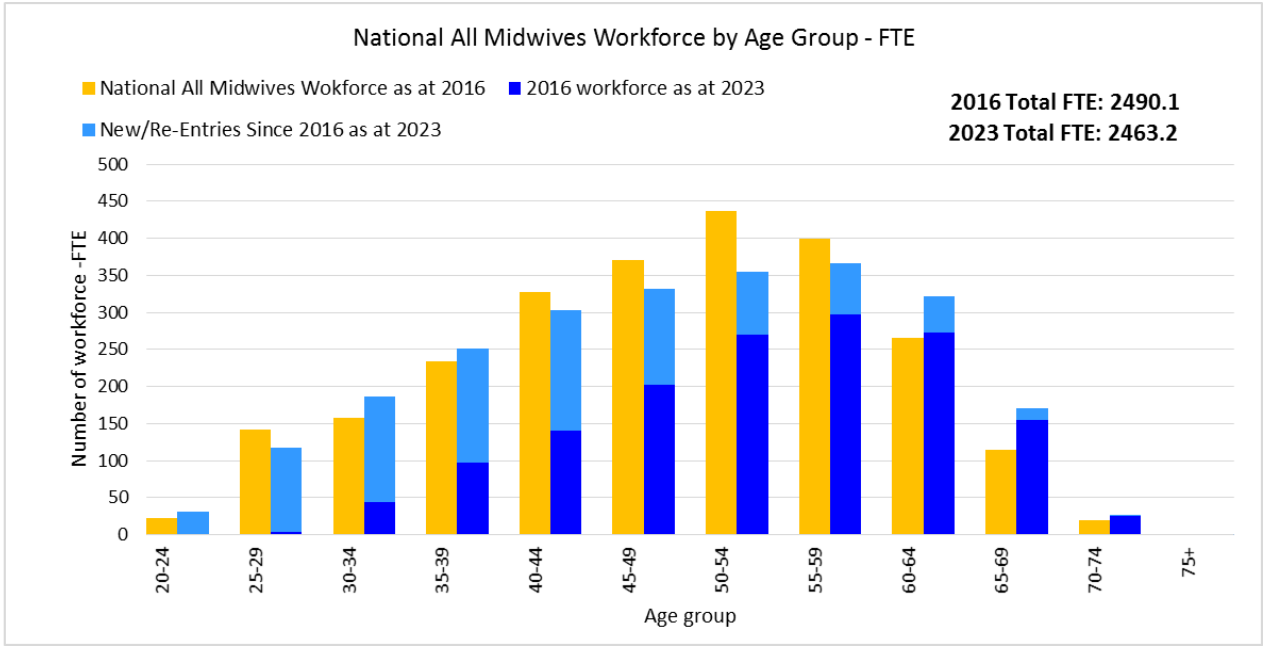
Using Big Data to forecast Midwives in New Zealand



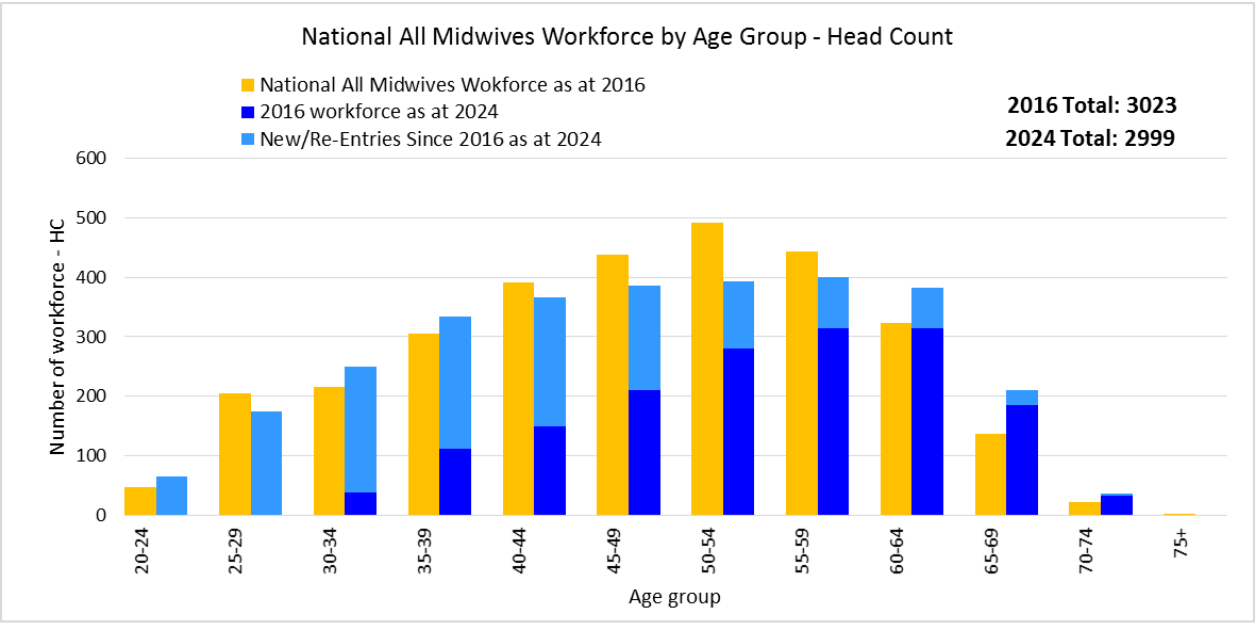


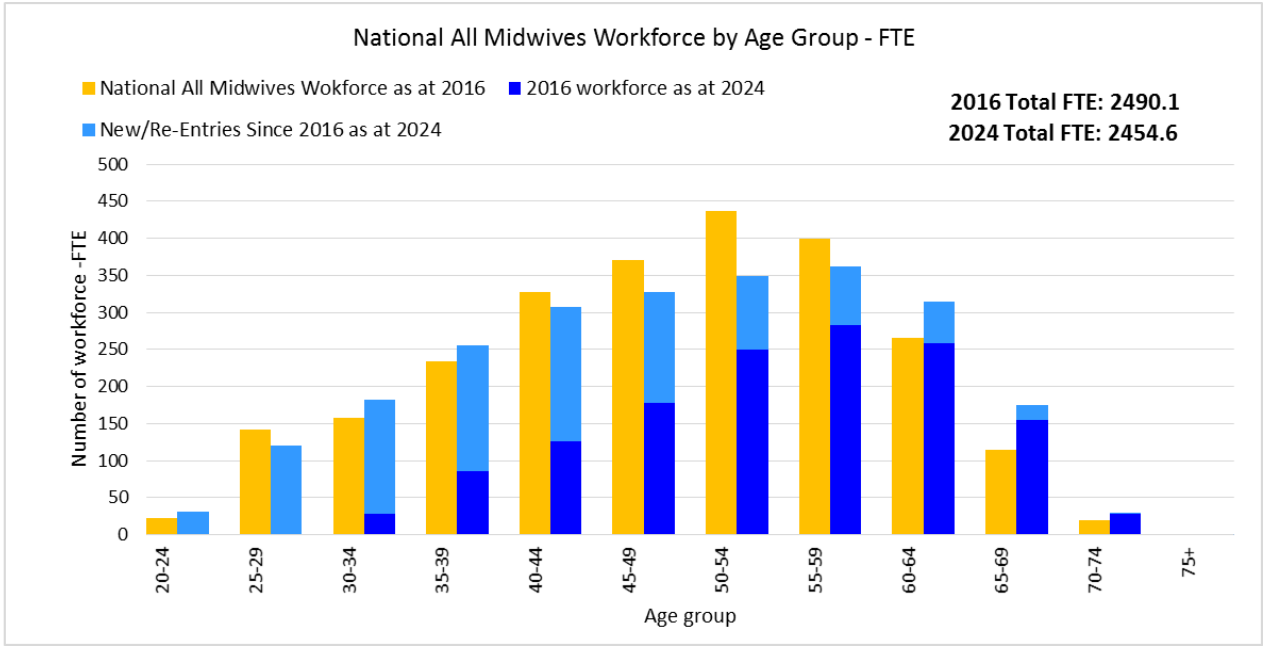
Using Big Data to forecast Midwives in New Zealand



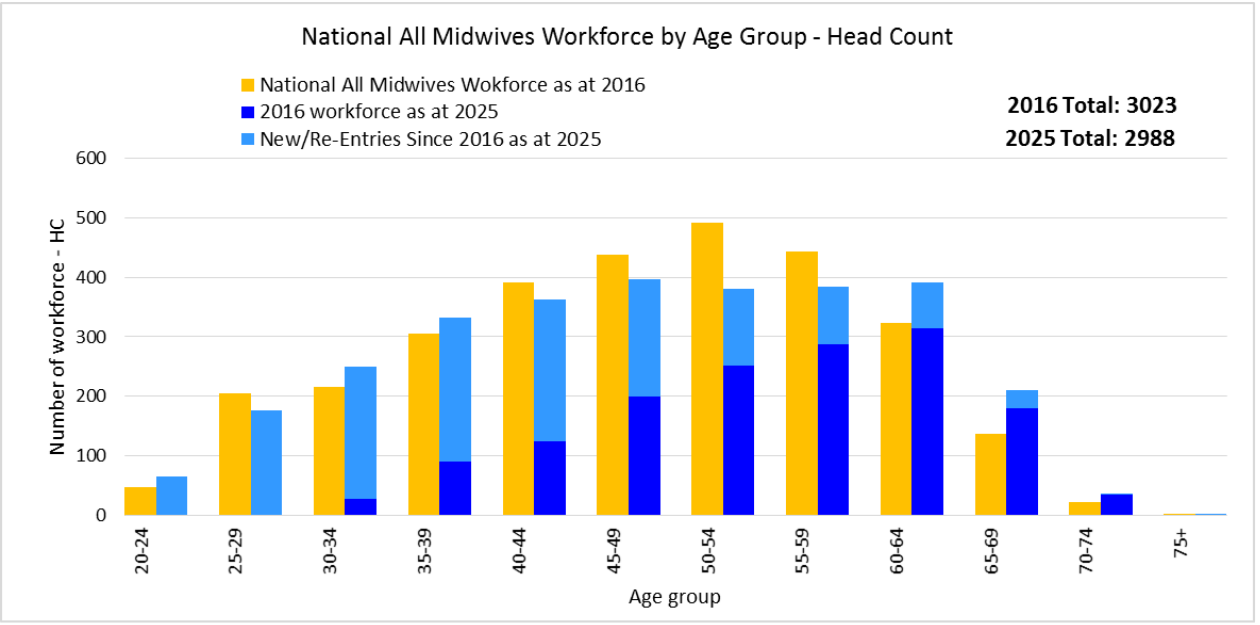


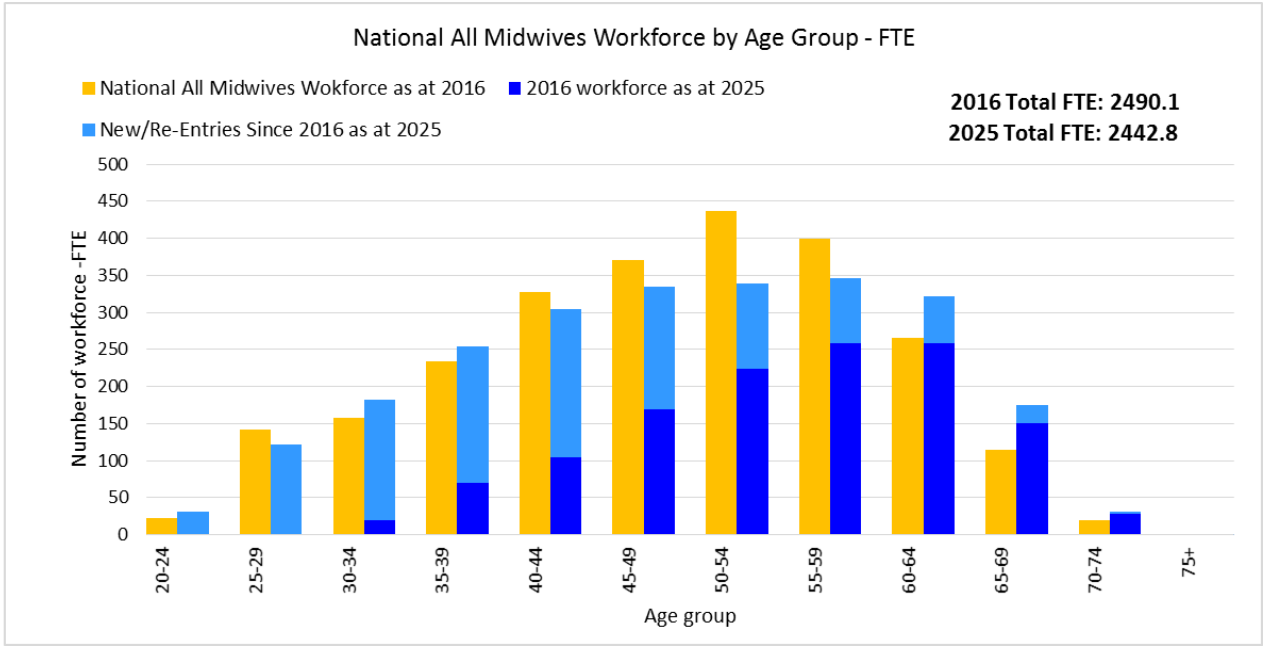
Using Big Data to forecast Midwives in New Zealand



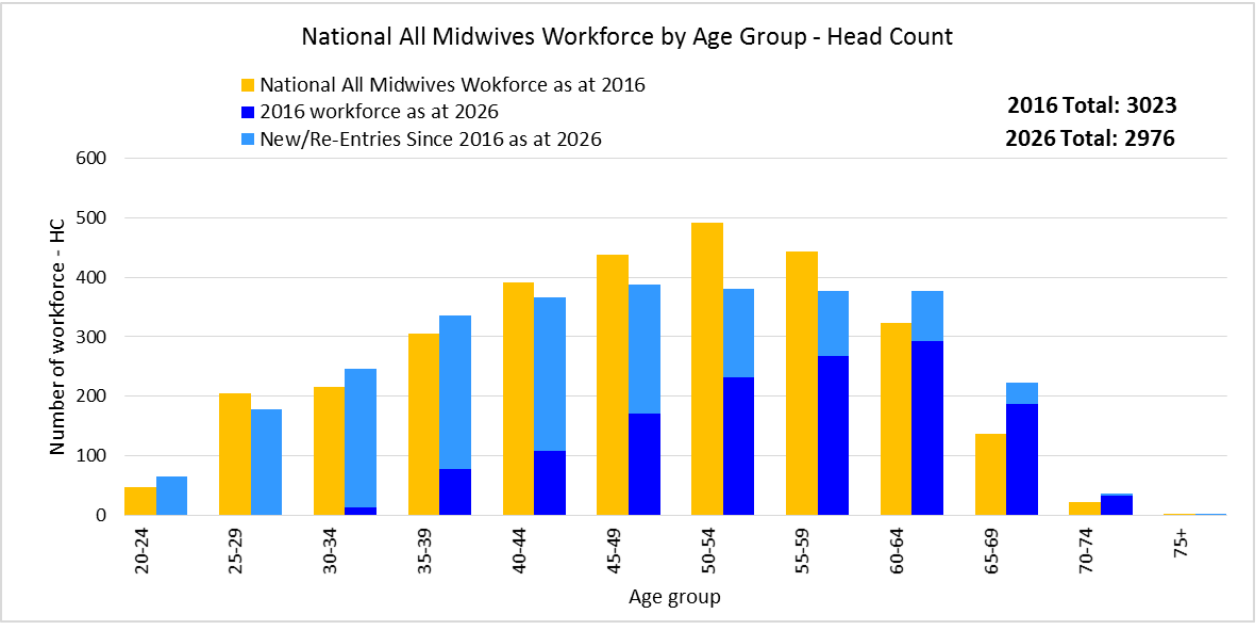


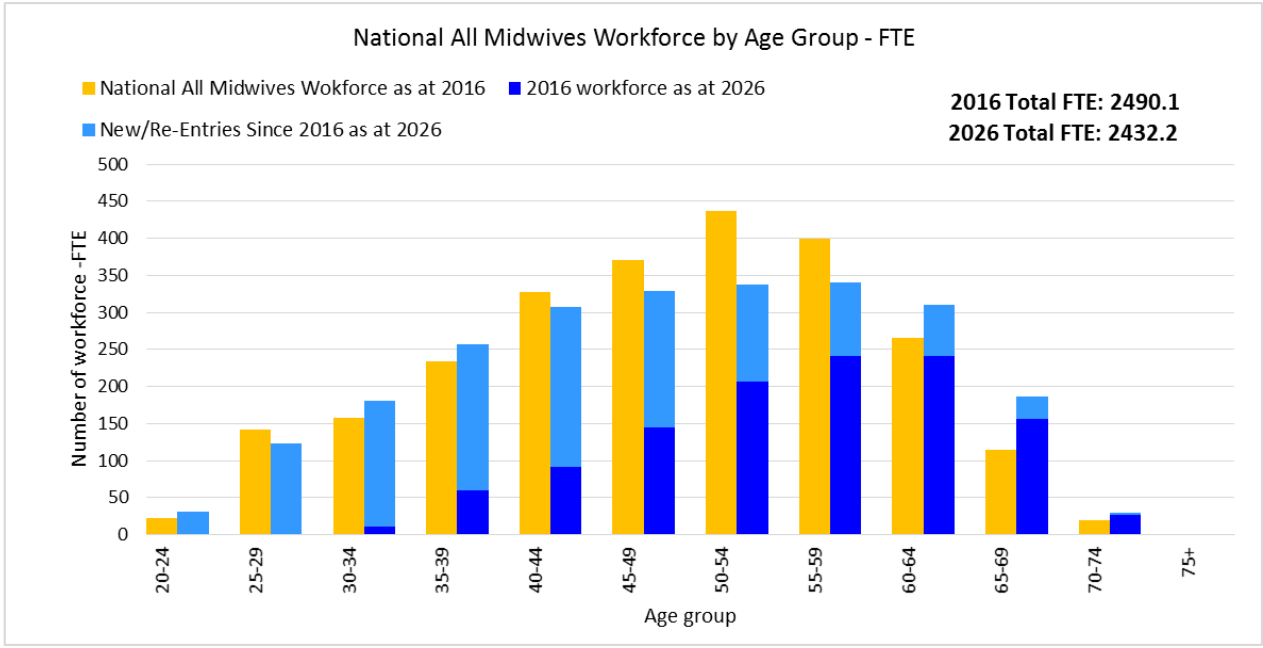
Using Big Data to forecast Midwives in New Zealand





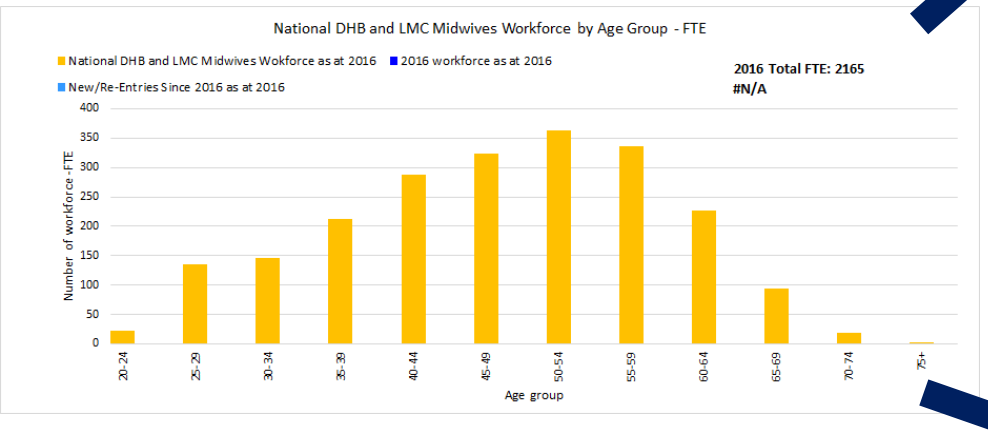
Using Big Data to forecast Midwives in New Zealand



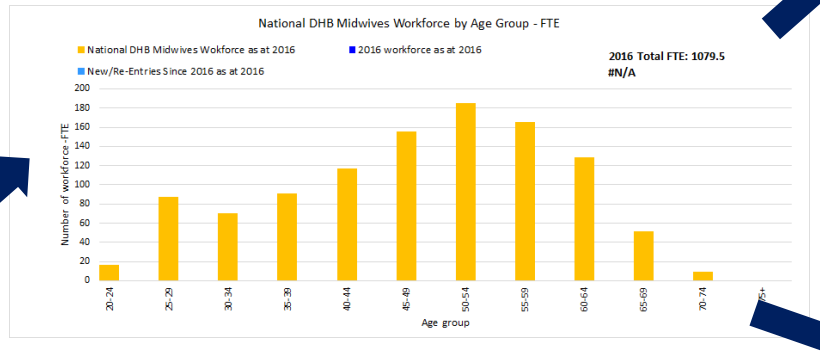


National, employment and region specific forecasting = 43 supply models

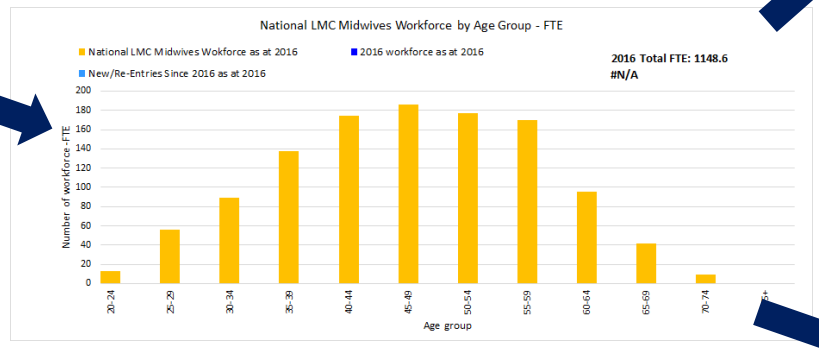
National workforce



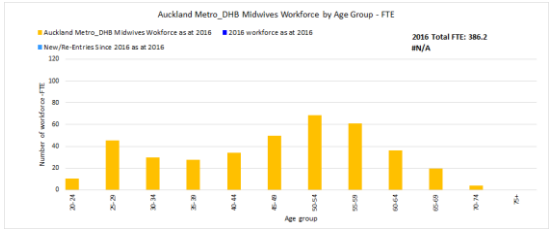
National DHB workforce

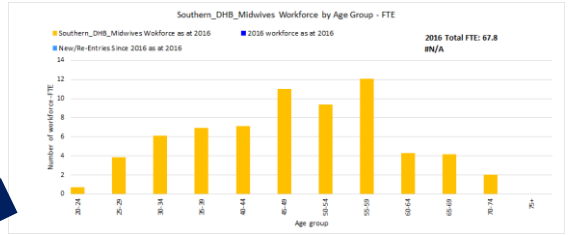


National LMC workforce

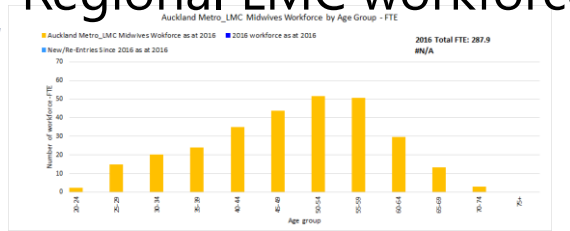


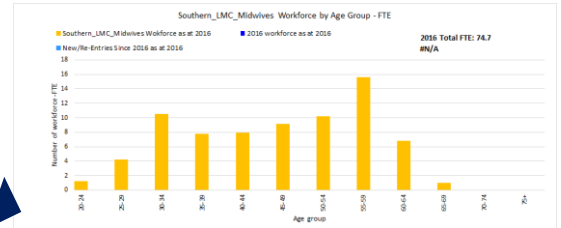
Regional DHB workforce





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 allows to look at possible improvements (regulation, education etc)