Data-driven evaluation of policy initiatives

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Department of Engineering Science
Outline

• Who am I?
• Faster Cancer Treatment
• Non-Acute Rehabilitation & ACC
• Government Initiatives & IDI
• Final Thoughts
Who am I?

- Dr Michael O’Sullivan
- Senior Lecturer in the Department of Engineering Science

University of Auckland alumni
- BSc (1st Class Hons) in Maths & CS
- MPhil (Dist) in Operations Research (OR)

Stanford University alumni
- MS (Eng Eco Systems & OR)
- PhD (Man Sci and Eng)

Faster Cancer Treatment

- Government target of 90% of priority 1 patients have less than 62 days from referral until first treatment
- Processes are complex
- No single person has overview of entire process
- How can we leverage data to evaluate policy changes?
Process Map
Simplified Process Map
Steps in Breast Cancer Pathway
Where to Improve?

Ind 1 ≤ 62 days
Ind 2 ≤ 14 days
Ind 3 ≤ 31 days
Where to Improve?

Ind 2 ≤ 14 days

Ind 1 ≤ 62 days

Ind 4 ≤ 21 days

Ind 3 ≤ 31 days
Where to Improve?

• Anecdotally, Ind2 is the problem
  – “If they get to their FSA on time, everything runs smoothly”
  – Often > 14 days, need more resourcing
    • Triage/Grading, Imaging, etc
Actual Pathways (Day 0 = 1 July 2013)
Simulation of Breast Stream

<table>
<thead>
<tr>
<th>Simulation Model</th>
<th>Targets Enforced</th>
<th>Lower Bound</th>
<th>Point Estimate</th>
<th>Upper Bound</th>
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<td>Prop</td>
<td>Dur</td>
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Ind2 "fixed"
# Simulation of Breast Stream

## Simulation Model

<table>
<thead>
<tr>
<th>Simulation Model</th>
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<th>Lower Bound</th>
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<tbody>
<tr>
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## Graphs

1. **Path Duration - 31 Day DTT-Treat**
2. **Path Duration - 21,31 Day FSA-DTT-Treat**

**Notes:**
- The graphs show the path duration for different simulation models.
- The targets enforced include 14 Day, 31 Day, and 21 Day, with values indicating whether Yes or No.
- The lower and upper bounds for duration (Dur) and proportion (Prop) are provided.
Outcome of Evaluation

• Don’t just focus on Ind2 (Referral to FSA)
• In parallel to this work, WDHB suggested 38 days Referral to DTT target
  – We suggested Ind2 (14 days Referral to FSA) & Ind4 (21 days FSA to DTT), i.e., 35 days Referral to DTT
• WDHB improved entire Breast Cancer Process pathway
Actual Pathways (Day 0 = 1 July 2014)
Simulation of New Breast Stream

Pathway Duration

Day

Non-Acute Rehabilitation & ACC

- ACC funds Public Health Acute Services (PHAS) and Non-Acute Rehabilitation (NAR) stays in hospital
- PHAS is bulk-funded, i.e., fixed amount per patient with extra funding on negotiation
- NAR is funded on a per diem basis
New Funding Policy

• ACC wants to move to a case-mix system for NAR
  – Simpler to administer for ACC and DHBs
• How can we leverage data to evaluate the amount to fund?
• National Minimum Data Set for PHAS and NAR
• ACC data for Community Services
• InterRAI (contextual) and AROC (functional) for more info
Patient Pathway

Total = 12468, Total Valid = 9742, Total Invalid = 2726

Accident

175

5293

4081

193

PHAS stay

PHAS Total = 9374

NAR stay

NAR Total = 9742

Community Services

Community Total = 5468

End of Treatment
Length of Stay (LoS)

A = Accident
P = PHAS
N = NAR in-patient
C = NAR Community services
Hospital (APN) LoS by DHB
Cost of Pathway by DHB
## InterRAI and AROC

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
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<td>interRAI Contact - B3</td>
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<tr>
<td>carerStressV</td>
<td>Carer stress</td>
<td>interRAI Contact – D20a</td>
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<tr>
<td>bathV</td>
<td>Self Care Item - bathing</td>
<td>FIM</td>
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<tr>
<td>medV</td>
<td>Managing medication</td>
<td>interRAI Contact - D4c</td>
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<tr>
<td>mentImpV</td>
<td>Cognitive Function - problem solving or memory</td>
<td>FIM</td>
</tr>
<tr>
<td>resV*</td>
<td>Domicile</td>
<td>interRAI Contact</td>
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<tr>
<td>AdmToile</td>
<td>Self-care items Toileting</td>
<td>FIM</td>
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<td>AdmBladd</td>
<td>Sphincter control bladder</td>
<td>FIM</td>
</tr>
<tr>
<td>AdmBowel</td>
<td>Sphincter control bowel</td>
<td>FIM</td>
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<tr>
<td>AdmXfrTo</td>
<td>Mobility items, transferring to toilet</td>
<td>FIM</td>
</tr>
<tr>
<td>AdmProb</td>
<td>Cognitive function, problem solving</td>
<td>FIM</td>
</tr>
</tbody>
</table>

Note. * Not significant, included for completeness
## NAR Cost Adjustments

### Coefficients:

|                  | Estimate | Std. Error | t value | Pr(>|t|)  |
|------------------|----------|------------|---------|-----------|
| (Intercept)      | 16358.7  | 1683.2     | 9.719   | < 2e-16 *** |
| resV             | -1069.1  | 1437.2     | -0.744  | 0.457545  |
| mentImpV         | -982.8   | 262.1      | -3.75   | 0.000214 *** |
| aloneV1          | 719.3    | 886.6      | 0.811   | 0.417838  |
| carerStressV     | 1119.9   | 1035.1     | 1.082   | 0.280222  |
| bathV            | -3189.5  | 1750.5     | -1.822  | 0.069489 . |
| medV             | 2190.1   | 953.7      | 2.297   | 0.022368 * |
| **Multiple R-squared** | 0.1293  |            |         |           |
| **Adjusted R-squared** |          |            |         | 0.1111    |
Outcome of Evaluation

• ACC can align funding and clinical pathways within NAR with a straightforward assessment
  – Ascertain any adjustors
  – Provide appropriate, individualised funding
Government Initiatives & IDI

• Government initiatives will have cross-sector benefits
  – e.g., being in work has recognised health benefits
• How can we leverage data to evaluate the impact of an initiative?
Context and Outcomes

• “Stitch” an individual’s contextual and outcome data together
  – E.g., age, employment status, days in contact with police
• Explore differences in outcomes that relate to different contextual data
  – E.g., people working < 15 hours per week have more days in hospital, but cost ACC less
Evaluate an Initiative

• Changes an individual’s context
• E.g., training programme
  – Realises a 50% increase in employment hours
  – Transforms someone working 12 hrs per week into someone working 18 hrs per week
  – Consequent change in days in hospital and increase in ACC cost
• Results in changes to individual’s outcomes = value of initiative
Understanding Value

Gather target cohort
Partition by context
Measure counts and outcomes for each partition

People in part-time work (< 30 hrs per week)

0-5 hrs (per week)
- 1,000 people, average 4 days per year in hospital

10-15 hrs
- 5,000 people, average 3.75 days per year in hospital

25-30 hrs

orUa
Evaluating Initiative

Estimate changes due to initiative

0-5 hrs (per week) 0-5 hrs (per week) 700 people, average 4 days per year in hospital

10-15 hrs 10-15 hrs 5,300 people, average 3.75 days per year in hospital

25-30 hrs 25-30 hrs

Value of initiative is $300 \times 0.25 \text{ days} = 75 \text{ hospital days per year} 
\approx $1,854 \times 75 = $139,050 \text{ per year}

* Average across 2014 patient costing available from 11 DHBs, adjusted to 2016
Cross Sector Investment

• Initiative run by one sector,
  – E.g., Ministry of Social Development for training programme

• Benefits to other sectors
  – E.g., Ministry of Health, hospital bed days

• Share the cost of the initiative = Data-Driven Cross-Sector Investment
Integrated Data Infrastructure

- IDI (Stats NZ) holds many linked datasets

Gather target cohort
Partition by context
Measure counts and outcomes for each partition

All happens in IDI!

People in part-time work (< 30 hrs per week)

0-5 hrs (per week) | 1,000 people, average 4 days per year in hospital
10-15 hrs | 5,000 people, average 3.75 days per year in hospital
25-30 hrs
IDI “Gotchas”

• Timeframe
  – 3 days to get data out for your research team
    • Random rounding (to base 3) for anonymisation
  – 10 days to get reports screened

• SQL vs SAS
  – SQL good to get data, not great for manipulation
  – SAS great for manipulation, beware of macros!
    • Validation! Unit testing?!
  – Read-only access, tricky to dynamically filter data “pulls”
    • Loop over list of SNZ IDs and pull from, e.g., NMDS, in “bunches”
Final Thoughts

• The data is there! = IDI, DHBs, ACC, etc
• We can (and should) use it to inform policy
• Tools of the trade
  – R (Statistics)
  – Python (Scripting, Programming)
  – SQL (Scripting)
  – SAS (Statistics, Scripting, approx. Programming)
Thanks!!!