Policy modelling and demographic ageing: The KIWI approach

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Singapore, SMU, 5 July 2013

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COMPASS Research: The Team – and KIWI

- ~10 years, $1 million p.a., grant-funded
- 6 contract staff, usually 3–5 graduate students
- Big user of existing data: (i) analysis, (ii) modelling
- For our micro-simulation projects we draw on:
  - Two research fellows, two statisticians, a data manager/programmer

Knowledge-based Inquiry system With Intervention/policy modelling
1. Care systems – data from multiple sources
   - Primary care (family doctor) system
     • Models the role of the “family” doctor
   - Balance of care systems
     • Extends model to incorporate other care elements

2. Life course – data from longitudinal studies
   - Early life course (childhood)
     • Uses existing cohort studies for ages 0-13
   - Later years
     • Uses existing longitudinal studies for over 65s
Outline

- Setting the scene
  - Overall framework
  - Decision support
  - Demographic ageing

- Deploying micro-simulation
  - Purpose
  - Example
  - Benefits

- Applying micro-simulation
  - Primary care
    - Model; Data; Simulation; Options
  - Balance of care
    - Model; Data; Options

- Drawing conclusions
Outline

Setting the scene

• Overall framework
• Decision support
• Demographic ageing

Deploying micro-simulation

• Purpose
• Example
• Benefits

Applying micro-simulation

• Primary care
  – Model; Data; Simulation; Options
• Balance of care
  – Model; Data; Options

Drawing conclusions
Overall framework

- **What is our research/policy question?**
  - The challenge of demographic ageing – policy options

- **Where does our data come from?**
  - Multiple sources. There is no single one. We need to integrate data.

- **Who is the “engaged community”, the audience?**
  - Policy advisers, academics, civil society (e.g. older people, their families)

- **What analytical techniques can we use?**
  - Micro-simulation. Integrates data sources, investigates policy options

- **What is the intended outcome?**
  - Clarifying the options for informed debate
Decision support

KIWI expert system and decision support

1. Add value to existing data
2. Present data within a realistic analytical framework
3. Use literature-derived estimates where appropriate
4. Construct a desk-based “tool” for interrogation
5. Work with colleagues in policy agencies throughout
Demographic ageing

- Demographic “transition”
  - Transition to low rates of birth and death
  - Extended life expectancy
  - Shifting dependency ratio

- Scenarios for “health expectancy”
  - Compression (health problems at the end)
  - Expansion (health problems throughout)
  - Dynamic equilibrium (a mix)

- Key “drivers” for policy outcomes
  - The older person (health and disability status)
  - The care system (practitioners, technology, institutional supply)
  - The social system (family, neighbourhood, volunteers)
Setting the scene

- Overall framework – question » outcome
- Decision support – desk-based policy tool
- Demographic ageing – scenarios, drivers

ANY QUESTIONS AT THIS POINT?
Setting the scene
- Overall framework
- Decision support
- Demographic ageing

Deploying micro-simulation
- Purpose
- Example
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Applying micro-simulation
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- Balance of care
  - Model; Data; Options

Drawing conclusions
Micro-simulation Modelling. Purpose

- Build a realistic computer-based model
  - For example, of early childhood

- Derive the “drivers” of the model from real data
  - For example, an actual birth cohort study

- Create a synthetic data set that replicates the real one by applying those “drivers”.

- Assess policy options on the synthetic data by altering key parameters
Micro-simulation modelling. An example

- We started with a “real” birth cohort
  - Christchurch Health & Development Study, with 1265 children born 1977 in Christchurch, followed ever since

- We derived statistical rules to create a synthetic data set (a ‘virtual cohort’) through to age 13
  - A sample of children with typical biographies over the life-course, allowing for variation

- We then simulated what might happen if policy were to change, by altering parameters
Micro-simulation modelling. Benefits

- Carry out counterfactual “experiments” on realistic but virtual (i.e. synthetic) data
  - Test policy scenarios on the computer, at your desk

- Use and combine real data in a flexible way

- Account for social complexity, heterogeneity & change

- Model pathways that may be amenable to influence

- Another piece of the policy-making jigsaw
Deploying micro-sim

- **Purpose** – realistic computer model
- **Example** – birth cohort: real to “virtual”
- **Benefits** – counterfactual “experiments”

ANY QUESTIONS AT THIS POINT?
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- Purpose
- Example
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Applying micro-simulation
- Primary care
  - Model; Data; Simulation; Options
- Balance of care
  - Model; Data; Options

Drawing conclusions
Primary Care

Primary Care in an Ageing Society (PCASO):
Recent illness, GP use, and GP activity

3-year project (2005-2008)
Funded by Health Research Council of New Zealand

Investigators: Peter Davis, David O’Sullivan, Ngaire Kerse, Laurie Brown (NatSem, Canberra), et al

Project team: Roy Lay-Yee (Co-investigator), Janet Pearson (Statistician), Martin von Randow (Analyst), Sanat Pradhan (Analyst) et al
Conceptual model of health and social care

1. Morbidity & disability experience

2. Family & community capacity

3. Practitioner repertoire

DOCTORS

HEALTH SYSTEM
- policy, service provision

COMMUNITY

Other social/public policy

FAMILY/HOUSEHOLD

health service utilisation
- go to doctor or not

health experience

intervention

support/care

support/participation
### Core scenarios for simulation

#### Demographic ageing

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Higher Threshold</th>
<th>Intensification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compress</td>
<td>Dynamic</td>
<td>Expand</td>
</tr>
<tr>
<td>Autonomous ageing</td>
<td><strong>Best</strong></td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
<td>Intermediate scenarios</td>
</tr>
<tr>
<td>Service-dependent ageing</td>
<td></td>
<td><strong>Optimistic scenarios</strong></td>
</tr>
</tbody>
</table>

#### Practitioner repertoire

- **1. Morbidity & disability experience**
- **2. Family & community capacity**
- **3. Practitioner repertoire**

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<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td>Age</td>
<td>Age</td>
<td>Age</td>
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<tr>
<td>Gender</td>
<td>Gender</td>
<td>Gender</td>
<td>Gender</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Ethnicity</td>
<td>Ethnicity</td>
<td>Ethnicity</td>
</tr>
<tr>
<td>Deprivation</td>
<td>Deprivation</td>
<td>Deprivation</td>
<td>Deprivation</td>
</tr>
<tr>
<td>Number of visits in last 12 months</td>
<td>Number of visits in last 12 months</td>
<td>Number of visits in last 12 months</td>
<td>Number of visits in last 12 months</td>
</tr>
<tr>
<td>Living arrangements</td>
<td>Living arrangements</td>
<td>Living arrangements</td>
<td>Living arrangements</td>
</tr>
<tr>
<td>Long-term conditions</td>
<td>Short-term &amp; long-term condition categories</td>
<td>Primary diagnosis categories</td>
<td>Primary diagnosis categories</td>
</tr>
<tr>
<td>Go to doctor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st listed reason for last visit in last 2 weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of visits in last 2 weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctor age, gender, ethnicity, etc</td>
<td></td>
<td>Doctor actions</td>
<td></td>
</tr>
<tr>
<td>Practice type, location, number of doctors</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How variables are imputed

Illness prevalence and health service utilisation rates
(from AU Health Survey 1995)

Doctor activity:
coefficients from statistical “logit” models
(from NZ GP Survey 2001/2)

For each person (in base file)

Derive and assign probability (PROB) for each variable to be imputed

Ask SAS for a random number (RN) between 0 and 1 (from uniform distribution)

If RN<=PROB then impute ‘yes’, else impute ‘no’
An individual’s health history unfolding ...

Person id 2: Male, aged 40, partnered

Has respiratory illness (primary condition)

Doctor and practice characteristics

Has other conditions

Goes to doctor (given ill)

Investigation?
Yes
No

Prescription?
No

Follow up?
Yes

Referral?
No

static model of 2002 …
• project into future
• test scenarios
Scenario modelling

- Map of policy scenarios
  1. Morbidity experience
  2. Community support
  3. Doctor activity

Average number of visits per year; Percentage: prescribed, referred
**Scenario mapping:** Characterising the policy options for morbidity experience, social support and practitioner repertoire

<table>
<thead>
<tr>
<th>Social support ²</th>
<th>Practitioner repertoire ³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Higher threshold</td>
</tr>
<tr>
<td><strong>Morbidity experience ¹</strong></td>
<td>Compress</td>
</tr>
<tr>
<td>Autonomous ageing</td>
<td>best</td>
</tr>
<tr>
<td>Service-dependent ageing</td>
<td>+ - +</td>
</tr>
</tbody>
</table>

1. ‘Compress (+)’ signifies that all GP users have below the median number of visits; ‘Expand (−)’ signifies that all GP users have above the median number of visits.
2. ‘Autonomous ageing (+)’ signifies that no GP users are living alone; ‘Service-dependent ageing (−)’ signifies that all GP users are living alone.
3. ‘Higher threshold (+)’ signifies probability of practitioner activity set at level below the median rate; ‘Intensification (−)’ signifies probability of practitioner activity set at level above the median rate.
## Scenario mapping: Mean number of visits per year for GP users aged 65+ in 2021

<table>
<thead>
<tr>
<th>Social support</th>
<th>Morbidity experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compress</td>
</tr>
<tr>
<td><strong>Autonomous aging</strong></td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Service-dependent aging</strong></td>
<td>8.7</td>
</tr>
</tbody>
</table>
Scenario mapping: Percentage of visits prescribed for GP users aged 65+ in 2021

<table>
<thead>
<tr>
<th>Social support</th>
<th>Practitioner repertoire</th>
<th>Morbidity experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Higher threshold</td>
<td>Intensification</td>
</tr>
<tr>
<td><strong>Autonomous aging</strong></td>
<td>Compress</td>
<td>Expand</td>
</tr>
<tr>
<td></td>
<td>46.2%</td>
<td>47.0%</td>
</tr>
<tr>
<td></td>
<td>(4.1 visits)*</td>
<td>(7.2)</td>
</tr>
<tr>
<td><strong>Service-dependent aging</strong></td>
<td>Compress</td>
<td>Expand</td>
</tr>
<tr>
<td></td>
<td>46.9</td>
<td>44.4</td>
</tr>
<tr>
<td></td>
<td>(4.1)</td>
<td>(6.7)</td>
</tr>
</tbody>
</table>

* no. of visits per year for those patients who received a prescription
Scenario mapping: Percentage of visits referred on for GP users aged 65+ in 2021

<table>
<thead>
<tr>
<th>Social support</th>
<th>Practitioner repertoire</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Higher threshold</td>
<td>Intensification</td>
</tr>
<tr>
<td></td>
<td>Morbidity experience</td>
<td>Morbidity experience</td>
</tr>
<tr>
<td></td>
<td>Compress</td>
<td>Expand</td>
</tr>
<tr>
<td>Autonomous ageing</td>
<td>5.5 (0.5 visits)*</td>
<td>4.9</td>
</tr>
<tr>
<td>Service-dependent ageing</td>
<td>5.1 (0.4)</td>
<td>4.6</td>
</tr>
</tbody>
</table>

* no. of visits per year for those patients who were referred on
Applying micro-sim

Primary Care

- Model – three key elements (health, family, doctor)
- Data – three sources
- Scenarios – limited projected change; doctor important

ANY QUESTIONS AT THIS POINT?
Balance of Care

BCASO = Balance of Care in an Ageing Society

- Data-driven simulation model of health and social care in older people

- **BCASO is funded by the Health Research Council**

- **Investigators:** Prof Peter Davis, Prof Ngaire Kerse, Prof Laurie Brown (Canberra), et al

- **Project team:** Roy Lay-Yee (Co-investigator), Janet Pearson (Statistician), Martin von Randow (Analyst), et al
Health Care: Two Policy Scenarios

- Long-term illness (yes/no)

  → health service use (practice nurse, GP, hospital)

- Practice nurse (only) visit → GP visits (number)
- GP visits (number) → hospital admissions (number)

- By age group 65-74, 75-84, 85+
- By gender, etc

Outcome: proportion/ volume/ cost? visits / admissions
Scenario map 1: Characterising the policy options for morbidity experience and health care (65+)

<table>
<thead>
<tr>
<th>Health care ²</th>
<th>Morbidity experience ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limited</td>
</tr>
</tbody>
</table>
| Practice nurse use | best
Proportion Volume Cost | + + | - + |
| GP use | + - | worst
- - |

1. **Limited (+)** signifies all 65+ have **no long-term illness**
   **Extensive (−)** signifies all 65+ have **long-term illness**

2. **Other provider use** (+) signifies all 65+ are high users of **practice nurse**
   **GP use** (−) signifies all 65+ are high users of **GPs**
Scenario map 2: Characterising the policy options for morbidity experience and health care (65+)

| Health care | Morbidity experience |  
|-------------|---------------------|---
|             | Limited             | Extensive |
| **GP use**  | + + (best)          | - + (worst) |
|             | proportion/ volume / cost | intermediate |
| **Hospital care** | + - (intermediate) | - - (worst) |

1. **Limited** (+) signifies all 65+ have **no long-term illness**  
   **Extensive** (−) signifies all 65+ have **long-term illness**

2. **GP use** (+) signifies all 65+ are high users of **GPs**  
   **Hospital care** (−) signifies all 65+ are high users of **hospital care**
Social Care: Two Policy Scenarios

- Disability level (none, mild, moderate, severe) → social care use (informal, formal, residential) (yes/no)

- Informal care (yes/no) → formal care (yes/no)
- Community care (i.e. home-based: informal, formal) → residential care (yes/no)

- By age group 65-74, 75-84, 85+
- By gender, etc

- Outcome: proportion/ volume / cost of individuals in care
Scenario map 3: Characterising the policy options for disability experience and social care (65+)

<table>
<thead>
<tr>
<th>Social care</th>
<th>Disability experience</th>
<th>Limited</th>
<th>Extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal</td>
<td></td>
<td>best</td>
<td>- +</td>
</tr>
<tr>
<td></td>
<td>proportion/volume/cost</td>
<td>+ +</td>
<td></td>
</tr>
<tr>
<td>Formal</td>
<td></td>
<td>intermediate</td>
<td>worst</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ -</td>
<td>- -</td>
</tr>
</tbody>
</table>

1. **Limited (+)** signifies all disabled 65+ have **mild disability**
   Extensive (−) signifies all disabled 65+ have **severe disability**

2. **Informal (+)** signifies all disabled 65+ receive care from **friends/family**
   Formal (−) signifies all disabled 65+ receive **formal care**
Scenario map 4: Characterising the policy options for disability experience and social care (65+)

<table>
<thead>
<tr>
<th>Social care ²</th>
<th>Disability experience ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limited</td>
</tr>
<tr>
<td><strong>Home-based</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>best</strong></td>
</tr>
<tr>
<td></td>
<td>+ +</td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ -</td>
</tr>
<tr>
<td></td>
<td>- -</td>
</tr>
</tbody>
</table>

1. **Limited (+)** signifies all disabled 65+ have *mild disability*  
   Extensive (−)” signifies all disabled 65+ have *severe disability*

2. **Home-based (+)** signifies all disabled 65+ receive care at **home**  
   Residential (−) signifies all disabled 65+ receive care in a **residential facility**
Applying micro-sim

Balance of Care

- Health care – nurses/GPs/hospital
- Social care – informal/home-based/residential

ANY QUESTIONS AT THIS POINT?
**Drawing Conclusions**

- Counterfactual modelling is a useful device for clarifying policy options

- Pragmatic use of data, but need to test models against external benchmarks

- Demographic ageing - of itself - may not be as much a policy problem as many think

- “Supply-side” factors may be crucial (e.g. practitioner behaviour, institutional provision)

- Talk to the older people themselves!