Data linkage for research

Prof Flavia Cicuttini, Musculoskeletal Unit, School of Epidemiology and Preventative Medicine, Monash University
Rheumatology Unit, The Alfred Hospital, Melbourne, Australia

Australian national health priority areas

- Cardiovascular disease
- Diabetes
- Injury
- Mental Heath
- Asthma
- **Musculoskeletal disease**
Why is musculoskeletal disease important?

- Diseases that kill attract attention
- Musculoskeletal diseases are the major cause of morbidity throughout the world
- Have substantial effect on health and quality of life
- Inflict an enormous burden of cost on health systems

Arthritis and Osteoporosis Victoria, 2013
Costs enormous

$55.1 BILLION

$9.2B HEALTH COSTS

$11.7B PRODUCTIVITY ($7.4B)
OTHER FINANCIAL COSTS ($4.3B)

$34.2B BURDEN OF DISEASE

Arthritis and Osteoporosis Victoria, 2013

Major unmet need

- No treatments for many of the conditions
- End stage OA → joint replacements
- Back pain → prescription narcotic epidemic
NHMRC Research funding

<table>
<thead>
<tr>
<th>NATIONAL HEALTH PRIORITY AREAS</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal and Torres Strait Islander Health</td>
<td>$45.5</td>
<td>$46.6</td>
<td>$41.5</td>
<td>$49.1</td>
<td>$56.2</td>
</tr>
<tr>
<td>Arthritis and Osteoporosis</td>
<td>$28.4</td>
<td>$26.7</td>
<td>$22.9</td>
<td>$21.7</td>
<td>$23.0</td>
</tr>
<tr>
<td>Asthma</td>
<td>$19.3</td>
<td>$20.5</td>
<td>$21.5</td>
<td>$23.5</td>
<td>$22.6</td>
</tr>
<tr>
<td>Cancer</td>
<td>$181.3</td>
<td>$192.3</td>
<td>$179.3</td>
<td>$188.</td>
<td>$191.9</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>$122.2</td>
<td>$121.8</td>
<td>$112.7</td>
<td>$123.1</td>
<td>$121.3</td>
</tr>
<tr>
<td>Dementia</td>
<td>$31.2</td>
<td>$27.6</td>
<td>$27.1</td>
<td>$33.5</td>
<td>$35.1</td>
</tr>
<tr>
<td>Diabetes</td>
<td>$81.0</td>
<td>$74.9</td>
<td>$65.1</td>
<td>$69.6</td>
<td>$69.6</td>
</tr>
<tr>
<td>Injury</td>
<td>$48.1</td>
<td>$51.8</td>
<td>$46.1</td>
<td>$58.9</td>
<td>$61.9</td>
</tr>
<tr>
<td>Mental Health</td>
<td>$70.2</td>
<td>$70.4</td>
<td>$73.3</td>
<td>$83.8</td>
<td>$86.4</td>
</tr>
<tr>
<td>Obesity</td>
<td>$39.2</td>
<td>$40.1</td>
<td>$41.4</td>
<td>$40.1</td>
<td>$37.8</td>
</tr>
</tbody>
</table>

What can do?

- Try for limited funding ............
- Are there opportunities to piggy back on other studies?

Potential advantages:
- Cost
- You can answer a question more quickly
- Take advantage of a lot of previous work through collaborations
Opportunities: Potential resources

Over 40 and under 70? Your chance to help your community and future generations

Australian Diabetes, Obesity & Lifestyle Study

Health 2000

A study of lifestyle and health

We need your help. Fix more information on us.

StaREE

Stimulating Research in the Elderly

58,000 women
In three cohorts aged 18-23, 45-50 and 70-75 when surveys began in 1996

40,000 recruited 1990-4
Follow-up 1994-8, 2003-7

10,000 recruited 1990
Follow-up 1998, 2000

Follow-up 1998, 2000

An example of the type of data available for Health 2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body weight, height, body mass index</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Fat mass, fat-free mass (bioimpedance)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waist and hip circumference, waist-hips ratio</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dietary history: 121 food frequency questionnaire</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Occupational history</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking and alcohol</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reproductive and gynaecological history (for women)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Blood samples</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is there a simple way to measure our outcomes of interest?

Normal joint  Early arthritis  End stage OA

Relevant to:
• symptomatic disease burden
• impact on health economics

How can we identify JR?

• We can ask
  – Estimated cost of questionnaires for Health2000
    $750,000
• Other options:
  – Are there data bases/registries?
Australian Orthopaedic Association National Joint Replacement Registry

- Data collected from 2002-current
- Information on
  - Type of arthroplasty
  - Reason for arthroplasty, i.e. arthroplasty for OA
- Accuracy of data >95%
- Almost complete on arthroplasty in Australia

Data linkage

Health2000  ↓  AusDiab  ↓

Australian Orthopaedic Association National Joint Replacement Registry
Linkage method to identify joint replacement

- Identifying information: first name, last name, DOB, gender
  → AOA NJRR → JR 1/1/2002 to 31/12/13
- Matching: Freely Extensible Biomedical Record Linkage (Febrl) system
- 4 matching runs performed
- Run 1: exact match on Health2000 identifiers → 91.0% exact match

Linkage method: other runs

- Probabilistic or ‘fuzzy’ matching criteria using the remaining unmatched procedures
- Allows for matches where the data fields may be close but not necessarily equal
- 3 probabilistic matches considered:
  - (1) Procedures with the same date of birth
  - (2) Procedures with the same postcode and first name
  - (3) Procedures with the same first and last name
What have we found re the hip?

- **Vit D** ↑ serum 25(OH)D is associated with ↑ risk of hip JR in males
- **Genetic factors** *HFE C282Y* homozygotes had a 2↑ risk of THR cf no C282Y mutation
  > men cf women
- **Hormonal factors** ↓ androstenedione concentration is associated ↑ risk of THR in men and women
- **Ethnicity:** ↓ THR in Italian/Greek cf Australia/UK
  Not just SES!
- **Birth factors** Low birth wt and preterm birth associated with ↑ risk of hip JR
- **Dietary factors** ↑ consumption of fresh red meat is associated with ↓ risk of THR

What have we found re the knee?

- **Obesity/body composition** ↑ fat mass and waist circumference are associated with ↑ risk of TKR
- **Metabolic syndrome** and ↑ number of MetS components are associated with ↑ risk of TKR
- **Vascular factors** ↑ retinal arterial narrowing is associated with ↑ risk of knee JR
- **Physical activity** ↑ levels of physical activity is associated with ↑ risk of TKR
- **Hormonal factors** ↓ androstenedione concentration is associated with ↑ risk of TKR in men
  ↓ estradiol concentration is associated with ↑ risk of TKR in women
  ↓ 2D:4D is associated with ↑ risk of TKR
- **Ethnicity:** ↓ TKR in Italian/Greek cf Australia/UK
  Not just SES!
**Overview of results**

- Risk factors for knee and hip OA differ
- Knee OA is related to metabolic factors
- Hip OA is linked to changes in bony geometry or bone shape

→ Implications for prevention and treatment

---

**Opportunities and challenges of data linkage**

- Data collected for another purpose so...
  - Not always exactly what you might want
  - Not exactly measured how you might want
- Data collection likely completely unrelated to your hypotheses so less potential bias
- Huge resource
  - Cost/time saving → efficiency for you, but also good way to optimize outcomes from time and money spent … win-win
What about other important contemporary issues?

- Prescription narcotic epidemic
- Overuse on imaging for back pain
- Safety of joint replacement

Prescription narcotic epidemic

>50% are for chronic back pain
Prescription narcotics and harm

Causes of joint pain

Factors inside the patient

- Joint specific
- Psychosocial

Factors outside the patient

Central pain mechanisms

McAlindon American Journal of Medicine, 2007
Opportunities to explore narcotic epidemic

58,000 women
In three cohorts aged:
18-23 yrs
45-50 yrs
70-75 yrs
at inception 1996

Linkage to PBS → patient level of information re prescribed drugs
le narcotics

Australian Longitudinal Study of Women’s Health

• Young cohort- women (18-23yrs) randomly selected from the Medicare database

<table>
<thead>
<tr>
<th></th>
<th>Response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (2000) - 9,688 answered survey (9,671 answered back pain question)</td>
<td>100%</td>
</tr>
<tr>
<td>Follow-up 1 (2003) - 9,081 answered survey (9,056 answered back pain question)</td>
<td>94%</td>
</tr>
<tr>
<td>Follow-up 2 (2006) - 9,145 answered survey (9,088 answered back pain question)</td>
<td>94%</td>
</tr>
<tr>
<td>Follow-up 3 (2009) - 8,200 answered survey (8,091 answered back pain question)</td>
<td>85%</td>
</tr>
<tr>
<td>Follow-up 4 (2012) - 8,010 answered survey (7,955 answered back pain question)</td>
<td>83%</td>
</tr>
</tbody>
</table>

Similar for: 45-50yr and 70-75yr cohorts

Extensive database including BMI, pain psychosocial etc
Challenges

- Accessing the data
- Use of large data sets
- Developing statistical methods for repeated measures
- What is the best way to analyse the narcotics.....lots of scripts!

Similar approach to understand factors driving the use of imaging for back pain

- Australian Longitudinal Study of women's health has been linked to Medicare data

X-ray  CT Scan  MRI
What about other important contemporary issues?

- Prescription narcotic epidemic
- Overuse on imaging
- Safety of joint replacements. Do they cause cancer?

Do some JR cause cancer?

- Linkage of Australian Orthopaedic Association National Joint Replacement Registry to cancer registries

  - Opportunities
    - Large contemporary data

  - Challenges:
    - Ethics every state and territory + AIHW
    - Lag time for data
    - Complex data sets
Conclusion

- A great opportunity to address questions in an efficient way
  - Reduced time and costs of studies
- Challenges in dealing with large data sets
  - How best to analyses the data?
  - How best to define variables eg narcotics?
- Key message:
  - Look around, think outside the square to identify these opportunities!

Team effort......

Professor Graham
Giles + team

Professor Jonathan Shaw
Assoc Prof Di Magliano + team

SPHPM: Drs Yuanyuan Wang & Monira Hussein, Assoc Prof Anita Wluka

Professor Wendy
Brown + team

Professor Stephen
Graves + team

Australian Longitudinal Study on Women's Health

AUSDIAB - Australian Diabetes, Obesity & National Diet Study

Over 40 and under 70?
Your chance to help your community and future generations

Australian Orthopaedic Association
National Joint Replacement Registry
THANK YOU!