ICU Research Using Administrative Databases:
What It’s Good For, How to Use It

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Disclosures

- None
Rationale

• You want to study some aspect of ICU care
  – What are the outcomes of nursing home residents admitted to ICU?
  – Does surgical intervention influence survival of patients with necrotizing pancreatitis?

• But conducting an RCT is not an option. And even if you had the people to read charts of ICU patients in your hospital, you don’t have an ICU database to identify all those of interest
  – and even if you did -- it’s next to impossible to get anything published when it’s from a single hospital
  – and you have no way to get information from a larger geographic region, nor the people power to read all those charts too

>> BUT YOU DON’T HAVE TO GIVE UP <<
**Introduction**

- Most critical care research uses prospective, purpose-made data on a limited topic over a relatively brief interval from a small population in one or a few ICUs
  - e.g. Van den Berghe’s tight glucose control study, ARDSNet studies

- Some observational studies have used data from existing clinical ICU databases containing detailed data from one-many ICUs
  - e.g. Project IMPACT, EURICUS, Manitoba ICU Database
  - but relatively few places have such databases

- Another possible source of data for ICU research is administrative data
  - maintained by health care funders such as governments and insurance companies; also individual hospitals
Obtainable from hospital, province or CIHI
  - there is national-level data at CIHI -- lots of good stuff, for the whole country
  - many provinces have additional data that can add very useful details

- Hospital abstracts -- details about hospitalizations
  - this is the key for ICU research (more coming up)

- Canadian Census of Population (q5yrs) -- allows for SES

- Rehabilitation database -- interested in rehab after ICU care?
  - includes functional measures at start and end
**Hospital Abstracts**

- These are the key for ICU research

- Detailed, *nationally-standardized* abstraction of hospital chart for *every* hospital admission
  - format since 2002/4 called DAD = Discharge Abstract Database
  - there are minor provincial variations

- Done after hospital discharge at each hospital by trained personnel
  - held at the hospital, and by the province -- and sent to CIHI

- 2.4 million acute hospital abstracts in 2010/11
Hospital Abstract Data Elements

- Unique patient identifier - allows linking across individual records (but only within a given province/territory)
- Hospital identifier
- Point of hospital entry (e.g. ED)
- Age, sex, postal code
- Time/date of hospital admit and discharge → LOS, in minutes
- “Institution from” and “Institution to” codes
  - can identify those admitted from/discharged to nursing homes
  - can link individual abstracts into episodes of care for direct interhospital transfers
- Discharge disposition -- includes died, left AMA
Hospital Abstract Data Elements

- Diagnoses -- up to 25, in ICD-10 format
  - an ancillary code delineates if it is the: “most responsible hosp dx”, preexisting dx, postadmit dx, (main hosp admit dx)
  - cancer details -- including staging

- Resource Intensity Weight (RIW) -- parameter correlated with LOS, based on diagnoses, procedures, etc
  - can be used as a rough severity of illness index

- Providers -- up to 8, identifies physician specialities

- Procedures done in hospital -- up to 20, standard CCI coding
  - ancillary fields: date, physician specialty, hospital location (e.g. OR), type of anesthesia, ±died in OR
  - can be used to identify if patient had “major surgical procedure”

- Types of blood products transfused -- but not amount
Hospital Abstract Data Elements

- ICU (SCU) information -- up to 6 occurrences
  - subtype of SCU; date/time of admission and discharge
  - flag for death in the SCU

<table>
<thead>
<tr>
<th>Code</th>
<th>SCU Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Medical Intensive Care Unit</td>
</tr>
<tr>
<td>20</td>
<td>Surgical Intensive Care Unit</td>
</tr>
<tr>
<td>25</td>
<td>Trauma Intensive Care Unit</td>
</tr>
<tr>
<td>30</td>
<td>Combined Medical/Surgical Intensive Care Unit</td>
</tr>
<tr>
<td>35</td>
<td>Burn Intensive Care Unit</td>
</tr>
<tr>
<td>40</td>
<td>Cardiac Intensive Care Unit Surgery</td>
</tr>
<tr>
<td>45</td>
<td>Coronary Intensive Care Unit Medical</td>
</tr>
<tr>
<td>50</td>
<td>Neonatal Intensive Care Unit</td>
</tr>
<tr>
<td>60</td>
<td>Neurosurgery Intensive Care Unit</td>
</tr>
<tr>
<td>70</td>
<td>Pediatric Intensive Care Unit</td>
</tr>
<tr>
<td>80</td>
<td>Respirology Intensive Care Unit</td>
</tr>
<tr>
<td>90</td>
<td>Step Down Medical Unit</td>
</tr>
<tr>
<td>95</td>
<td>Step Down Surgical Unit</td>
</tr>
</tbody>
</table>
Validity of ICU Data in Hospital Abstracts

[Garland, Med Care 50:e1,2012]

- Compared ICU care for adults in Manitoba DAD abstracts vs gold standard of the Winnipeg clinical ICU database, 2004-08

- Performance of DAD abstracts for identifying presence of ICU care:

<table>
<thead>
<tr>
<th># with ICU care</th>
<th># without ICU care</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
<th>PPV (95% CI)</th>
<th>NPV (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,344</td>
<td>143,726</td>
<td>97.7 (97.5, 98.0)</td>
<td>99.9 (99.8, 99.9)</td>
<td>98.3 (98.1, 98.6)</td>
<td>99.8 (99.8, 99.8)</td>
</tr>
</tbody>
</table>

- Identifying the number of separate ICU admissions

<table>
<thead>
<tr>
<th># as indicated by DAD abstracts</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>True #</td>
<td>1</td>
<td>516</td>
<td>16,212</td>
<td>247</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>207</td>
<td>1,154</td>
<td>65</td>
</tr>
<tr>
<td>3 or more</td>
<td>0</td>
<td>10</td>
<td>57</td>
<td>221</td>
</tr>
</tbody>
</table>

- Overall 93% correct
- Less accurate with more ICU admissions in a given hospitalization
Accuracy of Hospital Abstracts for ICU Timing

[Garland, Med Care 50:e1,2012]

- With a single ICU admission within a hospital abstract (87% of situations)
  - agreement within ±8 hrs for 97.7% of ICU admissions
  - agreement within ±8 hrs for 95.8% of ICU discharges

- With two ICU admissions within a hospital abstract (6% of situations)
  - agreement within ±24 hrs for 53.3% of ICU admissions
  - agreement within ±24 hrs for 49.7% of ICU discharges

Thus, Canadian hospital abstracts are quite reliable for identifying and quantifying ICU care.
Additional data available in provinces
- Physician visits -- date, diagnosis, procedures
- Rx drug claims (most, not all, provinces) -- specific ones may be of interest; # and types can serve as comorbidity measures (Schneeweiss, *Am J Epidemiol* 154:854, 2001)
- Home care usage; Nursing home residency -- dates start/end
- Death registry -- DOD, cause

Additional information about select subgroups
- e.g. RAI (Resident Assessment Instrument) -- assesses clinical, functional, behavioural, psychosocial, demographic, resource use variables; used for home care & NH patients in much of Canada

Some interesting StatsCan data can be linked to health data
- e.g. SLID (Survey of Labour and Income Dynamics)
Things You Can Derive from Admin Data

- Comorbid conditions
  - e.g. Charlson Comorbidity Index, or list of chronic conditions
  - obtained from diagnosis codes in hospital abstracts ± outpatient physician claims

- Census-based SES - as avg household income in postal code
  - e.g. categorized into quintiles or deciles
  - is a good surrogate of individual-level income
    (Mustard, *Health and Place* 5:157, 1999)

- Ways to use acute diagnosis
  - categorize into ICD-10 chapters
  - identify specific diagnoses or categories of interest
Administrative Data: Pros & Cons

**PROS**
- Systematically collected, population-based data -- huge N
- Long timescale -- can assess temporal changes
- Can use it for studies that would be too difficult or expensive to address with an interventional study
- Can answer important questions about critical illness -- huge range of questions can be addressed with large-scale retrospective data

**CONS**
- Limited clinical details
- Don’t know ICU admit diagnosis (unless came directly to ICU)
- No national death index (Vital Statistics in the provinces)
- Weak measures of severity of acute illness in hospital abstracts
  - RIW, in-hospital procedures
- Analysis is retrospective
  - can’t do interventional studies
  - but, good observational studies have similar effect sizes as RCTs (*NEJM* 342:1997, 2000)
Issues in Using Admin Data for Research

- Requires some money -- acquisition costs ± analysis costs
  - may not be allowed to carry away a disc and analyze it yourself -- so might have to pay for analyst too
  - e.g. for a recent proposed project: $11K to obtain CIHI data; $30K to obtain & do the analysis with Manitoba data

- Deidentification -- at CIHI, and in some jurisdictions you can only obtain deidentified data
  - internally linkable
  - NOT externally linkable
    - so can’t identify charts from the admin data to go and read
    - but in some locales they’ll let you import your specific data sets and link them to theirs -- for subsequent deidentified analysis (e.g. CancerCare Manitoba Registry)
Issues in Using Admin Data for Research - 2

- Analysis often/usually requires dealing with confounding variables (e.g. via multiple regression modeling)
  - these data don’t come from RCTs ⇒ those with vs. without the exposure or outcome of interest are usually different
  - e.g. hospital mortality in necrotizing pancreatitis w/wo surgical intervention --- the two groups likely differ by age, comorbidities

- “Episodes” of care
  - unique records for each hospital admission, SCU identification
  - BUT, with direct transfers these records do NOT constitute separate episodes of ICU care, or ICU-containing hospital care
  - failing to correctly link such records leads to erroneous admission rates, LOS, mortality rates, etc.
  - we’ve described how to make these linkages, to reconstruct the full episodes of care (Fransoo, *BMC Med Res Methodol* 12:133, 2012)
Getting Administrative Data in Canada

- Who has it?
  - Individual hospitals
  - Every provincial government
  - Canadian Institute for Health Information

- How do you get access to CIHI data?
  - if you have a CIHI contact, use it
  - if not, their Communications Department (communications@cihi.ca)
  - https://forums.cihi.ca/Forms/DataInquiry/data_inquiry_e.asp

- How do you get access to provincial administrative data?
  - varies by province
  - directly from the provincial health authority
  - through an academic or gov’t unit that holds the data (e.g. MCHP)
  - most easily facilitated by finding someone who uses it at your place
Final Items

- What it takes to get your hands on administrative data
  - a well-formed research plan ⇒ REB/IRB permission; privacy permissions (e.g. HIPC)
  - some money

- To actually use such data you need to wade in and understand the nuances of the individual data fields
  - get a copy of the *Data Dictionary*, and see what’s in there
  - consider recruiting a collaborator at your place who uses and knows about the local, provincial, or CIHI administrative data

- There are substantial similarities, and substantial differences in all this outside of Canada
  - multinational data enables cross-national comparisons
  - must validate accuracy of identifying ICU care in admin data from other countries -- no such validations have been published
A Few Real Examples

- Analysis of the U.S. National Hospital Discharge Database identified the incidence & mortality of sepsis (*NEJM* 348:1546, 2003)

- Estimated # of ICU beds needed in the subregions of Manitoba - by analyzing day-to-day fluctuations in ICU patient census

- Analyzed how ICU admission influences post-hospital medical resource use

- Do sex-differences in widowhood & other social supports explain the male predominance of ICU admissions in the elderly?

- How does critical illness/ICU admission affect peoples’ ability to work and generate income?
The End