Data Linkage with an Establishment Survey

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Outline

1. Introduction: NCHS data linkage program
2. Background on National Hospital Care Survey (NHCS) and National Death Index (NDI)
3. Data processing objectives & solutions
4. NHCS-NDI linkage overview
5. Conclusion and future directions
Introduction

• The NCHS data linkage program links survey data with the NDI and other administrative data on a recurring basis

• Recently the NHCS data was linked with the NDI
  – The linkage was conducted with support from the Office of the Secretary Patient Centered Outcomes Research Trust Fund (OS-PCORTF)

• This linkage presented new challenges
  – NHCS is an establishment survey
National Hospital Care Survey

• Collects health care statistics from 581 non-institutional, non-federal U.S. hospitals with six or more staffed inpatient beds

• Not currently nationally representative

• Data collected as elements of UB-04:
  ▪ Personally identifiable information
  ▪ Demographic information
  ▪ Encounter dates
  ▪ Diagnoses and procedures
  ▪ Revenue codes

https://www.cdc.gov/nchs/dhcs/index.htm
National Death Index (NDI)

• Centralized database of death record information on file in state vital statistics offices in the U.S.

• Death records added annually from 1979-2016

• Includes information on:
  ▪ State of death
  ▪ Date of death
  ▪ Death certificate number
  ▪ Cause of death (through NDI Plus service)

https://www.cdc.gov/nchs/ndi/index.htm
Objective 1: Processing the data

- For most linkages conducted in the NCHS Data Linkage Program
  - Typically one record per linkage eligible participant
  - Some alternate records are created based on nicknames or parsing out a last name with a hyphen

- However, the NHCS data are different
  - NHCS data are at the patient level, but not collected in the same way as other NCHS household surveys
  - Multiple encounters per patient
  - Multiple names, dates of birth, even at times different sexes reported

- Solution:
  - Transposed records to do a “roll-up” of alternate records per patient
Objective 2: Storing the data

• NCHS Data Linkage Program developed a process to store survey data in an standardized format for linkages

• Different pieces of information are broken up into different tables and stored in the record linkage repository (RLR)

• Solution:
  – NHCS posed unique storage challenges
  – New coding for multiple alternate records
  – New methods for ranking records
<table>
<thead>
<tr>
<th>PATIENT_ID</th>
<th>Date of Encounter</th>
<th>NAME</th>
<th>ADDRESS</th>
<th>DOB</th>
<th>SSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient_A</td>
<td>02/15/2014</td>
<td>Name 1</td>
<td>Address 1</td>
<td>DOB 1</td>
<td>SSN 1</td>
</tr>
<tr>
<td>Patient_A</td>
<td>03/05/2014</td>
<td>Name 2</td>
<td>Address 2</td>
<td>DOB 2</td>
<td>SSN 2</td>
</tr>
<tr>
<td>Patient_A</td>
<td>06/10/2014</td>
<td>Name 1</td>
<td>Address 3</td>
<td>DOB 2</td>
<td>SSN 2</td>
</tr>
<tr>
<td>Patient_B</td>
<td>01/30/2014</td>
<td>Name 1</td>
<td>Address 1</td>
<td>DOB 1</td>
<td>SSN 1</td>
</tr>
</tbody>
</table>
Record Linkage Repository (RLR)

Original survey data

**SUBJECT**
- Patient A
- Date of first contact
- Date last known alive

**NAME**
- Name 1
- Name 2

**ADDRESS**
- Address 1
- Address 2
- Address 3

Other tables (DOB, SSN, etc.)
Objective 3: Cleaning up the data

• Multiple records per patient were not always due to actual different records
  – Includes misspellings and abbreviations
    • Pear St./Peer St., John/Jon
    • St/Street, Ave/Avenue
  – Solution:
    • Spell out all abbreviations before deduplication
    • Collect all records with different spellings

• “Baby” names found in inpatient records
  – Solution: removed these names, but kept other valid PII for the patient
Objective 4: Accounting for incomplete records

- **Missing information:**
  - Race/ethnicity
    - Information not loaded
  - Contact dates
    - Used discharge date and discharge status to determine date of death or last encounter data from the survey
  - SSN
    - Medicare Health Insurance Claim (HIC) numbers were derived from insurance ID numbers following the CMS format
      

<table>
<thead>
<tr>
<th>Valid SSN derived from HIC</th>
<th>433,273</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total records with SSN</td>
<td>908,916</td>
</tr>
</tbody>
</table>

*Valid SSNs are those with full 9 digits and correctly formatted*
Standardized data ready for linkage

• How to link NHCS 2014 inpatient and emergency department (ED) data to 2014-2015 NDI

• The standard linkage algorithm was enhanced to accommodate the structure for the NHCS
  – Certain fields were not available (race, state of birth)
  – Other fields were part of the data that could be used in the algorithm (date of discharge where status=dead)
Linkage Approach

• Enhanced linkage algorithm conducted in two passes:
  1. Deterministic match using SSN from hospital records
    • Identifier fields: name, state of residence, and date of birth are compared to validate
  2. Probabilistic matching techniques used to identify likely pairs using other identifiers (not SSN)
    • SSN is not used to create the match pool so it is used to measure linkage accuracy
Preliminary Match Rates

• In the file, out of 3,244,917 eligible patient records, 168,253 linked to the NDI in 2014/2015
  – In order to be considered eligible for linkage, the patient’s record must contain at least two of the following: SSN, name, birth date

• This file is currently available for researchers through the NCHS Research Data Center with approved proposals
  https://www.cdc.gov/rdc/index.htm
Future Steps

• Use linked data to study mortality post hospital discharge (30-, 60-, 90-day mortality) and cause of death

• Electronic Health Records – NHCS 2016

• Link to other administrative data – CMS Medicare

• Link later years of NHCS and NDI
Conclusion

• Processing of establishment survey data differs from other survey data used in the Data Linkage Program

• Not one size fits all

• Taking the time to process the data helps increase pool of records that can be used in the linkage
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Questions? Comments?
Thank you!

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https://www.cdc.gov/nchs/data-linkage/index.htm