National Center for Health Statistics
Data Linkage

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

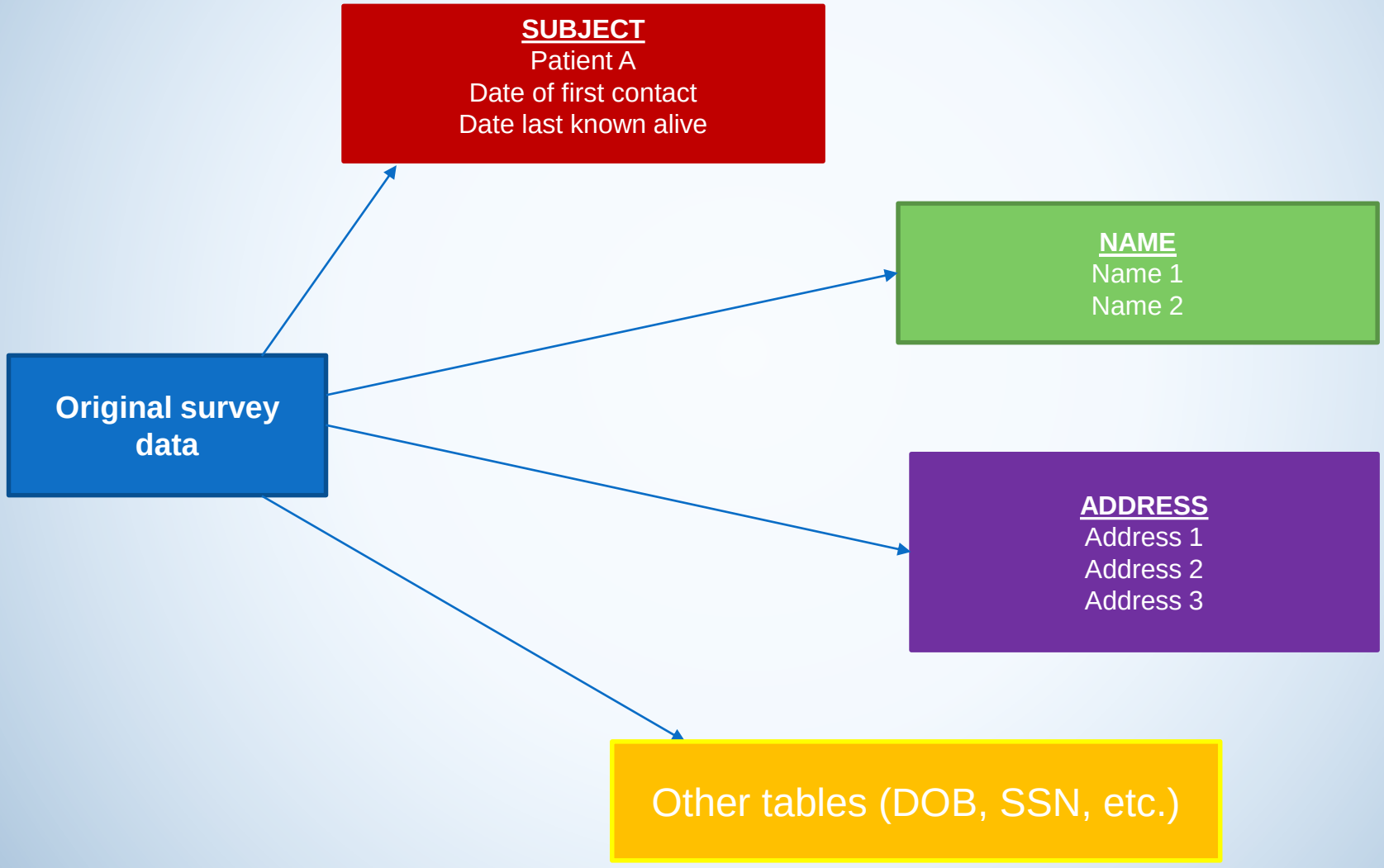
- Different pieces of information are broken up into different tables and stored in the record linkage repository (RLR)

- Solution:
  - NHCS posed unique storage challenges
  - New coding for multiple alternate records
  - New methods for ranking records

Original survey data

PATIENT_ID	Date of Encounter	NAME	ADDRESS	DOB	SSN
Patient_A	02/15/2014	Name 1	Address 1	DOB 1	SSN 1
Patient_A	03/05/2014	Name 2	Address 2	DOB 2	SSN 2
Patient_A	06/10/2014	Name 1	Address 3	DOB 2	SSN 2
Patient_B	01/30/2014	Name 1	Address 1	DOB 1	SSN 1

Record Linkage Repository (RLR)



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
  - Eg. "Babygirl", "Babyboy", "BabyAnderson"
  - 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

      #########$ | #########$$ | #########$#

Valid SSN	474,675
Valid SSN derived from HIC	433,273
Total records with SSN	908,916

** 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