Update on FY18 PCORTF Project: Enhancing Identification of Opioid-Involved Health Outcomes Using Linked Hospital Care and Mortality Data

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Project Goal

To improve public health surveillance and expand researchers' access to data on opioid-involved health outcomes by developing enhanced methods that make use of available structured and unstructured data from

- the National Hospital Care Survey (NHCS),

- the National Death Index (NDI), and

- the National Vital Statistics System restricted mortality data, drug specific information (NVSS-M-DO)

to identify specific opioids (e.g., fentanyl and heroin) involved in outcomes such as drug-related hospital visits and drug poisoning deaths.

Project Tasks

1. Create a merged <u>2014</u> NHCS Data Linked to NDI/NVSS-M-DO file and make file available in the NHCS RDC.

2. Develop methods of enhanced opioid-identification in hospital and death certificate data.

3. Create a merged <u>2016</u> NHCS Data Linked to NDI/NVSS-M-DO file with enhanced opioid identification methodology and make file available in the RDC.

4. Disseminate and promote new resources.

NCHS Data Sources
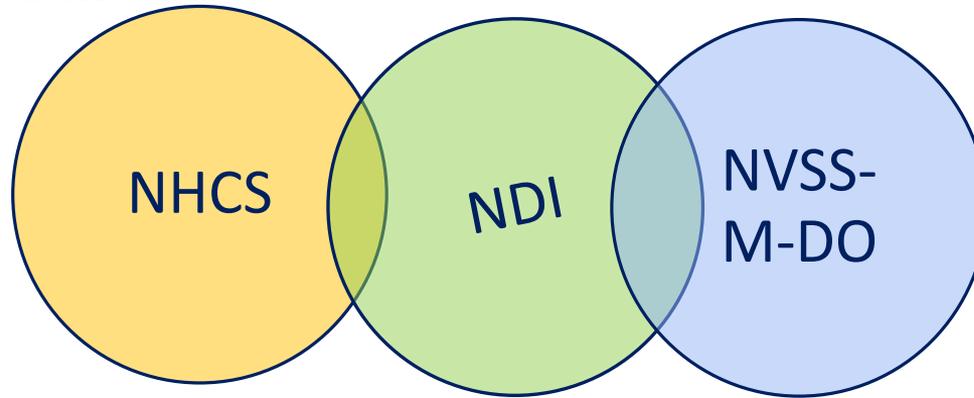
Types of information available

- Patient demographic variables
- Diagnoses
- Procedures
- Discharge status

- Underlying and multiple causes of death

- Drugs involved in the death

2014 NHCS linked to 2014-2015 NDI and NVSS-M-DO

- Contains information on care at the hospital, drugs-involved in the hospital visit, overdose deaths, and specific drugs involved in overdose deaths.
- The specific drugs involved in overdose deaths are identified using the Drugs Mentioned with Involvement (DMI) program.
  - Method was developed in collaboration with the FDA.
  - Involves extracting information from the literal text on death certificates.
- Allows for analysis of after hospitalization and hospital care prior drug overdose death.

Hospital Care

Drug Overdose Death
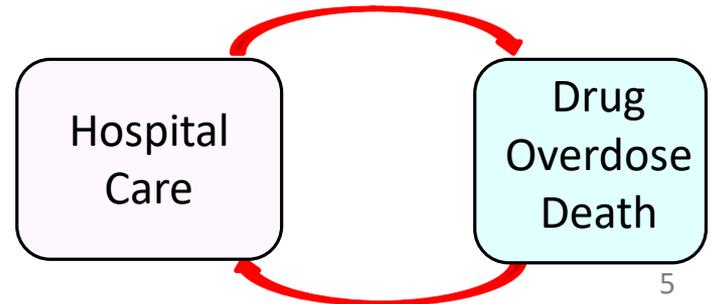
Example: Number of patients with an opioid-related IP hospitalization who died within one year post-discharge

	Number
Patients with an opioid-related IP hospitalization in 2014	24,059
Patients with an opioid-related IP hospitalization in 2014 with records that were eligible for linkage to the NDI	20,962
Patients who died within one year post-discharge[1]	1,805
Deaths due to drug overdose	341
Deaths due to drug overdose involving an opioid	243
[1] Based on the last opioid-related IP hospitalization. Excludes those who died during the hospitalization. NOTE: Data are not nationally representative. SOURCE: NCHS, 2014 National Hospital Care Survey linked to the 2014-2015 National Death Index.	

Example: **Specific opioid identified on death certificates among patients with an opioid-related IP hospitalization who died within one year post-discharge from a drug overdose death involving an opioid**

Drug	Number[1]	Percentage[2]
Heroin	108	44.4%
Fentanyl	48	19.7%
Oxycodone	31	12.8%
Methadone	29	11.9%
Morphine	28	11.5%
Other opioids[3]	21	8.6%
The term "opioid" or "opiate" was noted, but no specific drug was named.	23	9.5%

[1] Categories are not mutually exclusive. A death may involve more than one opioid (e.g., a death involving both hydrocodone and heroin would be counted in both categories). Deaths may also involve drugs other than opioids.

[2] The percentage of decedents (n=243) with this opioid mentioned as involved in the death.

[3] Includes oxymorphone, codeine, hydromorphone, buprenorphine and tramadol. For each of these drugs, there were fewer than 10 deaths that mentioned this drug as involved in the death.

NOTE: Data are not nationally representative.

SOURCE: NCHS, 2014 National Hospital Care Survey linked to the 2014-2015 National Death Index and to the NVSS-M-DO.

Opioid Case Definition

- **Natural Opioids** (e.g., morphine, codeine)
- **Semi-Synthetic Opioids** (e.g., oxycodone, hydrocodone)
- **Prescription Synthetic Opioids** (e.g., tramadol, fentanyl)
- **Illicit Opioids** (e.g., heroin, Krokodil, illicitly-manufactured fentanyl and its analogs)
- **Substances with Opioid-like effects** (e.g., kratom)

Stimulant Case Definition

- **Prescription Stimulants**
  - Adderall
  - Dexedrine
  - Ritalin

- **Illicit Stimulants**
  - Cocaine
  - Crack
  - Methamphetamine

Involvement Case Definition

1. **Any opioid use (past or present) including:**

   - Use
   - Abuse
   - Dependence
   - Poisoning
   - Adverse Effects
   - Addiction

2. **Acute opioid overdose (toxicity due to a high dose of opioids) including:**

   - Intoxication
   - Toxicity
   - Poisoning

Identifying Opioid Involvement in the Hospital Data

- Opioid-involved hospital encounters are limited to mentions of opioid use <u>prior</u> to arrival at the hospital.
  - Excluded mentions opioids administered during the encounter <u>or</u> opioids prescribed upon discharge
- Methods for identifying opioids:
  - Structured data:
    - Code-based algorithms
  - Unstructured data:
    - Adapting the DMI for use in hospital data
    - Developing a method using Natural Language Processing (NLP)

Evidence of Involvement in the Hospital Setting: Structured Data

- **Diagnoses**
  - ICD-10-CM & SNOMED-CT
- **Reasons for Visit**
  - ICD-10-CM & SNOMED-CT
- **Problem Lists**
  - ICD-10-CM & SNOMED-CT

- **Medications**
  - RxNORM & SNOMED-CT
- **Procedures**
  - HCPCS, CPT, ICD-10-PCS
- **Laboratory Tests**
  - LOINC

Status of Code-Based Algorithms Development

- **Status**:
  - Converted SNOMED codes to ICD-10-CM except for medications.
  - Applied existing ICD-10-CM based algorithm for a baseline count of opioid-involved visits.
  - Conducted exploratory analysis of selected procedure codes related to opioid use.
  - Initial medical code lists are being reviewed by subject matter experts (SMEs).

Evidence of Involvement in the Hospital Setting: Unstructured Data

- Selected Keywords in Clinical Notes Fields
  - Chief Complaint/Reason for Visit Narrative
  - History of Present Illness Narrative
  - History and Physical Note
  - Evaluation and Plan Note
  - Progress Note
  - Referral Note

Status and Challenges: DMI Program

- The DMI vocabulary accounts for new drugs, changes in drug nomenclature, and assigns more principal variants (generic drug names).

- **Status**:
  - Modified the 2016 DMI SAS program to run on NHCS clinical hospital notes and other text data to identify opioid-involvement.

- **Challenges**:
  - Clinical notes data from Continuity of Care Documents (CCD) needs to be parsed so the DMI program can run effectively.

Overview of NLP Plan

- The basic steps for the development of a NLP program to detect opioid-involved cases are:
  - Create comprehensive lists of all opioids and selected stimulants.
    - Based on lists provided by federal agencies
    - Include brand & generic names, street names, alternate spellings & misspellings
  - Perform initial query to identify encounters with drug mentions.
  - Confirm true cases and annotate data to characterize opioid use.
  - Use annotated data as training data to train program to distinguish between true cases and false positives.

Opioid Lists Used in Development of NLP

- Enhanced State Opioid Overdose Surveillance (CDC)

- Division of Vital Statistics (NCHS)

- National Electronic Injury Surveillance System - Cooperative Adverse Drug Event Surveillance Project (CPSC/FDA/CDC)

- Drug Slang Terms and Code Words (DEA)

- Drugs Mentioned with Involvement (FDA)

- Opioid and Stimulant List (FDA)

Benefits of the NLP Approach

- NLP provides a complimentary and efficient way to query both direct and indirect mentions of opioid-involvement.

- This strategy makes it easier to:
  - Capture relevant data despite misspellings, abbreviations, colloquialisms, etc.
  - Add flexibility to queries by adding/modifying new rules as needed.
  - "Teach" the computer to discover new terms and patterns in the data.
  - Examine the context surrounding key terms to help weed out false positives.

Hospital Clinical Notes: Applying DMI Program

"Patient PCP: Date: CHIEF COMPLAINT: Unresponsive (Patietn Fount in XXXX bath room on the floor not responding.)   HPI: is a 47 year old male with history of diabetes and chronic back pain/chronic opioid use who presents to the ED via EMS with a chief complaint of substance abuse/loss of consciousness. Per EMS was found down in a XXXX bathroom after ""snorting something"". He was unconscious with diminished respiratory rate and pinpoint pupils. He was given intranasal Narcan x 2 and IV Narcan x 1 with arousal. He is currently awake, alert and appropriately responding to questions.   Reportedly was in a minor motor vehicle accident yesterday as well as today. After accident yesterday states he developed chest pain which has been persistent throughout the day. He denies head trauma, LOC, or additional injuries. This afternoon he was in a ""3 car fender bender"".

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Status and Challenges: NLP

- **Status**:
  - Staff is refining plan to reformat text data for easy parsing by Python.
  - Finalizing NLP development plan based on case definition decisions.

- **Challenges**:
  - Python package installation took longer than excepted to complete. Currently, verifying that the programs work correctly in secure computing environment.
  - Text data must be correctly formatted before we can fully test draft Python program.

Next Steps: Identifying Opioids in Hospital Data

- Parse out the CCD clinical notes so the DMI program can identify opioid involved encounters.

- Finalize NLP development plan based and run algorithm on EHR and mortality data.

- Harmonize the previous three methods (coded algorithm, DMI program, and NLP) into an enhanced methodology for identifying opioid-involvement.

- Adapt the algorithm to identify other substances of interest (e.g., stimulants).

Next Steps: Merge Data Sets and Dissemination

- Merge <u>2016</u> NHCS Data Linked to 2016-2017 NDI and NVSS-M-DO file with enhanced opioid identification methodology and make file available in the NCHS RDC.

- Plan with BSC Workgroup about dissemination efforts.

- Test beta version of the hospital report web portal.

FY19 PCORTF Project: Identifying Co-Occurring Disorders among Opioid Users Using Linked Hospital Care and Mortality Data: Capstone to an Existing FY18 PCORTF Project

- New project started on May 1, 2019.
- The project will be identifying opioid cases with co-occurring substance abuse and mental health disorders using linked NHCS and mortality data.
- The FY19 project will use the methods developed in the FY18 PCORTF project.
- Project includes a validation study that will be conducted on the opioid and co-occurring substance abuse and mental health disorders algorithms.

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