The National Hospital Care Survey: Modernizing the Monitoring of the Nation's Health Care by Linking Electronic Health Records to Death Record Information and Administrative Data

Carol DeFrances Ph.D., Geoff Jackson M.S., Amy Brown M.P.H.

Division of Health Care Statistics

October 24, 2019

Agenda

- Background about the National Center for Health Statistics

- Overview of the National Hospital Care Survey

- Work on data linkage

- Spotlight on Special Projects that explore opioid-involvement using linked hospital and mortality data

National Center for Health Statistics (NCHS)

CDC National Center for Health Statistics

- **Monitor** the nation's health by collecting, analyzing, and disseminating health data

- **Compare** data across time, populations, providers, and geographic areas

- **Identify** health problems, risk factors, and disease patterns

- **Inform** actions and policies to improve the health of the American people

NCHS Data Collection Systems

- Vital Records
  - Birth, death, marriages, and divorce records

- Population Surveys
  - National Health Interview Survey
  - National Health and Nutrition Examination Survey
  - National Survey of Family Growth

- Provider Surveys
  - National Ambulatory Medical Care Survey
  - National Hospital Ambulatory Med Care Survey
  - National Hospital Care Survey
  - National Post-Acute and Long-Term Care Study (NPALS), formerly known as the National Study of Long-Term Care Providers (NSLTCP)

National Hospital Care Survey (NHCS)

Hospital-Care Research and Analysis Topics

- Rare diagnoses and experimental procedures

- Stays in the Intensive Care Unit

- Admissions from the ED

- Opioid-involved emergency department (ED) visits and overdoses

- 30-day mortality after a hospital visit

- Tracking patient's hospital visits over time

One Data Source Has All This Information and More…

Goal and Objectives

- Goal:
  - Provide reliable and timely healthcare utilization data for hospital-based settings.

- Objectives:
  - Move toward electronic data collection, particularly electronic health records.
  - Provide benchmark data for comparison to national data.
  - Link episodes of care across hospital units as well as link to other data sources such as the National Death Index (NDI) and Medicare data.

NHCS Sample Design, Data Coverage, and Sources

- Hospitals are randomly selected to provide nationally representative data on hospital utilization. The sampled hospitals represent facilities of similar size, service type, and/or geographic location and cannot be replaced.

- The 2019 NHCS sample consists of 598 non-institutional, non-federal hospitals with six or more staffed inpatient beds.

- Participating hospitals are asked to submit all inpatient discharges and emergency department (ED) visits for up to a 12-month period. Outpatient department (OPD) data were last collected in 2016 and may be added in the future.

- Data sources are UB-04 administrative claims, electronic health records (EHR), and Vizient.

Hospital Recruitment Challenges

- Participation is voluntary.

- Protecting the identity of sampled hospitals complicates recruitment efforts.

- Hospitals have competing demands.

- Hospitals lack the resources to respond to our request.

- Making the business case for participation is an ongoing challenge.

2016 Data Elements by Source

UB-04:

- Personally identifiable information (PII)
- Patient's age and sex
- Encounter dates
- Diagnoses and procedures
- Revenue codes
- Insurance information

EHR:

- Personally identifiable information (PII)
- Patient's age and sex
- Encounter dates
- Diagnoses and procedures
- Procedure outcomes
- Lab tests and results
- Medications and vital signs
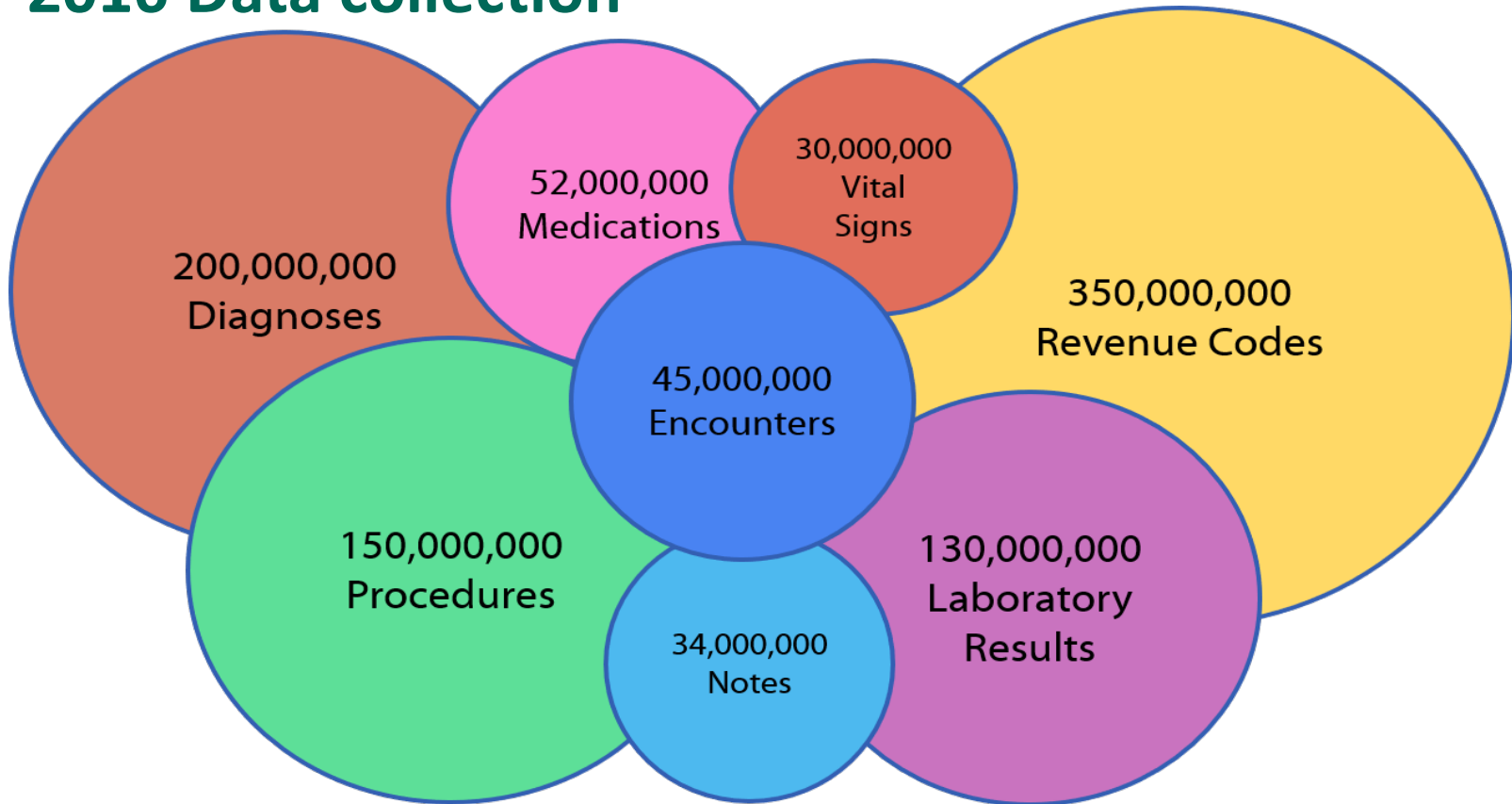- Clinical notes (for ED visits only)
- Race and Hispanic origin

Vizient:

- Patient's age and sex
- Diagnoses and procedures
- Revenue codes
- Lab tests and results

Challenges of Using Different Data Sources

- The only common data elements among the three sources are patient age, patient sex, diagnoses, and procedures.

- Claims and Vizient data have standardized code systems for diagnoses and procedures, while EHR data is not standardized.

- The number of hospitals that can be included will change depending on the research question.

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2016 Data collection

200,000,000 Diagnoses

52,000,000 Medications

30,000,000 Vital Signs

350,000,000 Revenue Codes

45,000,000 Encounters

150,000,000 Procedures

34,000,000 Notes

130,000,000 Laboratory Results

Data Linkage

NHCS Data Linkage

- The inclusion of Patient PII allows users to:
  - Follow episodes of care across hospital settings;
  - Measure repeat visits; and
  - Link to external data sources such as the National Death Index (NDI) and CMS data.
- With support from the Office of the Secretary Patient Centered Outcomes Research Trust Fund (OS-PCORTF) the following NHCS files were linked:
  - 2014 NHCS data with the 2014-2015 NDI
  - 2014 NHCS data with the 2014-2015 NDI linked to the 2014-2015 Drug Involved in Mortality (DIM) file
  - 2014 NHCS data with the 2014-2015 CMS Master Beneficiary Summary File (MBSF)
  - 2016 NHCS data with the 2016-2017 NDI

Source of Data: National Death Index (NDI)

- Centralized database of death record information on file from state vital statistics offices in the U.S.
  - Housed at National Center for Health Statistics
- Includes information on:
  - State of death
  - Date of death
  - Cause of death
- Linked NHCS-NDI data offer opportunities to study mortality post hospital discharge

https://www.cdc.gov/nchs/ndi/index.htm

In-hospital and Post-Acute Mortality

	In-hospital	In-hospital + 0-90 Days Post-Acute Mortality
Total number of deaths	10,946 (0.3%)	78,097 (2.4%)
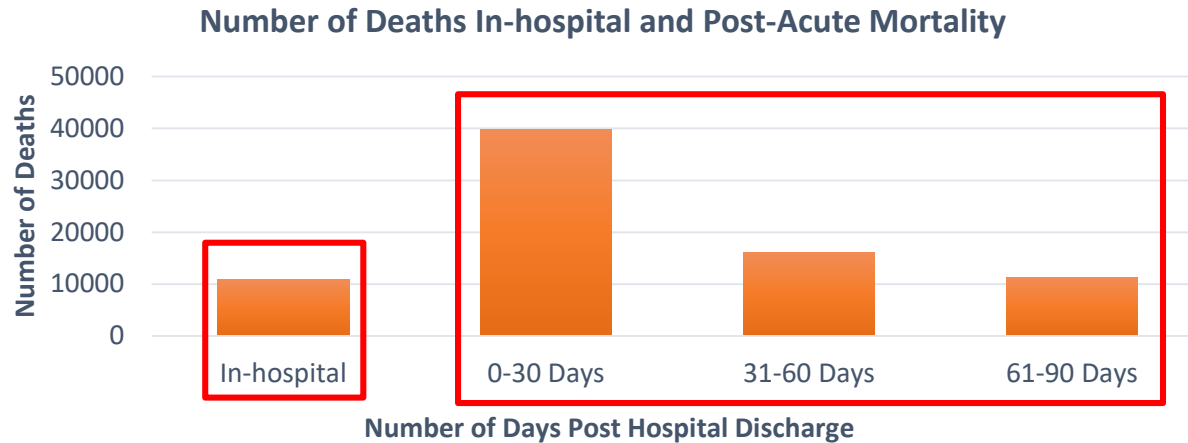
Number of Deaths In-hospital and Post-Acute Mortality

Data source: 2014 NHCS Linked to 2014/2015 NDI

Note: Unweighted estimates, not nationally representative

Underlying Cause of Death for Patients with a Post Coronary Artery Bypass Graft Procedure
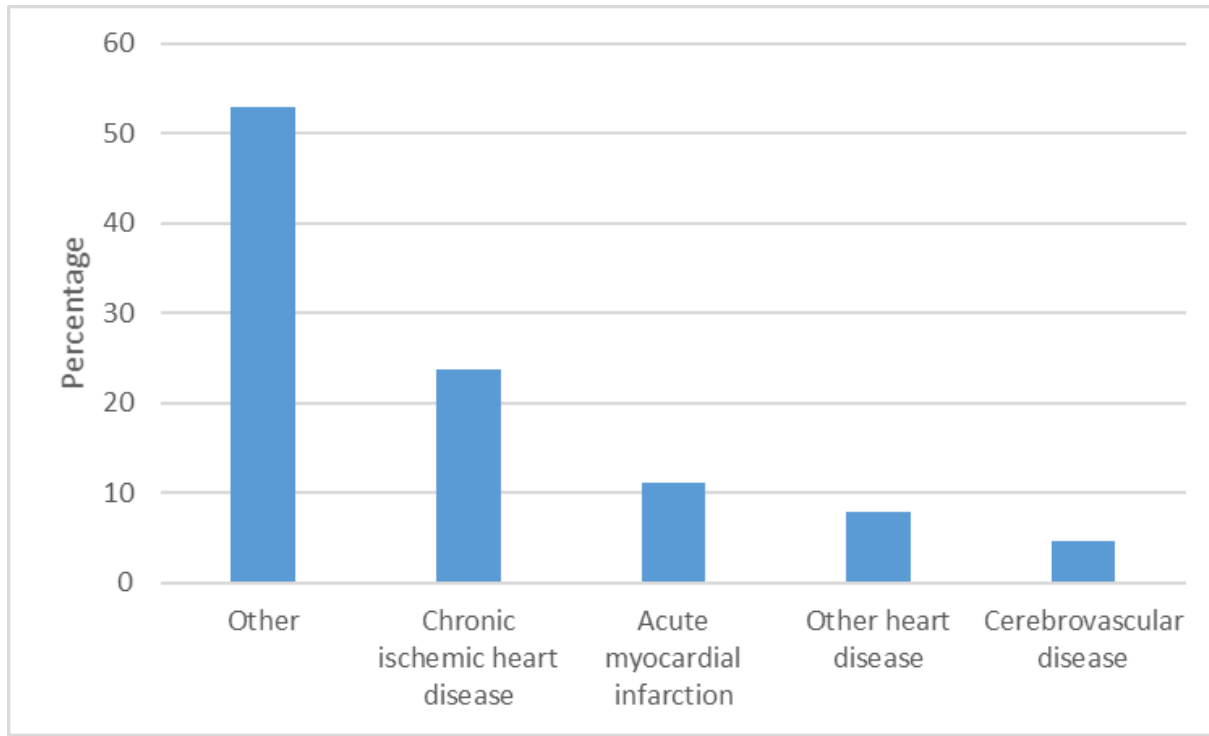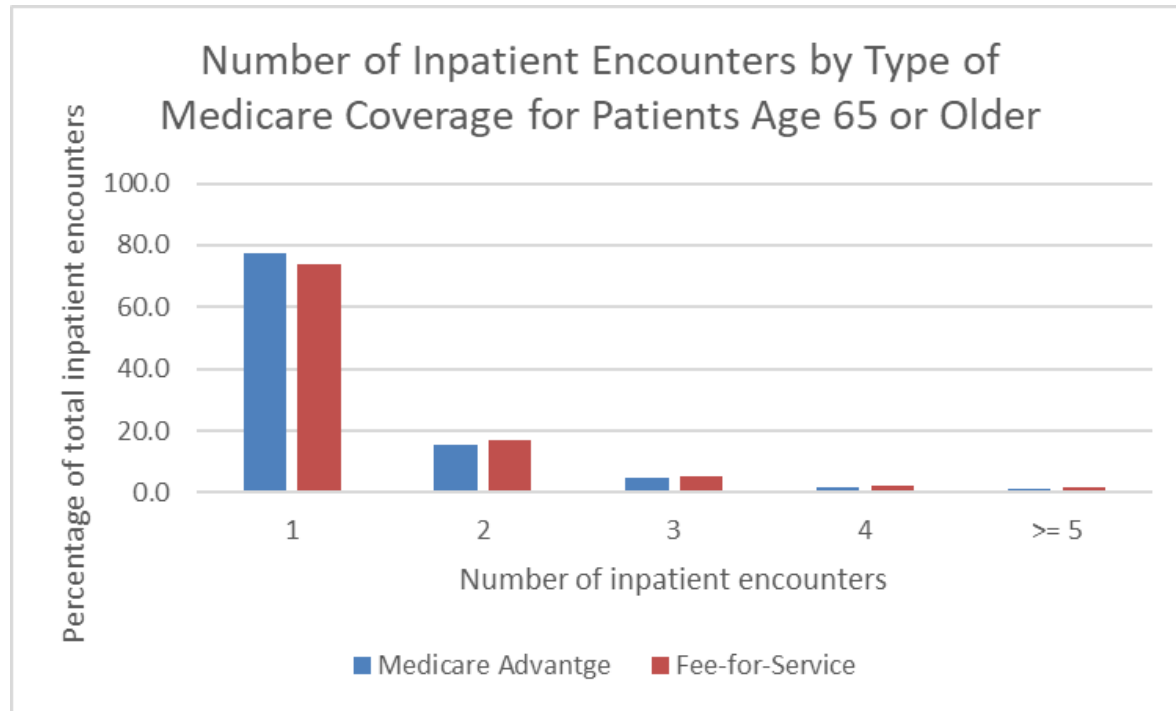

Data source: 2014 NHCS Linked to 2014/2015 NDI

Note: Unweighted estimates, not nationally representative

Data Source: CMS Master Beneficiary Summary File

- Contains data on all Medicare beneficiaries enrolled in/or entitled to Medicare within the calendar year
  - **Base (A/B)**: beneficiary characteristics, monthly entitlement indicators, reasons for entitlement (initial and current), and monthly Medicare Advantage indicators.
  - **Part D**: variables specific to Medicare Part D Prescription Drug Plan.
  - **Cost & Utilization**: summarized information about the service utilization and Medicare payment amounts by type of claim, includes prescription drugs.
  - **Conditions**: variables that indicate a Medicare beneficiary has received a service or treatment for selected chronic health conditions.

Example using 2014 NHCS linked to 2014/2015 CMS data

Number of Inpatient Encounters by Type of Medicare Coverage for Patients Age 65 or Older

Data source: 2014 National Hospital Care Survey Data Linked to 2014/2015 Master Beneficiary Summary File

Note: Unweighted estimates, not nationally representative

NHCS Data Linkage Program

CMS MBSF

Examine comorbidities and coverage that may be associated with hospital-related services and health outcomes for linked Medicare enrollees.

National Hospital Care Survey

NDI **DIM**

• Examine post acute mortality and cause of death.
• Identify opioid hospitalizations and deaths and specific drugs involved.
• Identify opioid and co-occurring mental health disorders.

CMS Part D and Assessment Data

Examine adherence to prescription drug recommendations post hospital discharge.

HUD Data

Examine federal housing assistance impact on re-admissions and mortality.

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Accessing NHCS in the NCHS Research Data Center

- Through the NCHS Research Data Center (RDC), researchers can access
  Individual years: 2013-2016 NHCS data
  Linked files: 2014 NHCS Data Linked to 2014/2015 NDI
                            2014 NHCS Data Linked to 2014/2015 NDI linked to the 2014/2015 DIM
                            2016 NHCS Data Linked to 2016/2017 NDI
                            2014 NHCS Data Linked to 2014/2015 Master Beneficiary Summary File

- For information on preparing an RDC proposal, please visit:
  https://www.cdc.gov/rdc/index.htm

- For more information on the NHCS data available in the RDC:
  https://www.cdc.gov/rdc/b1datatype/Dt1224h.htm
  https://www.cdc.gov/nchs/data-linkage/nhcs-ndi.htm

Opioid-Involvement Projects

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

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
- Drug Involved in Mortality (DIM), formerly known as 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.

DIM

- Includes information on the specific drugs involved with overdose deaths.
- The specific drugs are identified by the Drugs Mentioned with Involvement program. It was developed in collaboration with the FDA and involves extracting information from the literal text on death certificates.

Opioid-Involvement Case Definitions

Eligible Opioids

Prescription opioids, such as:
- Morphine
- Oxycodone
- Meperidine

Illicit opioids, such as:
- Heroin
- Illicitly manufactured fentanyl/fentanyl analogs

Medication-Assisted Treatment (MAT), such as:
- Methadone
- Buprenorphine
- Naltrexone

Substances with Opioid-Like Effects, such as:
- Kratom
- Loperamide
- Tianeptine

Opioid Use

OVERALL USE: Pt used an opioid at any time prior to presenting at the hospital

OVERDOSE: Pt used an opioid recently and presented with acute opioid poisoning

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

GOAL:

- Serve as a capstone to PCORTF FY18 project to improve public health surveillance and expand researchers' access to data on health outcomes of opioid users with **co-occurring substance use disorders and mental health issues**

- Will be followed by a study to validate algorithms from both the FY18 and FY19 PCORTF projects to identify the use of opioids and the existence of co-occurring disorders

Co-Occurring Disorders Case Definitions

Substance Use Disorders
Alcohol Use Disorder
Cannabis Use Disorder
Cocaine Use Disorder
Opioid Use Disorder
Hallucinogen Use Disorder
Inhalant Use Disorder
Amphetamine Use Disorder
Sedative, Hypnotic or Anxiolytic Use Disorder
Tobacco Use Disorder
Psychoactive Use Disorder

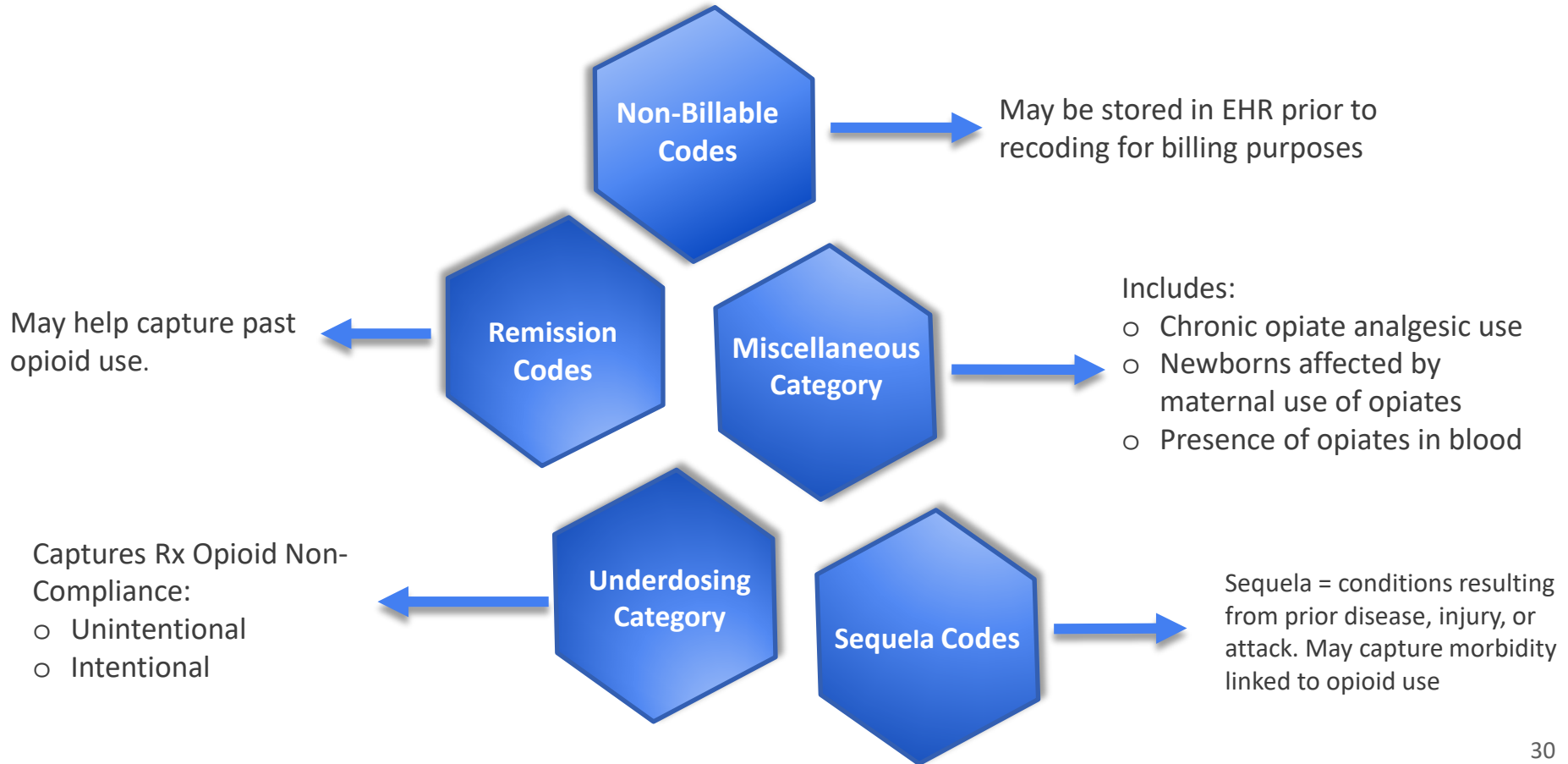| Selected Mental Health Issues |
|---|
| Depressive Disorders, including:
• Major depression (single and current episodes)
• Premenstrual dysphoric disorder
• All other depressive disorders
• Suicidal ideation |
| Anxiety Disorders, including:
• Acute stress reaction
• Generalized anxiety disorders
• Obsessive compulsive disorders
• Panic disorders
• Posttraumatic stress disorder (PTSD)
• Social anxiety disorders/social phobias |

Enhanced Diagnosis Code Algorithm

Non-Billable Codes → May be stored in EHR prior to recoding for billing purposes

May help capture past opioid use. ← **Remission Codes**

Miscellaneous Category → Includes:
- o Chronic opiate analgesic use
- o Newborns affected by maternal use of opiates
- o Presence of opiates in blood

Captures Rx Opioid Non-Compliance:
- o Unintentional
- o Intentional
← **Underdosing Category**

Sequela Codes → Sequela = conditions resulting from prior disease, injury, or attack. May capture morbidity linked to opioid use

Exploring Integration of Additional Medical Code Systems

Exploring Use of Other Standard Code Systems, including:

- Procedure codes (CPT, HCPCS, ICD-10-PCS)
- Medication codes (RxNORM, SNOMED, NDC)
- Laboratory test codes (LOINC)

Sample Machine Learning Classifier Application: Opioid Terms

"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 depression 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.   SHx: IVDA, Tob, denies ETOH.

Note: Data are synthetic and only used for demonstrative purposes.

Sample Machine Learning Classifier Application: Overdose Terms

"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 depression 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.   SHx: IVDA, Tob, denies ETOH.

Note: Data are synthetic and only used for demonstrative purposes.

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Sample Machine Learning Classifier Application: SUD & MHI Terms

"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 depression 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.   SHx: IVDA, Tob, denies ETOH.

Note: Data are synthetic and only used for demonstrative purposes.

Current and Future Research Products

- *AVAILABLE NOW IN RDC:*
  - **2014 NHCS/NDI/DIM file**
  - **2014 summary report** describing data and examples of research questions

- *IN PROGRESS:*
  - **2016 enhanced NHCS/NDI/DIM file** w/variables from validated algorithms
  - Interactive **web portal** for participating hospitals to create custom reports

  - Final **project reports, webinars, and conference presentations** describing enhanced methodology and exploratory analysis findings
  - **Algorithm tools**, such as keyword lists, sample SAS code, and access to machine learning classifiers

Example Research Questions Using Enhanced Data

- **What are characteristics of patients who had at least one opioid-involved hospital encounter?**

- **What are the most frequent types of opioids taken by patients with opioid-involved hospital encounters?**

- **What services were provided during opioid-involved encounters?**

- **What are common patterns of hospital use in the months prior to a opioid-involved overdose death?**

2019 Call for Applications

NCHS/AcademyHealth Health Policy Fellowship Program

Conduct Research Using National Center for Health Statistics Restricted Data Files

PURPOSE

This Fellowship Program promotes a wide variety of health services research that uses data from the National Center for Health Statistics (NCHS). The program also offers collective opportunities with AcademyHealth and NCHS.

AS A FELLOW, YOU WILL:

– Conduct research for up to 12 months at NCHS using restricted data files with strong preference for data linked to external sources;

– Attend and present research at the AcademyHealth Annual Research Meeting; and

– Network with current and past AcademyHealth Fellows and Scholars.

For more information on the NCHS Data Linkage Program, **visit https://www.cdc.gov/nchs/data-linkage/index.htm**.
The application cycle is slated to open in October 2019.

To be informed when the application cycle opens, or if you have any questions, please contact **nchs@academyhealth.org**.

Contact Information

- **Carol DeFrances**

  email: csd0@cdc.gov

  phone number: 301-458-4440

- **Geoff Jackson**

  email: mlq2@cdc.gov

  phone number: 301-458-4703

- **Amy Brown**

  email: wri1@cdc.gov

  phone number: 301-458-4134

Questions

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Backup Slides

Methodology Highlights: NLP and Machine Learning cont.

PROBLEM: : A simple random sample may not provide enough true and false cases

SOLUTION: Stratified random samples from the following "buckets":

FY18 Buckets

- Encounters w/at least one **opioid use DX code**
- Encounters w/o a DX code, but at least one **opioid keyword.**
- Encounters w/**opioid overdose codes.**
- Encounters w/o a DX code, but at least one **opioid overdose keyword.**
- Random encounters **not falling into any of above buckets.**

FY19 Buckets

- Encounters w/at least one **SUD DX codes**
- Encounters w/o a DX code, but at least one **SUD keyword.**
- Encounters w/ at least one **MHI diagnosis code**
- Encounters w/o a DX code, but at least one **MHI keyword.**
- Random encounters **not falling into any of the above buckets.**

Current Product: 2014 Linked Data Now Available

- Researchers can now access linked file with data from:
  - 2014 NCHS
  - NDI 2014-2015
  - DIM with terms from 2014 DMI drug term list
- See NCHS RDC website for:
  - Full list of available variables
  - Summary report describing data and examples of research questions

Future Products: 2016 Linked Data w/Enhanced Algorithm Variables

- RDC users will be able to access linked file with data from:
  - 2016 NCHS w/ variables from enhanced & validated algorithms
  - NDI 2016-2017
  - DIM with terms from updated 2016 DMI drug term list
- Sampled hospitals will be able to run reports on their own data in an interactive web portal:
  - Submitted encounters flagged for opioid-involvement and co-occurring disorders
  - 30-, 90- and 120-day discharge mortality rates among patients with flagged encounters

Future Products: Reports, Papers and Presentations

- Final reports will be posted to the NCHS website and will describe:
  - Development of enhanced methodology
  - Research design and key findings of validation study
- Project staff will host webinars and apply to present at conferences to demonstrate analyses that can be performed using the new linked data files

Future Products: Tools researchers can use to apply algorithms

Researchers will have access to tools to run the algorithms on their own data, such as:

- Lists of codes and keywords used in algorithms

- Sample SAS programs

- Code-based or downloadable versions of the machine classifiers for clinical text data