Structuring, Managing, and Using Patient Work Information in EHRs to Improve Patient Care & Public Health

- The Relevance to Public Health of Work Information Contained in EHRs
- Structuring Patient Work Information in EHRs to Improve Patient Care & Public Health
- Using Work Information in EHRs for Clinical and Public Health Activities
NIOSH EHR Workgroup

• Division of Respiratory Disease Studies
  – Eileen Storey, Margaret Filios, Genevieve Luensman, Mark Hoover, Stacey Marovich (CACI, Inc.), Sherry Baron

• Division of Safety Research
  – John Myers, Michael Goldcamp

• Division of Surveillance, Hazard Evaluations, and Field Studies
  – Marie H. Sweeney, Kerry Souza, Doug Trout, Sue Nowlin

• Education and Information Division
  – Donna Van Bogaert

• National Personal Protective Technology Laboratory
  – Charles Oke

• Office of the Director
  – John Piacentino, Ken McKneely, Jennifer Lincoln, Yvonne Boudreau
The Relevance to Public Health of Work Information Contained in Electronic Health Records (EHRs)

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National Institute for Occupational Safety and Health
Public Health Informatics Conference
Atlanta, GA
April 30, 2014

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.
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• Collaborators
  – Cambridge Health Alliance (CHA):
    • Laura Brightman & Rose Goldman (slides)
  – Massachusetts Department of Public Health
    • Letitia Davis & Lenore Azaroff
Images of Work
Images of Work
Images of Work
Images of Work
Images of Work
Why Work Matters

• Workers spend close to 1/2 their waking time at work
  – Work affects health
  – Health affects work
  – Work is a contributor to health disparities
Examples

- Work-related asthma
- Construction worker fall from a ladder
- Diabetes in a health care worker rotating shifts
- Influenza in a transit worker
- Hepatitis in a food-service worker
- Musculoskeletal issue in a carpenter
- Take-home exposures
Why Work Matters

• Fatal work-related injury and illness combined
  – 8th leading cause of death

• Non-fatal work-related injury or illness annually affects
  – ~ 3 million private-sector workers
  – ~ 821,000 state/local government workers
    • 150,000 hospitalizations

• Work-related injuries annually account for
  – ~ 3 million emergency department visits
  – ~ 150,000 hospitalizations

• Annual cost estimate > $250 billion
Support for Work Information in EHRs

- 2011 Institute of Medicine
- 2012 American College of Occupational and Environmental Medicine (ACOEM)
- 2012 Council of State and Territorial Epidemiologists (CSTE)
- 2012 American Public Health Association
- 2012 National Center for Vital and Health Statistics (NCVHS)
- 2012 HHS Environmental Justice Strategy
First Contact
Improving Patient and Public Health

• Massachusetts Department of Public Health (MDPH) & Cambridge Health Alliance (CHA)

• Occupation captured during registration
Improving Patient and Public Health

• Links between demographics and occupation

• Most common occupations among Portuguese-speaking patients:
  • Women: Cleaning Maid or Housekeeper
  • Men: Maintenance & Construction Painter
Health Implications

- Housekeepers have > 2x the national average rate of occupational illness and injury with lost work time.

- Maintenance and construction painters are at risk for falls, exposure to lead paint and solvents.
OH Resources on CHA intranet after occupation data collection
Expanded Provider Education

• Grand Rounds and Other Presentations

  – Importance of occupation in primary care & chronic disease management
  – Top 10 occupations at CHA
  – Checking lead levels in painters
  – Managing diabetes in night shift workers
  – Work-related asthma and allergies
  – Choice of medications based on work (non-drowsy, diuretics)
  – Considering return-to-work issues after illness or hospitalizations
How to provide the necessary information and tools?
Structuring Patient Work Information in EHRs to Improve Patient Care and Public Health

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Public Health Informatics Conference
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Acknowledgements

• Public Health Data Standards Consortium (PHDSC): Anna Orlova, Maiko Minami, Lisa Nelson (file cabinet analogy, CDA sub-section template slide)

• University of Utah, Department of Biomedical Informatics: Catherine Staes (slides), Hannah Edwards, Jeff Duncan, Jitsupa Peelay

• Stacey Marovich (slides)
Occupational Data for Improving Worker Health
Foundation for Improving Worker Health
Occupational Data for Health (ODH)
What Are Occupational Data for Health (ODH)?
What Are Occupational Data for Health (ODH)?
Organizing ODH

ODH “File Cabinet”
Organizing ODH (File Cabinet)

- The Collections of Questions = Organizers (Drawers)
- The Questions (Variables) = Data Elements (Folders)
- Possible Answers = Value Set (Pages)
ODH-Organizers (Drawers)

Collections of Questions
(aka, collections of variables)
<table>
<thead>
<tr>
<th>Occupation History</th>
<th>Employment Status</th>
<th>Usual Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Schedule</td>
<td>Occupational Injury</td>
<td>Occupational Exposure</td>
</tr>
</tbody>
</table>
ODH-Data Elements (Folders)

The Questions (*aka*, Variables)
### OCCUPATIONAL HISTORY
- Current Industry Description
- Current Industry Code
- Current Occupation Description
- Current Occupation Code
- Current Job Duties
- Current Occupation Start Date
- Current Employer Name
- Current Employer Location

### USUAL EMPLOYMENT
- Usual Industry Description
- Usual Industry Code
- Usual Occupation Description
- Usual Occupation Code
- Usual Employment Duration
- Usual Employment Start Year
<table>
<thead>
<tr>
<th>WORK SCHEDULE</th>
<th>EMPLOYMENT STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Hours Worked per Wk</td>
<td>Current Employment Status</td>
</tr>
<tr>
<td>Current Days Worked per Wk</td>
<td></td>
</tr>
<tr>
<td>Current Work Schedule</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OCCUPATIONAL INJURY</th>
<th>OCCUPATIONAL EXPOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Cause</td>
<td>(TBD)</td>
</tr>
</tbody>
</table>
ODH-Value Sets (Pages)

Possible Answers
CDC_Census Coding System

CDC_Census Occupation
CDC_Census Industry
CDC_CensusOccupation- based on Census Classification System

544 occupation categories (label and code)

Frontline supervisors/Managers of fire fighting and prevention workers (3720)

Fire Fighters (3740)

Categorized to

>31,000 Occupation Titles (labels in Census Alphabetical Indexes plus CDC-added occupations)

Fire chief

Fire fighter
Fire patrol
Fire crew worker

http://www.cdc.gov/niosh/topics/coding/faq.html#Information
CDC_CensusOccupation- based on Census Classification System

- 6 occupational groups
- 13 occupational groups
- 23 major occupational groups

- Service occupations
- Protective service occupations

- Frontline supervisors/Managers of fire fighting and prevention workers (3720)
- Fire Fighters (3740)

http://www.cdc.gov/niosh/topics/coding/faq.html#Information
CDC_CensusIndustry - based on Census Classification System

- **15 industry groups**
- **21 major industry sectors**
- **272 industry categories (label and code)**

**Justice, public order, and safety activities (9470)**

- >21,000 Industry Titles (labels in Census Alphabetical Indexes plus CDC-added industries)

**Public administration**

**Fire department**
**City fire department**

http://www.cdc.gov/niosh/topics/coding/faq.html#Information
**Work Schedule**
- Current Hours Worked per Wk
- Current Days Worked per Wk
- Current Work Schedule
  - Current Work Schedule

**Employment Status**
- Current Employment Status
  - Employed for Wages
  - Active Duty Military
  - Volunteer
  - Student
  - Homemaker
  - None of the Above

**Occupational Injury**
- External Cause
  - ICD-10-CM Codes

**Occupational Exposure**
- (TBD)
ODH Data Elements and Value Sets - Technical Definitions

Define the variables and the possible answers
ODH- Technical Definitions

- Organizer (drawer)- LOINC code
- Data Element (folder)- LOINC code
- Value Set (pages)- OID (object identifier)
- Values- SNOMED, CDC_Census, ICD-10-CM
How Do All of These Building Blocks Fit Together?
ODH-Relational Information Model
ODH Relational Information Model - Basic Diagram

- **PERSON**
  - From zero to many
  - From one to one
  - From zero to one

- **Usual Employment**
- **Occupational Status**
- **Occupational History**
- **Work Schedule**
- **Occupational Exposure**
- **Occupational Injury**

Capture scenario such as "Volunteer Firefighter"

Link an Occupational History entry to a Work Schedule entry.
This is Mom’s

This is mine

From zero to many
- From one to one
- From zero to one

ODH Relational Information Model - Basic Diagram
ODH Entity Relationship Diagram
ODH Entity Relationship Diagram – Occupational History Organizer

<table>
<thead>
<tr>
<th>OccupationalHistory</th>
<th>PK</th>
<th>OccupationalHistoryID</th>
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</thead>
<tbody>
<tr>
<td>FK3</td>
<td>OccupationalHistoryIndustryDescription</td>
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<tr>
<td>FK3</td>
<td>OccupationalHistoryIndustryCode</td>
<td></td>
</tr>
<tr>
<td>FK3</td>
<td>OccupationalHistoryIndustryValueSetOID</td>
<td></td>
</tr>
<tr>
<td>FK1</td>
<td>OccupationalHistoryOccupationDescription</td>
<td></td>
</tr>
<tr>
<td>FK1</td>
<td>OccupationalHistoryOccupationCode</td>
<td></td>
</tr>
<tr>
<td>FK1</td>
<td>OccupationalHistoryOccupationValueSetOID</td>
<td></td>
</tr>
<tr>
<td>FK1</td>
<td>OccupationalHistoryJobDuties</td>
<td></td>
</tr>
<tr>
<td>FK2</td>
<td>OccupationalHistoryCurrentOccupationDate</td>
<td></td>
</tr>
<tr>
<td>FK2</td>
<td>OccupationalHistoryStartDate</td>
<td></td>
</tr>
<tr>
<td>FK2</td>
<td>OccupationalHistoryEndDate</td>
<td></td>
</tr>
<tr>
<td>FK2</td>
<td>OccupationalHistoryWorkScheduleID</td>
<td></td>
</tr>
<tr>
<td>FK2</td>
<td>OccupationalHistoryHoursWorkedPerWeek</td>
<td></td>
</tr>
<tr>
<td>FK2</td>
<td>OccupationalHistoryDaysWorkedPerWeek</td>
<td></td>
</tr>
<tr>
<td>FK5</td>
<td>PersonEmploymentStatusID</td>
<td></td>
</tr>
<tr>
<td>FK5</td>
<td>EmployerName</td>
<td></td>
</tr>
<tr>
<td>FK5</td>
<td>EmployerLocation</td>
<td></td>
</tr>
<tr>
<td>FK4</td>
<td>FamilyRelationshipTypeID</td>
<td></td>
</tr>
<tr>
<td>FK6</td>
<td>PersonID</td>
<td></td>
</tr>
<tr>
<td>FK6</td>
<td>EnteredDate</td>
<td></td>
</tr>
</tbody>
</table>

Person

<table>
<thead>
<tr>
<th>PK</th>
<th>PersonID</th>
</tr>
</thead>
</table>

Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Integrating ODH

Collaborative application of the information model
But we’re talking about individual patient electronic health records!
Capturing Patient ODH

Focus on Industry and Occupation (I/O)
Registration Clerk

Medical Registrar

Gather Industry & Occupation (I/O)

Care Provider

Medical Record
Rules for Gathering and Coding I/O

Behavioral Risk Factor Surveillance System (BRFSS) Interviewers Guide
Capture of I/O-
Electronic Patient Interface

• Goal-  Begin to define business requirements...
  – to gather *codable I/O information*, for both current and usual work situations
  – through a *patient interface*
  – with *limited burden*

• Preliminary investigation-
  – Catherine Staes, Department of Biomedical Informatics, University of Utah
This is not a survey!

9. For whom do/did you work? (name of company, business, organization or other employer). If you are not working now, please respond regarding your main occupation before you stopped working.

   Shoosville Laundry

10. What type of business or industry is/ was this? (e.g. hospital, newspaper publishing, mail order house, auto repair shop, bank, etc.)

   Laundry

11. What kind of work do/did you do or what was your job title? (e.g. registered nurse, personnel manager, auto mechanic, accountant, grinder operator, etc.)

   Attendant

12. What are/were your most important activities or duties? (e.g. patient care, directing hiring policies, repairing automobiles, reviewing financial records, operating grinding mill, etc.)

   Overseeing customer needs and keeping area clean
Capture of I/O-
Electronic Patient Interface Strategies

Branching logic

Examples

Prompt

Autocode

Drill-down to select
Capture of I/O - Preliminary Investigation

1. Interview Supervisor
2. Interface Entry
3. Prototype Dropdown
4. Interview Subject
5. Repeat Interface Entry
Capture of I/O-
Electronic Patient Interface

• I/O can be captured from patient using a series of questions and feedback

• Patients require context to understand the level of granularity required (to get accurate, codable data)

• Language used in a dropdown format needs to be plain English (e.g., index entries vs. categories)
Capture of I/O in a Clinical Setting - Pilot Project

• 3-year pilot project initiated October 2013
  – St John’s Community Health Centers in Los Angeles
    • Small network of community health centers
  – Modifying EHR to contain I/O text and codes
  – Year-long collection of patient I/O to begin in 2014
Coding I/O

For more information on coding I/O see http://www.cdc.gov/niosh/topics/coding/
NIOSH Industry and Occupation Computerized Coding System

• Aids trained coders
  – Originally built for higher quality data – text entry based on guidance
  – Provides CDC_Census codes

• Options
  – Batch processing
  – Computer-assisted (weighted match)
  – New! Intelligent dropdown

• Engine available via web services

• http://www.cdc.gov/niosh/topics/coding/software.html
<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td># Registration records</td>
<td>86,949</td>
</tr>
<tr>
<td># Records with (any) occupation data</td>
<td>27,054</td>
</tr>
<tr>
<td># Records coded by NIOCCS</td>
<td>10,967 (40%)</td>
</tr>
<tr>
<td># Records coded by NIOSH human coders</td>
<td>7,312</td>
</tr>
<tr>
<td># Records not codeable</td>
<td>7,728</td>
</tr>
<tr>
<td># Potentially codeable records remaining</td>
<td>1,042</td>
</tr>
</tbody>
</table>
Interoperability of ODH

Clinical Document Architecture (CDA) sub-section template
Example - Reporting to Public Health

Format - Clinical Document Architecture (CDA)
ODH sub-section is part of the Healthy Weight (HW) profile shown here at the Interoperability Showcase!
ODH and Clinical Decision Support (CDS)

Interface of Work and Health
Knowledge is Available!
ODH Clinical Decision Support (CDS) Project- 2013-2017

- Develop knowledge base reports that apply occupational health knowledge to primary care settings
- Select a clinical setting and implement within a CDS tool in their EHR system
- Assess over 12 months, measuring usefulness and usability
ODH CDS Project-Knowledge Base Reports

• Synthesize knowledge base reports for three topics targeting primary care practice

  – Diagnosis and management of an occupational disease (occupational asthma)

  – Consideration of work environmental factors in managing a chronic disease (diabetes)

  – Guidance for return-to-work determinations, especially for non work-related condition(s) (musculoskeletal injury)
Four Layers of Knowledge for CDS

4. Executable
   System-specific

3. Structured
   Expressed in codes

2. Semi-Structured
   Recommendation = clinical scenario + clinical action

1. Narrative
   e.g., guidelines

BLOCK PARTY
Foundation for “Occupational Data for Health”
Using Work Information in EHRs for Clinical and Public Health Activities

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National Institute for Occupational Safety and Health

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NIOSH Activities

• Glossary Development
  – Developing common terms for use

• Public Health Functional Profile Development
  – Driving the “actions” that occur when using an EHR
NIOSH EHR Glossary

• Developed to provide HL7 guidance in defining occupational health related terms for EHR standards
• To ensure consistent data collection and usage
NIOSH EHR Glossary

- Defined 30 terms
  - Occupation and Industry Related
    - Work
    - Job
    - Hobby
  - Other Factors
    - Hazard
    - Personal Protective Equipment
    - Risk
NIOSH EHR Glossary

- Definitions derived from multiple sources
  - Dictionary
  - Bureau of Labor Statistics
  - American Community Survey
  - OSHA
  - Manuscripts
NIOSH EHR Glossary

• Entries were designed to meet the needs of multiple stakeholders
  – Public health
  – Providers
  – Patients
NIOSH EHR Glossary Review

• Comments were requested and received -April 2013
  – American College of Occupational and Environmental Medicine
  – Council of State and Territorial Epidemiologists
  – Bureau of Labor Statistics
  – National Center for Health Statistics
NIOSH EHR Glossary Review

– National Health and Nutrition Examination Survey
– Association of Occupational and Environmental Clinics
– Occupational Safety and Health Administration
– Social Security Administration
– Bureau of Census
NIOSH Glossary Status

- Spring of 2013 – provided, with comments, to HL7
- Currently a “parking lot” item
Public Health Functional Profile Project

• Development is led by the Public Health Data Standards Consortium (PHDSC)
• NIOSH participates as a Working Group member representing Occupational Health
• Year 4 of the PHDSC Public Health Functional Profile (PHFP) Project
NIOSH Objectives

• Develop an Occupational Health Functional Profile by:
  – Review and revision of the existing profile
  – Adding functionality as necessary

• Introduce work information into other Functional Profiles

• Influence EHR-S FM development
Background - PHDSC

- Develops standards associated with Health Information Technology
- Focused on the Public Health perspective in national standardization efforts
- Convened the Electronic Health Record Public Health Task Force
Background - EHR-S Functional Model

• Developed by the HL7 Technical Committee and modified by the HL7 Electronic Health Record Workgroup

• A document to standardize the functions that may be present in an EHR-S

• The current model is the 2nd release
What is a Functional Profile?

• Profiles are derived from the EHR-S Functional Model
• A document that defines the set of EHR-S functions applicable to a specific purpose
  – Functions are the capabilities of the system
  – Profiles contain a subset of all possible functions
• Provides developers information on needs of specific stakeholders
• Provide guidance for EHR-S FM revision
Current Functional Profile Development

Functional profile development is driven by the Electronic Health Record System (EHR-S) Functional Model

Source: http://www.hl7.org/implement/standards/
Background – Model/Profile Definitions

• **Domain** – stakeholder group
• **Function** – capability of the system
• **Description** – written statement explaining the action of the function
• **Conformance Criteria** – minimum level of capability a function must possess to claim conformance to the EHR-S FM and PHFP
PHFP History

• Initial PHFP domains - 2011
  – Vital Records
  – Early Hearing Detection and Intervention
  – Chronic Diseases and Cancer Surveillance

• Vitals Records profile was a precursor to the PHFP

Source: http://www.phdsc.org/
PHFP History

• 5 domains added – 2012
  – Birth Defects
  – Deep Vein Thrombosis & Pulmonary Embolism
  – Healthcare Statistics
  – Occupational Disease, Injury, and Fatalities
  – Public Health Laboratory

Source: http://www.phdsc.org/
Profile Function Groups

- Overarching Criteria
- Care Provision
- Care Provision Support
- Population Health Support
- Administration Support
- Record Infrastructure
- Trust Infrastructure
### The Functional Profile

<table>
<thead>
<tr>
<th>Function</th>
<th>Statement</th>
<th>Description</th>
<th>Conformance Criteria</th>
</tr>
</thead>
</table>
| Capture Referral | Request | Enable the receipt and process incoming referrals |}

**Domain**

**Conformance Criteria**
Occupational Disease, Injury, and Fatalities (ODIF) Domain

- NIOSH participation via conference call
- Focus on ensuring the inclusion of work/occupation information in PHFP
  - Edit current version of PHFP (release 2)
  - Assist in reconciliation of EHR-S comments from balloting
Possible Profile Edits

- Adding functions or conformance criteria
- Semantic changes to existing function cells
- Elevation of priority level of existing conformance criteria
Conformance Criteria Priority Levels

• **Shall** – the function must perform this task to meet stakeholder needs
• **Should** – the function would be more effective if this criteria were met
• **May** – this criteria is something some stakeholders would use but is not necessary
• **NOTE**: these priority levels may differ between domains for the same criteria
Examples of Edited Conformance Criteria

- The system SHALL provide the ability to capture injury at work for US standard Certificate of Death (as specified in the NCHS ES).
- The system MAY SHOULD provide the ability to receive clinical, and administrative data, and demographic (e.g., insurance information, work history) as part of the referral process from a PHR-S.
Functions in Action

• Presents for his raccoon bite
  – Care Provision.1.1 “Manage Patient History”
    • Current occupation - the occupation in which an individual is engaged at the time that he or she presents to a health care provider, regardless of duration
    • Usual occupation - the occupation a person has held for the longest time during his or her life, regardless of the occupation currently held.

• ODIF edit requests occupational history
Functions in Action

- Raccoon bite is related to current occupation
  - Care Provision.6.3 – “Manage Treatment” – generates order for wound dressing
- Respiratory illness related to usual occupation
  - Care Provision Support.1.1 “Manage Patient Record” – ODIF conformance criteria requires (SHALL) management of occ. history
  - Care Provision Support.4.6.2 “Support for Referral Recs” – clinic provides referral to specialist
Functions in Action

• Population Health Support.2.1 – “Support for Epidemiological Investigation Data Collection”
  – Researcher queries system for respiratory disease
  – Links firefighter occupation to respiratory disease
  – Finds in notes (Care Provision.3.3 – “Manage Clinical Documents and Notes”) that firefighter was potentially exposed to asbestos (hazard)
  – Rabies case is reported to health department
Glossary in Action

• Hazard - a source of potential harm to an individual’s physical or mental health.
  – occupational hazard is specific to work or work environment
  – biological, physical, psychological, chemical, or radiological in nature

• Exposure - actual contact or interaction with a specific hazard that increases an individual’s risk of a detrimental physical or mental health outcome (asbestos in the firefighter case)
Functions in Action

• Administrative Support.2.1 – “Synchronize Patient Demographic Data”
  – System updates patient record to include “caddy” as current and updates occupational history

• Data is maintained and kept secure through Record and Trust Infrastructure functions

• Data is available for future clinical/research use
Examples of ODIF Edits

• Work information as a demographic variable
• Inclusion of occupational history in patient history
• Ensuring the ability of the system to capture work information from death certificates
• Occupational history related to birth defects and infant mortality
Examples of ODIF Edits

• Linking medication to work
• Addition of occupation related reports
Project Status

• Revisions to Release 2 were completed Spring 2013
• May 2013 PHFP R2 was balloted – comments only
• December 2013 group convened to reconcile comments
• Reconciliation completed March 2014
Conclusion

• Work impact on health
• Currently EHR-S does not include work adequately
• Development of Occupational Disease, Injury, and Fatality Profile is a pathway to the inclusion of work
Thank you! Questions?

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