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Centralized Interactive Phenomics Resource (CIPHER): A Platform for Electronic Health Data-Based Phenomics Science

Systems Demonstration - Clinical Research Informatics

S56

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VA Boston Healthcare System

#AMIA2023

Disclosure

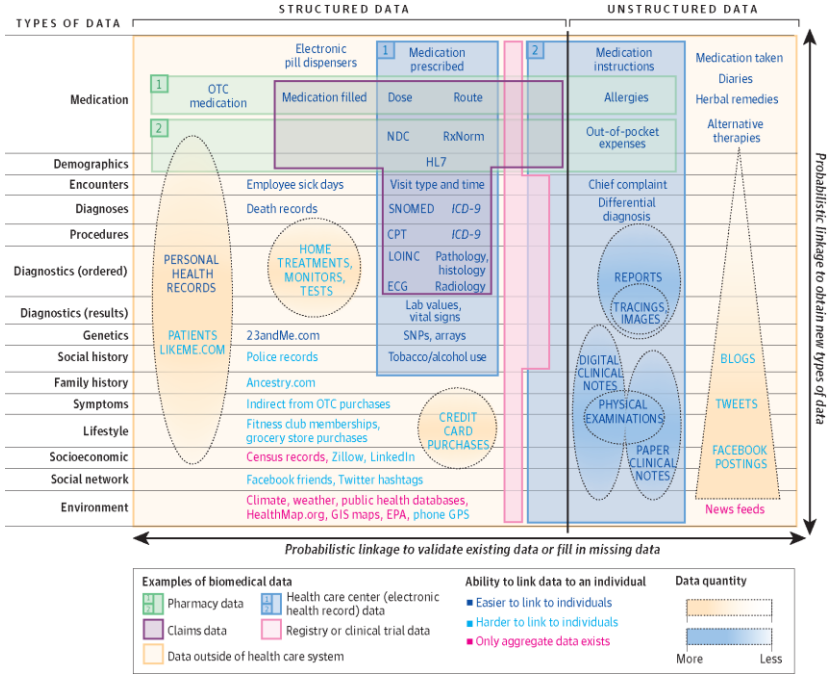
I and my spouse/partner have no relevant relationships with commercial interests to disclose.

Learning Objectives

After participating in this session, the learner should be better able to leverage the Centralized Interactive Phenomics Resource (CIPHER) platform for electronic health records (EHR) based phenotyping by

- searching the library for phenotype definitions,
- contributing phenotypes, and
- browsing connected data visualization tools.

EHRs are a rich resource for clinical research and healthcare operations



Weber JAMA 2014

Phenotyping

- Code curation
- Machine learning
- Other approaches

Heart failure

Diabetes

PTSD

Phenotype development has its challenges

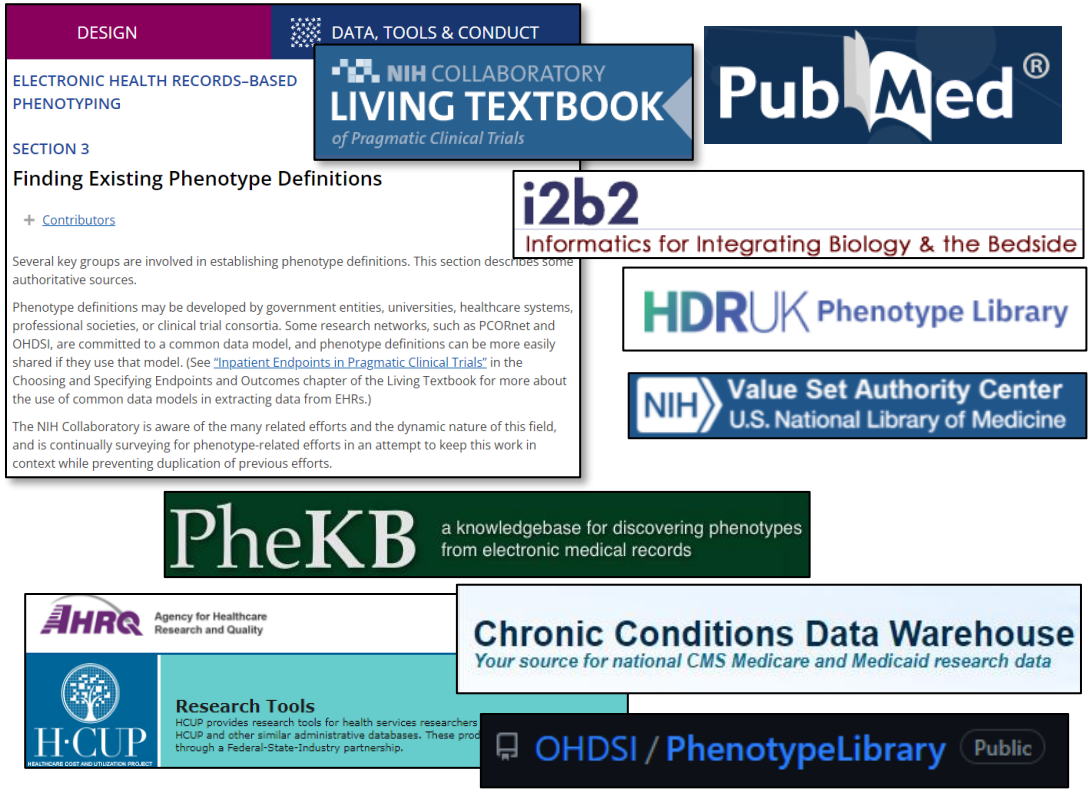
Institutional knowledge

Computing resources

Clinical expertise

System specific data variability

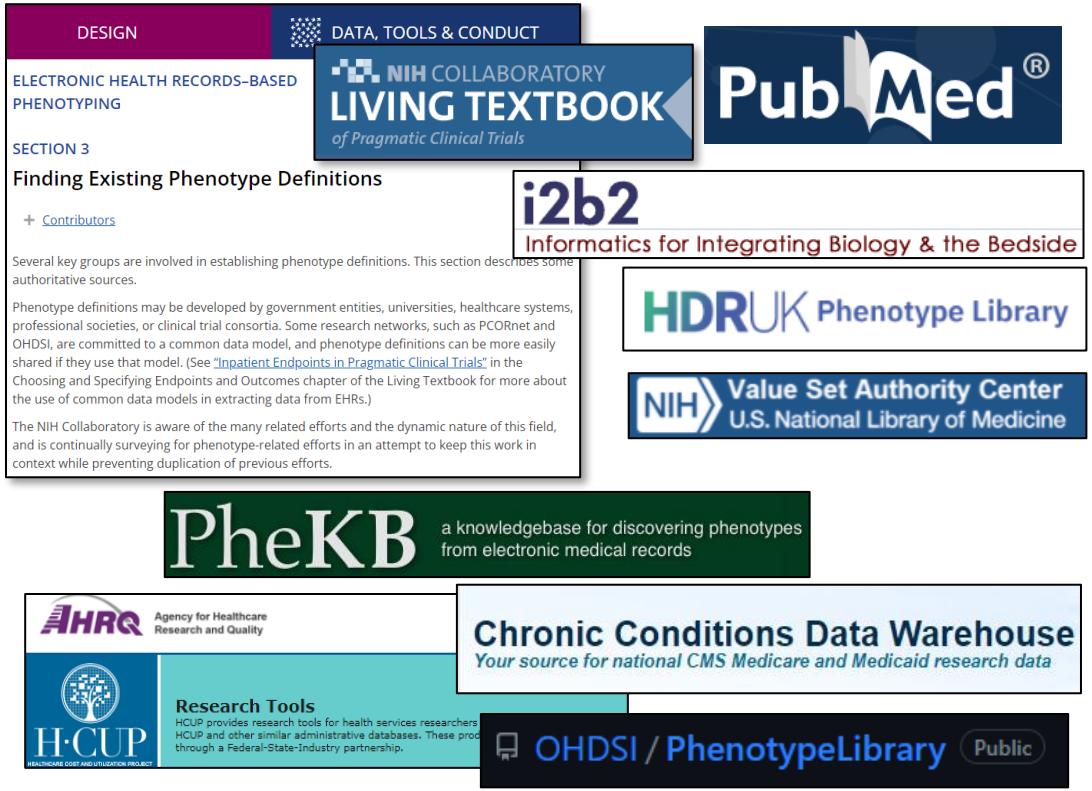
Phenotype libraries allow reuse of existing definitions



Benefits

- Reuse existing definitions
- Evaluate portability
- Save time and expedite reusability

There are opportunities for improvement and enhancement



Challenges

- Targeted user community
- Focused scope
- Metadata captured
- User features and capabilities

CIPHER: A public phenotype library developed in the VA by phenomics experts

Development Aims

- CIPHER metadata standard
- Scale content management
- Navigation and search
- Integrated visualization tools
- Health system agnostic

CIPHER's phenotype metadata standard

Phenotype Name

Phenotype Description
Phenotype purpose and aims (E.g., to maximize sensitivity)

Publication / Acknowledgment

Algorithm Description
Logic applied to components to generate algorithm

Code Samples
Programming code or code repository link

Population
Population used to develop algorithm

Authors / Contacts

Data Sources
Data source used to generate the phenotype

Data Classifications
Disease, demographics, laboratory test, etc.

Role in Analysis
Primary outcome/exposure, inclusion requirement, etc.

Related Disease Domain
Cardiovascular, dermatology, genitourinary, etc.

Unique Identifier

Keywords
MESH Terms

Methods Used
Rules based, machine learning, etc.

Context of Development
Research, healthcare operations, etc.

Algorithm Components
Medical Vocabularies
(ICD, LOINC, etc.)

Algorithm Creation Date

Lab Units / Values

Algorithm Validation / Performance Metrics
Sensitivity, specificity, etc.

Attachments
Tables, figures, slides, etc.

Legend
- Free Text
- Semi-controlled Authority
- Standard Vocabulary
- Empirical Value
- Other

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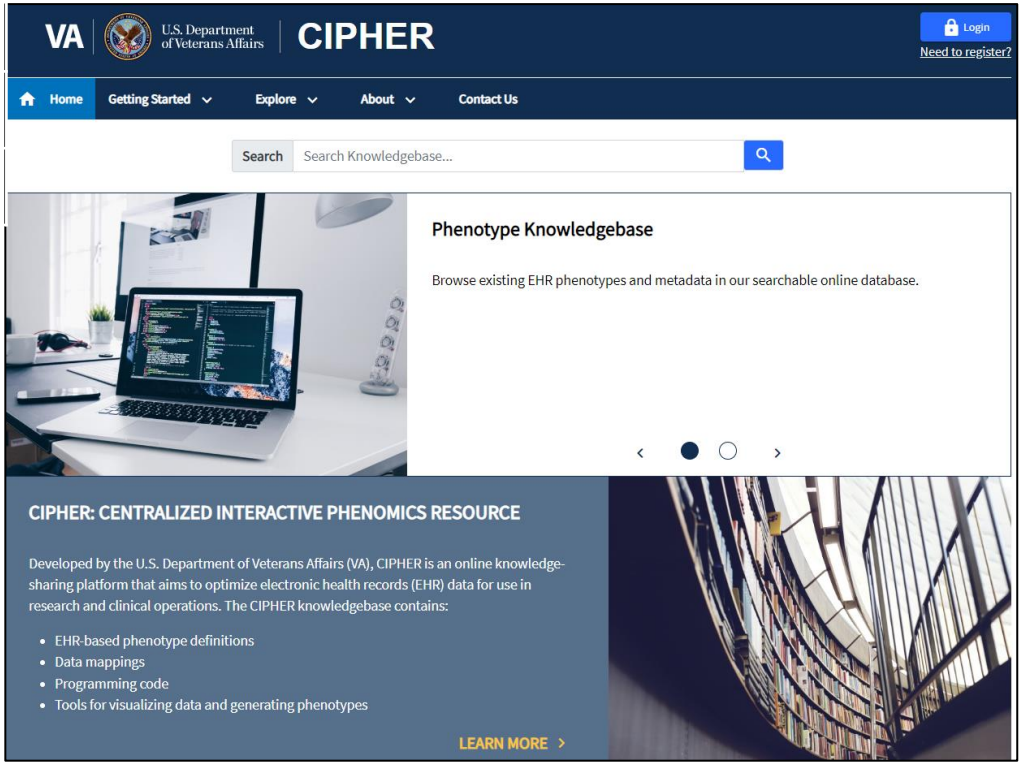
CIPHER website components

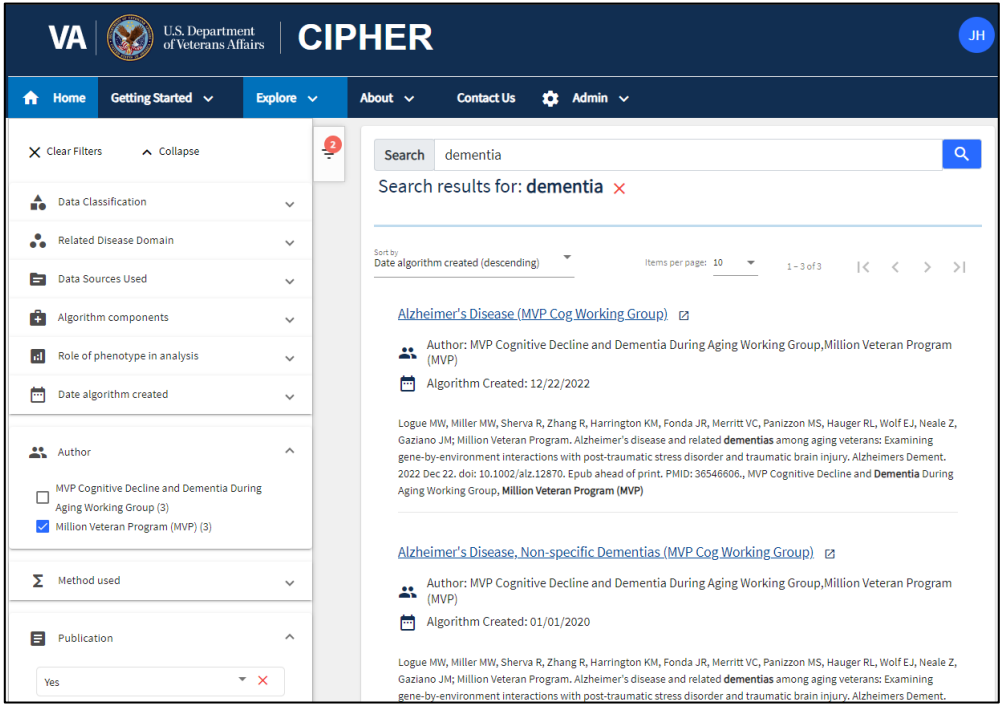
1. Phenotype knowledgebase
2. Phenotype collection workflow
3. Data visualization tools



Searchable database of phenotype articles

1. Phenotype knowledgebase
2. Phenotype collection workflow
3. Data visualization tools

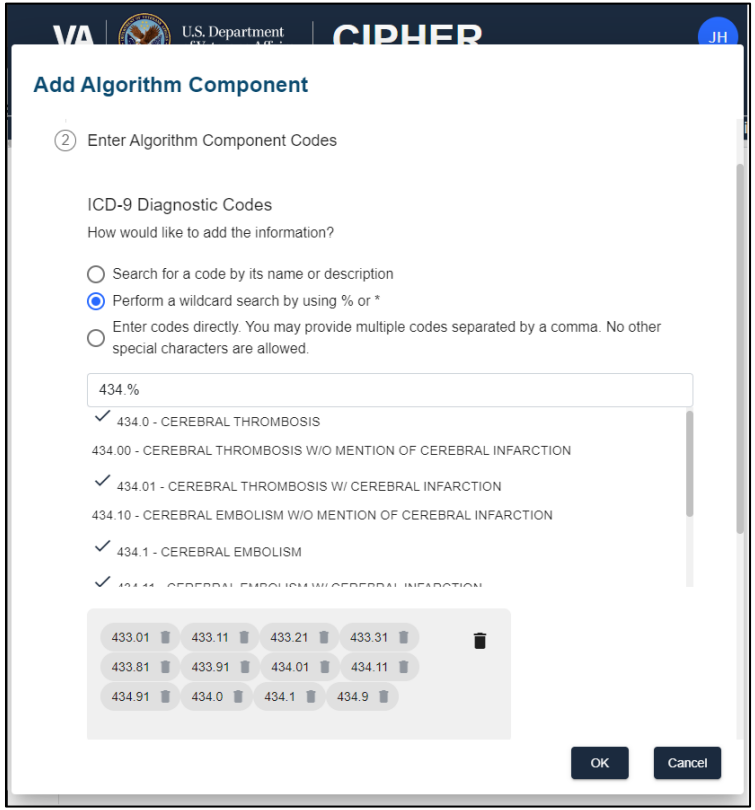
- ✓ CIPHER standard
- ✓ Unique phenotype article identifier
- ✓ Complex searching
- ✓ Change control



Standardized collection of phenotype metadata

1. Phenotype knowledgebase
2. Phenotype collection workflow
3. Data visualization tools

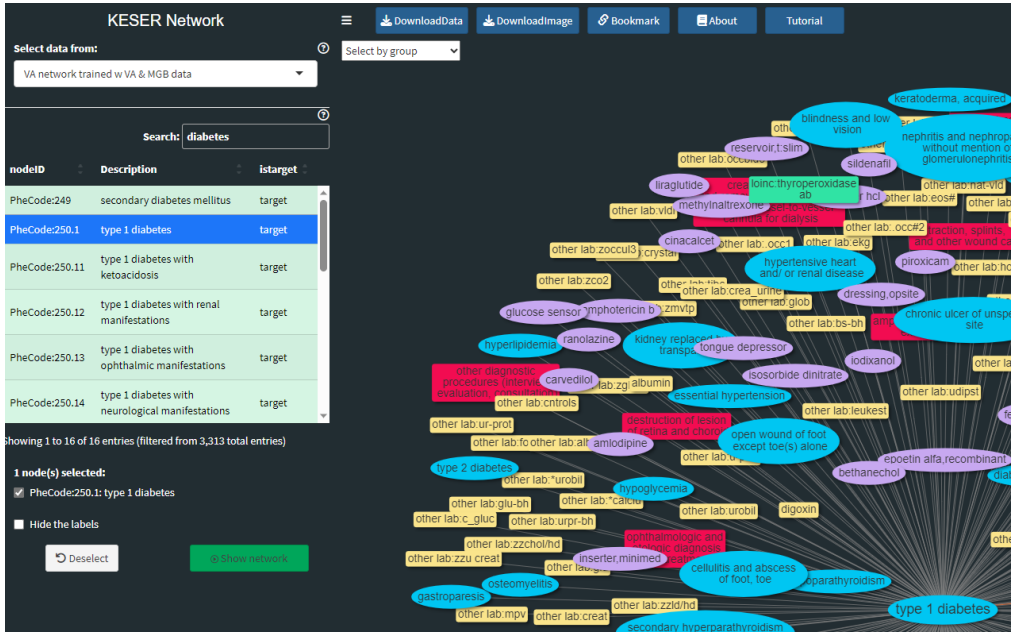
- ✓ Validation against standard vocabularies
- ✓ CIPHER review
- ✓ Populate into knowledgebase



Tools connected to phenotype definition knowledgebase

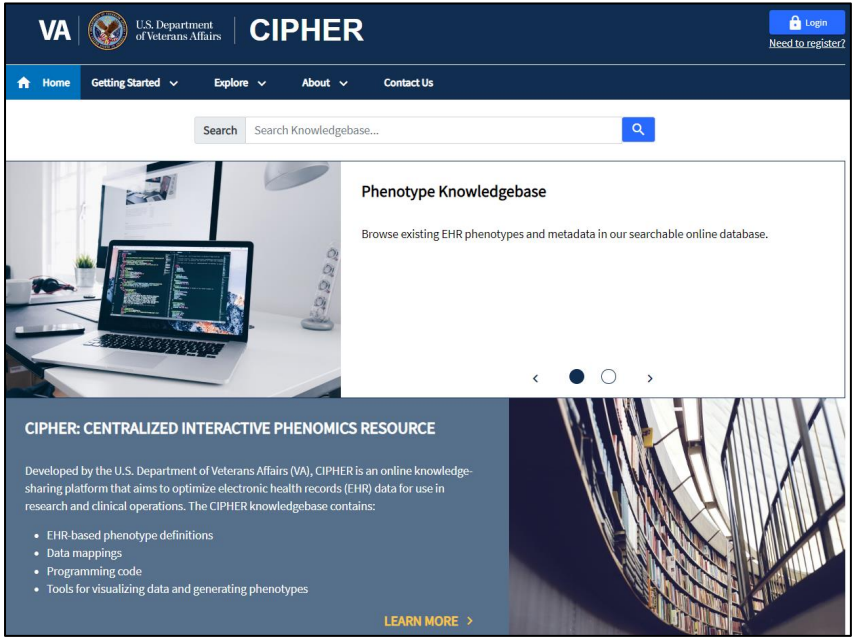
1. Phenotype knowledgebase
2. Phenotype collection workflow
3. Data visualization tools

- ✓ *ICD Hierarchy*: View code mappings
- ✓ *KESER*: Aid phenotype development
- ✓ Link to knowledgebase



Hong NPJ Digit Med 2021

CIPHER demonstration



CIPHER
CENTRALIZED INTERACTIVE PHENOMICS RESOURCE

https://phenomics.va.ornl.gov/

CIPHER's user base continues to grow

Current Users

MILLION VETERAN PROGRAM

VA | U.S. Department of Veterans Affairs

HARVARD MEDICAL SCHOOL

Mass General Brigham

Boston MCRC

Total Phenotypes	4,200+
Published	3,900+

Future Collaborations

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

NIH National Institutes of Health
Turning Discovery Into Health

AHRQ Agency for Healthcare Research and Quality

CHARGE CONSORTIUM
COHORTS FOR HEART & AGING RESEARCH IN GENOMIC EPIDEMIOLOGY

CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES

U.S. Department *of* Defense

4CE

All of Us RESEARCH PROGRAM

Strengths and limitations of CIPHER

Strengths

- Standard metadata collection
- Healthcare system agnostic
- Validation of standard vocabularies
- Integrated data visualization tools
- Structure is designed for expansion

Limitations

- Licensed data elements may have restrictions (UMLS)
- No linkage to patient level data

Future directions and next steps

Future directions

- Expand database content
- Integrate additional tools
- Expand partners and contributors
- Collect user feedback

How you can use CIPHER

- Browse phenotypes and tools
- Contribute phenotypes and tools
- Share user feedback and ideas

Acknowledgements

- Kelly Cho
- Anne Ho
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- Edward Zielinski
- Suma Muralidhar
- Mike Gaziano
- Rachel Ramoni
- Katherine Liao
- Tianxi Cai
- David Gagnon
- Stacey Whitbourne
- SuChun Cheng
- Vidul Panickan
- Andy Zimolzak
- John Russo
- Laura Davies
- David Heise
- Keith Connatser
- Chad Steed
- Anuj Kapadia

https://phenomics.va.ornl.gov/

Thank you!

Email me at:
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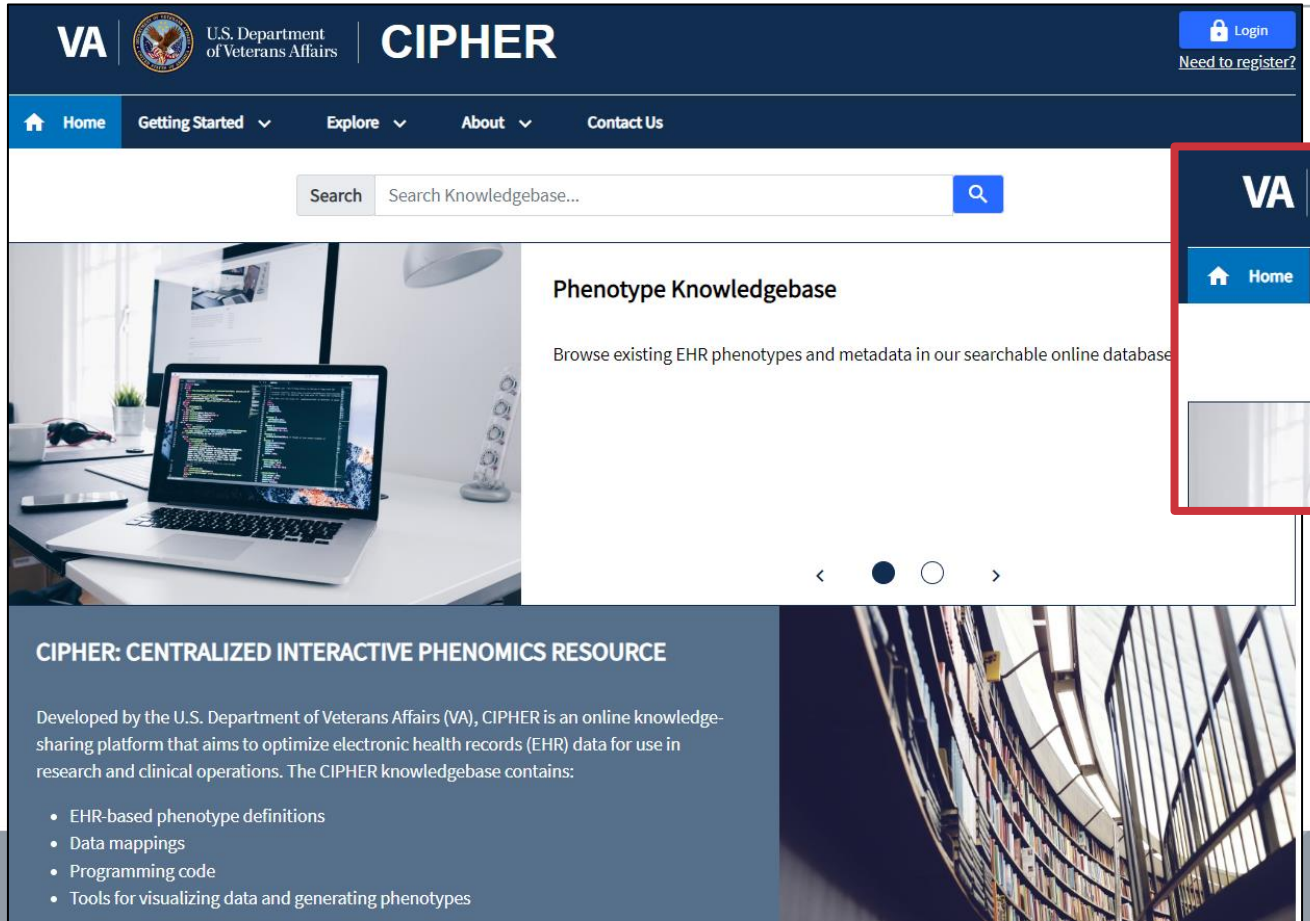
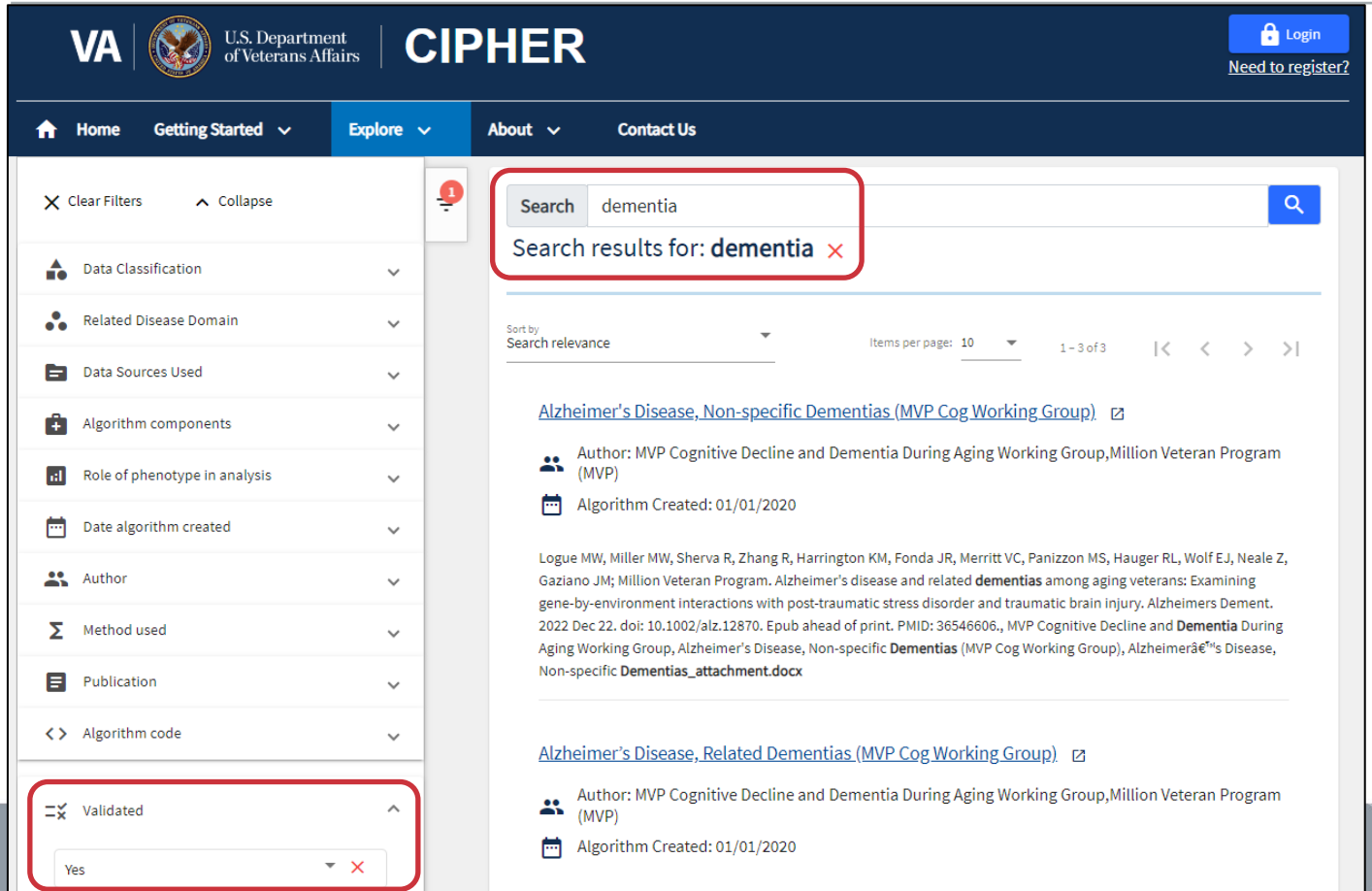
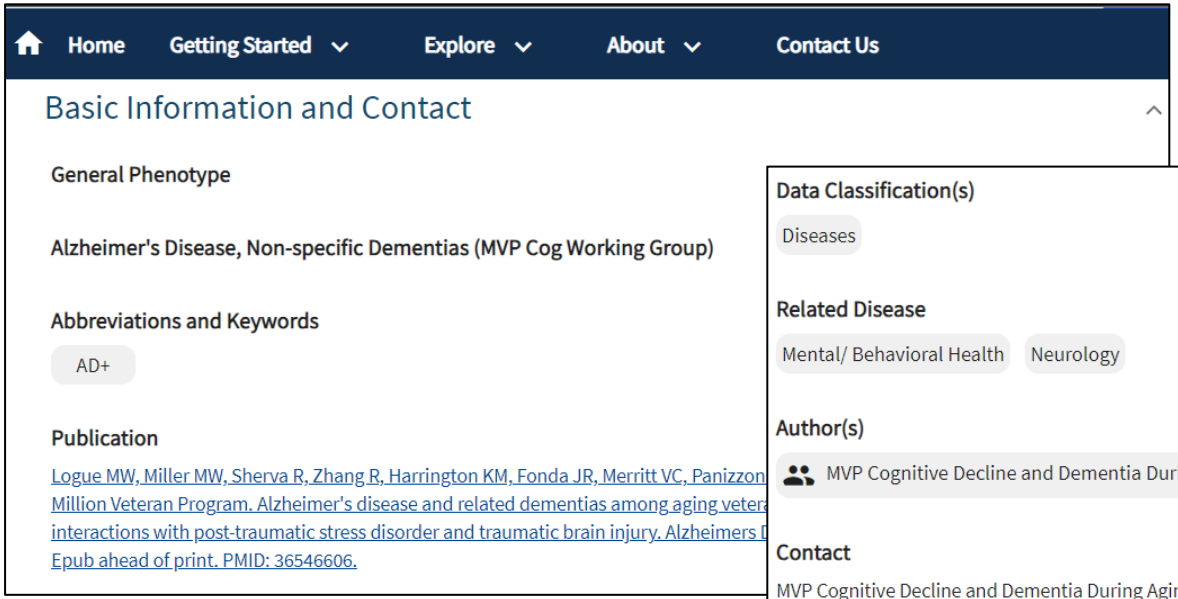
Search for a phenotype definition

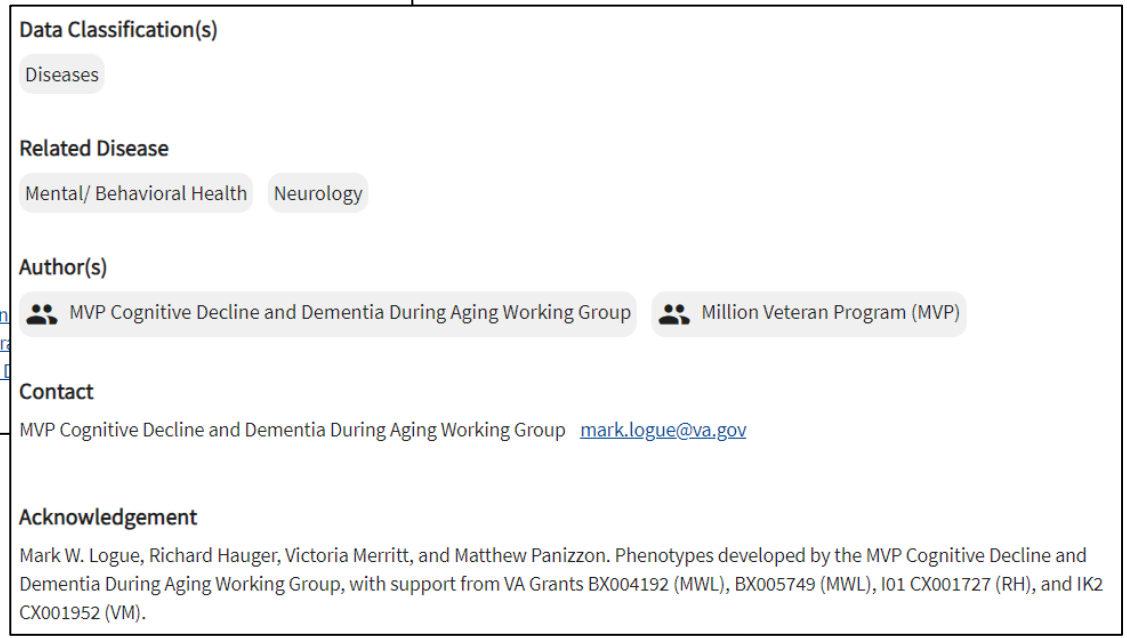


Search for a phenotype definition

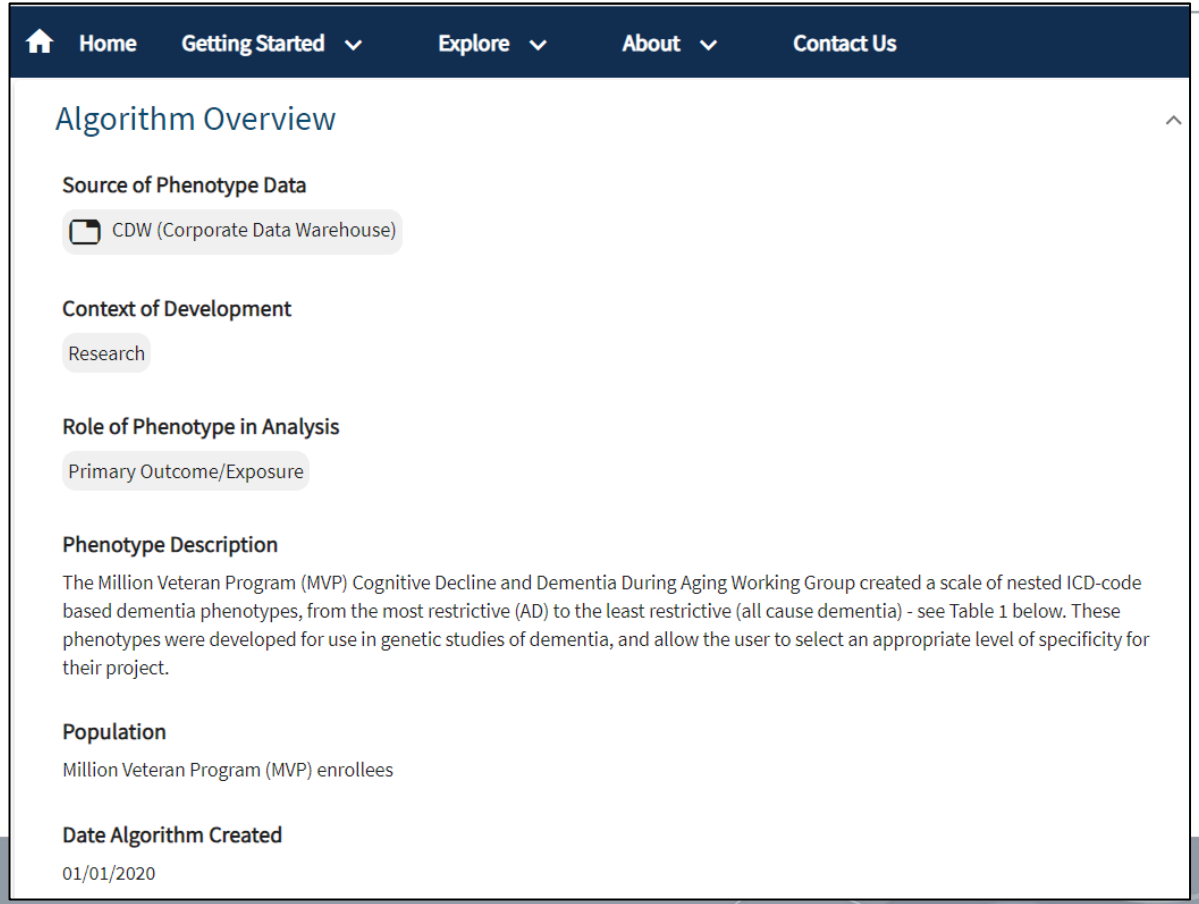


Review definition: Basic information

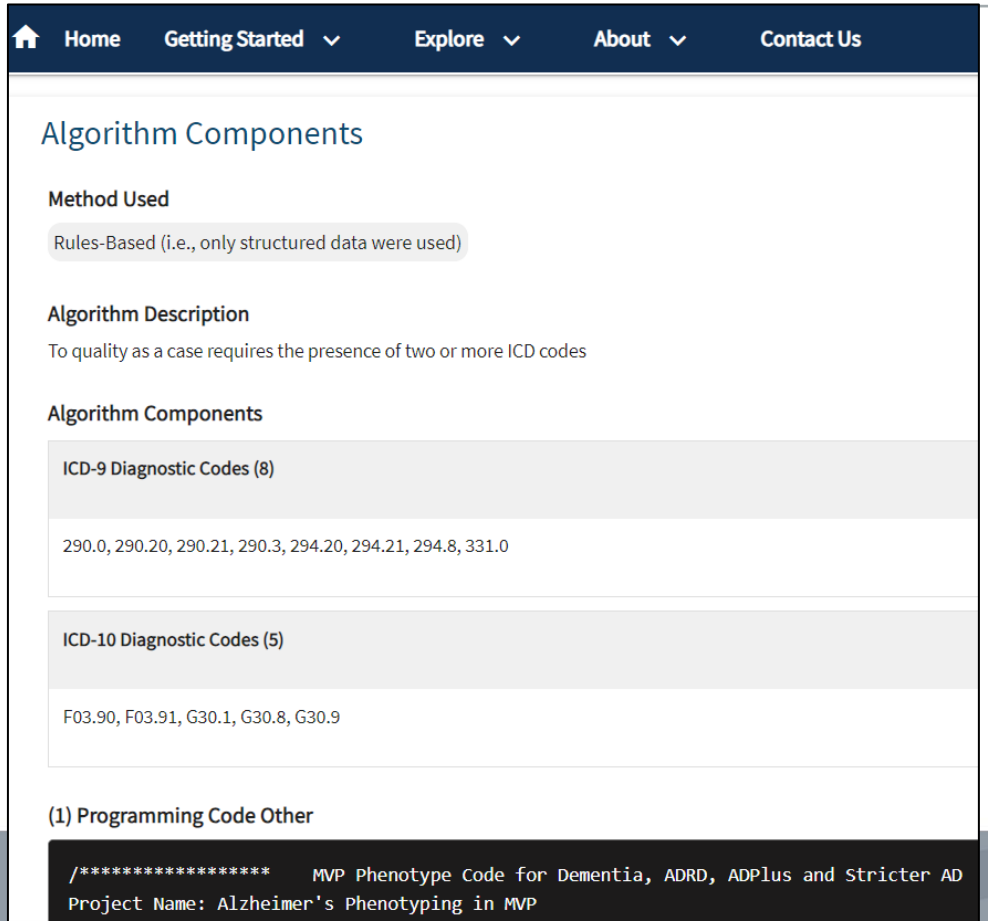




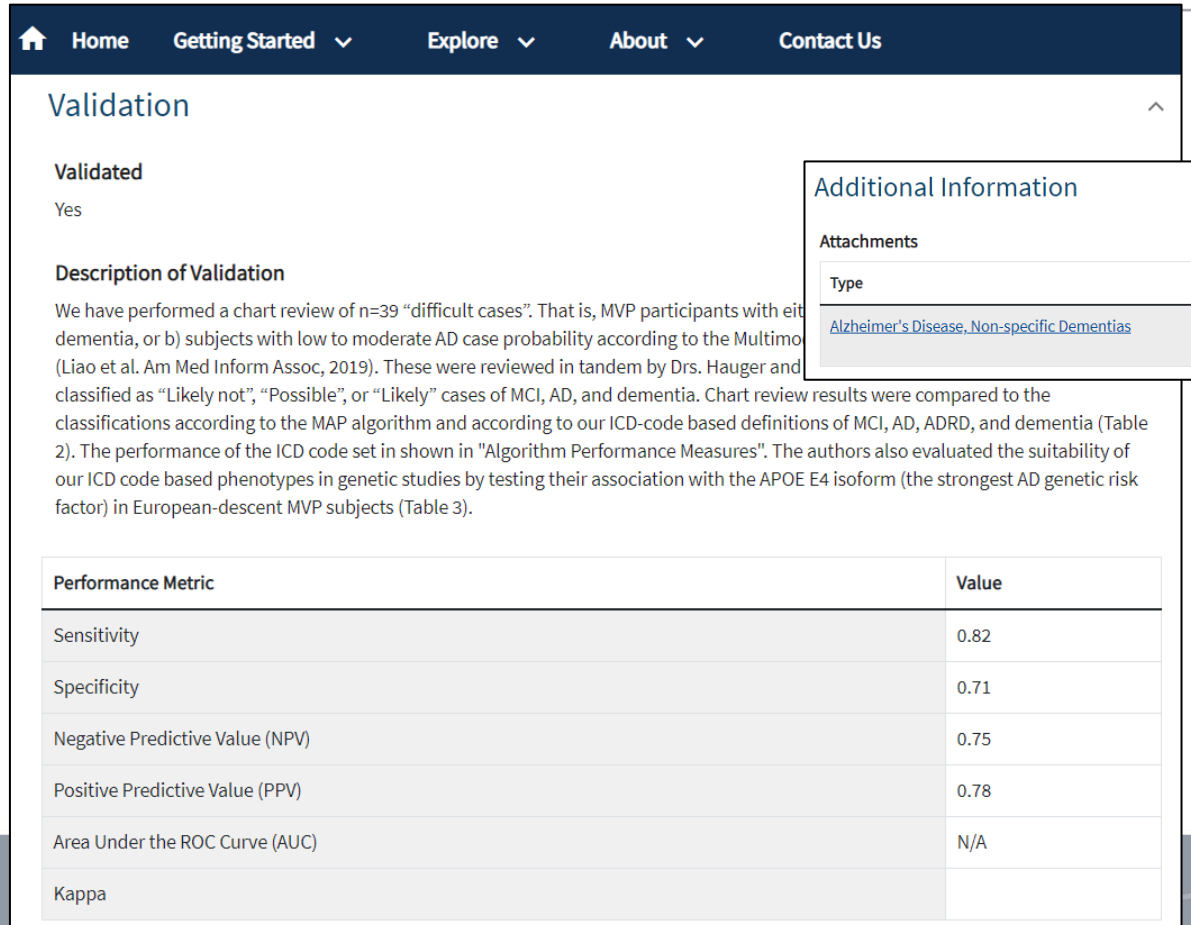
Review definition: Algorithm overview

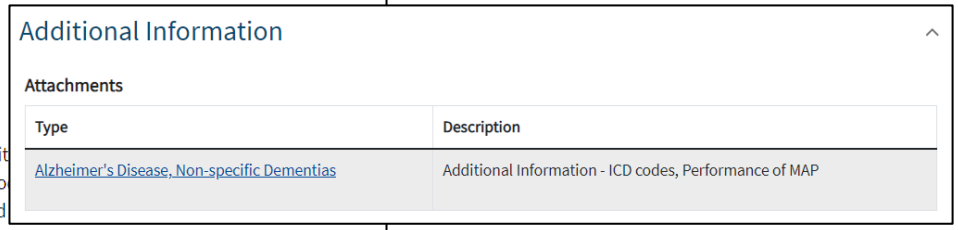


Review definition: Algorithm components

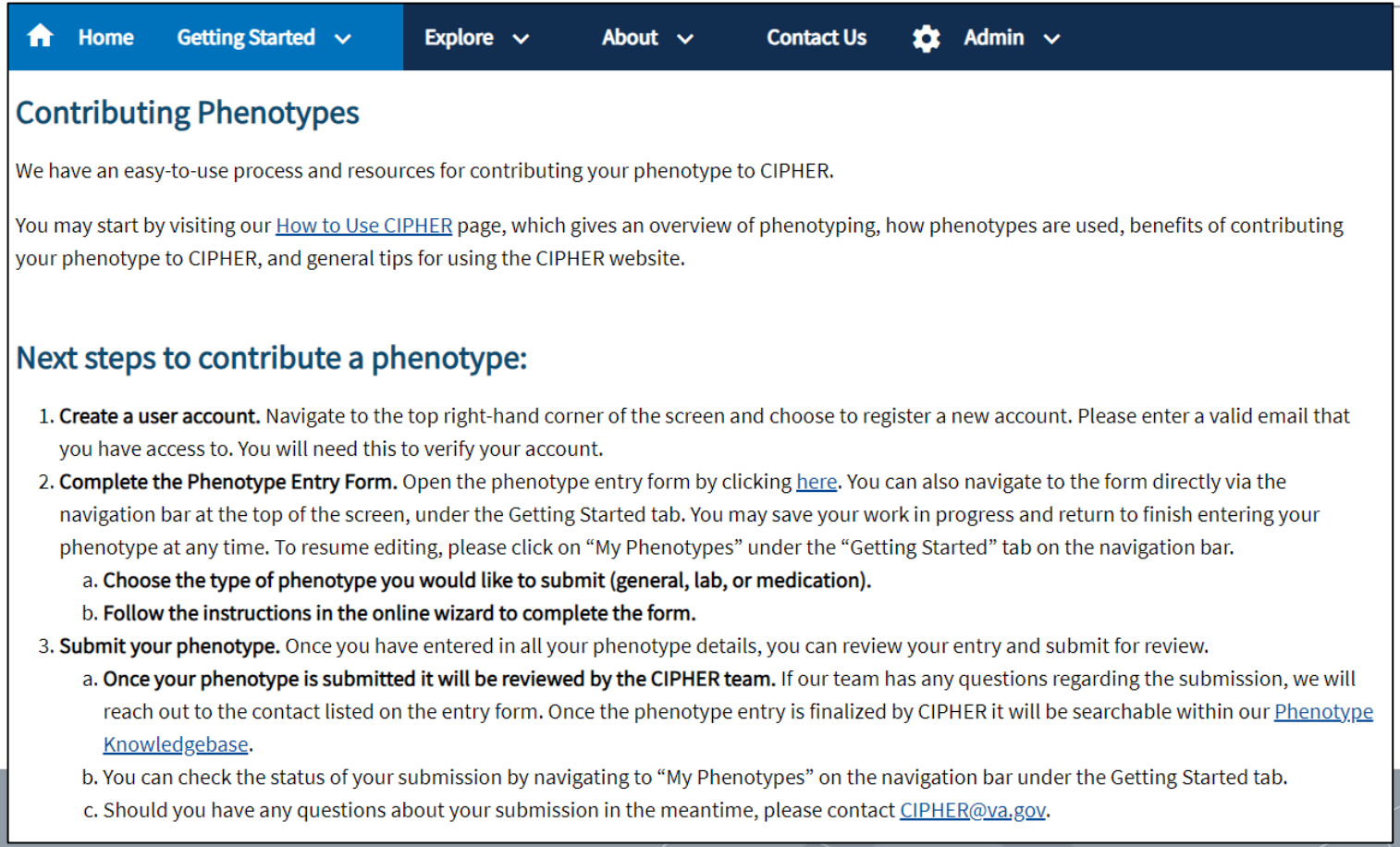


Review definition: Validation & additional information





Contributing phenotypes



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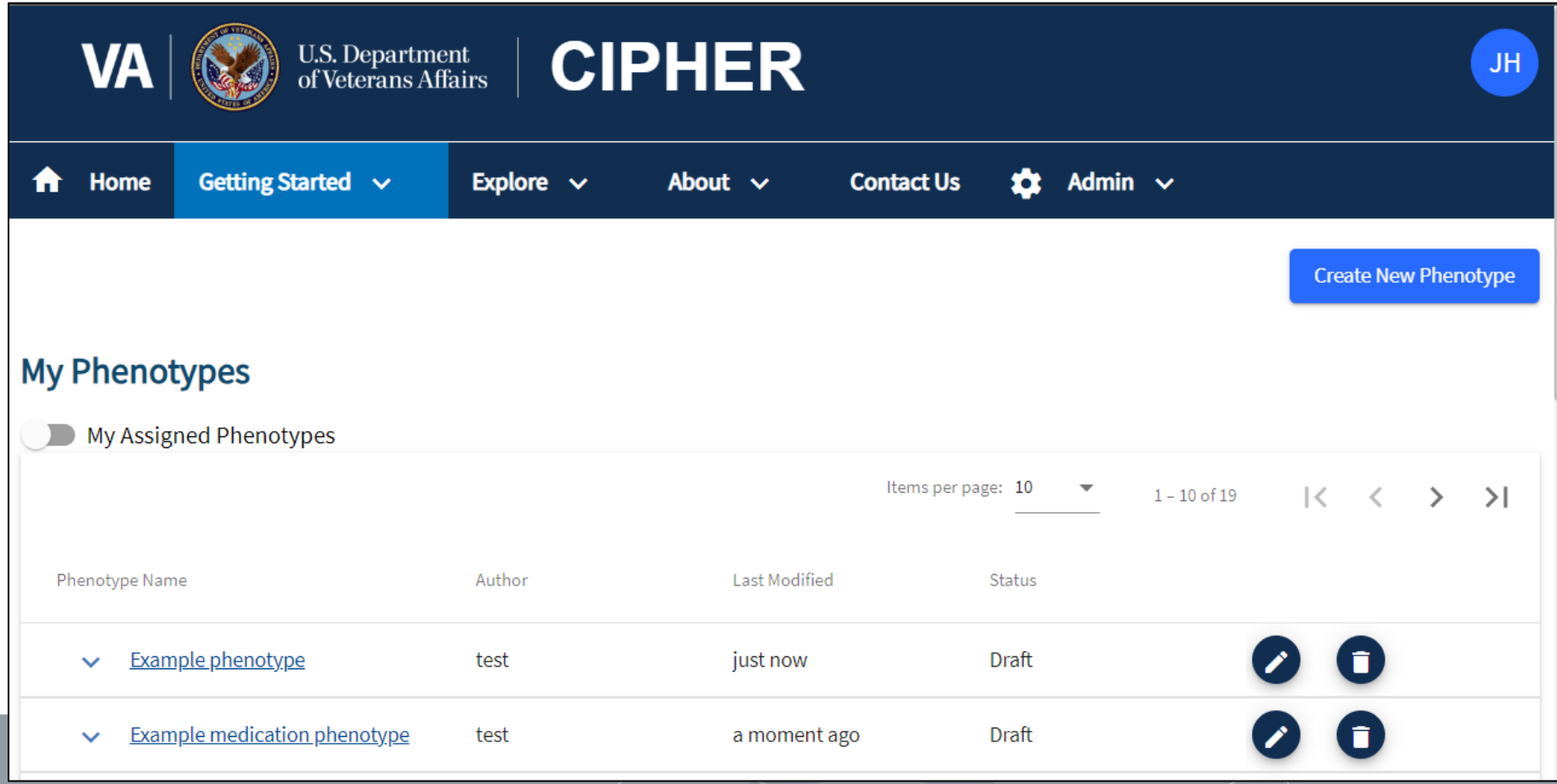

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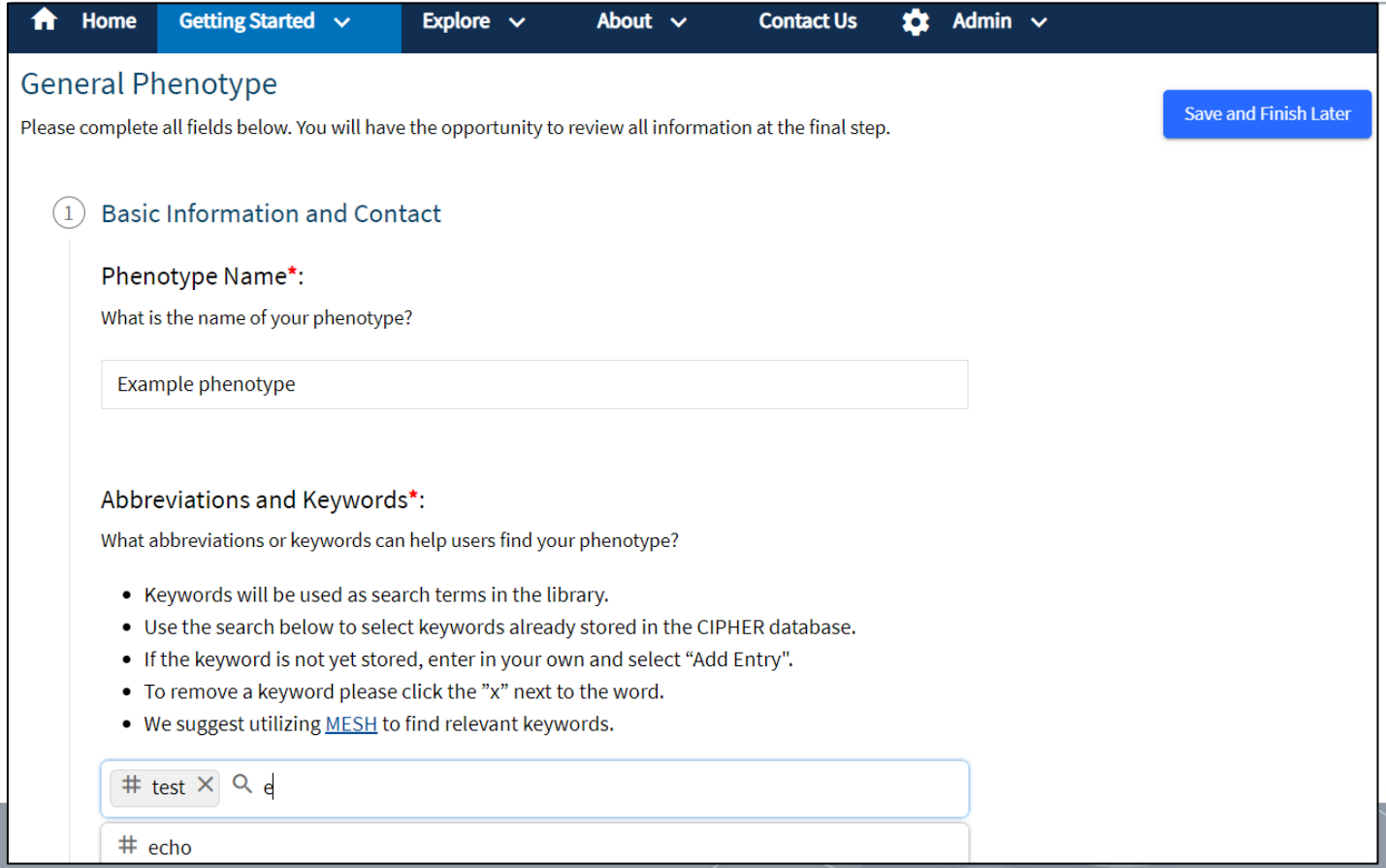

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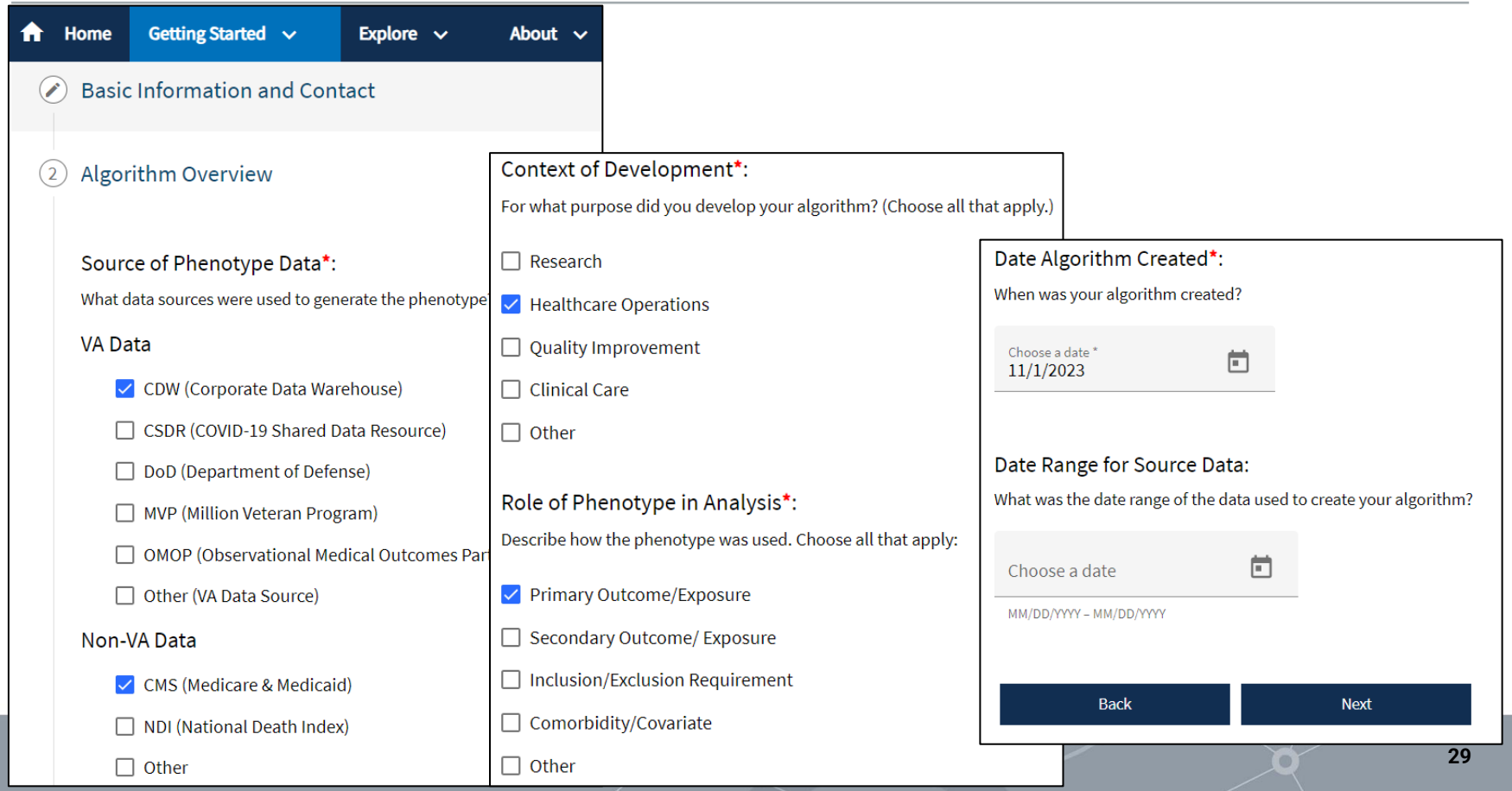

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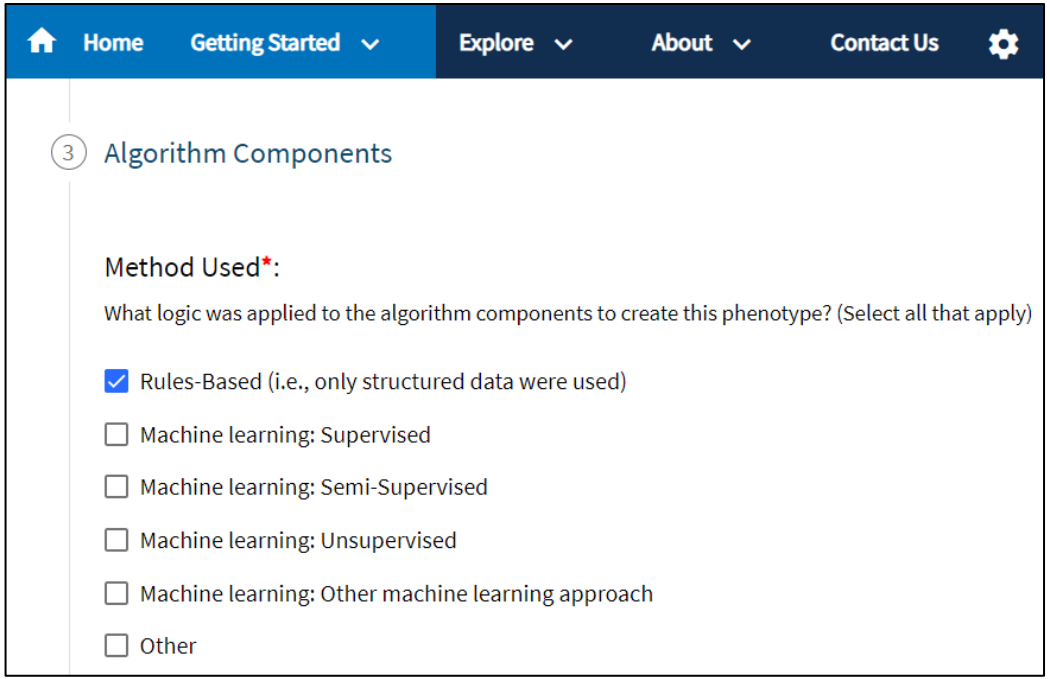

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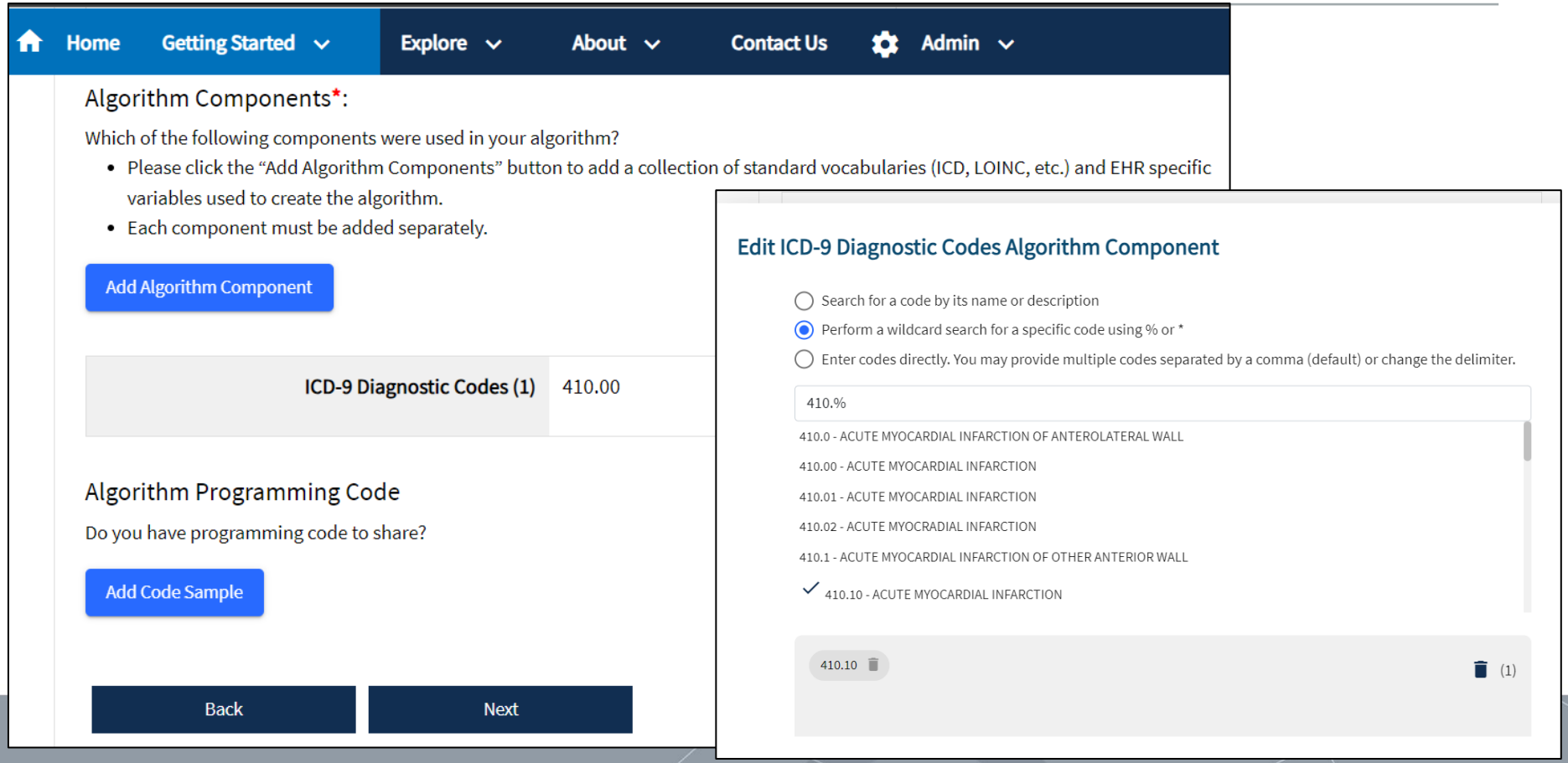

Visualization tools: KESER

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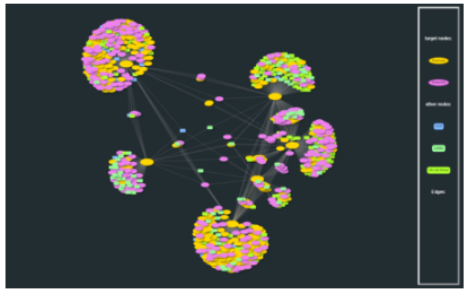
Billing codes, or ...ses (ICD) codes, are often leveraged to define a patient's phenotype in EH... not always organized meaningfully for the purpose of high-throughput phe... the use of ICD codes for research by regrouping ICD-9 and ICD-10 billing codes

- Visualization Tools
- About Visualization Tools
- Browse Knowledgebase
- Million Veteran Program (MVP)



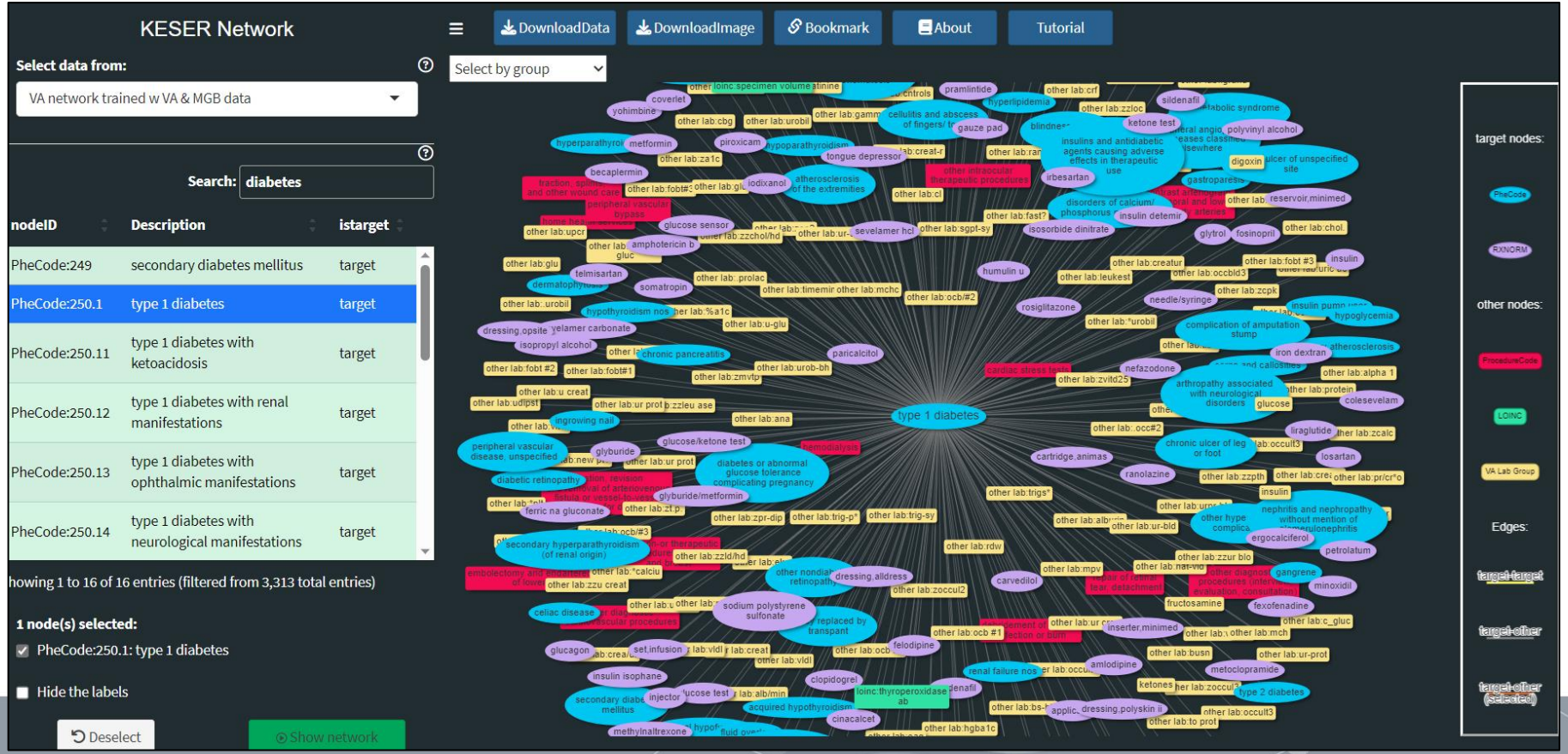
Knowledge Extraction via Sparse Embedding Regression Network

Infer relatedness among diseases, treatment, procedures and laboratory measurements by creating a visual, interactive knowledge map.

Overview | Uses | Author & Citation

The increasing availability of EHR systems has created enormous potential for translational research. However, it is difficult to know all the relevant codes related to a phenotype due to the large number of codes available. Codified concepts include all ICD diagnosis codes (rolled up to PheCodes), medications (mapped to RxNorm at ingredient level), procedures (rolled up to clinical classification system (CCS) procedure codes), as well as laboratory test results (mapped Logical Observation Identifier Names and Codes (LOINC), short names at the U.S. Department of Veterans Affairs (VA), or local lab codes).

Visualization tools: KESER



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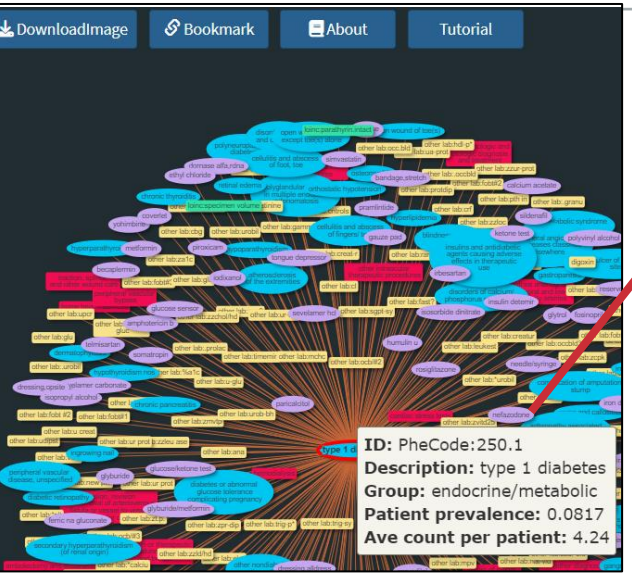
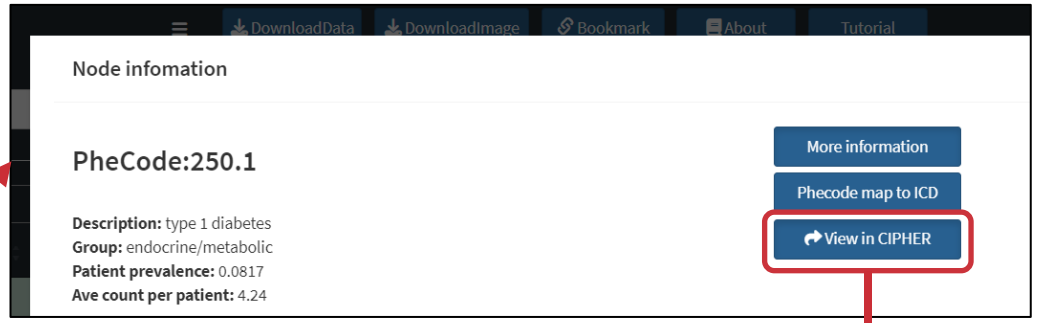
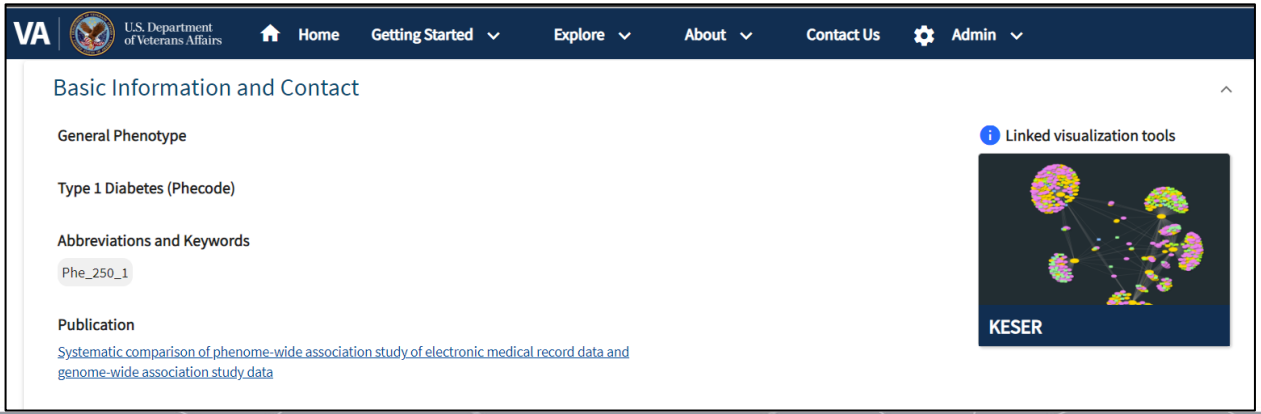
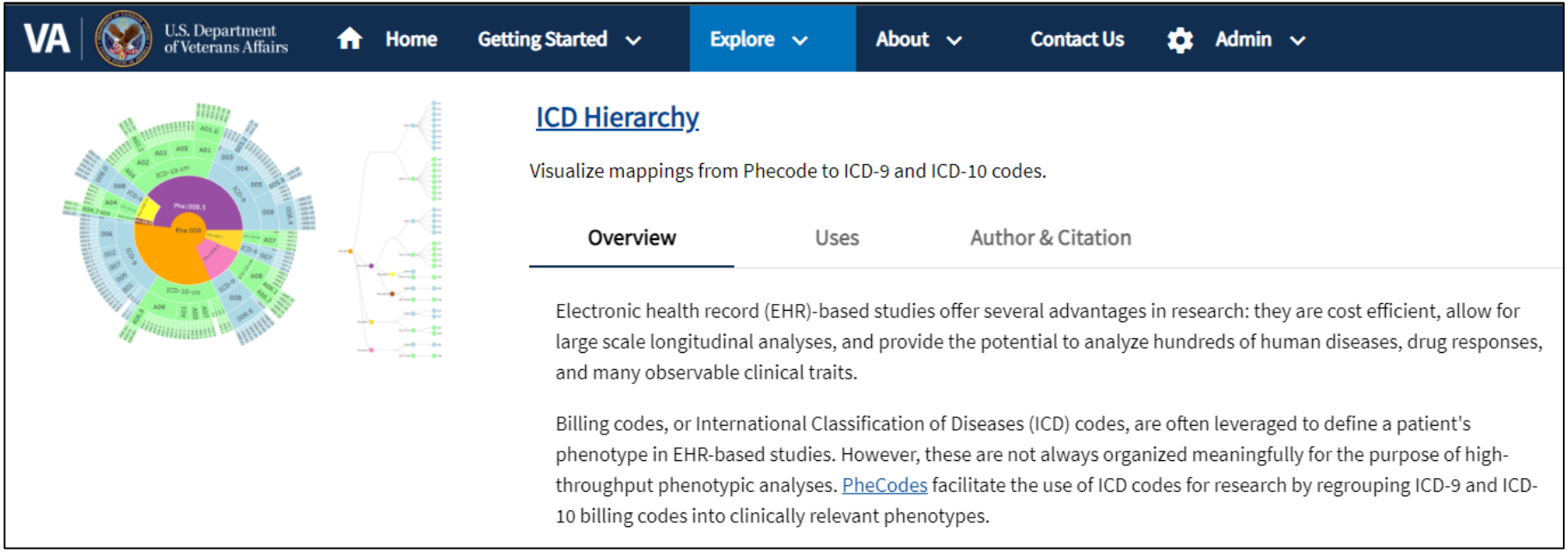






Visualization tools: ICD Hierarchy



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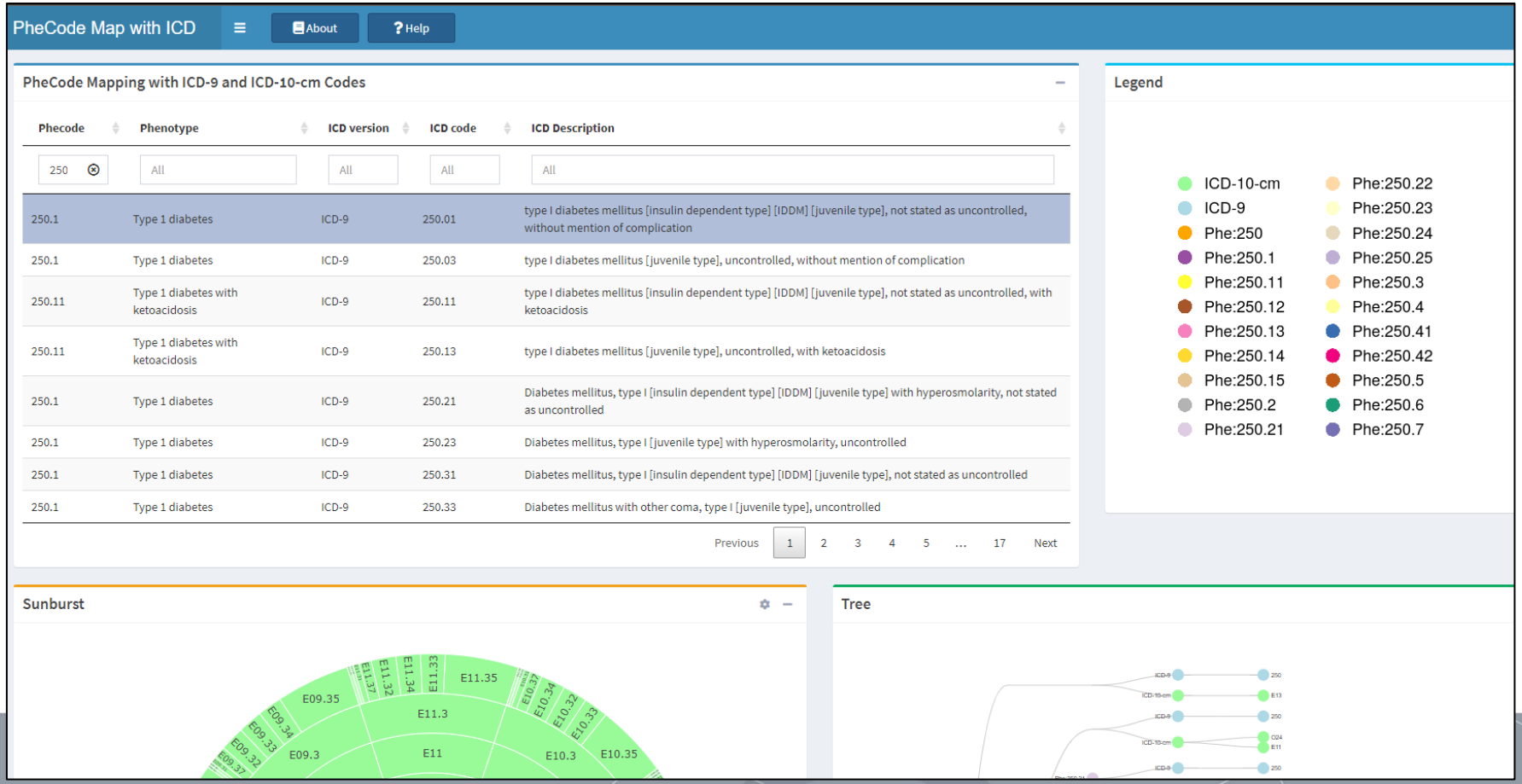

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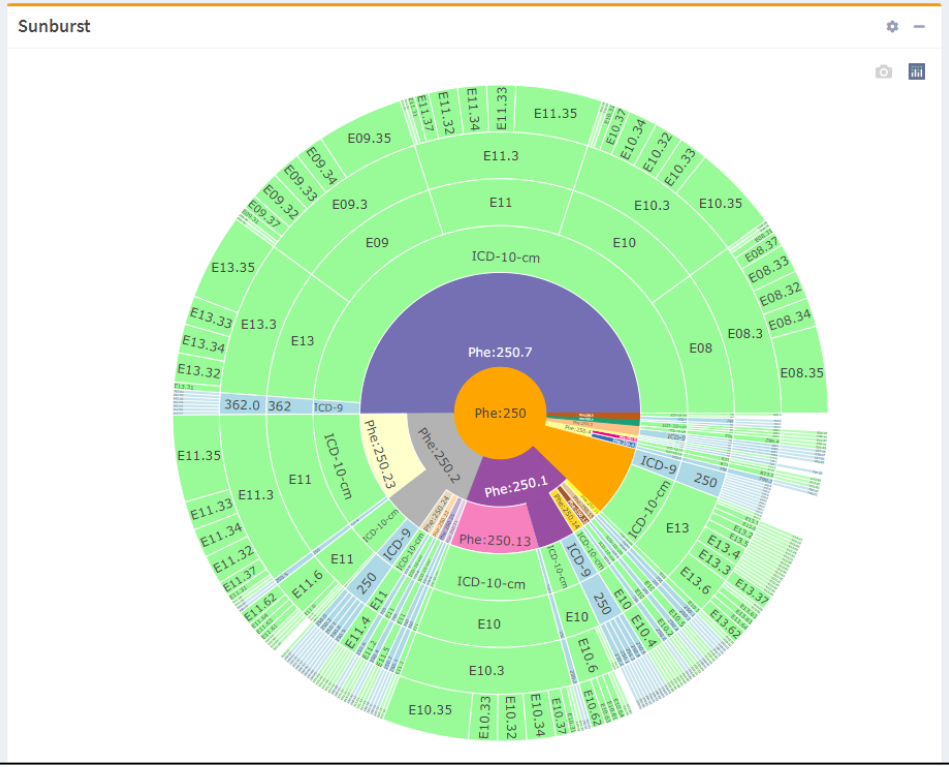
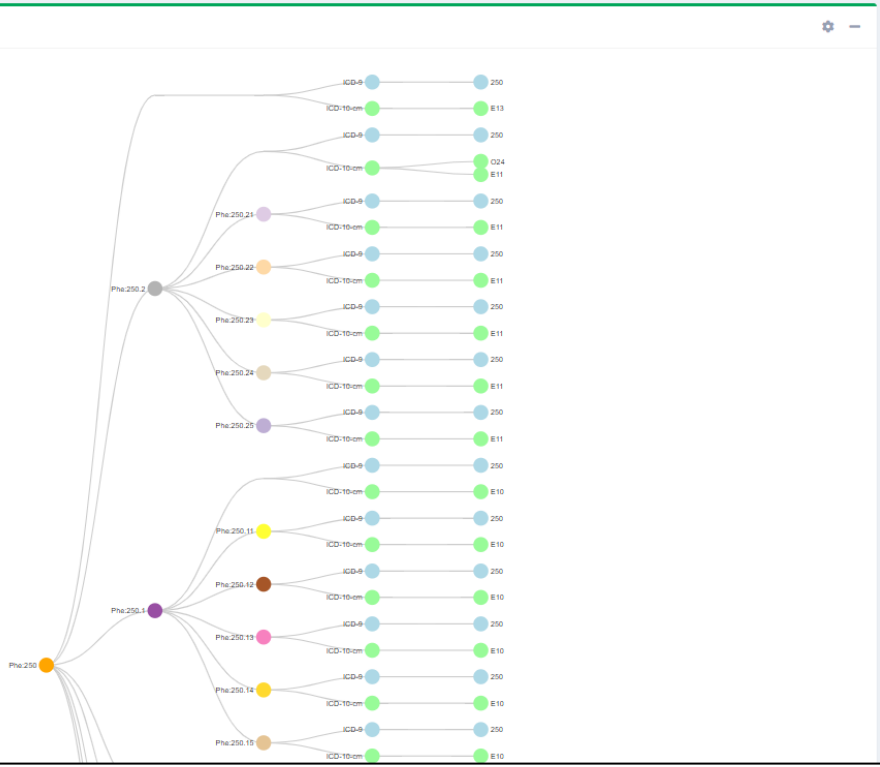
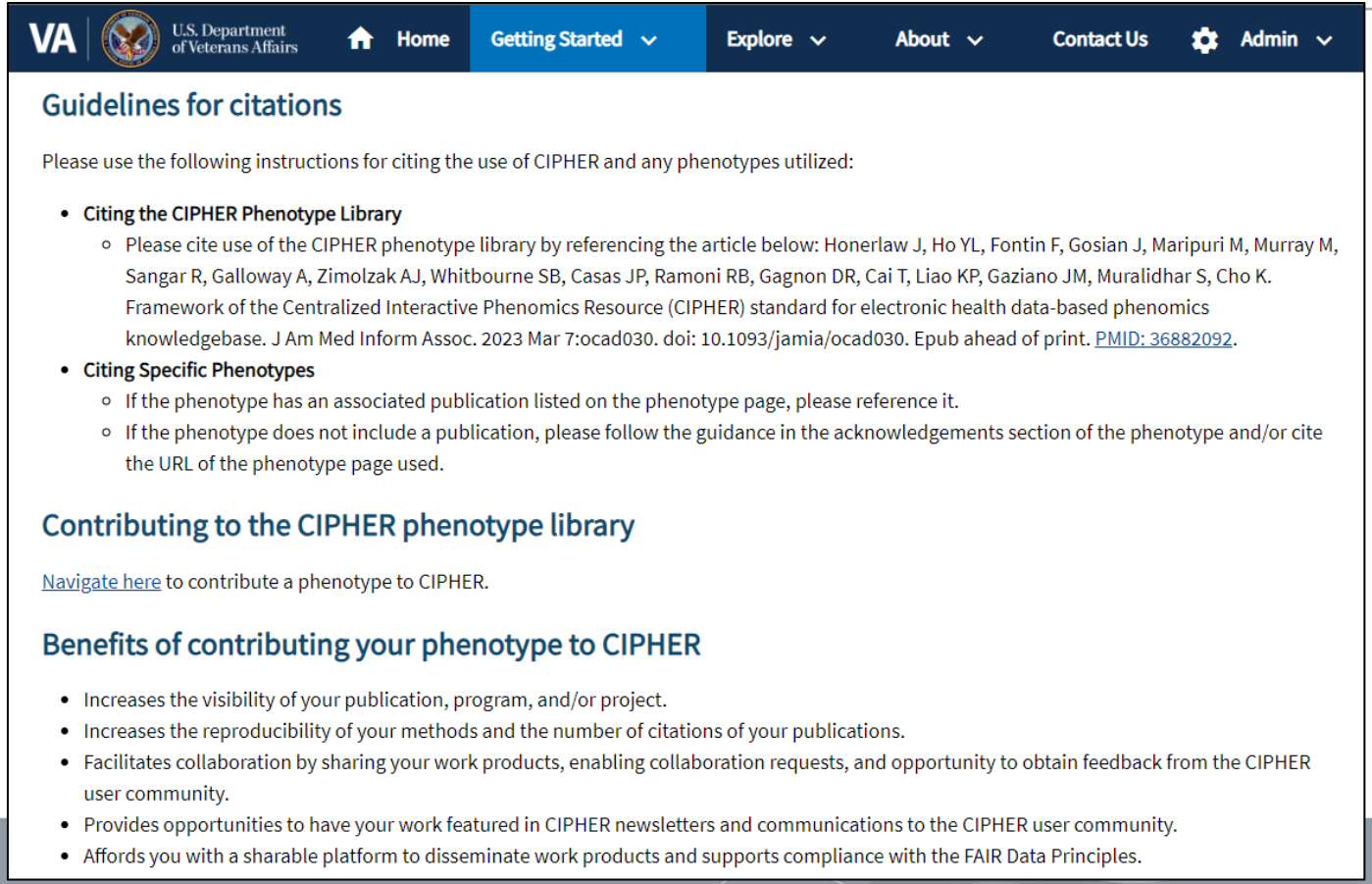




Guidelines for using CIPHER



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Guidelines for citations

Please use the following instructions for citing the use of CIPHER and any phenotypes utilized:

- **Citing the CIPHER Phenotype Library**
  - Please cite use of the CIPHER phenotype library by referencing the article below: Honerlaw J, Ho YL, Fontin F, Gosian J, Maripuri M, Murray M, Sangar R, Galloway A, Zimolzak AJ, Whitbourne SB, Casas JP, Ramoni RB, Gagnon DR, Cai T, Liao KP, Gaziano JM, Muralidhar S, Cho K. Framework of the Centralized Interactive Phenomics Resource (CIPHER) standard for electronic health data-based phenomics knowledgebase. J Am Med Inform Assoc. 2023 Mar 7:ocad030. doi: 10.1093/jamia/ocad030. Epub ahead of print. PMID: 36882092.
- **Citing Specific Phenotypes**
  - If the phenotype has an associated publication listed on the phenotype page, please reference it.
  - If the phenotype does not include a publication, please follow the guidance in the acknowledgements section of the phenotype and/or cite the URL of the phenotype page used.

Contributing to the CIPHER phenotype library

Navigate here to contribute a phenotype to CIPHER.

Benefits of contributing your phenotype to CIPHER

- Increases the visibility of your publication, program, and/or project.
- Increases the reproducibility of your methods and the number of citations of your publications.
- Facilitates collaboration by sharing your work products, enabling collaboration requests, and opportunity to obtain feedback from the CIPHER user community.
- Provides opportunities to have your work featured in CIPHER newsletters and communications to the CIPHER user community.
- Affords you with a sharable platform to disseminate work products and supports compliance with the FAIR Data Principles.