



# Identifying Alcohol Use Disorder Phenotypes Using Regular Expressions

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# Alcohol use disorder is common, costly, & problematic



Around **28.8 million adults** ages 18 and older were reported with Alcohol Use Disorder (AUD) in 2021. Additionally, **753,000 youth** (12-17 years) were diagnosed with AUD ([NIH, 2020](#)).



It can cause disruption to daily life, relationships, and health. The average cost of alcohol use in the US averages around **\$2,000 a year** and more.



Unfortunately, it may go undetected by clinicians who may not recognise the signs of AUD; stigma

<https://www.apa.org/topics/substance-use-abuse-addiction/alcohol-disorders>

<https://landmarkrecovery.com/the-cost-of-alcohol-use-disorder/>

# Alcohol and Substance Use Disorder Phenotyping: ICD Codes

- [International Statistical Classification of Diseases and Related Health Problems](#) (ICD) is a medical classification list that contains diseases, diagnosis, and symptoms.
- These codes are used to help identify cases like substance use disorders (SUD) which extends to alcohol use disorders (AUD).
- However, ICD codes may not be the most accurate way to detect cases due to complex electronic health record data (E.H.R).



## 2024 ICD-10-CM DIAGNOSIS CODE F10.10

### Alcohol abuse, uncomplicated



ICD-10-CM Code:	F10.10
ICD-10 Code for:	Alcohol abuse, uncomplicated
Is Billable?	Yes - Valid for Submission ✓
Chronic Condition Indicator: <sup>[1]</sup>	Chronic
Code Navigator:	<a href="#">View Adjacent Codes</a>

#### TABLE OF CONTENTS

1. Code Information
2. Approximate Synonyms
3. Clinical Classification
4. Clinical Information
5. Tabular List of Diseases and Injuries
6. Index to Diseases and Injuries References
7. Diagnostic Related Groups Mapping
8. Convert to ICD-9 Code
9. Patient Education
10. Other Codes Used Similar Conditions
11. Code History

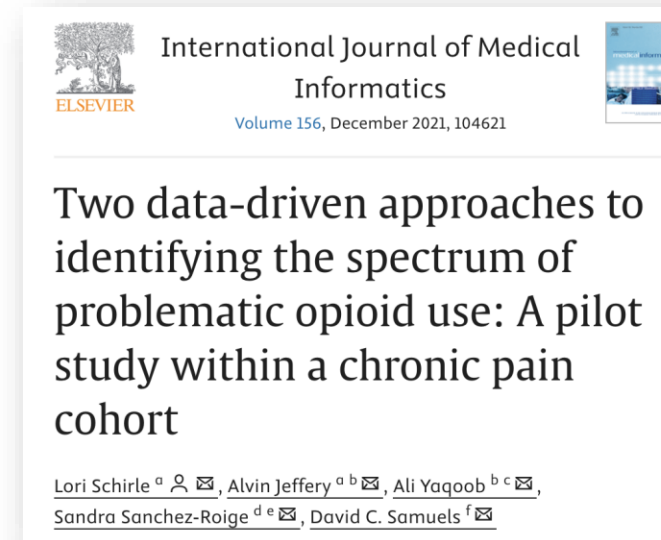
#### Code Classification

- Mental and behavioural disorders  
(F01-F99)
- Mental and behavioral disorders due to psychoactive substance use  
(F10-F19)
- Alcohol related disorders  
(F10)

F10.10 is a **billable diagnosis code** used to specify a medical diagnosis of alcohol abuse, uncomplicated. The code is valid during the current fiscal year for the submission of HIPAA-covered transactions from October 01, 2023 through September 30, 2024.

# Natural Language Processing (NLP) and AUD Identification

- Studies have shown that using natural language processing (NLP) to identify SUD concepts in clinical notes have promising results.
- Automation of Addiction Behaviors Checklist for opioid use disorder



## Detecting Problematic Opioid Use in the Electronic Health Record: Automation of the Addiction Behaviors Checklist in a Chronic Pain Population

[Angus H. Chatham](#),<sup>a,1</sup> [Eli D. Bradley](#),<sup>a,1</sup> [Lori Schirle](#), PhD,<sup>a,b</sup> [Sandra Sanchez-Roige](#), PhD,<sup>c,d</sup> [David C. Samuels](#), PhD,<sup>e</sup> and [Alvin D. Jeffery](#), PhD<sup>a,f</sup>

Schirle, L., Jeffery, A., Yaqoob, A., Sanchez-Roige, S., & Samuels, D. C. (2021). Two data-driven approaches to identifying the spectrum of problematic opioid use: A pilot study within a chronic pain cohort. *International Journal of Medical Informatics*, 156, 104621. <https://doi.org/10.1016/j.ijmedinf.2021.104621>

Chatham, A. H., Bradley, E. D., Schirle, L., Sanchez-Roige, S., Samuels, D. C., & Jeffery, A. D. (2023). Detecting Problematic Opioid Use in the Electronic Health Record: Automation of the Addiction Behaviors Checklist in a Chronic Pain Population. *medRxiv : the preprint server for health sciences*, 2023.06.08.23290894. <https://doi.org/10.1101/2023.06.08.23290894>

# How can we expand and use this knowledge for AUD?

- This project aims to expand the phenotyping of SUD by focusing on AUD within a chronic pain cohort.
- Using natural language processing techniques, the primary objective is to use **regular expressions (regex)** to search clinical notes for key terms aligned with the **Alcohol Use Disorders Identification Test (AUDIT)**.





## **Why is this important?**

### Automation and Application:

If automation of AUD phenotyping with regex proves to be accurate and reliable, this method can enhance diagnosis, identification, and prevention within multiple clinical and genetic contexts.

# Methods: Chronic Pain Cohort

Total Patients (VUMC Synthetic Derivative)	Sex Demographics	Race Demographics
8,063	Female - 63% Male - 37%	Asian - 1% Black - 16% White - 80.6% Other - 1.5%

- Chronic pain defined by ICD codes (relating to chronic pain) occurring 2 different days in patient E.H.R
- 3,485,348 clinical notes compiled into 68 note files



# Methods: AUDIT-C

- The Alcohol Use Disorders Identification Test (AUDIT) is a screening tool used to assess drinking behaviors and alcohol consumption.
- The AUDIT-C is a shortened version of this checklist that includes the first three questions of the AUDIT. Our team previously developed regex patterns for the first three questions.

## AUDIT-C Questionnaire

Patient Name \_\_\_\_\_ Date of Visit \_\_\_\_\_

### 1. How often do you have a drink containing alcohol?

- ☐ a. Never
- ☐ b. Monthly or less
- ☐ c. 2-4 times a month
- ☐ d. 2-3 times a week
- ☐ e. 4 or more times a week

### 2. How many standard drinks containing alcohol do you have on a typical day?

- ☐ a. 1 or 2
- ☐ b. 3 or 4
- ☐ c. 5 or 6
- ☐ d. 7 to 9
- ☐ e. 10 or more

### 3. How often do you have six or more drinks on one occasion?

- ☐ a. Never
- ☐ b. Less than monthly
- ☐ c. Monthly
- ☐ d. Weekly
- ☐ e. Daily or almost daily



# Methods:

## AUDIT and RegEx

- Of the 10 questions, this project focused on developing questions #4, 8, and 9.
- These questions were converted into **regular expressions (regex)** which are tools that can search for patterns and matches to specific key words and phrases within text.

4. How often during the last year have you found that you were not able to stop drinking once you had started?

(0) Never  
(1) Less than monthly  
(2) Monthly  
(3) Weekly  
(4) Daily or almost daily

☐

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?

(0) Never  
(1) Less than monthly  
(2) Monthly  
(3) Weekly  
(4) Daily or almost daily

☐

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9. Have you or someone else been injured as a result of your drinking?

(0) No  
(2) Yes, but not in the last year  
(4) Yes, during the last year

☐

# Example for question 8

```
/\b(.\b(alcohol|etoh|alchol|drinking\s|alcohol|drinking\s|heavily|drinking)\b.*\b(blackout(s)?|black\sout(s)?|memory\sloss|forg(?:et(s)?|etting|ot)|brownout)\b.?\b
```

Text

Tests

NEW

1 match (0.0ms)

John Doe, a 45-year-old male, presents with complaints of significant memory loss following an episode of heavy alcohol consumption. The patient reports that he drank six beers within a few hours during a social event last night. Upon waking this morning, he discovered that he could not recall substantial portions of the previous evening, including conversations and activities that occurred while he was intoxicated. The patient describes this memory loss as a "blackout," where he was conscious and engaging in activities but unable to form lasting memories.

## Example for question 9

```
/((.?\b(alcohol|etoh|alchol|drinking\s|alcohol|drinking\s|heavily|drinking)\b.*?\b(injur(?:e|ed|ing|ies)|hurt|cut|fell|break|broke)\b.?))
```

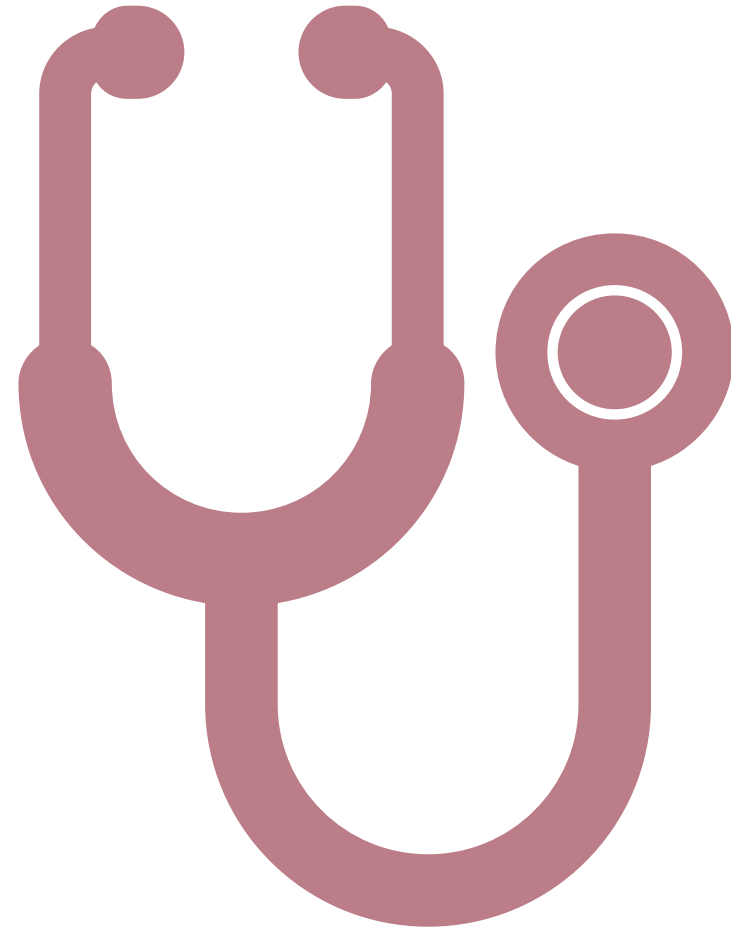
Text Tests **NEW**

1 match (1.0ms)

Patient presents to the emergency department following a motor vehicle accident. The patient admits to consuming a significant amount of alcohol prior to the incident. He reports feeling heavily intoxicated and losing control of the vehicle, resulting in a collision. He sustained minor injuries, including lacerations on his arms and a bruised rib. Another vehicle was involved in the accident, and the driver of that vehicle sustained moderate injuries and was transported to another hospital for treatment.", -

## Results - Chronic Pain Cohort

- After testing regex patterns on 15 of the compiled note files, we found:
  - 2 matches for question 9
  - 1 match for question 8
  - No matches for question 4



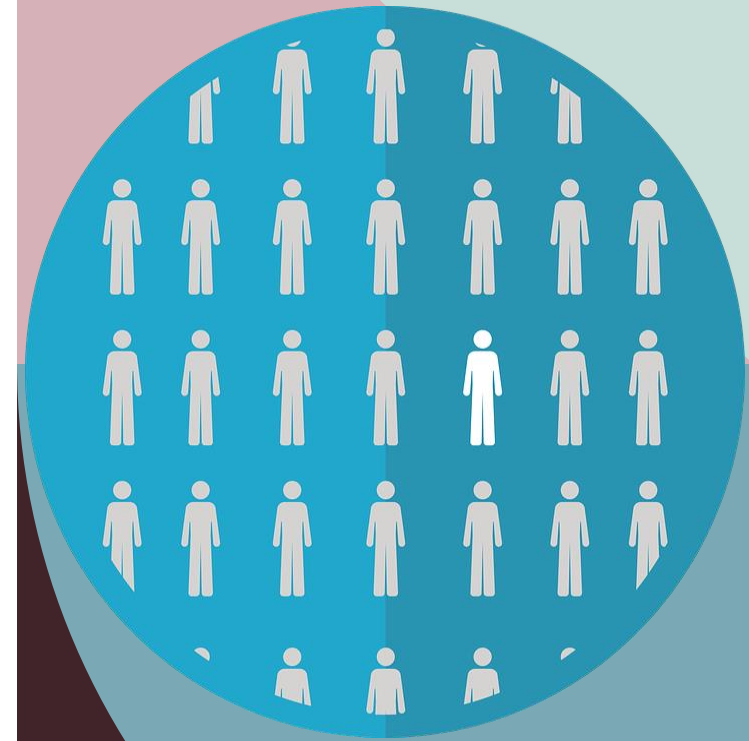
# Challenges and Future Directions

## Cohort Selection:

The chronic pain cohort for this project was initially created for a study on opioid use disorders.

## Future Studies:

Potentially explore using a different cohort, such as one specifically selected for alcohol use disorder or including patients with liver conditions, to enhance generalizability and robustness of findings.



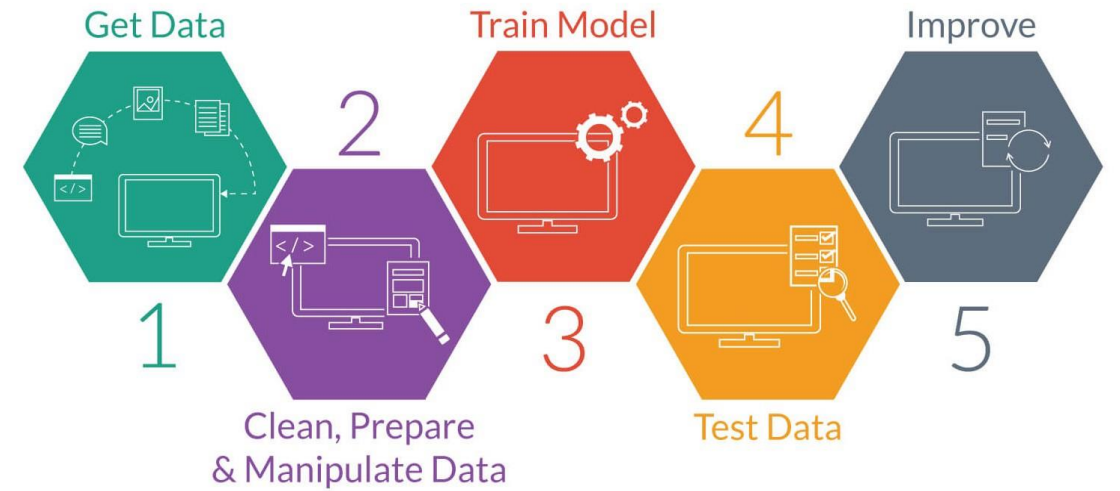
# Challenges and Future Directions

## Regular Expressions:

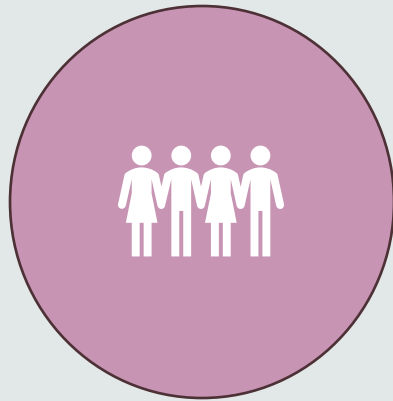
- Searching for simple phrases or words serves as an easy way to identify patterns within text.
- However, searching for more nuanced terms may prove to be a more complex process.

## Advanced NLP Techniques:

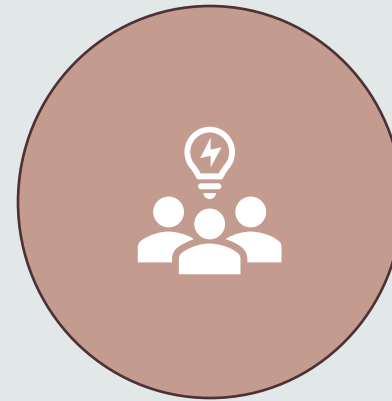
- Incorporate advanced LLMs to capture the nuances of the AUDIT questions more effectively.



# Future Steps



New cohort  
focused on AUD



Further testing  
and eventual  
evaluation by  
experts



# Acknowledgements & Funding

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- This work was funded by NIH NLM 5R25LM014216 and Avenir DP1 under Award Number DP1DA056667.



**Thank you!**

**Any Questions?**



# AUDIT Checklist

## The Alcohol Use Disorders Identification Test: Interview Version

Read questions as written. Record answers carefully. Begin the AUDIT by saying "Now I am going to ask you some questions about your use of alcoholic beverages during this past year." Explain what is meant by "alcoholic beverages" by using local examples of beer, wine, vodka, etc. Code answers in terms of "standard drinks". Place the correct answer number in the box at the right.

<p>1. How often do you have a drink containing alcohol?</p> <p>(0) Never [Skip to Qs 9-10]            (1) Monthly or less            (2) 2 to 4 times a month            (3) 2 to 3 times a week            (4) 4 or more times a week</p> <input type="text"/>	<p>6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?</p> <p>(0) Never            (1) Less than monthly            (2) Monthly            (3) Weekly            (4) Daily or almost daily</p> <input type="text"/>
<p>2. How many drinks containing alcohol do you have on a typical day when you are drinking?</p> <p>(0) 1 or 2            (1) 3 or 4            (2) 5 or 6            (3) 7, 8, or 9            (4) 10 or more</p> <input type="text"/>	<p>7. How often during the last year have you had a feeling of guilt or remorse after drinking?</p> <p>(0) Never            (1) Less than monthly            (2) Monthly            (3) Weekly            (4) Daily or almost daily</p> <input type="text"/>
<p>3. How often do you have six or more drinks on one occasion?</p> <p>(0) Never            (1) Less than monthly            (2) Monthly            (3) Weekly            (4) Daily or almost daily</p> <p><i>Skip to Questions 9 and 10 if Total Score for Questions 2 and 3 = 0</i></p> <input type="text"/>	<p>8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?</p> <p>(0) Never            (1) Less than monthly            (2) Monthly            (3) Weekly            (4) Daily or almost daily</p> <input type="text"/>
<p>4. How often during the last year have you found that you were not able to stop drinking once you had started?</p> <p>(0) Never            (1) Less than monthly            (2) Monthly            (3) Weekly            (4) Daily or almost daily</p> <input type="text"/>	<p>9. Have you or someone else been injured as a result of your drinking?</p> <p>(0) No            (2) Yes, but not in the last year            (4) Yes, during the last year</p> <input type="text"/>
<p>5. How often during the last year have you failed to do what was normally expected from you because of drinking?</p> <p>(0) Never            (1) Less than monthly            (2) Monthly            (3) Weekly            (4) Daily or almost daily</p> <input type="text"/>	<p>10. Has a relative or friend or a doctor or another health worker been concerned about your drinking or suggested you cut down?</p> <p>(0) No            (2) Yes, but not in the last year            (4) Yes, during the last year</p> <input type="text"/>
<p>Record total of specific items here <input type="text"/></p> <p><i>If total is greater than recommended cut-off, consult User's Manual.</i></p>	