

What Clinical Notes Could Tell Us About Chronic Pain?: Role of AI and NLP in Disability Determination

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Management of Chronic Pain and Implications for Disability Determination

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Unstructured Data = Iceberg Under Water



Abundance of Text Data in Health

Over 37M citations indexed by PubMed.
(2025)



Books, Journals,
Peer-reviewed literature



Medical Records

Over 500M “documents” within Michigan Medicine!
(2024)



Prescriptions

6.7B retail prescriptions filled at
US pharmacies in 2022
(IQVIA Institute, May 2023)

Medical Natural Language Processing



Computable Phenotyping from EHR



- Goal: Use narrative medical records to identify patients with certain criteria (e.g., disease state, medication, health conditions)

Admission Date: [**2113-3-22**] Date of Birth: [**2036-1-16**] Service: SURGERY Allergies: No Known Allergies / Adverse Drug Reactions Attending:[**First Name3 (LF) 1390**] Chief Complaint: right hemopneumothorax, bilateral pulmonary c rib fractures, multiple facial fractures, degloving ear Major Surgical or Invasive Procedure: right chest tube placement History of Present Illness: 74M was struck by his car after attempting to d work on it. Car rolled over him and dragged hi He was brought to the ED by ambulance. He H pain, chest pain and a laceration to the head. of consciousness. A chest tube was placed in t hemopneumothorax. Following the chest tube patient had an episode of hematemesis and hy resolved spontaneously. At baseline the patient home facial contus fracture. Past Medical History: Hypertension Social History: Patient lives in [**Location 1411**] with his wife. drinks 2 glasses wine nightly. Family History: Non-contributory.	Disch Sex: M Physical Exam: VS: 97.6 90 138/77 18 98 GA: alert and oriented x 3 CVS: normal S1, S2, no m Resp: mild bibasilar crack [**Last Name (un) **]: soft Ext: warm, no edema, wel Pertinen Results: [**2113-3-22**] 01:25PM CL-95* TCO-31* [**2113- [**2113- MCH-34 [**2113-3-22**] 01:28PM bnzodzn-NEG barbitrt-NE [**2113-3-22**] 01:28PM [**2113-3-22**] 01:28PM [**2113-3-26**] 05:00AM B MCV-95 MCH-34.8* MCH [**2113-3-26**] 05:00AM B [**2113-3-25**] 05:10AM B K 4.0 Cl-102 HCO3-29 An [**2113-3-25**] 05:10AM B [**2113-3-22**] CT SINUS 1. Numerous facial fractur most closely to a Le Fort t anterior,lateral and superi the right including the infe 2. Hemorrhage contained 3. Chronic non-displaced [**2113-3-27**] CHEST (P Small right apical pneumo posterior interspace, slightly smalle pleural effusion has proba clear. Moderate cardiome lateral rib fractures.	Brief Hospital Course: Summary of Injuries susta fractures, right hemopne contusions, L zygomatic a plate fractures, left lateral minimally displaced orbit papyrica fracture, right or lateral wall maxillary sinu Review of Systems: logic: Patient was r IV prn during his medication. At di medication. Ophthalmolo status following displace assessed facial fractures they will follow up with hi fractures he was placed restricted to a soft diet.N dens fracture and it was from an injury 20 years ag hospital day 6 he was tri receiving valium. Standi to baseline mental status requires no further neuro fracture. Cardiovascular: Followin hemodynamically stable. hypotension in the emerg hemodynamically stable. Pulmonary: A chest tube ED. The chest tube was increase in pneumothora CXR revealed this chang was stable. While in the decompensation due to s his respiratory status rem epidural for pain control.	GI: Patient suffered no intra soft diet without issue. He his facial fractures. GU/Renal: Patient has a fol but it was discontinued whe His electrolytes were replet remained stable. Endocrine: He was placed ICU. At discharge sliding s was no longer requiring ins noted on CT and needs to outpatient, Heme: Patient underwent s down slowly. He received o hospital, after which he req hematocrit was stable. He prophylaxis. Skin: Patient right ear lacer plastic surgery. He was plac treatment course, was disc Medications on Admission: lopressor (unknown dosage Discharge Medications: Metoprolol Tartrate 12.5 mg DROP BOTH EYES, Levofl Discharge Disposition: Home With Service Facility: [**Location (un) 932**] vna Discharge Diagnosis:	Discharge Condition: Good Discharge Instructions: Please call your doctor or nurse practitioner if you experience the following: *You experience new chest pain, pressure, squeezing or tightness. *New or worsening cough, shortness of breath, or wheeze. *If you are vomiting and cannot keep down fluids or your medications. *You are getting dehydrated due to continued vomiting, diarrhea or other reasons. Signs of dehydration include dry mouth, rapid heartbeat, or feeling dizzy or faint when standing. *You see blood or dark/black material when you vomit or have a bowel movement. *You experience burning when you urinate, have blood in your urine, or experience a discharge. *Your pain is not improving within 8-12 hours or is not gone within 24 hours. Call or return immediately if your pain is getting worse or changes location or moving to your chest or back. *You have shaking chills, or fever greater than 101.5 degrees Fahrenheit or 38 degrees Celsius. *Any change in your symptoms, or any new symptoms that conc you. Please contact the Dr. [**Last Name (STitle) 90000**] at [**Telep Surgery to make a follow-up appointment for 1 week from discharge. Please contact your primary care provider and make [**Name In appointment within 2 weeks. You will need to have an ultrasoun of your thyroid as well as work-up of an inguinal hernia. Completed by:[**2113-3-29**]
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AI models can better identify disease traits than just ICD codes

Natural Language Processing Effectively Identifies Risky Alcohol Use from Clinical Notes

NLP identification



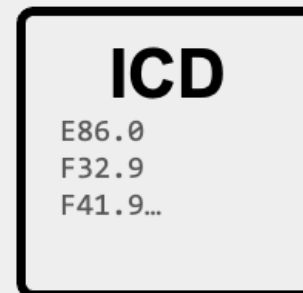
87%

True positives
Detected



NLP identified 3 times more patients with risky alcohol use than ICD codes using a clinician-labeled comparator set.

ICD code identification



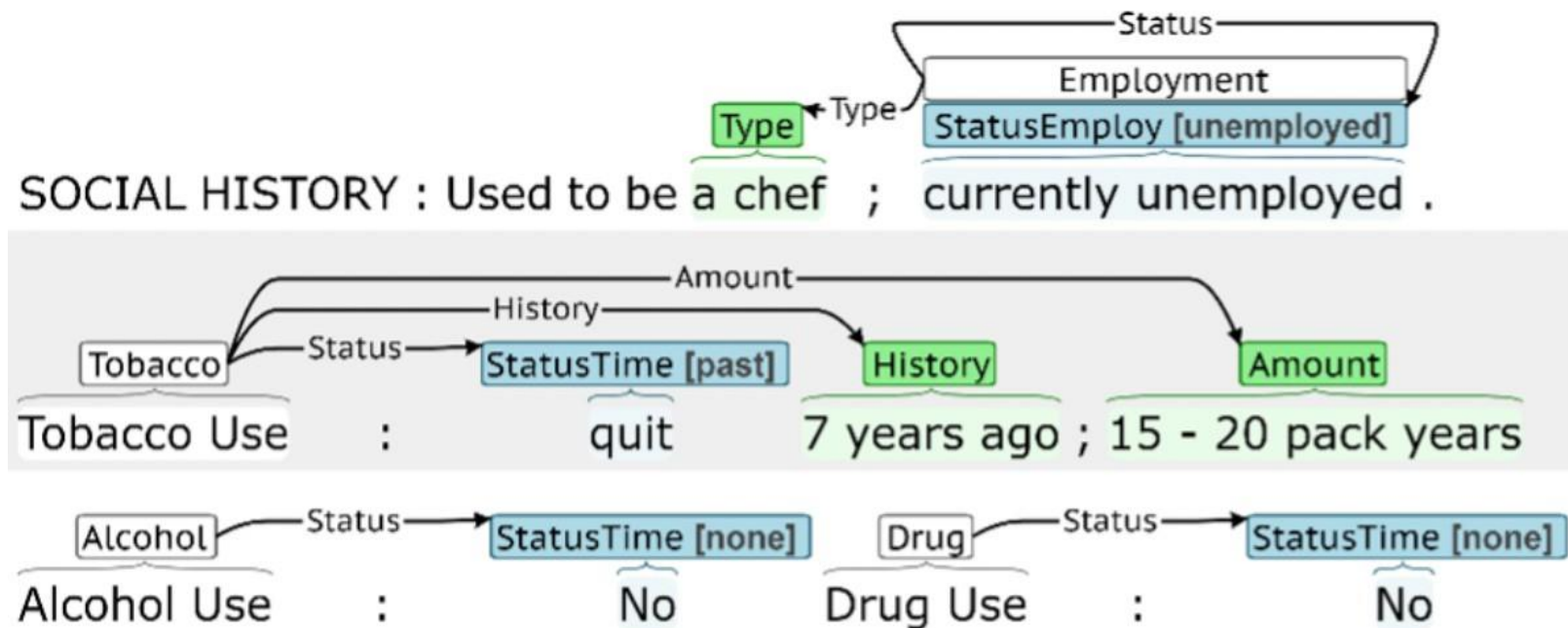
29%

True positives
Detected

Vydiswaran, et al. Automated-detection of risky alcohol use prior to surgery using natural language processing. *Alcohol, Clinical and Experimental Research*, 2024 Jan; Volume 48, Issue 1 p.153-163. DOI: 10.1111/acer.15222

Extracting Patient Information from EHRs

- ❑ Social Determinants of Health
 - ❑ Alcohol Use, Drug Use, Tobacco Use, Employment status
- ❑ Disease state, Medication use, changes over time
- ❑ Current state of the art systems use **deep neural network models**



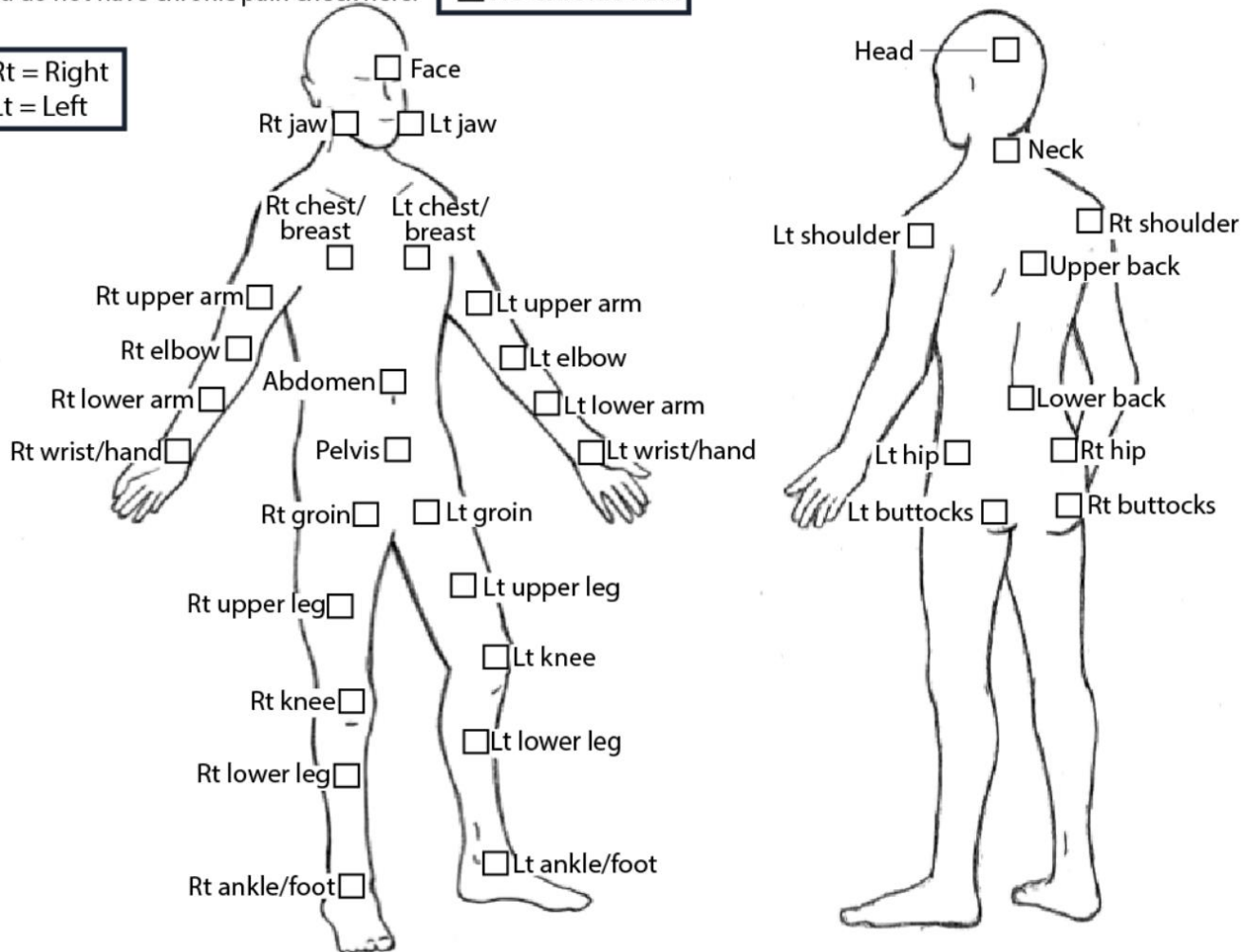
Characterizing Pain

Michigan Body Map

On the image below, **CHECK ALL** areas of your body where you have felt ***persistent or recurrent pain*** present for the last ***3 months or longer (chronic pain)***.

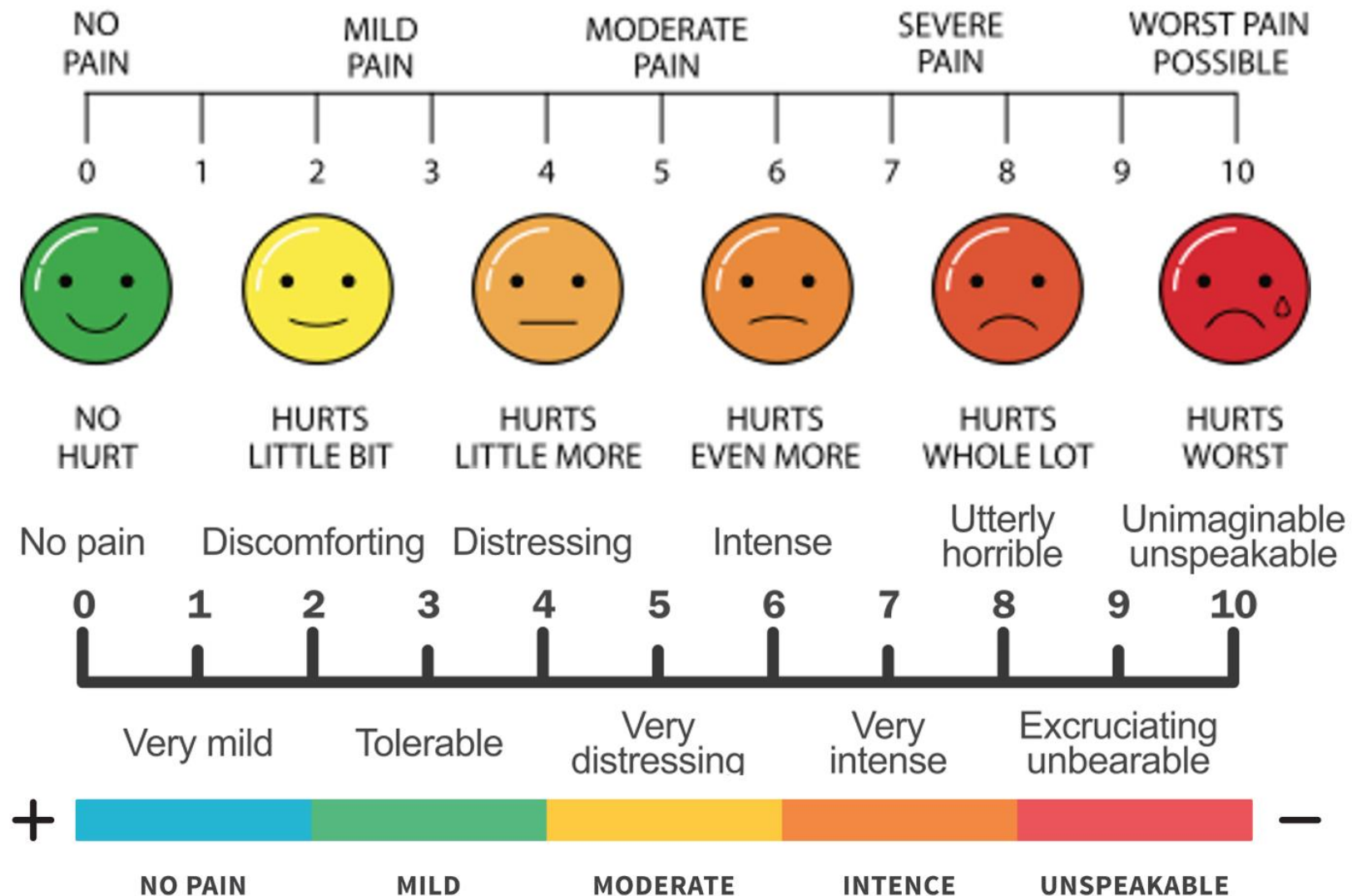
If you do not have chronic pain check here: ☐ No Chronic Pain

Rt = Right
Lt = Left



Michigan Body Map. Accessed from <https://medicine.umich.edu/dept/pain-research/clinical-research/michigan-body-map-mbm>. Last accessed Apr 14, 2025.

Characterizing Pain (2)



Characterizing Pain using EHRs

- ❑ Chronic Pain Phenotypes on structured data fields: pain intensity, treatment modalities, diagnosis codes, and interventions
- ❑ Pain scores: 0 (no pain) to 10 (worst pain imaginable) on Visual Analog Scale
- ❑ ICD-9 and ICD-10 codes for pain-related conditions
- ❑ Pain medications, including pain-related prescriptions, including opioids, NSAIDs, anticonvulsants, and muscle relaxants
- ❑ Pain interventions: CPT codes for pain-intervention procedures

Pain Characterization in Clinical Notes

- ❑ Patient's self-reported pain score is subjective
- ❑ A score of 8/10 can be manageable for some patients, unbearable for others
- ❑ Physicians interpret patient self-reports in clinical notes
- ❑ This is the fundamental, clinical documentation of patient care!
- ❑ Errors / biases in documentation can persist for a long time

Primary Care Visit

Subjective: The patient complains of chest pain that started earlier today. They rate the pain as a 7/10 and describe it as a sharp, stabbing sensation. They deny any previous history of similar symptoms.

Objective: Vital signs are normal (130/80mmHg). The physical exam reveals tenderness upon palpation in the chest area. No other abnormalities noted.

Assessment: Possible musculoskeletal injury causing chest pain.

Plan: Recommend physical rest and aspirin for pain management. Follow up in two weeks if symptoms persist or worsen.



Annotating Pain Features in Clinical Notes

Primary Care Visit

Subjective: The patient complains of chest pain that started earlier today. They rate the pain as a 7/10 and describe it as a sharp, stabbing sensation. They deny any previous history of similar symptoms.

Objective: Vital signs are normal (130/80mmHg). The physical exam reveals tenderness upon palpation in the chest area. No other abnormalities noted.

Assessment: Possible musculoskeletal injury causing chest pain.

Plan: Recommend physical rest and aspirin for pain management. Follow up in two weeks if symptoms persist or worsen.



Pain is Underdiagnosed & Misdiagnosed

pubmed.ncbi.nlm.nih.gov/24526049/

> [NeuroRehabilitation](#). 1997;8(3):201-22. doi: 10.3233/NRE-1997-8307.

Misdiagnosis of chronic pain as hysterical

pmc.ncbi.nlm.nih.gov/articles/PMC7944961/



LETTER ▶ [Reumatologia](#). 2021 Feb 28;59(1):64. doi: [10.5114/reum.2021.103452](#) [↗](#)

Fibromyalgia: the underdiagnosed disease of pain

[Consuelo Rivera-Miranda Giral](#)^{1,✉}, [Rosa Diaz-Manchay](#)², [Franco Leon-Jimenez](#)^{3,4,5}

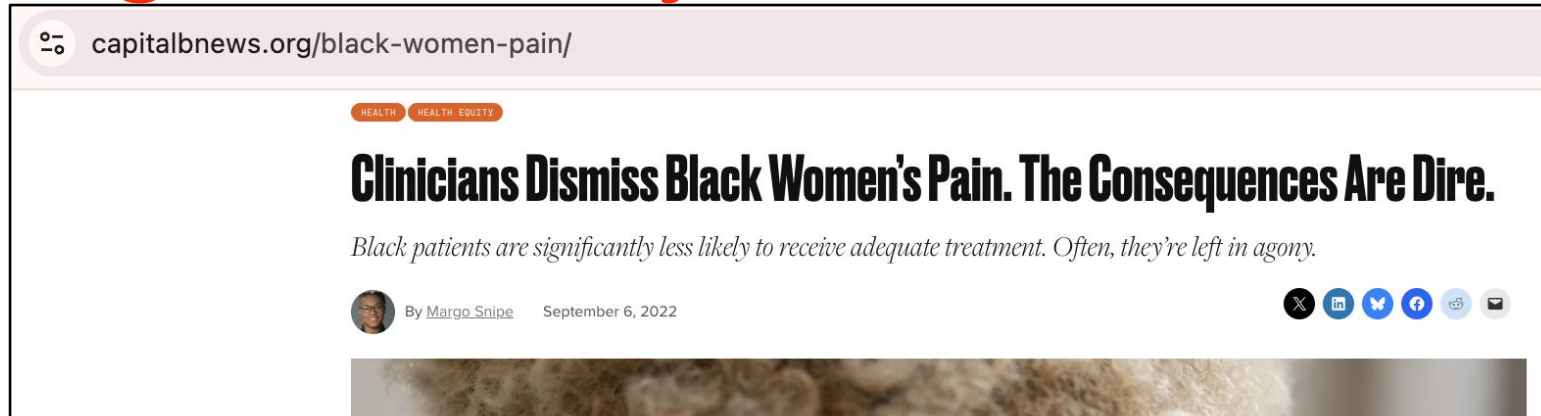
standpoint.
understanding
to medical

en
diagnosis itself
d can

Keywords: Chronic pain; Conversion; DSM; Diagnosis; Fibromyalgia; Hysteria; Myofascial pain.



Diagnosing Pain is Subject to Human Bias



► Proc Natl Acad Sci U S A. 2016 Apr 4;113(16):4296–4301. doi: [10.1073/pnas.1516047113](https://doi.org/10.1073/pnas.1516047113)

Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites

[Kelly M Hoffman](#)^{a,1}, [Sophie Trawalter](#)^a, [Jordan R Axt](#)^a, [M Norman Oliver](#)^{b,c}

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PMCID: PMC4843483 PMID: [27044069](https://pubmed.ncbi.nlm.nih.gov/27044069/)



Physicians have shown a pattern of distrust when Black patients seek help with pain, especially Black women. (Jamie Grill/Getty Images)



Trained AI Models Retain these Biases

 pmc.ncbi.nlm.nih.gov/articles/PMC11459244/



JAMA Network

[Click to view article >](#)

► JAMA Netw Open. 2024 Oct 7;7(10):e2437977. doi: [10.1001/jamanetworkopen.2024.37977](https://doi.org/10.1001/jamanetworkopen.2024.37977) 

Racial Differences in Pain Assessment and False Beliefs About Race in AI Models

[Brototo Deb](#) ^{1,2,✉}, [Adam Rodman](#) ^{3,4}

► [Author information](#) ► [Article notes](#) ► [Copyright and License information](#)

PMCID: PMC11459244 PMID: [39374021](#)

Abstract

This comparative effectiveness research study examines the association between racial differences in pain assessment and false beliefs about biologization of race by large language models compared with a human baseline.



Key Takeaways

Questions, Comments: vgvinodv@umich.edu

- ❑ Health Records contain an abundance of information.
Understanding **health text is critical to improve healthcare**
- ❑ **ICD codes and structured data** provide an incomplete description of pain and other comorbidities
- ❑ **AI/Deep Learning methods are effective** in phenotyping patient cohorts of interest better than ICD codes and structured data.
- ❑ Large Language Models (LLMs) have advanced significantly in recent years, but **biased data begets biased models**.
- ❑ Active research on validated **intersectionality-aware AI models** in determining phenotypes such as pain





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