

Querying from Scratch - Cooking Up New Syndromes

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Council of State and Territorial Epidemiologists



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Development of Unintentional Injury Syndromes to Describe Drowning, Falls, and Hip Fracture-Related ED Visits

Briana Moreland, MPH

Cherokee Nation Operational
Solutions

Centers for Disease Control and
Prevention

November 17, 2021



Burden of Unintentional Injuries



of injury death among children
aged 1 to 4 years



injury death among older adults
(≥ 65 years)



adults are caused by falls

Developing Unintentional Injury Syndromes

- + **National Electronic Injury Surveillance System-All Injury Program (NISSESS)**

- + 2019

- + www.cdc.gov/injury/wisqars

- + **Healthcare Cost and Utilization Project-Nationwide Emergency Department Sample (HCUP-NEDS)**

- + 2018

- + www.hcup-us.ahrq.gov

Surveillance of Unintentional Injuries

Commonly used data sources for injury surveillance are not timely

Unintentional Drowning Syndrome (In Progress)

ICD-10-CM*	
T75.1	Drowning and nonfatal submersion
V90	Drowning and submersion due to accident to watercraft
V92	Drowning and submersion due to accident on board watercraft, without accident to watercraft
W16 with 6 th character=1 (except 16.4 and 16.9 where 5 th character=1)	Fall, jump, or diving into water causing drowning and submersion
W22.041	Striking against wall of swimming pool causing drowning or submersion
W65-W74	Accidental non-transport drowning and submersion

*7th Character of A or missing

Discharge Diagnosis
Field

Unintentional Drowning Syndrome (In Progress)

Inclusion	Exclusion
Drown	Feel like drowning, drown self, plan to drown, tried to drown Misspellings: withdrown, blood drown, indrown, syndrown
Found bottom of pool Underwater Water AND inhale, aspirate, cough, turn blue, AND lake, pool, tub, bath, swim, river, creek, pond, ocean, wave, spring	Ear, eye, bathroom, drink/ask for water, substance inhalation
Submerge	Burn, cast, splint, not/denies submerge, partially submerge, submerged object, sting ray
Fall/fell AND pool AND cough, resuscitate, wheeze	None
Swim AND unresponsive, struggle	None

Chief Complaint
Field

CDC Falls 65 and Older Version 1

Discharge Diagnosis Field

ICD-10-CM*	
V00.11-V00.89 with 6 th character=1	Falls related to pedestrian conveyance
W00-W15, W17, W19	Falls
W16 with 6 th character=2 (except W16.4 and W16.9 where 5 th character=2)	Fall, jump, or diving into water
W18.1, W18.2, W18.3	Other falls

*7th character of A or missing

CDC Falls 65 and Older Version 1

Inclusion	Exclusion
Rolled off/out of bed	None
Loss of balance Stumble	None
Slip	Dyslipidemia, pink slip, slipped disc, slip disc, disc slip, slipper
Trip	Atrip, amytrip, trip to, strip, lithotripsy, tripod, bus trip, triple
Fall/fell	Fallopian, no fall, denies fall, without fall, catheter fell, tube fell, asleep, W20, V80, assault, altercation, fight, suicide, seizure, heart attack, stroke (except history of stroke), ischemic attack (except history of ischemic attack), cardiac arrest (except Z86), motor vehicle collision

Chief Complaint
Field

CDC Hip Fracture 65 and Older Version 1

Discharge Diagnosis Field

ICD-10-CM*	
S72.0	Fracture of head and neck of femur
S72.1	Pertrochanteric fracture
S72.2	Subtrochanteric fracture
M97.0	Periprosthetic fracture around internal prosthetic hip joint

*7th character of A,B,C or missing

CDC Hip Fracture 65 and Older Version 1

Inclusion	Exclusion
Overall	Chip, metastata
Hip fracture, hip fx, fracture of right hip, fracture of left hip	Previous hip fracture, history of hip fracture, post hip fracture
Broken/broke hip, broken/broke left hip, broken/broke right hip	history of broken hip, history of broken right hip, history of broken left hip
intertroch, subtroch, pertroch femoral neck, neck of femur, head of femur, femoral head, trochanter AND fracture, fx, broke, break intracapsular fracture, fracture of epiphysis, midcervical fracture, apophyseal fracture AND femur	None
Hip deformity External rotation AND hip	S73

Chief Complaint
Field

Comparing NSSP to HCUP-NEDS

Data Sets

HCUP-NEDS (2018)

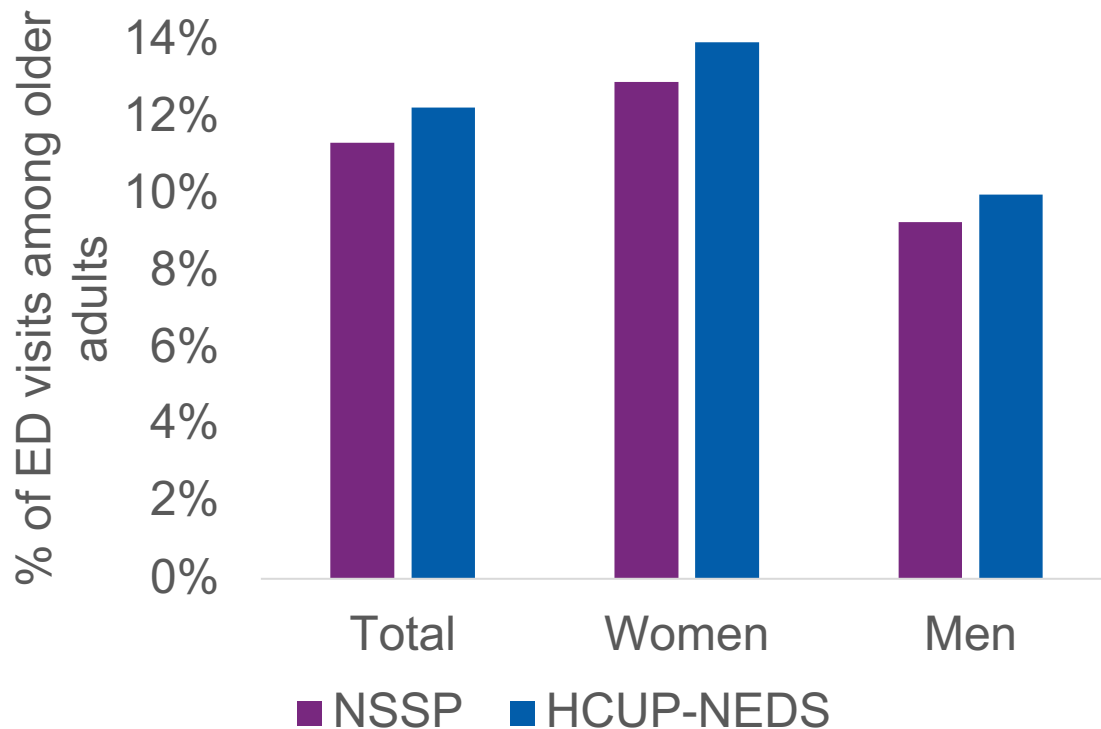
- + Nationally representative of U.S. EDs
- + Data from 990 hospital EDs across 36 states
- + ICD-10-CM codes were used to identify visits related to falls and hip fractures among older adults

NSSP (2018)

- + Covers about 71% of U.S. EDs
- + Data quality filters limited analysis to EDs with an average weekly informative discharge diagnosis $\geq 68\%$ and an average coefficient of variance of ≤ 35

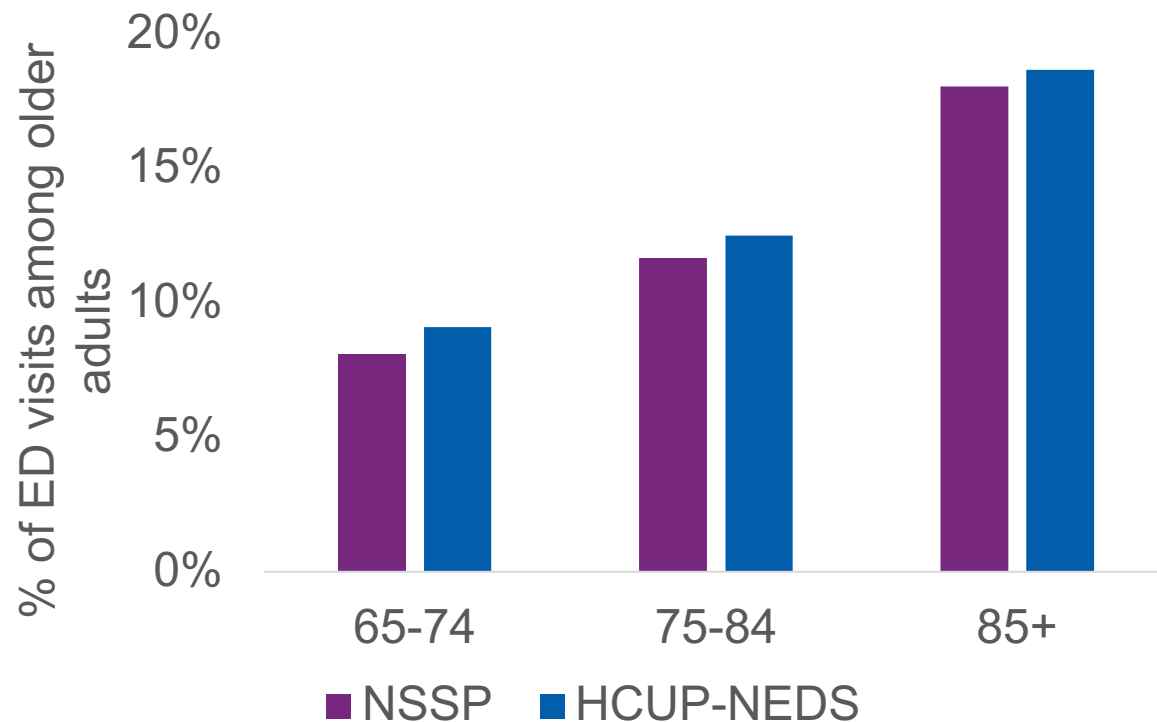
All analysis was limited to adults aged ≥ 65 years

Fall-Related ED Visits 2018



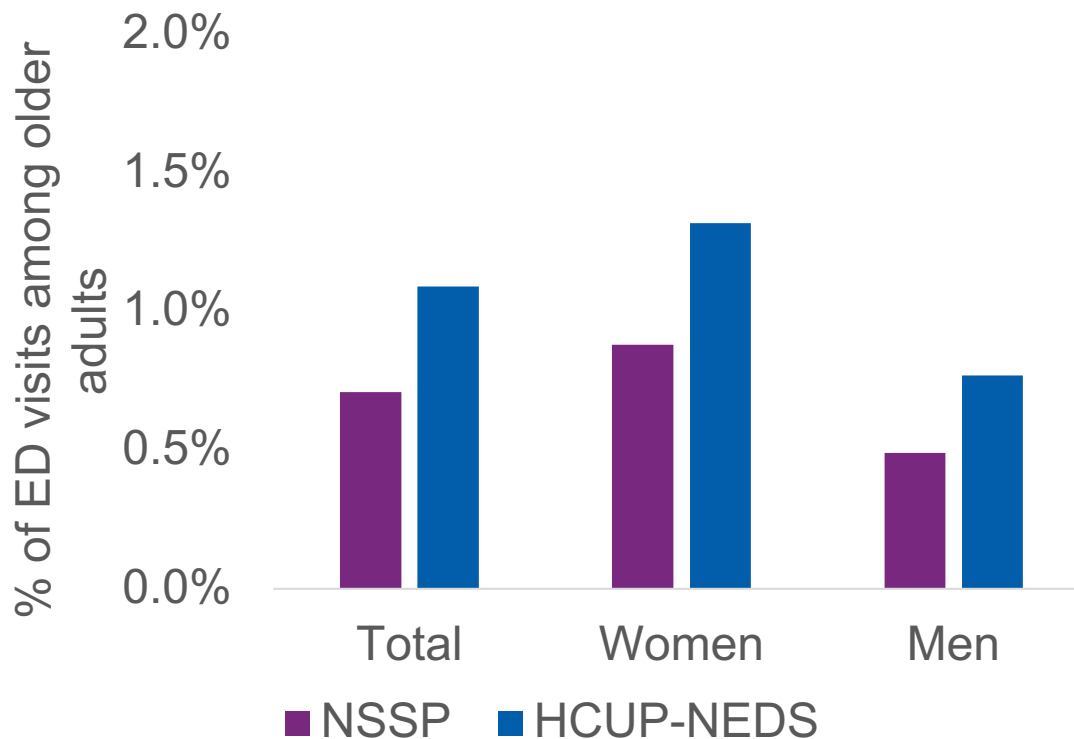
- The % of ED visits among older adults related to a fall was 7% less in NSSP compared to HCUP-NEDS
- A higher % of older women's ED visits were fall-related compared to older men's across both data sets

Fall-Related ED Visits 2018



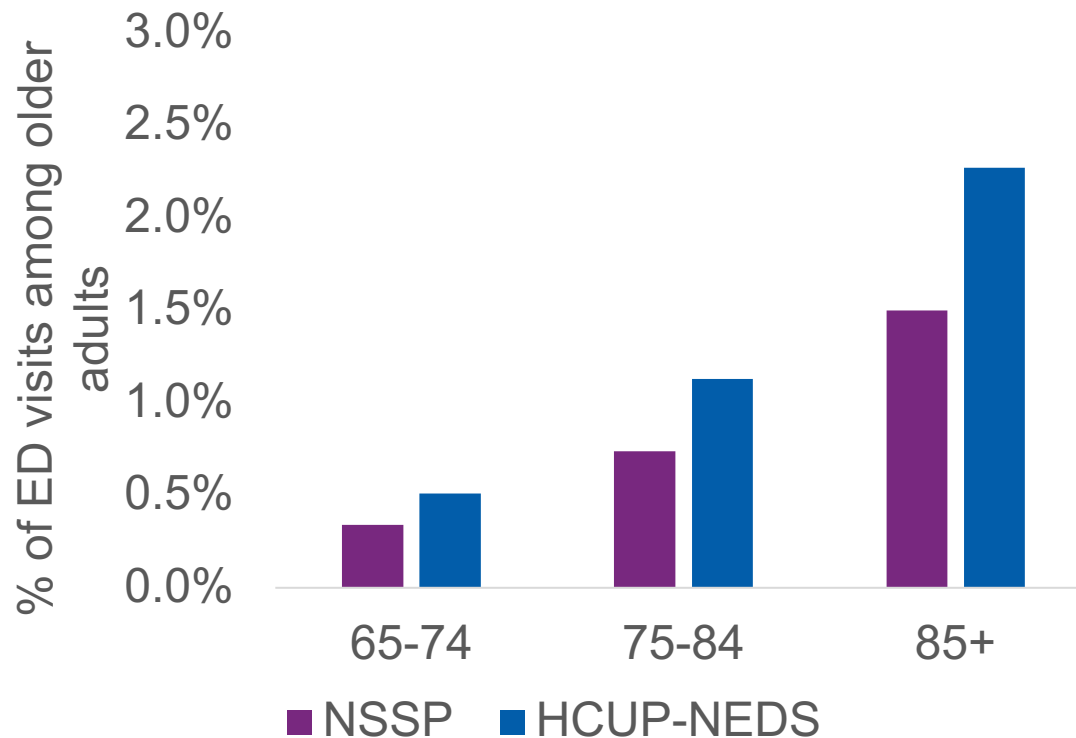
The % of ED visits related to a fall increased with age across both data sets

Hip Fracture-Related ED Visits 2018



- The % of ED visits among older adults related to a hip fracture was 35% less in NSSP compared to HCUP-NEDS
- A higher % of older women's ED visits were hip fracture-related compared to older men's across both data sets

Hip Fracture-Related ED Visits 2018



The % of ED visits related to hip fractures increased with age across both data sets

Conclusion

- NSSP can be used to provide real time fall and hip fracture ED data
- Prevalence of falls and hip fractures among older adults was lower in NSSP compared to HCUP-NEDS
- Lessons learned from developing the fall and hip fracture syndromes will be applied to the drowning syndrome

References

Slide 2

CDC. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. [Accessed 2021 Oct 1]. National Center for Injury Prevention and Control, Atlanta, GA. <https://www.cdc.gov/injury/wisqars/>

Parkkari J, Kannus P, Palvanen M, Natri A, Vainio J, Aho H, et al. Majority of Hip Fractures Occur as a Result of a Fall and Impact on the Greater Trochanter of the Femur: A Prospective Controlled Hip Fracture Study with 206 Consecutive Patients. *Calcif Tissue Int* 1999;65(3):183–7. DOI: 10.1007/s002239900679

Slides 5, 7, 9

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Slide 12

NEDS Overview. Healthcare Cost and Utilization Project (HCUP). [Accessed 2021 Oct 1]. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/nedsoverview.jsp

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Thank you!

Questions?
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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.





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Query comparisons & syndromic role in surveillance for Cannabis-related Adverse Events

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Public Health Division

CSTE Syndromic Surveillance
Conference

*Day 2 Breakout - Querying
from Scratch: Cooking up new
Syndromes*

November 17, 2021

Objectives

Syndromic surveillance quality assessment and improvement for use in cannabis-related public health surveillance

- Summarize evolving need for monitoring cannabis-related adverse events
- Review available queries
- Contrast queries and provider-determined contribution



These aren't your Grandma's brownies: Increasing THC concentration in cannabis products
Image from State of Alaska DHSS, Division of Public Health, Marijuana education campaign

<https://dhss.alaska.gov/dph/Director/Pages/marijuana/excessive.aspx>

Background

Oregon: Legalized & regulated cannabis markets

- Medical dispensaries in 2014
- Retail sales in 2015

Across the US: Legalization has spread; growing availability and evolving products have been associated with some acute adverse events requiring public health response

- Contaminated cannabis products
- THC concentration variability/unintended exposure
- Late 2019-early 2020: EVALI outbreak associated with vaping product additives
- 2021: Delta-8 THC products

Syndromic Surveillance for Cannabis-related Adverse Events

- **The evidence base for cannabis contribution to health effects is of mixed quality, and context is changing**
 - cannabis may be a contributing/complicating factor rather than a primary cause
- CSTE and CDC epi groups focused on query development during initial states' legalization (2014-2015)
- Query originally developed by Colorado in 2014 was widely shared and later modified to include ICD-10-CM codes
- Marijuana v3 CC/DD Category query is currently active in NSSP-ESSENCE
- Given evolving cannabis-related health concerns, syndromic surveillance remains an important tool for public health (see Hartnett 2020, CDC 2021)

How well do queries work?

- Positive predictive value (PPV): % of cases **identified by a query that are *true positive****
 - DeYoung et al. (2017): in 15 Denver, Colorado EDs, based on ruling out spurious cases
 - **93%** PPV (phase 1, ICD-9-CM, N=524)
 - **96%** PPV (phase 2, ICD-10-CM, N=698)
 - Marx et al. (2019): 3 Colorado EDs, based on clinical impression review
 - **36%-64%** PPV, varied across EDs (N=422)
- **How well do queries work *now*?**



* important: what is the definition of “true”?

Methods for provider comparison

- Partnered with Portland, Oregon, emergency department (ED)
 - Urban, academic, Level 1 trauma center
- ED added a question to their Electronic Medical Record (EMR) for clinicians to answer for ALL patients:

*Do you think **cannabis** use was a significant factor leading to today's ED visit? (yes, no)*

- Clinicians at the ED received
 - Information on relevant health outcomes associated with cannabis and opioid use, and discussion of determining “cause”
 - Follow up to assure clinicians were completing the field
- Created capacity to compare provider- vs. ESSENCE- vs. administrative-identified cases

Queries: Cannabis-related Emergency Department (ED) Visits

- **Oregon query (2017)** uses chief complaint (CC) and discharge diagnosis (DD)

Text
ICD-10-CM
F-codes and
T-code

```
^ marij^,or ,^ maraju^,or ,^ thc ^,or ,^ cbd ^,or ,^ cannab^,or ,^ canab^,or ,^ mj ^,or  
,(^ smok^,and, ^ pot ^),or,(^ smok^,and, ^ weed ^),or ,^ hash ^,or ,^ hemp  
^,or,^f121^,or ,^f12.1^,or ,^f122^,or ,^f12.2^,or ,^f129^,or ,^f12.9^,or ,^t407^,or  
,^t40.7^
```

- **NSSP query (2020)** also uses CC/DD

Text

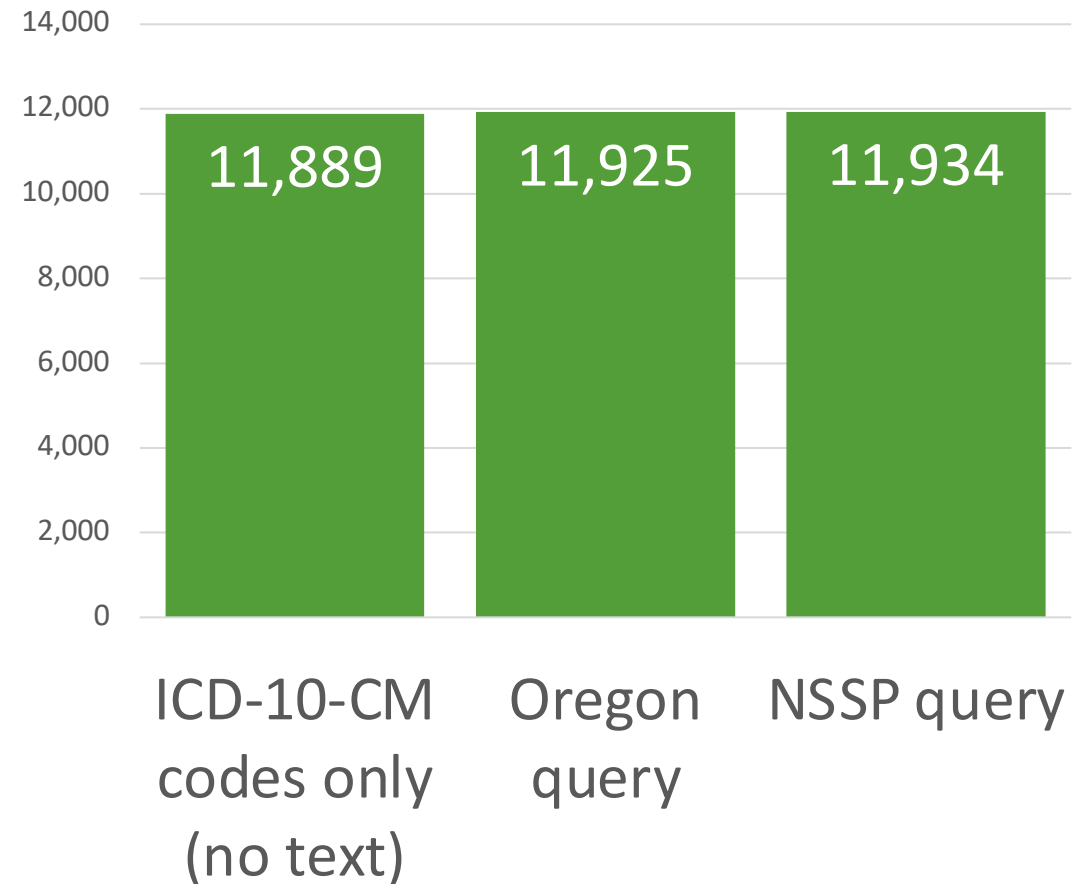
```
(,^marij^,or,^maraj^,or,^ marichuana^,or,^ maru[ja]^,or,^cannab^,or,^mary jane^,or,^  
THC ^,or,THC ^,or,^ THC,or,THC),andnot,(^synth^,or,^ k2 ^,or,^ k2,or,k2  
^,or,k2,or,^denies marij^,or,^denies smoking marij^,or,^denies use today^,or,^denies  
usage^,or,^denies cannab^),or,(,^ingest^,or,^edible^,or,^smok^),and,(^ MJ ^,or,^  
hash^,or,^weed^,or,^hahish^,or,^hemp^,or,^ganja^,or,^reefer^,or,^brownie^,or,^kush^,  
or,^blunt^,or,^joint^),),andnot,(^synth^,or,^ k2 ^,or,^ k2,or,k2 ^,or,k2),or,^smok^  
wet^,or,^smok^ pot ^,or,^CBD^,ANDNOT,(^CBD Dilat^,or,^CBD Dialat^,or,^Dilated  
CBD^,or,^CBD Stone^,or,^CBD Strict^,or,^CBD St[ie]nt^,or,^Dialated CBD^,or,^Dilatd  
CBD^,or,^CBD Patency^,or,^CBD Sludge^,or,^Common Bile Duct^,or,^CBD
```

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Obstruct^),or,^[; / ]f121^,or,^[; / ]f12.1^,or,^[; / ]f122^,or,^[; / ]f12.2^,or,^[; / ]f129^,or,^[; / ]  
f12.9^,or,^[; / ]t407^,or,^[; / ]t40.7^
```

ICD-10-CM
codes

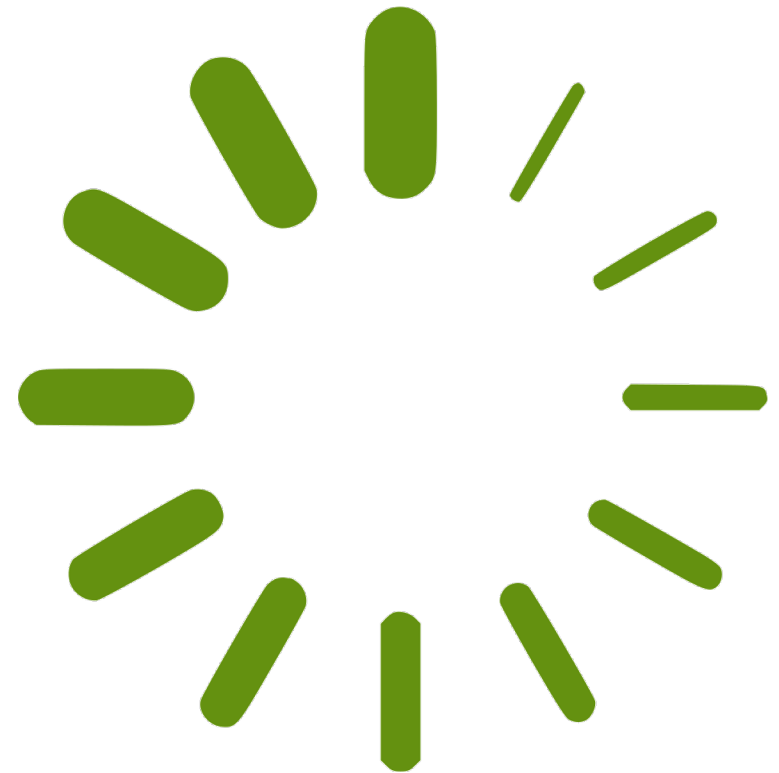
Query Results

- Oregon statewide data
- October 2018 – September 2019
 - Pre-pandemic
 - Some overlap with EVALI
- Cases
 - Nearly 12,000 identified using ICD-10-CM components of queries in CC and DD fields alone
 - +36 (0.3%) cases using full Oregon query
 - +9 (0.1%) additional cases using full NSSP query



Methods.... loading

- Partnered with a single ED to compare provider-determined EMR vs. ESSENCE
- ESSENCE DUA restricts talking about results from one site
 - Still awaiting legal approval to talk about results using ESSENCE data
- Findings from Billing vs. Provider data* in the same facility are similar to findings from ESSENCE vs. Provider data: **we will discuss those**



*Hendrickson et al., 2021

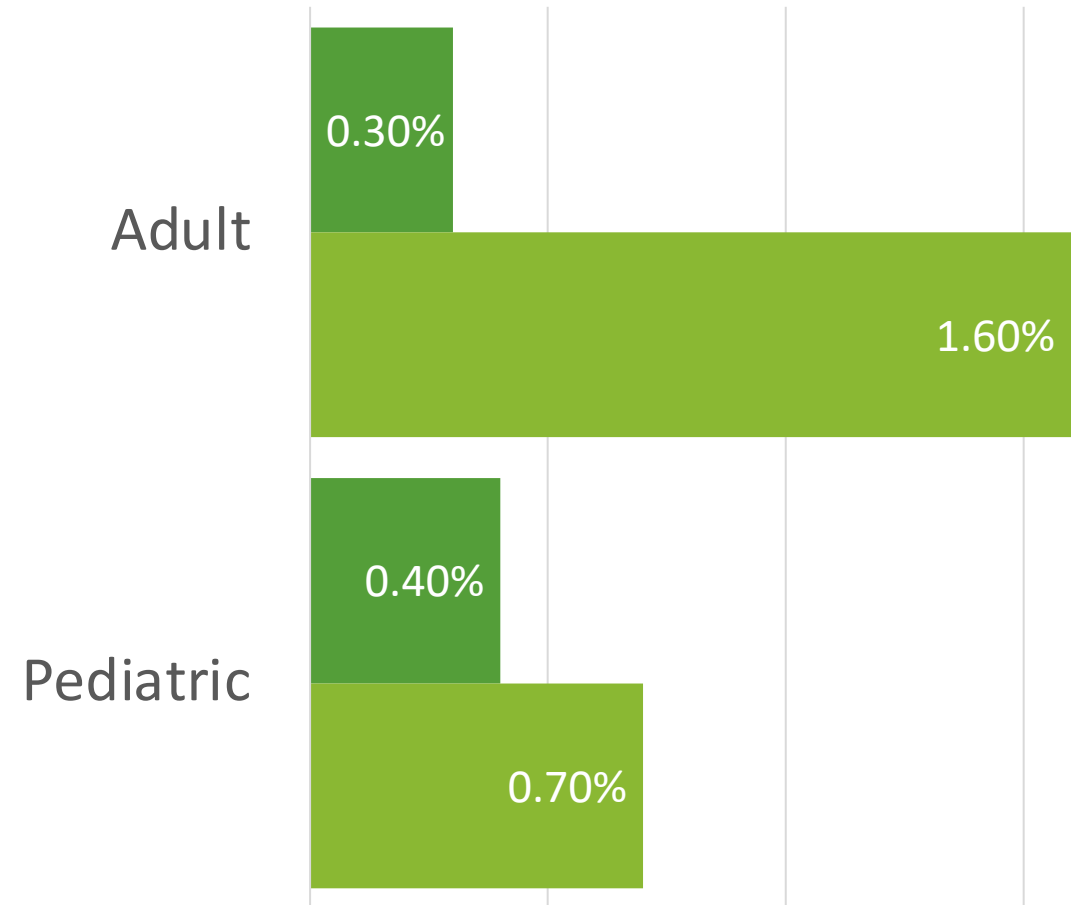
Discharge Diagnosis-based vs. Provider Cannabis-related visits: Prevalence

36,252 total visits*

- 25,736 Adult
- 10,526 Pediatric (< age 18)

Provider determination found many more cases than discharge diagnosis codes

- +1% prevalence for adults (5x greater)
- +0.3% prevalence for peds

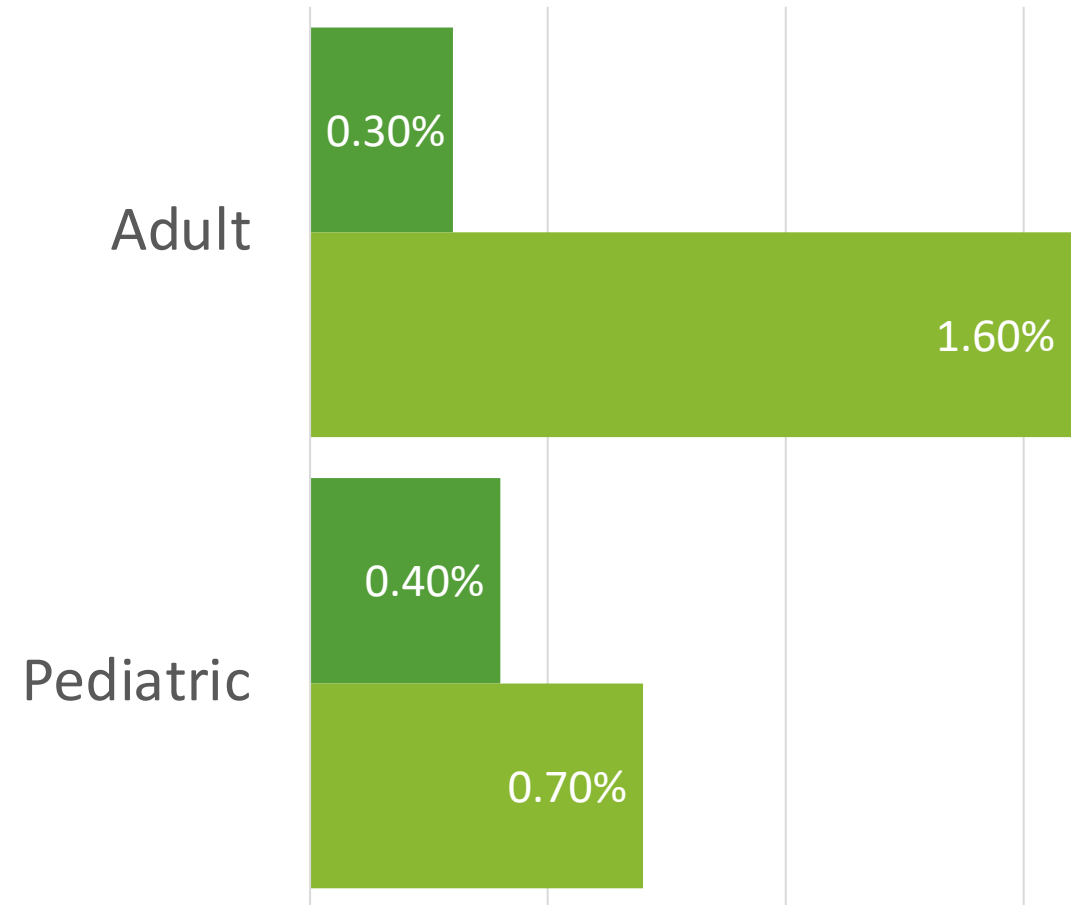


*cases with complete information from providers for the EMR cannabis contribution question (77% of total)

Reference: Hendrickson et al., 2021

Discharge Diagnosis-based vs. Provider Cannabis-related visits: Quality

- Using provider identification as the “gold standard”
- *Sensitivity*: % of provider-identified that had a cannabis DD code
 - 22% for adults
 - 17% for peds
- *Specificity*: % of those not identified by providers not identified with DD codes
 - Nearly 100% for both
- *Positive Predictive Value (PPV)*: % of those identified by query/DD that were confirmed by providers
 - Similar to prior study (Marx, et al.)



Discussion

- Queries with different text performed similarly, suggesting small variations in text may not have big effects
- DD-only or ESSENCE queries may underestimate burden, but are specific
- Method allows “real-time” determination by clinicians vs. retrospective chart review in other studies, this may be efficient
 - Method allows query sensitivity calculation among all cases, not just PPV
- Once capacity is built, questions can be modified to compare with other ESSENCE or DD case definitions, including different topics
 - It does take time to modify EMRs, ESSENCE interface, train clinicians and implement
 - DUAs may need to be modified

Limitations

- Results are from one state with legal retail cannabis, and one urban hospital; may not be generalizable to other states/regions
 - Reporting practices can vary by hospital system (e.g., see Marx et al.)
- Clinicians may not be the best “gold standard” for assessing “true contribution”
 - Evidence base is mixed about relationship between cannabis and some health conditions, so it could be difficult to accurately determine “contribution”
 - Orientation to the project could have affected perceptions (e.g., learning about potential harms from cannabis could have increased likelihood of attribution)
 - Validation* of provider determination was positive: Researchers at the ED conducted a chart review of a sample of cases (N=98) early in the project period and found 82% of cases identified as positive by clinicians had chart documentation of cannabis contribution (82% PPV, with chart documentation as gold standard); 100% *not* identified by providers had *no* cannabis mention in chart
- Clinicians answered the EMR question for most cases (23% missing)
 - Lead researchers prompted and supported clinicians to complete the field
 - Individual clinician completion was 62-91%

*see Hendrickson et al., 2021

Recommendations: Syndromic Surveillance & Cannabis

- Syndromic surveillance supports real-time monitoring of adverse event clusters
 - Cannabis regulatory agency partners have interest in monitoring cannabis-related outbreaks; may need education about syndromic systems and limitations
- Changes in context (e.g., legalization) may affect what providers ask, what patients disclose
 - Be aware of legal changes; alert to changes in systems' intake forms
- Future evolution of cannabis products may change query performance in unknown ways
 - Be aware of new cannabis products in markets, language to describe them
 - Triangulate with other sources (e.g., Poison Center) that provide more detail about exposures, including cannabis product types

Thank You!

Julia Dilley, PhD MES

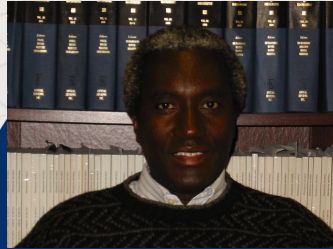
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References

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Defining diphenhydramine overdoses in Tennessee

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Background

- Diphenhydramine (DPH) - antihistamine used mainly as a sedative, hypnotic, and antiemetic
- Reports of misuse of DPH and cough or cold medications
 - About 4% of youth 12-17 years reported lifetime over-the-counter cough/cold medication misuse in a 2006 national survey (1).
 - 63% increase of intentional DPH exposures in individuals 10 years or older, for 2005–2016 period (2).
 - DPH was the 11th most frequently mentioned drug in overdose deaths nationally in 2016 (3).

Background ...

- ***FDA warning, Sept 2020*** - Teen misuse of diphenhydramine “sparked by dangerous “Benadryl Challenge” promoted on social media” (4).
- Anticipatory guidance is the “most valuable tool against the “Benadryl Challenge” - The American Academy of Pediatrics (5).
- In 2021, in TN - Concern from the field on the misuse of Benadryl® and similar products by youth
 - *Conducted an exploratory investigation on the extent of the problem* - using emergency department records reported to the TN ESSENCE.

Methods

- Names including brand names and street names and ICD-10-CM codes for diphenhydramine were gathered
 - T45.0X.. - Poisoning by antiallergic and antiemetic drugs
 - Not specific for diphenhydramine
- The Chief Complaints and Discharge Diagnosis (CC and DD) field in ESSENCE were used to create the definition for diphenhydramine overdoses.

Methods ...

- Different combinations of queries were developed and used to identify the records in ESSENCE:
 - Text only
 - Systemized Nomenclature of Medicine (SNOMED) codes only
 - ICD-10-CM codes only
 - “SNOMED or Text”
 - “ICD codes or SNOMED codes”
 - “ICD codes or SNOMED codes or Text”
 - “ICD codes or Text”
 - “ICD codes and Text”
- Data for the various queries was analyzed for the period between the beginning of January 2019 to end of June 2021.

Findings

Suspected diphenhydramine overdose records identified by various queries*

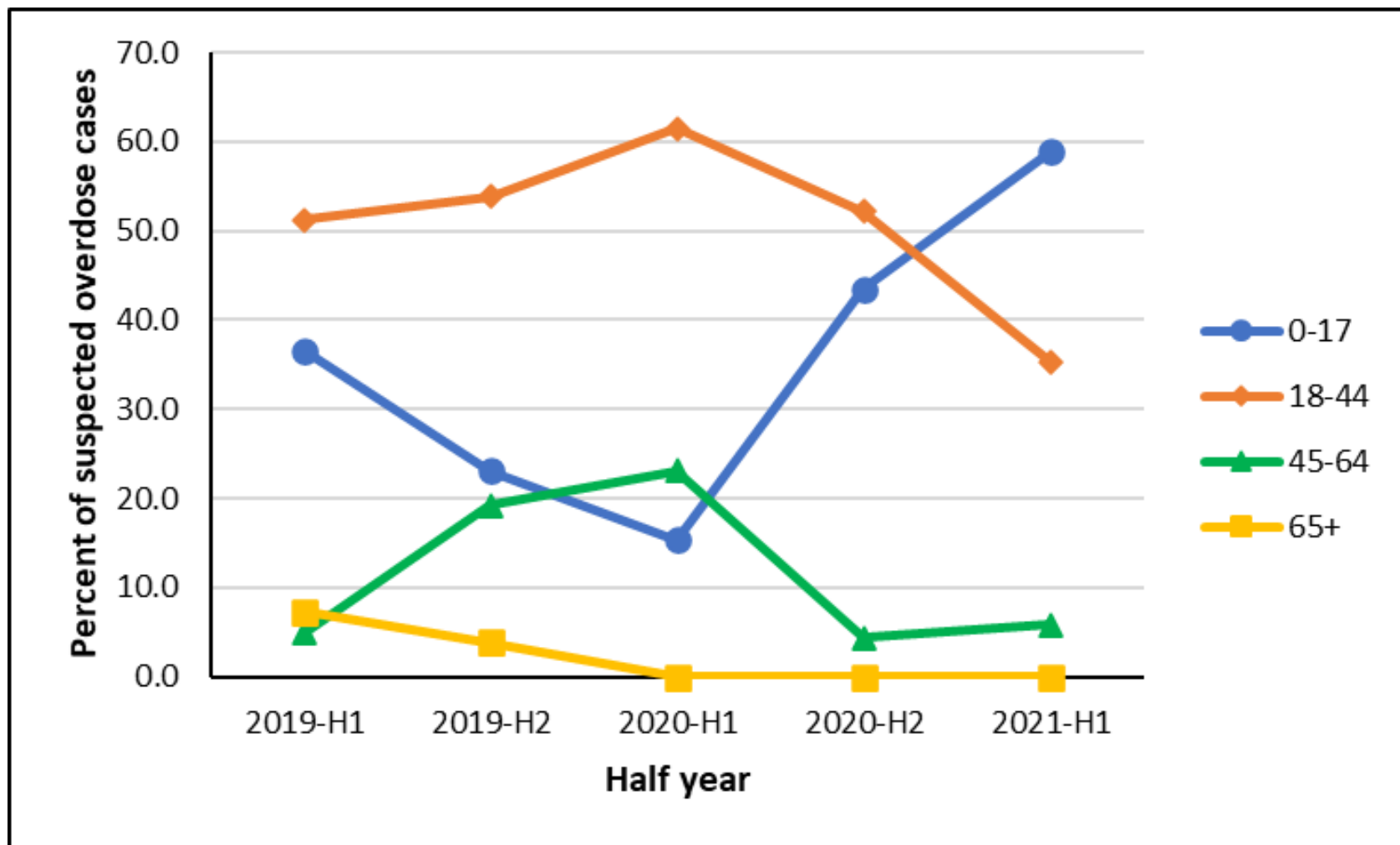
Query	Jan 2019-June 2021
Text only	2,810
ICD-10-CM	819
ICD-OR-Text	3,509
ICD-AND-Text	120

***SNOMED query did not identify any records**

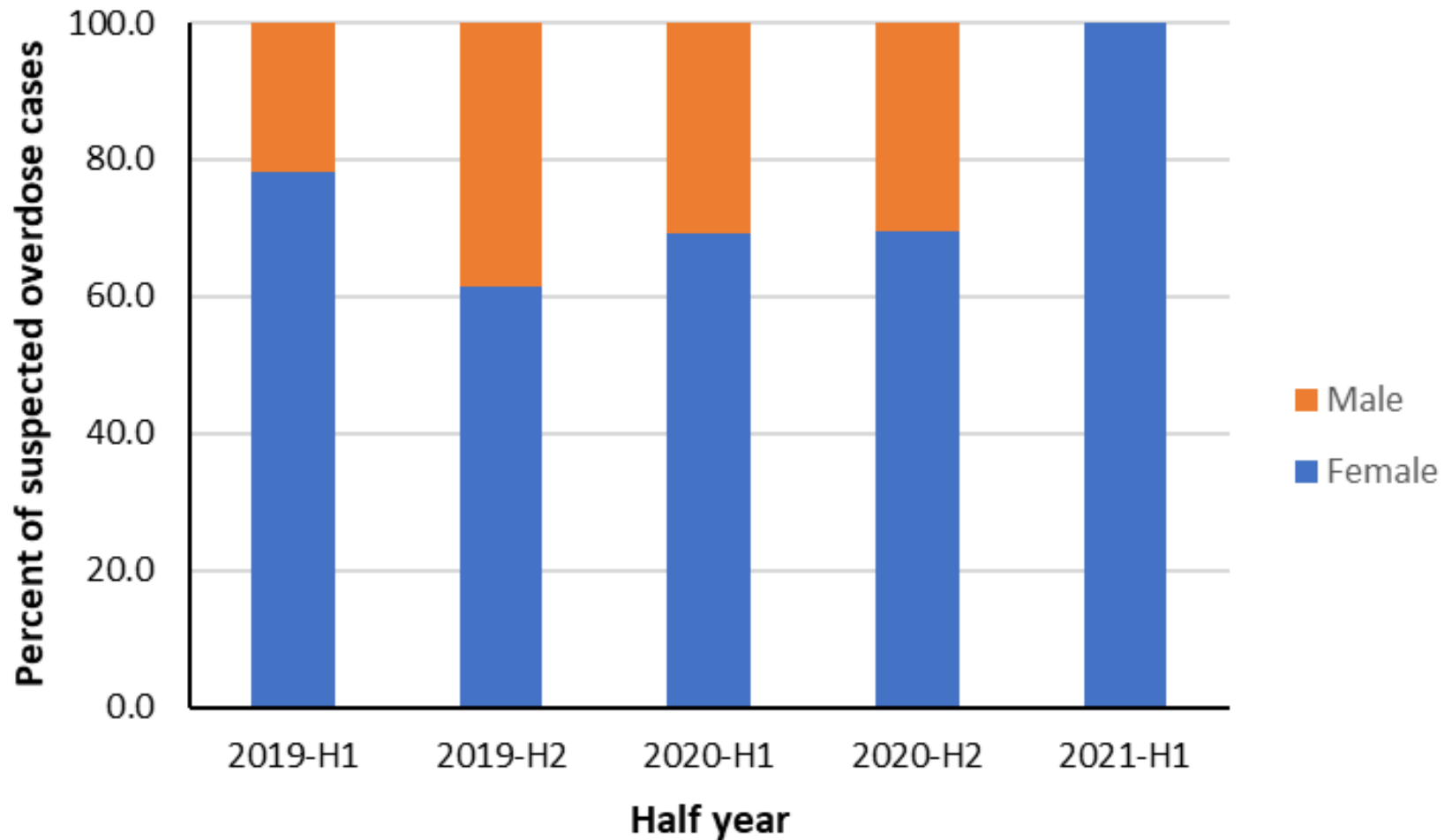
More on queries...

- For the “Text only” query there were 223 records which although they had the search text in the CC field, their DD field was blank
 - Such records (also those without correct ICD-10-CM codes) would not be picked up in the “ICD-10-CM codes-AND-Text” query
- For the “ICD-10-CM” code query, there were a number of records which although they had the right ICD-10-CM code in the DD field they did not have the search “ text in the CC field.
 - Instead, the text present were such as “feel sick”, ingestion, “eye problems’, unresponsive, etc.
 - Such records would not be picked up in the “ICD-10-CM codes-AND-Text” query.

Percent of suspected diphenhydramine overdose cases by age



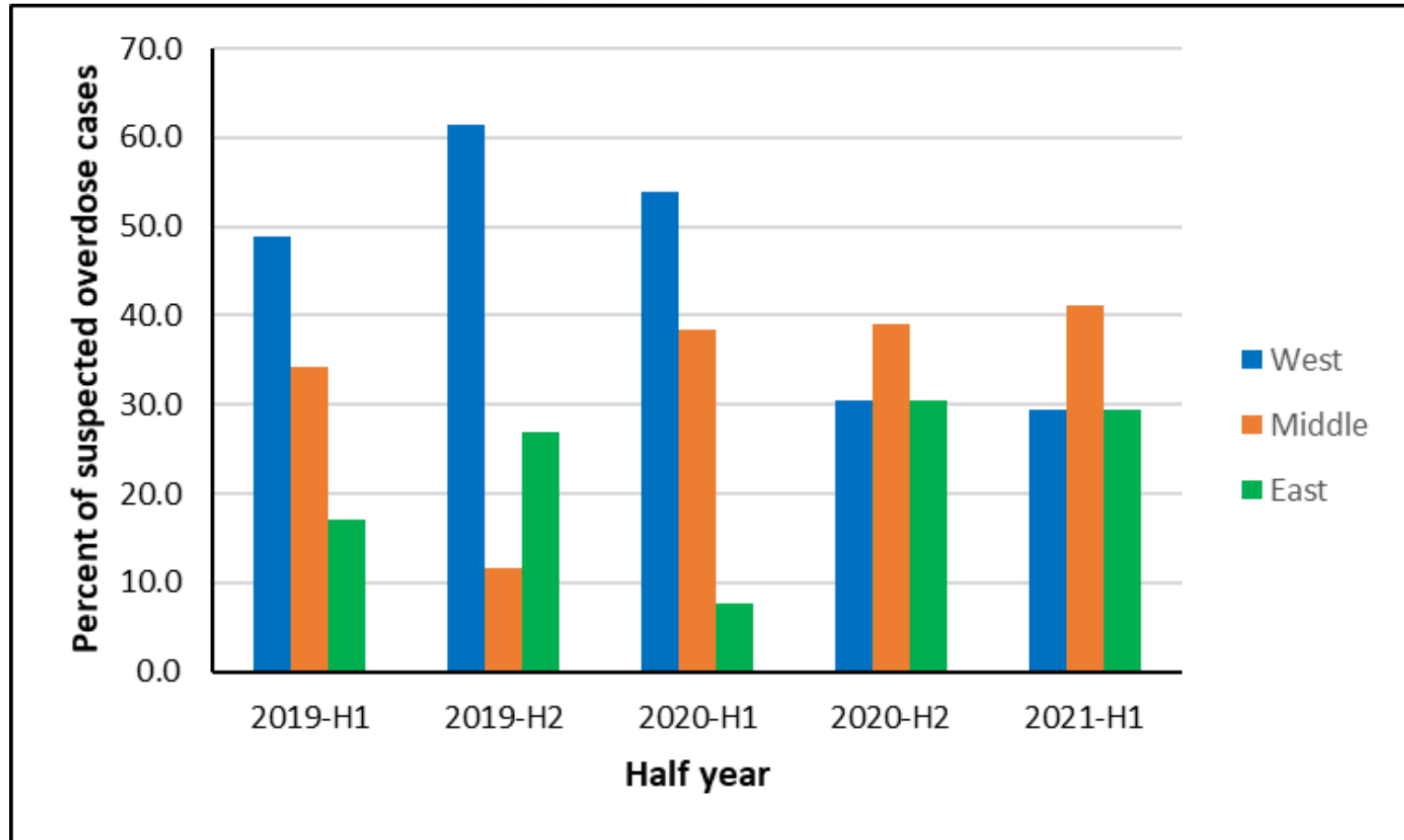
Percent of suspected diphenhydramine overdose cases by sex



Percent of suspected diphenhydramine overdose cases by Grand Divisions of TN



East Middle West



Conclusion

- The most conservative estimate of diphenhydramine overdoses was obtained when the “ICD-10-CM codes AND Text” query was used.
- The findings of this exploratory inquiry led to alerting of stakeholders about the potential of misuse of diphenhydramine in the 0-17 age group in the state of Tennessee.

References

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Questions?

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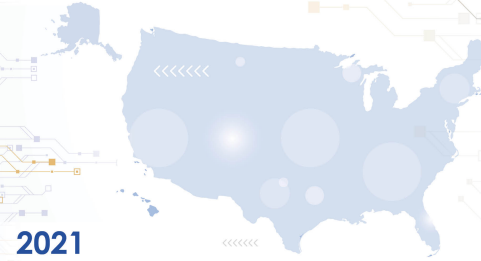
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National Syndromic Surveillance Program

Community of Practice

Resources that Advance the Science and
Practice of Syndromic Surveillance



2021

Syndromic Surveillance Symposium

Week of November 15, 2021



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