

FASTER Syndrome Refinement - Standardizing Firearm Injury Surveillance

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Moderator: Diksha Ramnani, MPH – Monterey County Health Department

Presenters:

Erica Bennion, MPH – Utah Department of Health

Meredith Davis, MPH – Virginia Department of Health

William Baker-Robinson, MS – HSR&D Center to Improve Veteran Involvement in Care, VA
Portland Health Care System

Miriam E. Van Dyke, PhD, MPH – National Center for Injury Prevention and Control, CDC



Council of State and Territorial Epidemiologists



Erica Bennion, MPH
Utah Department of Health



Validation of the CDC Firearm Injury Version 2 Definition in Utah, April-May 2020

Erica Bennion, Akanksha Acharya, Stephen Barnes, Deanna Ferrell, Sophie Lockett-Cole, Gary Mower, Jerry Nelson, Ynhi Nguyen

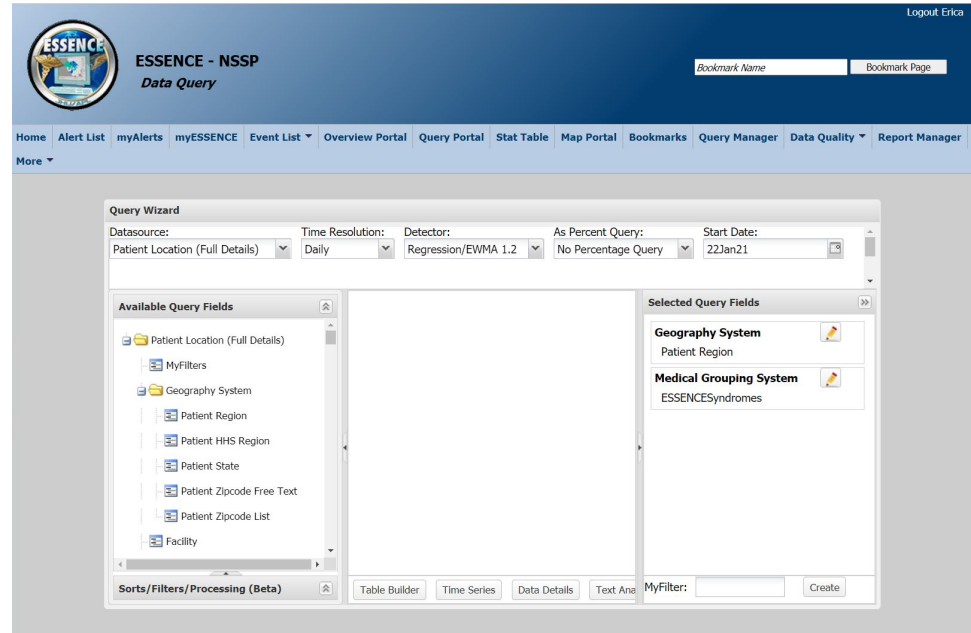
Background

ESSENCE

- Managed by NSSP
- Cloud based
- 100% of emergency departments in

Utah currently report data to

ESSENCE



The screenshot displays the ESSENCE - NSSP Data Query web application interface. The top navigation bar includes the ESSENCE logo, the title "ESSENCE - NSSP Data Query", and a "Logout Erica" link. Below the navigation bar, a menu contains links for Home, Alert List, myAlerts, myESSENCE, Event List, Overview Portal, Query Portal, Stat Table, Map Portal, Bookmarks, Query Manager, Data Quality, and Report Manager. The main content area features a "Query Wizard" window with the following settings: Datasource: Patient Location (Full Details), Time Resolution: Daily, Detector: Regression/EWMA 1.2, As Percent Query: No Percentage Query, and Start Date: 22Jan21. The "Available Query Fields" list includes Patient Location (Full Details), MyFilters, Geography System (Patient Region, Patient HHS Region, Patient State, Patient Zipcode Free Text, Patient Zipcode List), and Facility. The "Selected Query Fields" list shows Patient Region under the Geography System and ESSENCE Syndromes under the Medical Grouping System. At the bottom, there are tabs for Table Builder, Time Series, Data Details, and Text Analysis, along with a "MyFilter:" input field and a "Create" button.

Background

CDC Firearm Injury Version 2

- Intended to capture initial visits for a firearm injury of the all intents
- Definition includes relevant discharge diagnosis and SNOMED codes, and some chief complaint keywords (both for matching and negation)
- Quarterly validation of this query sent to CDC as part of FASTER grant

Methods

Query

- April - May 2020
- 47 of Utah's 49 ED facilities reported during this period
- Duplicate medical record numbers for gunshot wound within a 3-day window were removed

Methods

Manual Review

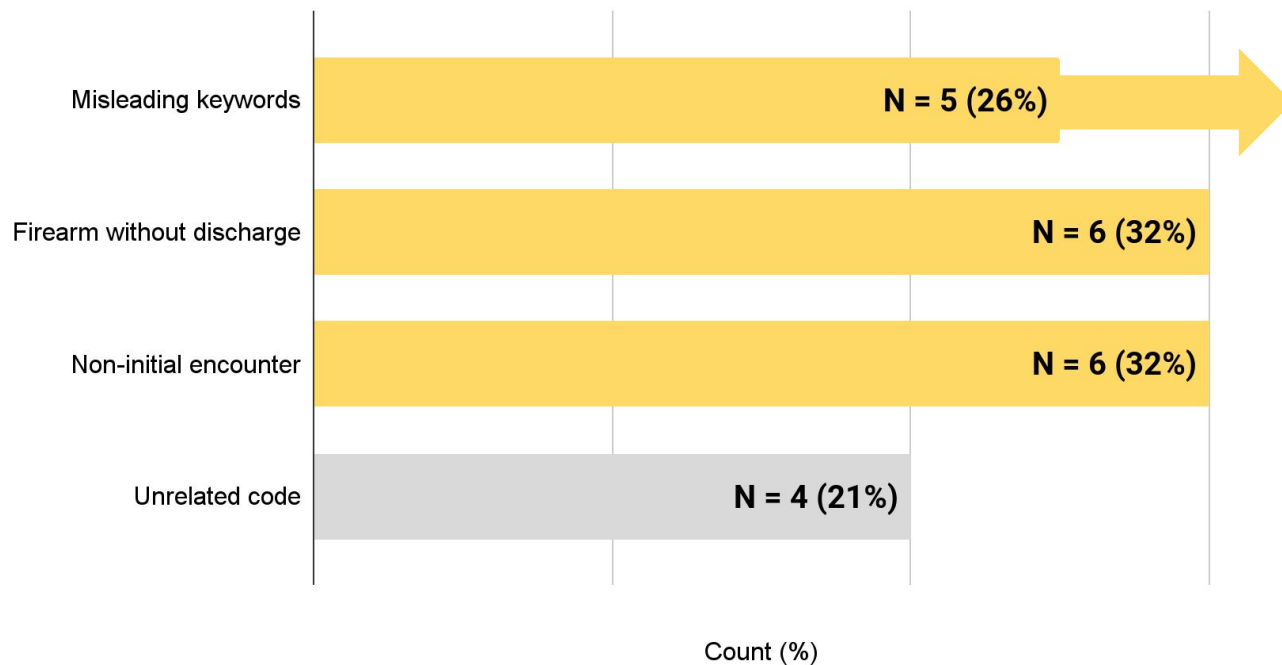
- A team of eight participated in the review:
 - Two reviewers per record
 - Conflicts sent to two arbiters
 - One unresolved conflict was determined by the group
- Medical record fields used in the review:
 - Medical record number, date, all chief complaint fields, all discharge diagnosis fields, clinical impression, triage notes, and admit reason
- Possible determinations:
 - Probable, ruled out, or undetermined
 - Only probable were considered true positives

Results

- Query captured 85 unique records
- 67 probable, 19 ruled out, 2 undetermined
- Positive predictive value = 75.3%

Results

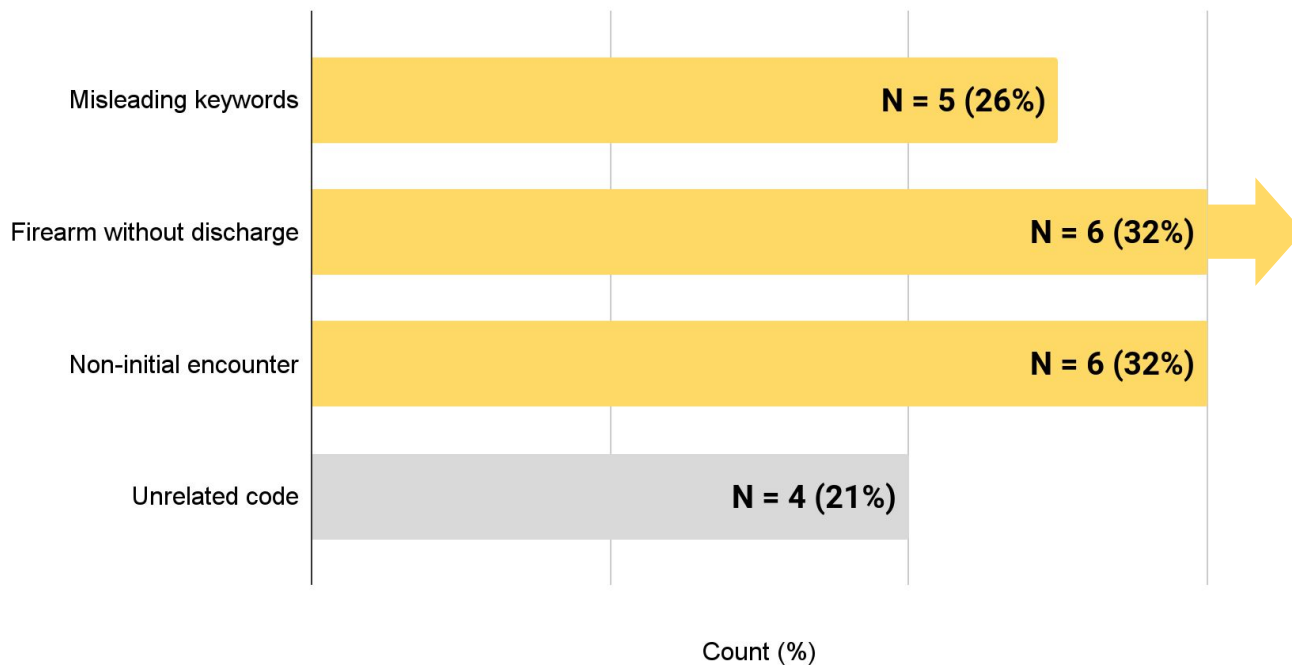
Reasons for false negatives (N= 19)



- Pellet gun
- Airgun
- Nail gun
- Bullet bike
- Exit wound (referring to compound fracture)

Results

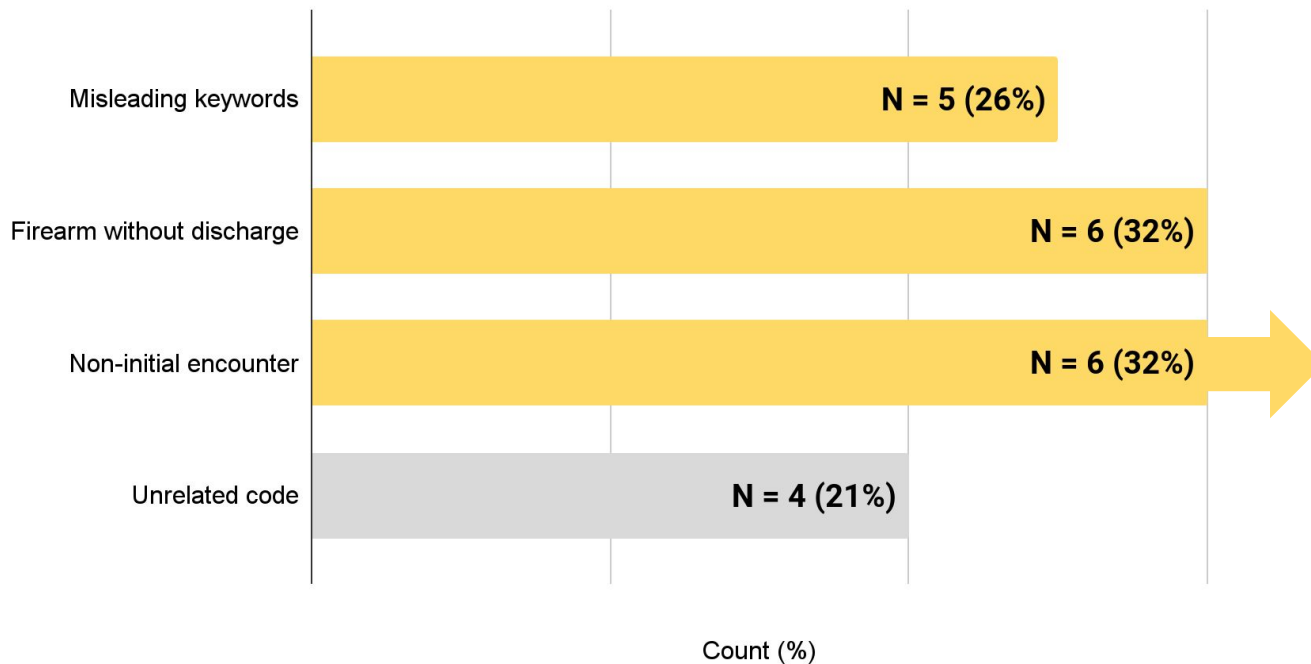
Reasons for false negatives (N= 19)



- **Carrying a firearm drunk**
- Attempted to take husband's firearm **earlier that day**
- **Trigger caught thumb**
- Hand injury while target shooting
- Cap gun **cartridge exploded**
- Cutting open **live round** when it **exploded**

Results

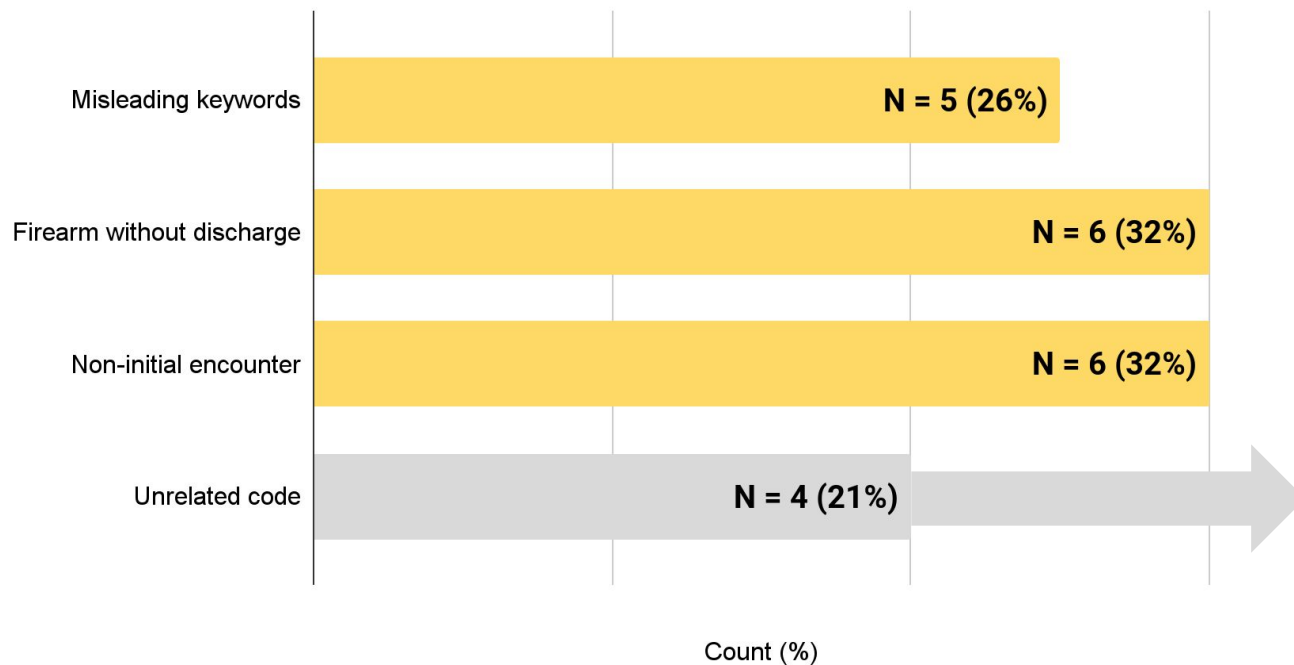
Reasons for false negatives (N= 19)



- Gunshot wound **about a month ago**
- Shot in chest **last month**
- **2 weeks ago** came for bullet removal
- Had open heart surgery after gunshot wound
- Had wound from gun that needed to be **checked** and **redressed**
- Numbness from gunshot wound began recently
- Z51.89 - Encounter for other specified aftercare

Results

Reasons for false negatives (N= 19)



- E955.9
- X95.9
- W34.00
- W33.01

Conclusions & Recommendations

- Consider potential loss of sensitivity with all additional negations
- Negations for misleading keywords
 - “Pellet gun”, “airgun”, “nail gun”, “bullet bike”
 - “Exit wound” without mention of firearm
- Negations for firearm without discharge
 - “Carrying a firearm” without mention of discharge
 - Mention of firearm in past (e.g. attempted to take firearm *earlier that day*)

Conclusions & Recommendations

- Negations for non-initial encounters
 - “Last month”, “a month ago”, “weeks ago”
 - “Redressed” in reference to wound
 - Z51.89 - Encounter for other specified aftercare
- UDOH to communicate with facilities about unrelated codes

Acknowledgements

Thank you to my colleagues Akanksha Acharya, Stephen Barnes, Wei Beadles, Rachelle Boulton, Deanna Ferrell, Randon Gruninger, Sophie Luckett-Cole, Gary Mower, Jerry Nelson, and Ynhi Nguyen for helping me understand ESSENCE and conduct this manual review.



Meredith Davis, MPH
Virginia Department of Health





VALIDATION OF SYNDROMIC SURVEILLANCE FIREARM INJURY DEFINITIONS USING A HOSPITAL TRAUMA REGISTRY

Meredith Davis, MPH

Division of Surveillance and Investigation

November 17, 2021

BACKGROUND

- Virginia Department of Health (VDH) funded by CDC Firearm Injury Surveillance Through Emergency Rooms (FASTER) project
- CDC developed four syndromic surveillance definitions for firearm injury (FAI)
 - Overall FAI v2 and Assault, Intentional, and Unintentional FAI
- Goal: To evaluate CDC FAI definitions using a hospital trauma registry
- Partnered with a Level 1 Trauma Center (Hospital A) to perform evaluation

HOSPITAL A TRAUMA REGISTRY

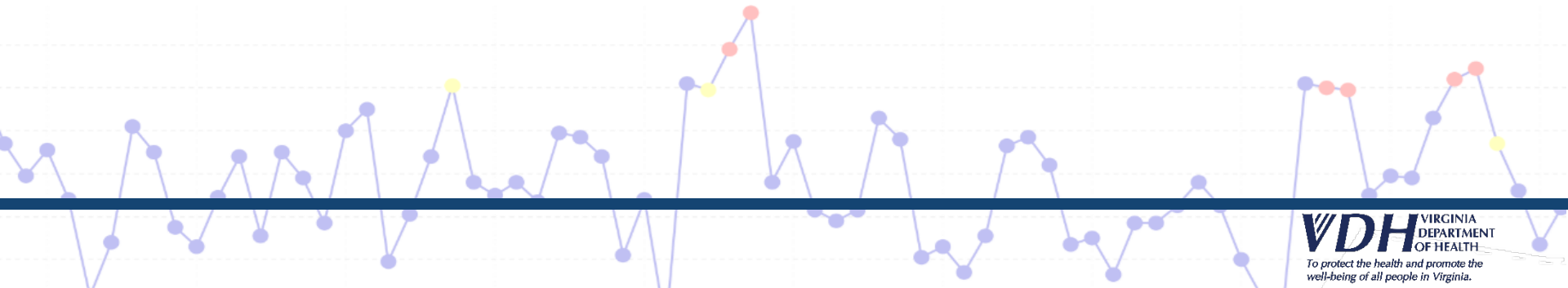
- Separate database from hospital electronic medical record (EMR) system
 - Data collected in registry not shared back to EMR
- Population captured by registry
 1. Inpatient admissions from ED trauma bay
 2. Patients transferred to Hospital A then discharged from ED
 3. Any ED visit with trauma protocol activation
- Includes mechanism of injury; all firearm injuries categorized as “gunshot wound” (GSW)

TRAUMA REGISTRY INTENT OF INJURY

- Determined by registrar after review of ED notes and EMS notes
- Entered manually as an ICD-10 code to describe external cause of injury (e-code)
 - Not a billable code
- Intent assigned by registry is not populated in the patient's EMR - unique to trauma registry

METHODS: DATA SOURCES

- Virginia ESSENCE
 - ED visit to Hospital A between June 1 – November 30, 2020
 - Met at least one firearm injury definition:
 - CDC Firearm Injury v2
 - CDC Assault Firearm Injury v1
 - CDC Intentional Firearm Injury v1
 - CDC Unintentional Firearm Injury v1
- Hospital A Trauma Registry
 - Mechanism of injury = GSW (gunshot wound)



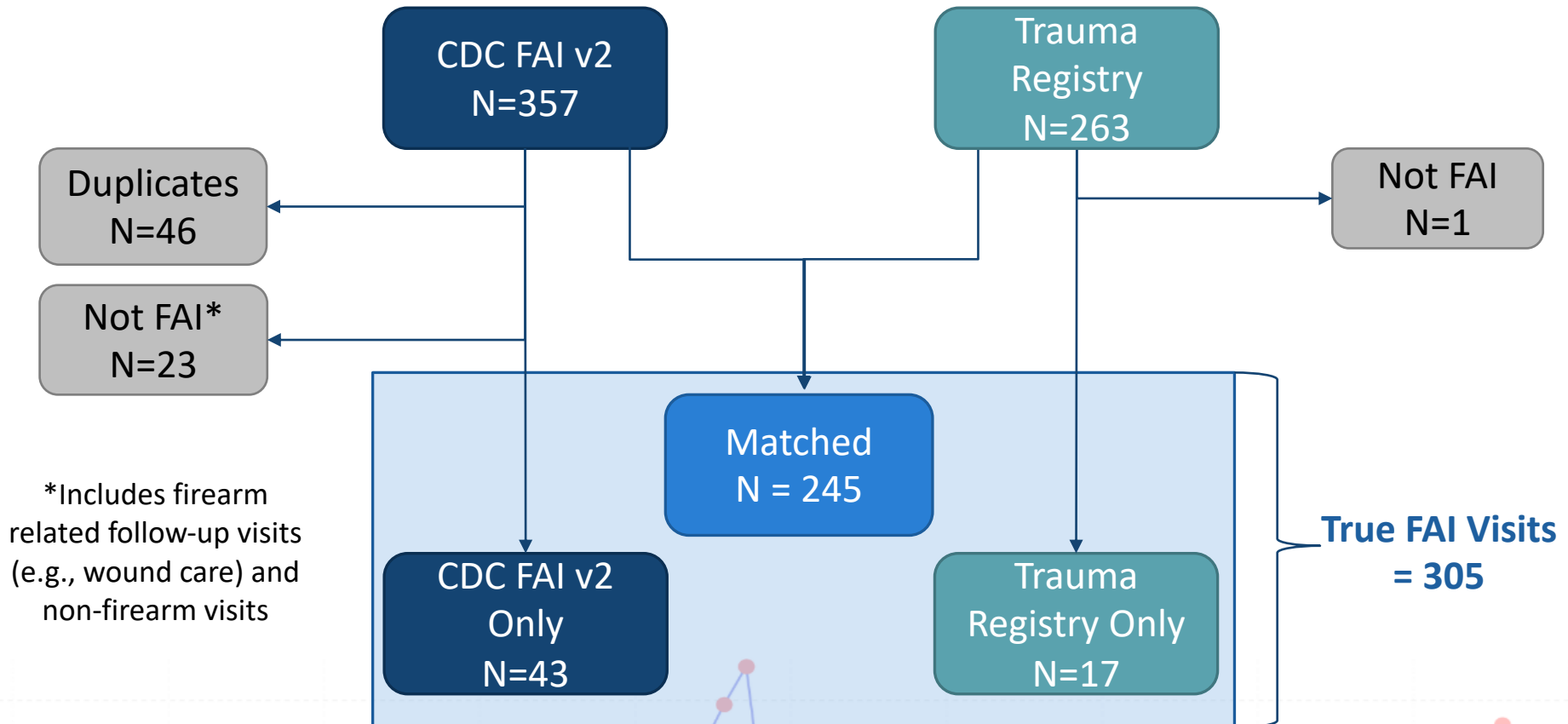
RECORD MATCHING PROCESS

- ESSENCE and Trauma Registry data matched using medical record number (MRN) and visit date
- For records with same visit date but not MRN, Hospital A conducted manual match
 - Reviewed hospital EMR system for all past MRNs used for the patient
 - Verified match with date of birth or age

ANALYSIS

- Classified each record (matched and unmatched) as:
 - True firearm injury
 - Not a firearm injury (including firearm related follow-up visits)
 - Duplicate
- Calculated positive predictive value and sensitivity of CDC FAI v2 definition
- Further characterized records found in only one data system (ESSENCE or Trauma Registry)
- Among matched records explored differences between CDC intent-based definitions and Trauma Registry intent code

OVERALL RESULTS



CDC OVERALL FIREARM INJURY v2

DEFINITION PERFORMANCE

Sensitivity	94.4% (288 / 305)	➔ 17 false negatives
Positive Predictive Value (PPV)	80.7% (288 / 357)	➔ 69 false positives

FALSE NEGATIVES (N=17)

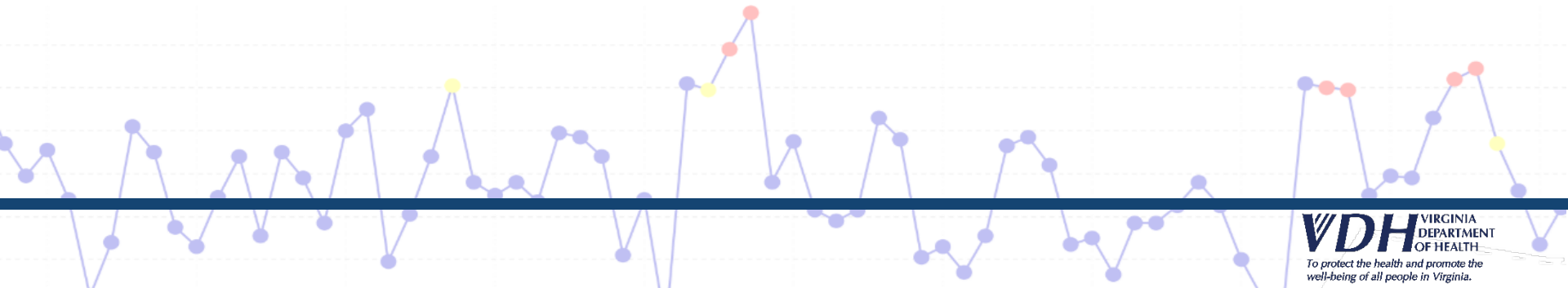
- 17 true firearm injury visits found only in Trauma Registry, not pulled by CDC FAI v2 in Virginia ESSENCE
- Zero had firearm injury diagnosis code in ESSENCE

Reason Not in ESSENCE	Number (%) of Visits
Chief complaint (CC) not parsed*	10 (59)
CC not FAI related	4 (24)
CC contained exclusion term	3 (18)
Total	17

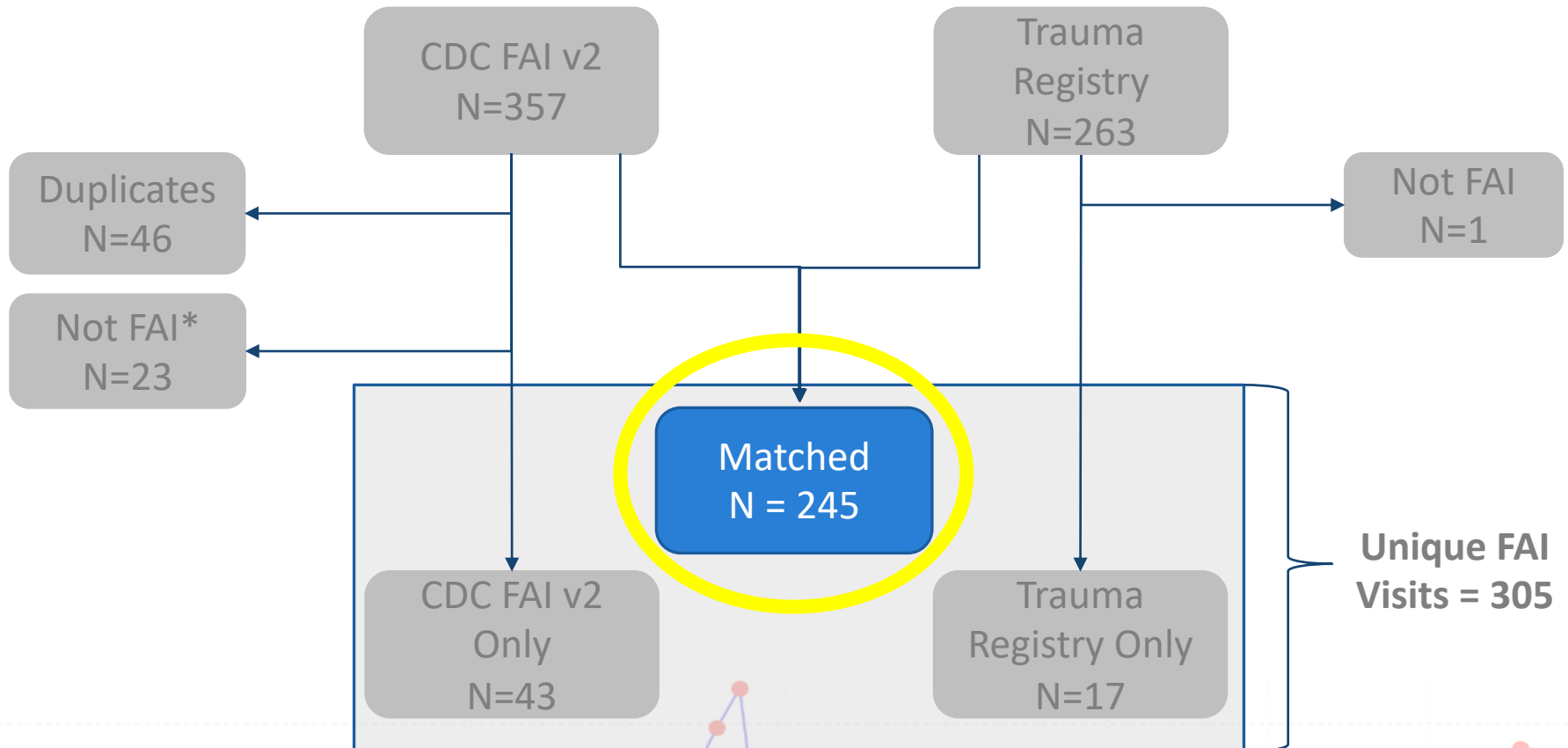
*Terms included GSWs, GWS

FALSE POSITIVES (N=69)

- Duplicate records (n=46)
 - Same visit date/time but different MRN
 - Likely resulted from MRN and DOB assigned when patient arrived in trauma
- Follow-up firearm injury records (n=18)
 - 12 (67%) incorrectly coded as initial visits
 - 4 included term “s/p” or “status post” indicating past injury
- Not firearm injury (n=5)

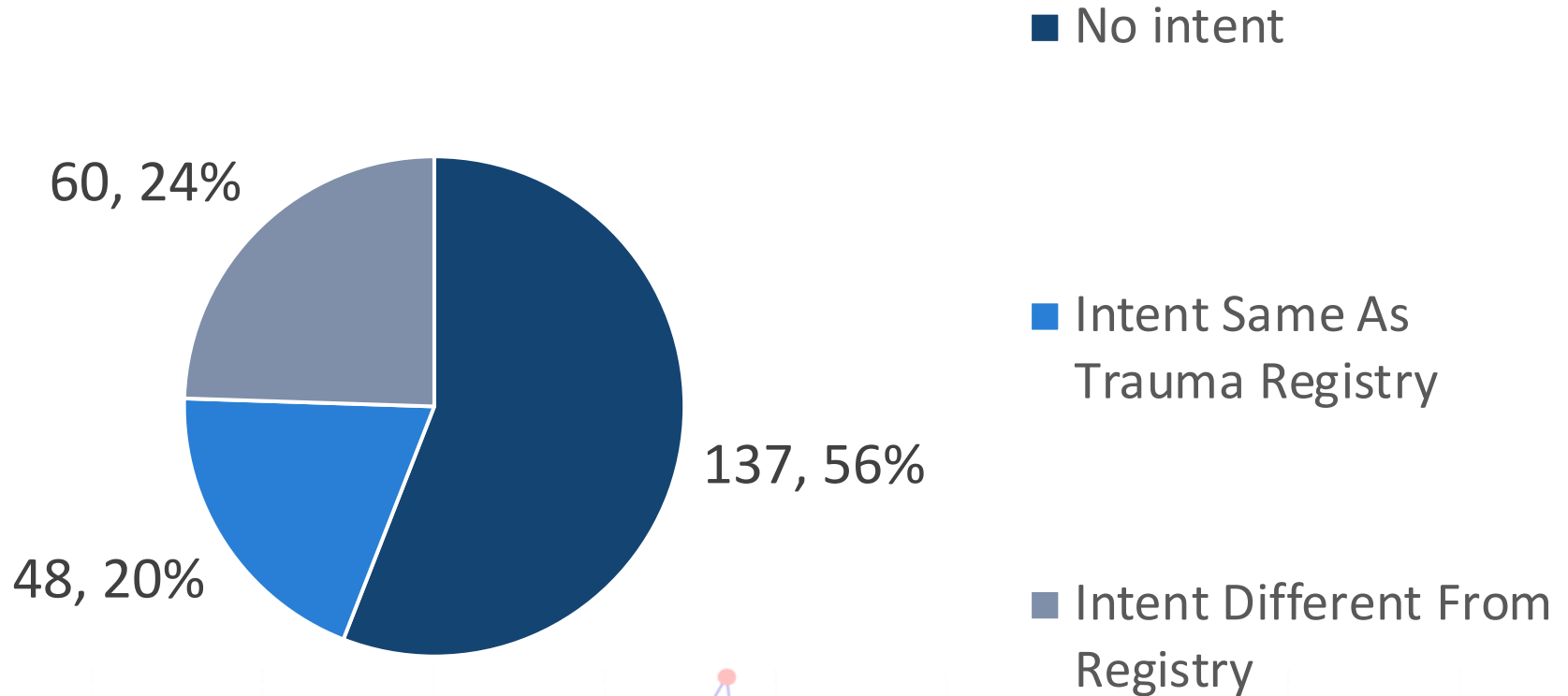


MATCHED RESULTS



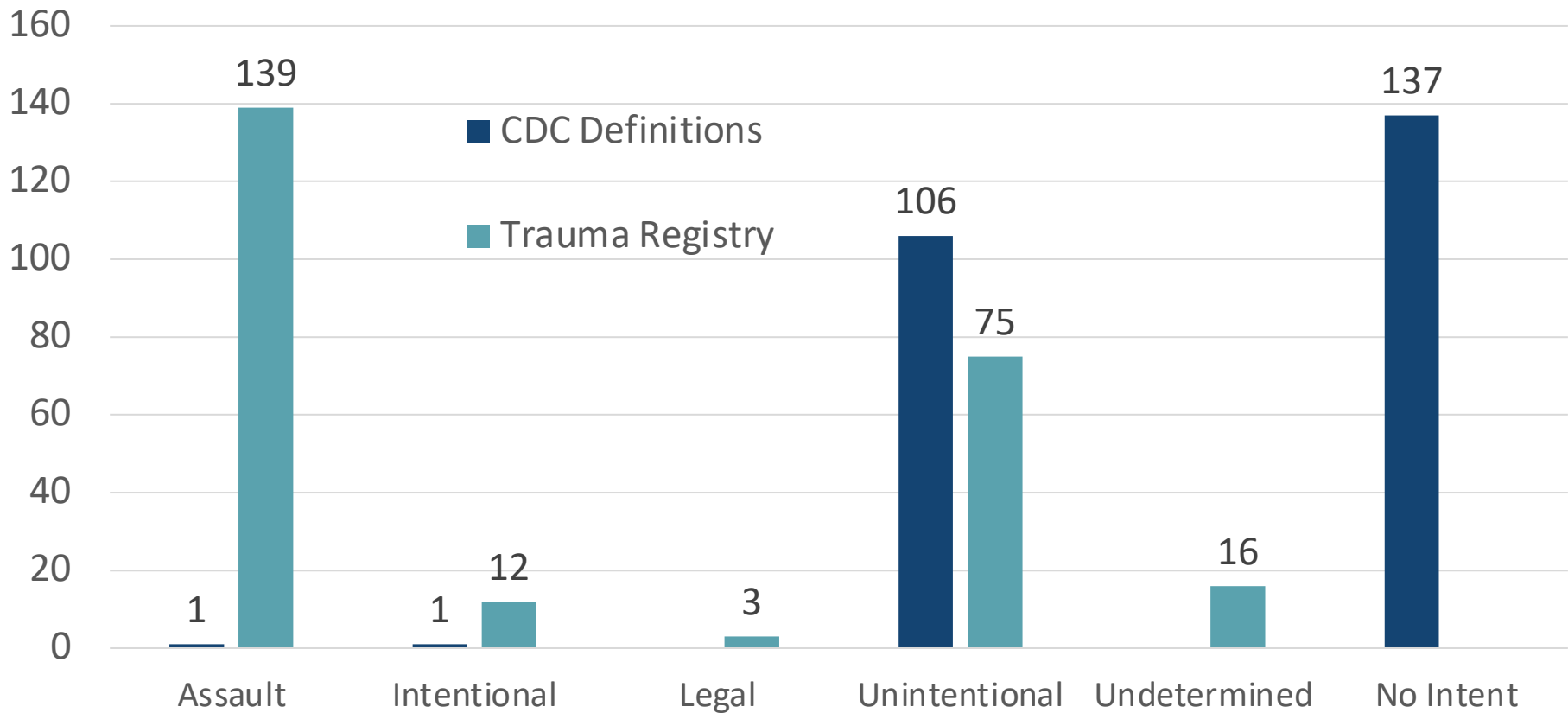
INTENT OF INJURY FROM CDC DEFINITIONS

Matched Visits (N=245)



INTENT OF INJURY BY DATA SOURCE

Matched Visits (N=245)

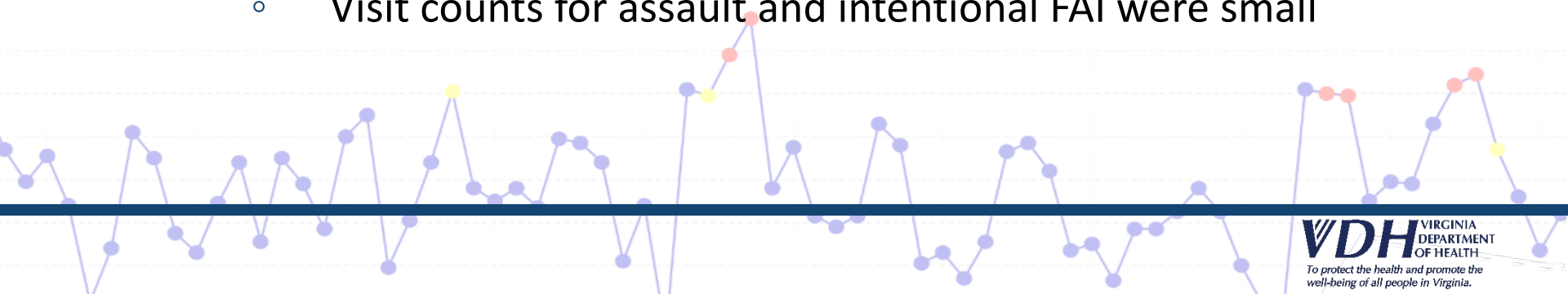


CDC FAI DEFINITION PERFORMANCE

- Overall FAI v2 performed well (sensitivity=94%, PPV= 80%)
- Intent-based definitions may misrepresent actual burden
 - Caveat: 90 of 288 true FAI visits (31%) had ≥ 1 diagnosis code cut off due to DD field length limit in Virginia ESSENCE
 - Unintentional FAI v1 overestimated burden compared to Trauma Registry
 - Assault FAI v1 and Intentional FAI v1 underestimated burden compared to Trauma Registry

LIMITATIONS

- Validation against one hospital trauma registry may not be generalizable
- Virginia ESSENCE differs from NSSP in some aspects (e.g., field size of DD)
- Analysis included only 6 months of data
 - Visit counts for assault and intentional FAI were small



NEXT STEPS

- ✓ Provided suggestions to CDC for firearm definitions
 - Separate Undetermined from Unintentional intent
 - Add other GSW related terms: “GSWs” and “GWS”
 - Consider negation term “s/p” or “status post”
- ✓ Expanded discharge diagnosis field length
- ❑ Conduct repeat evaluation in Spring 2022
- ❑ Explore methods for identifying duplicates in Virginia ESSENCE

ACKNOWLEDGEMENTS

- Hospital A Partners
- Erin Austin, MPH
- Stephanie Neal, MPH

Questions?

Meredith Davis, MPH
Enhanced Surveillance Epidemiologist
Virginia Department of Health
Meredith.davis@vdh.virginia.gov

syndromic@vdh.virginia.gov



William Baker-Robinson, MS

HSR&D Center to Improve Veteran Involvement in
Care, VA Portland Health Care System



Validation of CDC Firearm Injury Syndrome Definitions Using Triage Notes in Oregon ESSENCE Data

Date: November 17, 2021 Presented By: Will Baker-Robinson



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Co-Authors

- » Kathleen Carlson MS, PhD
 - OHSU Contract PI
 - Associate Professor, Epidemiology
 - Core Investigator, HSR&D Center to Improve Veteran Involvement in Care
- » Susan DeFrancesco JD, MPH
 - Senior Research Associate
 - Project Coordinator
- » Yachana Bhakta MPH
 - Research Associate
- » Danielle Krushnic MPH
 - Research Associate
- » Lauren Maxim PhD
 - Senior Research Associate



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Oregon Health Authority Project Team

- » Laura Chisholm PhD, MPH, MCHES
 - Injury and Violence Prevention Section Manager
 - Oregon FASTER PI
- » Dagan Wright MSPH, PhD
 - Senior Injury Epidemiologist
- » Amanda Couch EMT, MDI
 - Operations Coordinator and Program Support Specialist
- » Yasuhiro Tanaka
 - Injury Surveillance Analyst



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Grant Funding

CDC/NCIPC: NU17CE010029 (PI: Laura Chisholm) Oregon Firearm Injury Surveillance through Emergency Rooms (FASTER)



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Quick FASTER Overview

- » The goal of the FASTER project is to detect firearm injuries in ESSENCE and disseminate information to community partners on a timely basis
- » There are 4 CDC firearm injury syndrome definitions:
 - (1) Overall
 - By Injury Intent: (2) Unintentional, (3) Intentional, and (4) Assault
 - Records detected by the overall syndrome definition but not Unintentional, Intentional, or Assault have *undetermined* intent
- » Each firearm injury syndrome uses discharge diagnosis and chief complaint data
- » If a record has a firearm injury discharge diagnosis, the chief complaint information is not examined

Presentation Data

- » OR ESSENCE Records Detected by the CDC Overall Firearm Injury Syndrome Definition
- » April 1, 2017 to March 31, 2021
- » 2,386 Records
- » A note on data fields and terminology:
 - Chief complaint = ChiefComplaintParsed
 - Triage notes = TriageNotesOrig
 - Discharge diagnosis = DischargeDiagnosis

Intent is Mostly Detected by Discharge Diagnosis

CDC Firearm Syndrome Definition	N (%) Detected by Discharge Diagnosis	N (%) Detected by Chief Complaint	N (%) Total
Unintentional	1770 (74.2%)	3 (0.1%)	1773 (74.3%)
Intentional	32 (1.3%)	2 (0.1%)	34 (1.4%)
Assault	66 (2.8%)	1 (0.0%)	67 (2.8%)
Undetermined	2 (0.1%)	495 (20.8%)	497 (20.8%)
More than one intent Syndrome Definition	14 (0.6%)	1 (0.0%)	15 (0.6%)
Total	1884 (79.0%)	502 (21.0%)	2386 (100.0%)

Comparing Triage Notes and Chief Complaint

Triage Notes

- » 653 (27.4%) Missing
- » 48 Facilities Report Triage Notes
- » 13 Facilities Don't Report Triage Notes
- » 277 (11.6%) Missing from Facilities which don't report triage notes
- » Median # of Words: 93
- » Max # Words: 1380
- » Interquartile Range: 226.5

Chief Complaint

- » 57 (2.4%) Missing
- » 61 Facilities Report Chief Complaint
- » 0 Facilities Don't Report Chief Complaint
- » Median # of Words: 3
- » Max # Words: 35
- » Interquartile Range: 2

Methods

- » Two researchers manually reviewed each record
- » Each made two classifications using chief complaint, triage notes, and in some circumstances clinical impression
- » Did a firearm injury occur?
 - No, Potentially (not enough information)
- » What is the firearm injury intent?
 - Unintentional, Intentional, Assault, and Undetermined
- » Discordance in classification was resolved through group consensus

Overall Syndrome Definition Performance

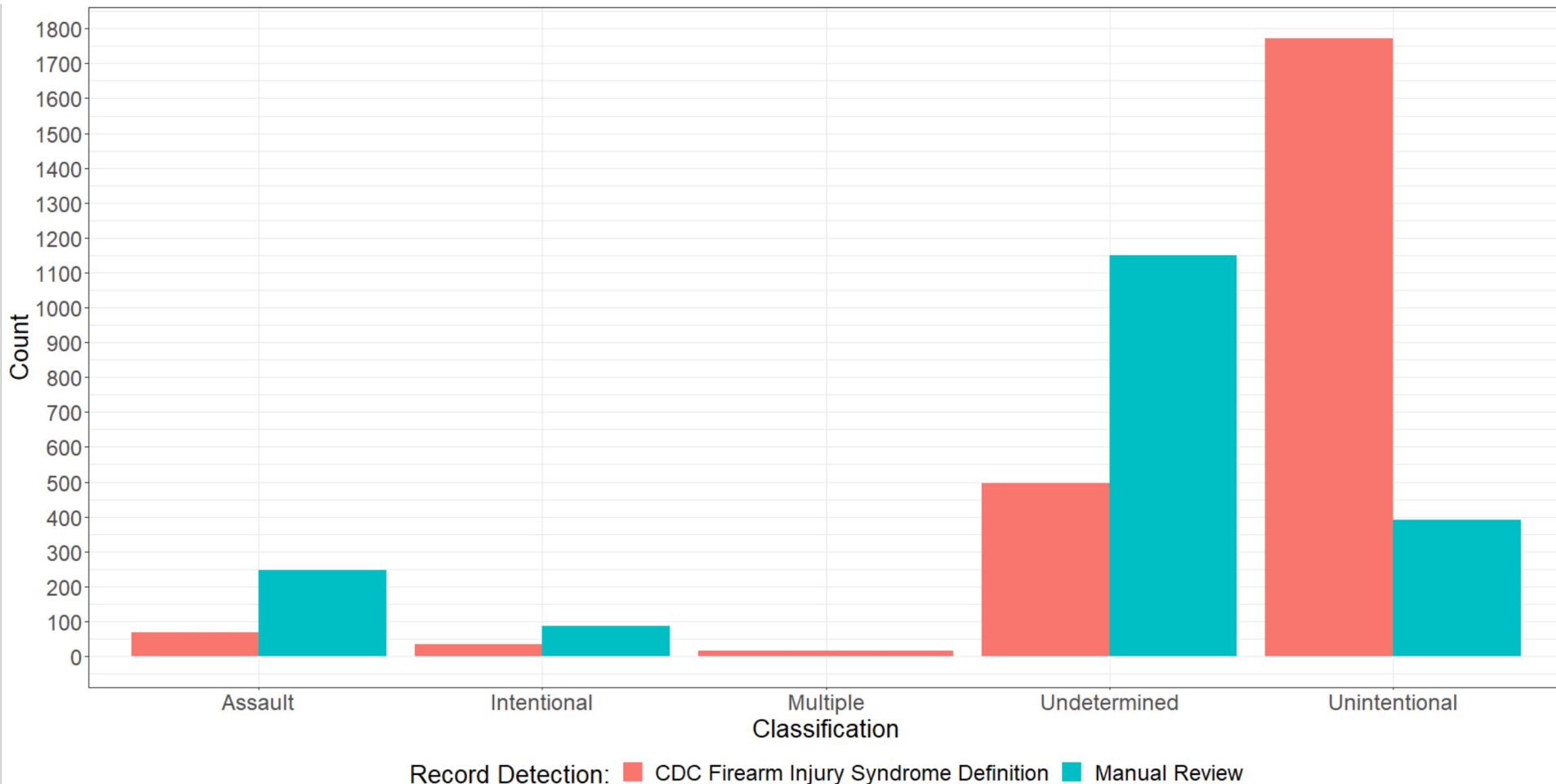
- » Unable to classify 230 cases using Triage Notes, Chief Complaint, and Clinical Impression

Manual Classification Overall Firearm Injury			
CDC Overall Firearm Injury V2	True	False	Total
True	1,876	280	2,156

- » Positive predictive value: 87.0%
- » We didn't examine records not detected by the syndrome definition
- » 205 (73.2%) of false positives were detected by ICD-10 codes for firearm injury

Comparing Manual Review and CDC Firearm Injury Syndrome Definitions

False positives (n = 280) and unclassifiable records (n = 230) not displayed.



Unintentional Firearm Injury

	Manual Classification Unintentional Firearm Injury		
CDC Unintentional Firearm Injury v1	True	False	Total
True	356	1,227	1,583
False	36	537	573
Total	392	1,764	2,156

CDC Unintentional Firearm Injury V1 Operating Characteristics	
PPV	29.0 %
Sensitivity	90.8%
Specificity	30.4%

1,227 (100%) of false positives were detected by the ICD-10 codes for Unintentional firearm injury

Intentional Syndrome Performance

	Manual Classification Intentional Firearm Injury		
CDC Intentional Firearm Injury v1	True	False	Total
True	2	31	33
False	85	2,038	2,123
Total	87	2,069	2,156

CDC Intentional Firearm Injury V1 Operating Characteristics	
PPV	6.1%
Sensitivity	2.3%
Specificity	98.5%

29 (93.5%) of false positives were detect by ICD-10 codes for Intentional firearm injury

Assault Syndrome Definition Performance

	Manual Classification Assault Firearm Injury		
CDC Assault Firearm Injury v1	True	False	Total
True	8	54	62
False	241	1,853	2,094
Total	248	1,908	2,156

CDC Assault Firearm Injury V1 Operating Characteristics	
PPV	12.9%
Sensitivity	3.2%
Specificity	97.1%

54 (100%) of false positives were detect by ICD-10 codes for Assault firearm injury

A Suggestion for Improving Overall Syndrome Definition

- » CC = Chief Complaint; DD = Discharge Diagnosis
- » New logic:
 - (DD == FAI **OR** CC == FAI) **AND** CC/DD != Exclusion criteria
 - Subtle change but now exclusion criteria applied to both CC and DD
- » Original PPV: 87.0%

Metric	Syndrome definition with updated logic	With air and pellet gun exclusion criteria also added
PPV	89.4%	90.1%
False Positive Reduction	59	77
False Negative	3	9

- » ICD-10 Codes W34.010, X95.01, X74.01, and Y24.0 are external cause codes for air and pellet gun injury (common false positives)

Conclusion

- » The CDC Firearm Injury Syndrome definitions mostly detect records using discharge diagnosis information
- » Triage Notes can be used to provide rich narrative information but have some limitations due to missingness and differences in the kinds of notes reported
- » The overall syndrome definition performs well
- » For the intent based syndromes, discharge diagnosis and chief complaint alone are insufficient for the determination of intent
 - This is due to accuracy issues in discharge diagnosis coding and limited intent information in chief complaint
- » Adding air gun exclusion criteria and reworking the logic of the syndrome definition will substantially reduce false positives
- » More work needs to be done to quantify the number of false negatives

Questions?

Will Baker-Robinson

bakerrob@ohsu.edu



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Thank you!

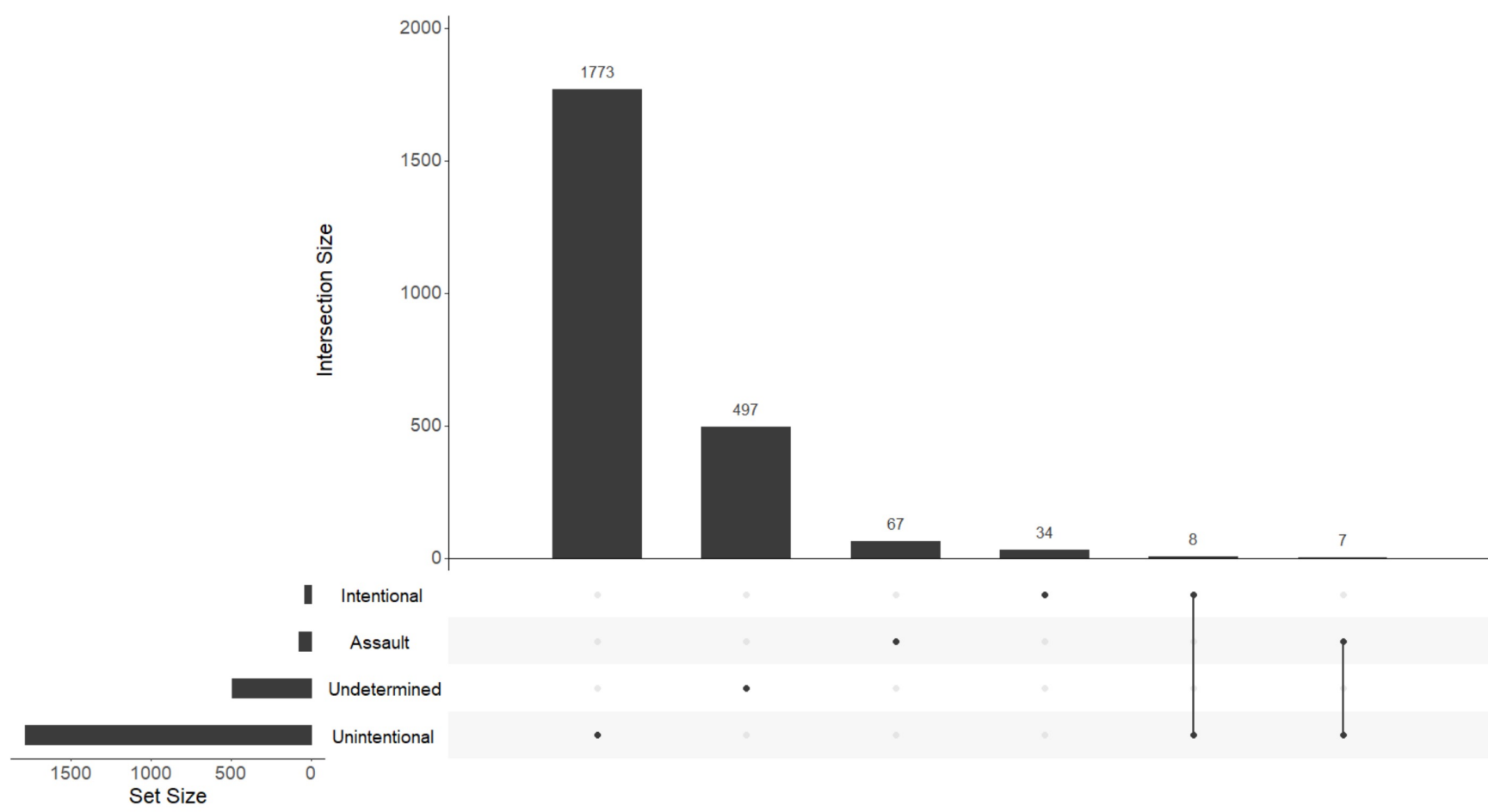


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Chief Complaint in the syndrome definition vs. Chief Complaint alone

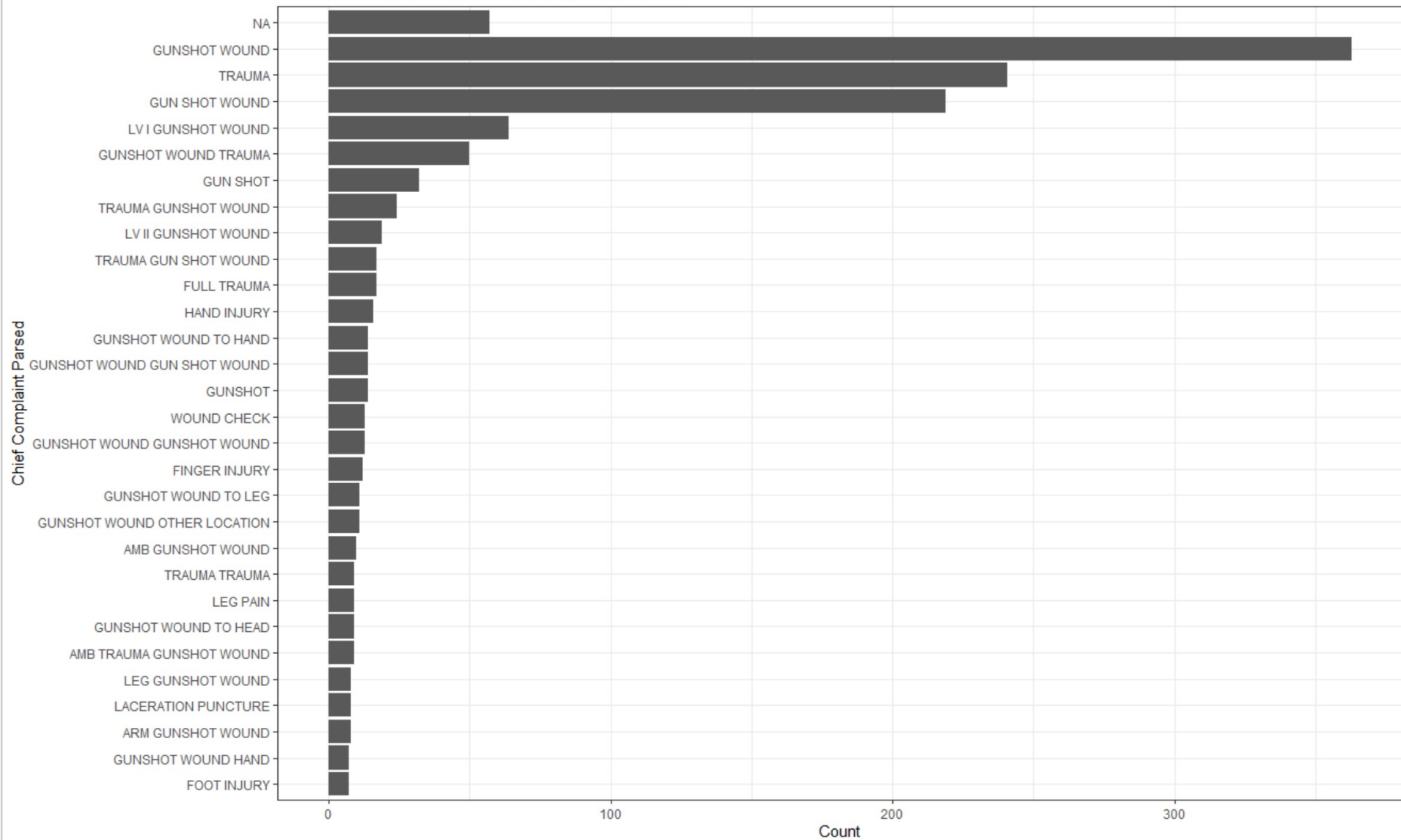
CDC Firearm Syndrome Definition	N Detected by Chief Complaint in Syndrome Definition	N Detected by Chief Complaint when not first considering Discharge Diagnosis
Unintentional	3	5
Intentional	2	2
Assault	1	1
Undetermined	495	496
More than one intent Syndrome Definition	1	1

Visualization of Injury Intent as categorized by CDC Firearm Syndrome Definitions



Top 30 Chief Complaints

OR ESSENCE Firearm Injury Data April 2017 to March 2021





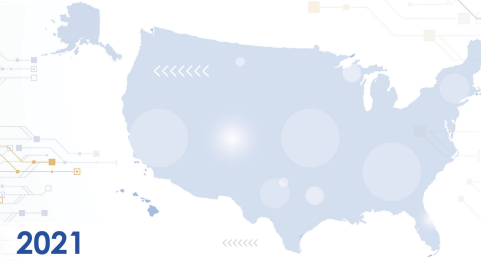
Miriam E. Van Dyke, PhD, MPH
Centers for Disease Control and
Prevention



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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