

FASTER Syndrome Refinement - Standardizing Firearm Injury Surveillance

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

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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

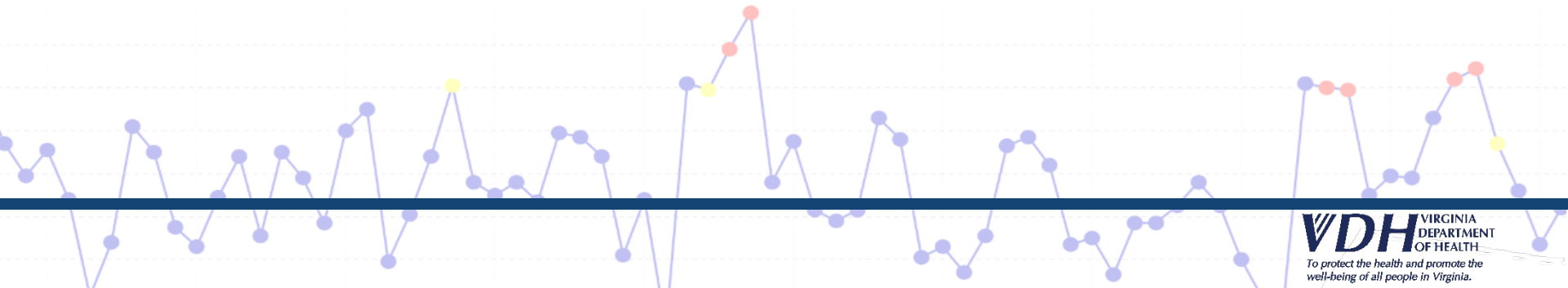
- Separate database from hospital electronic medical record (EMR) system
 - Data collected in registry not shared back to EMR
- Population captured by registry
 1. Inpatient admissions from ED trauma bay
 2. Patients transferred to Hospital A then discharged from ED
 3. Any ED visit with trauma protocol 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)



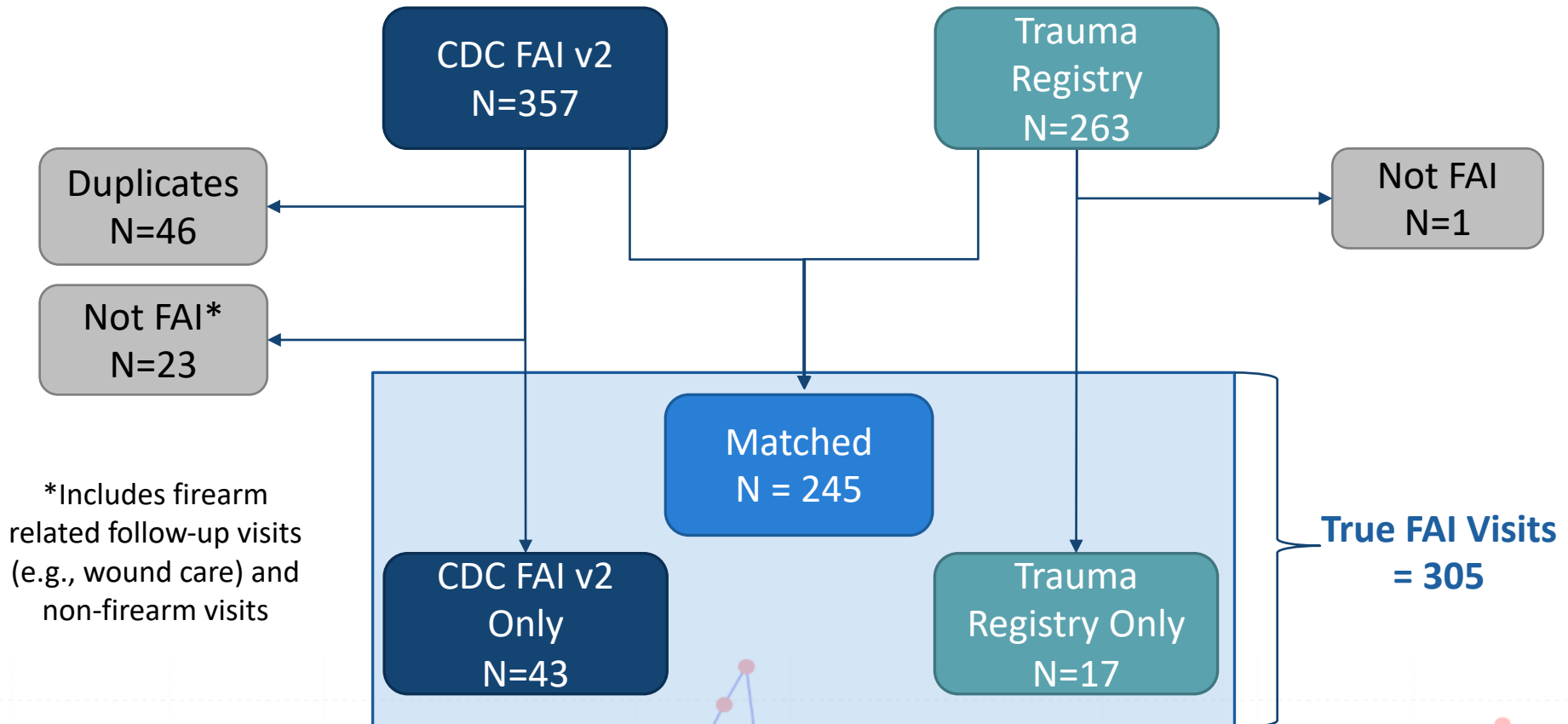
RECORD MATCHING PROCESS

- 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)

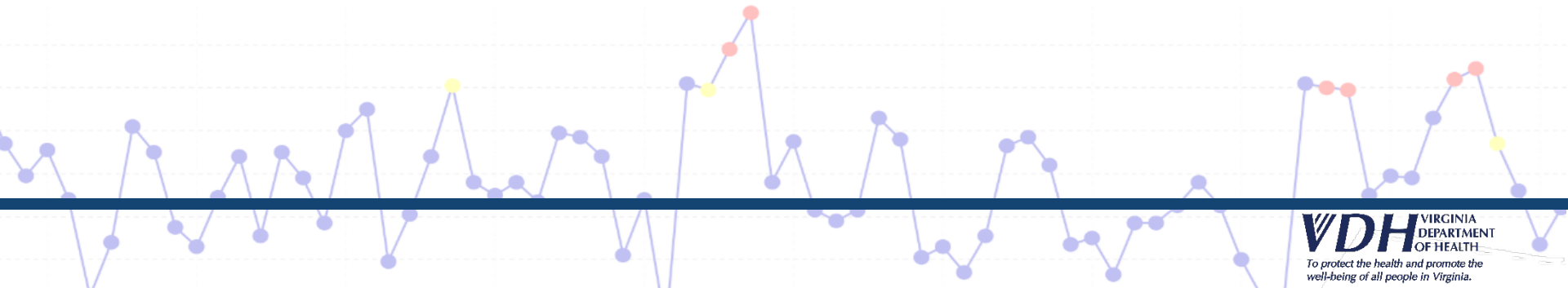
- 17 true firearm injury visits found only in Trauma Registry, not pulled by CDC FAI v2 in Virginia ESSENCE
- Zero had firearm injury diagnosis code in ESSENCE

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

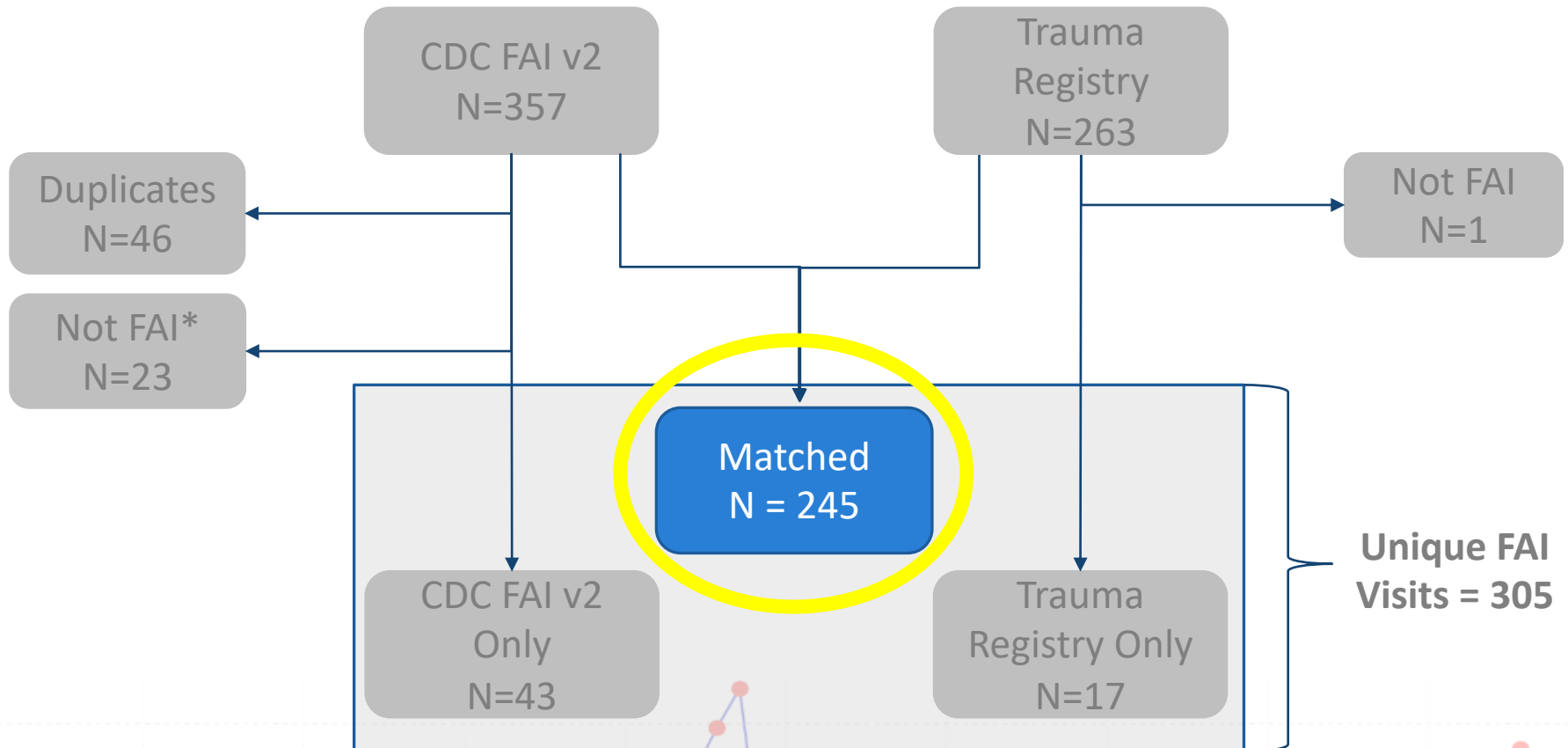
*Terms included GSWs, GWS

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)

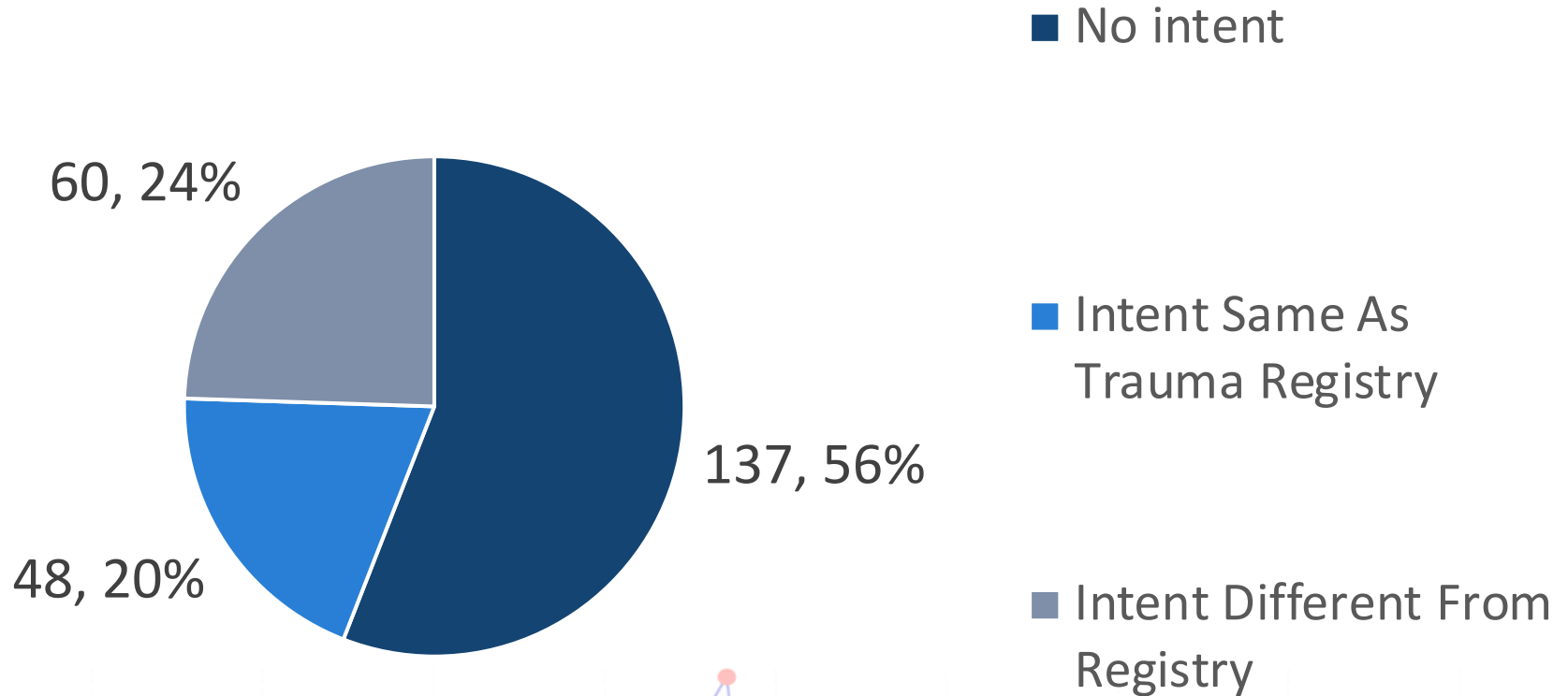


MATCHED RESULTS



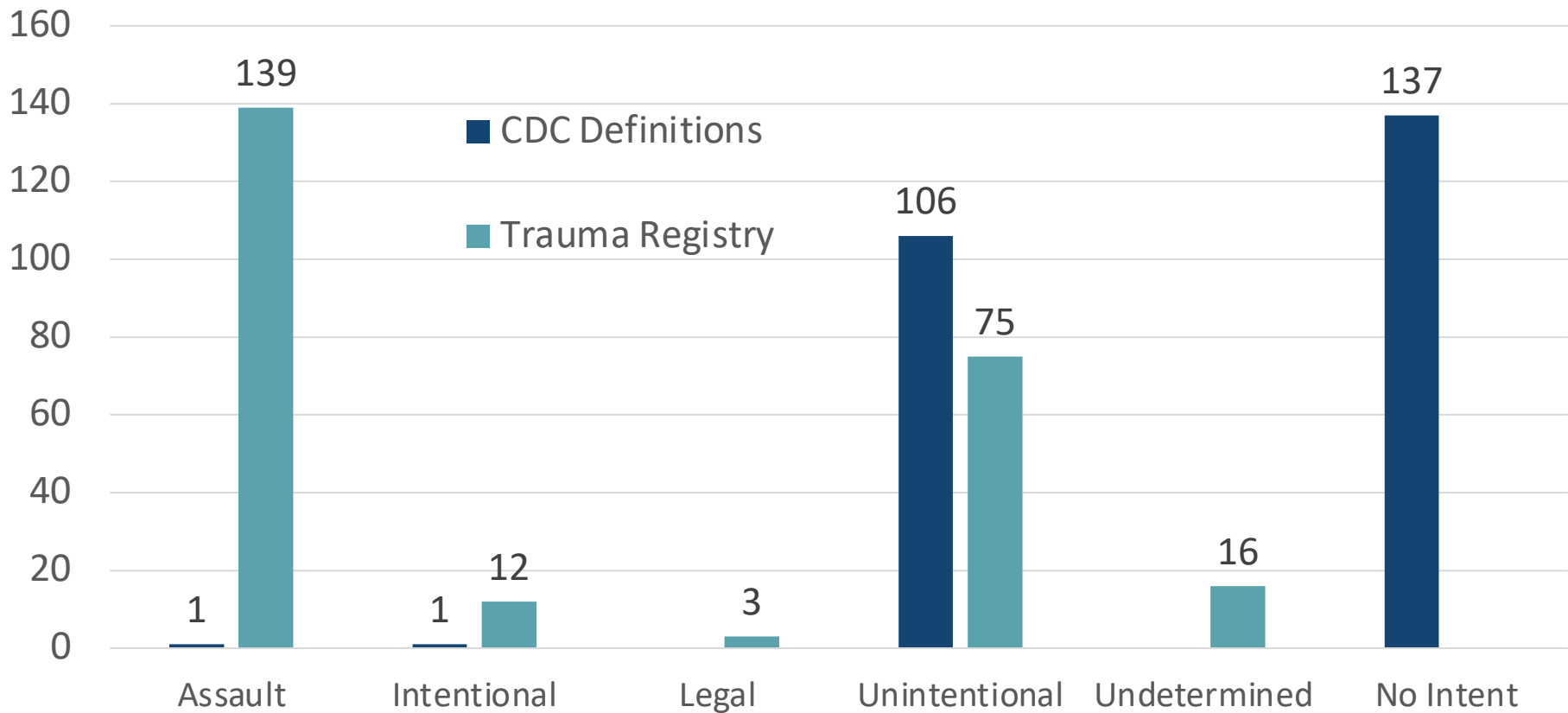
INTENT OF INJURY FROM CDC DEFINITIONS

Matched Visits (N=245)



INTENT OF INJURY BY DATA SOURCE

Matched Visits (N=245)

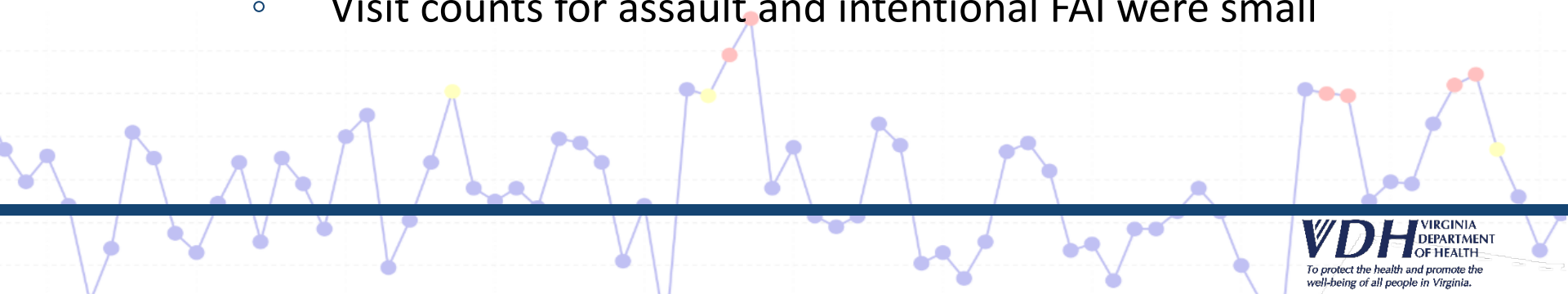


CDC FAI DEFINITION PERFORMANCE

- 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?

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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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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

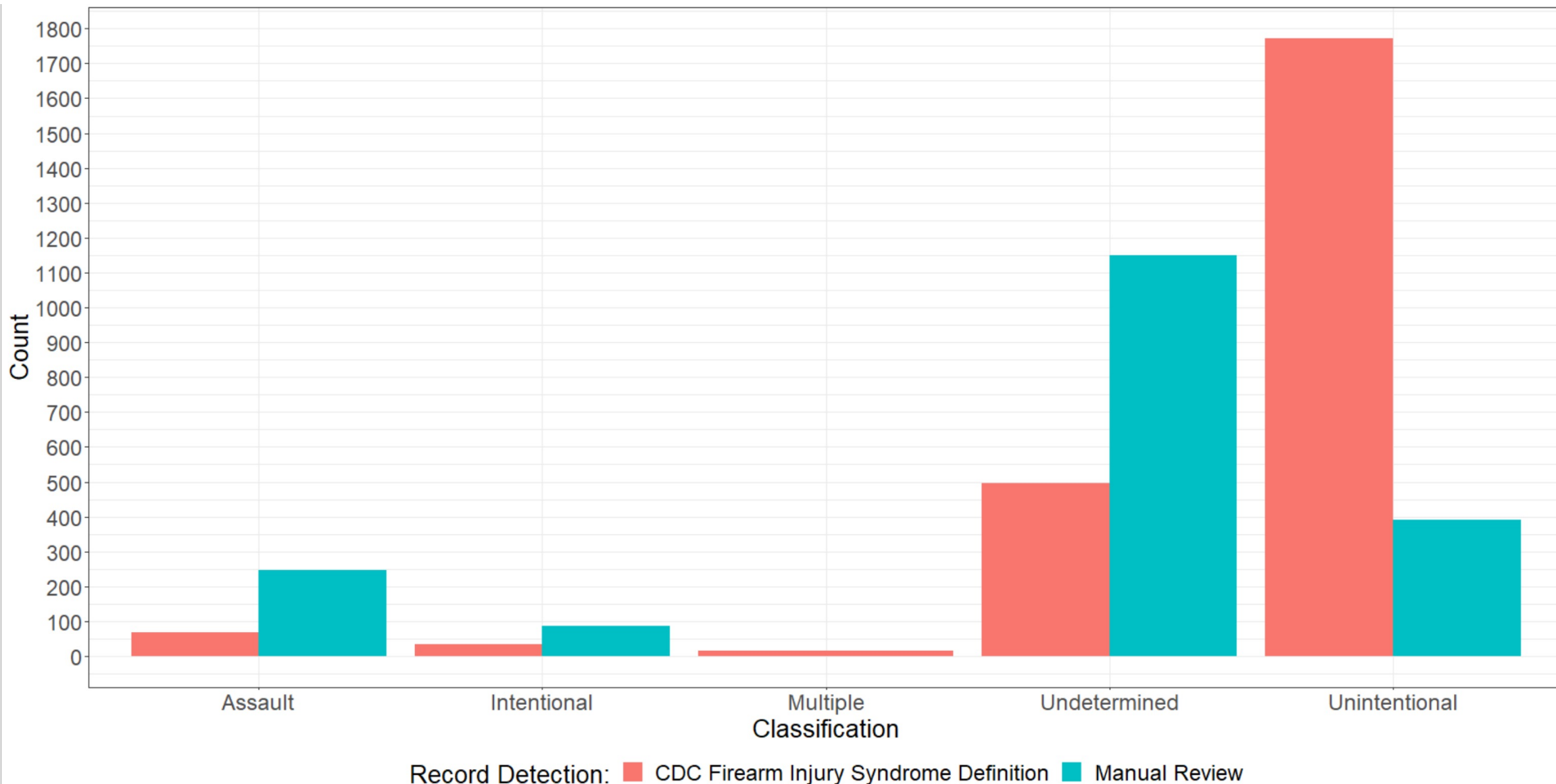
- » Unable to classify 230 cases using Triage Notes, Chief Complaint, and Clinical Impression

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?

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Thank you!

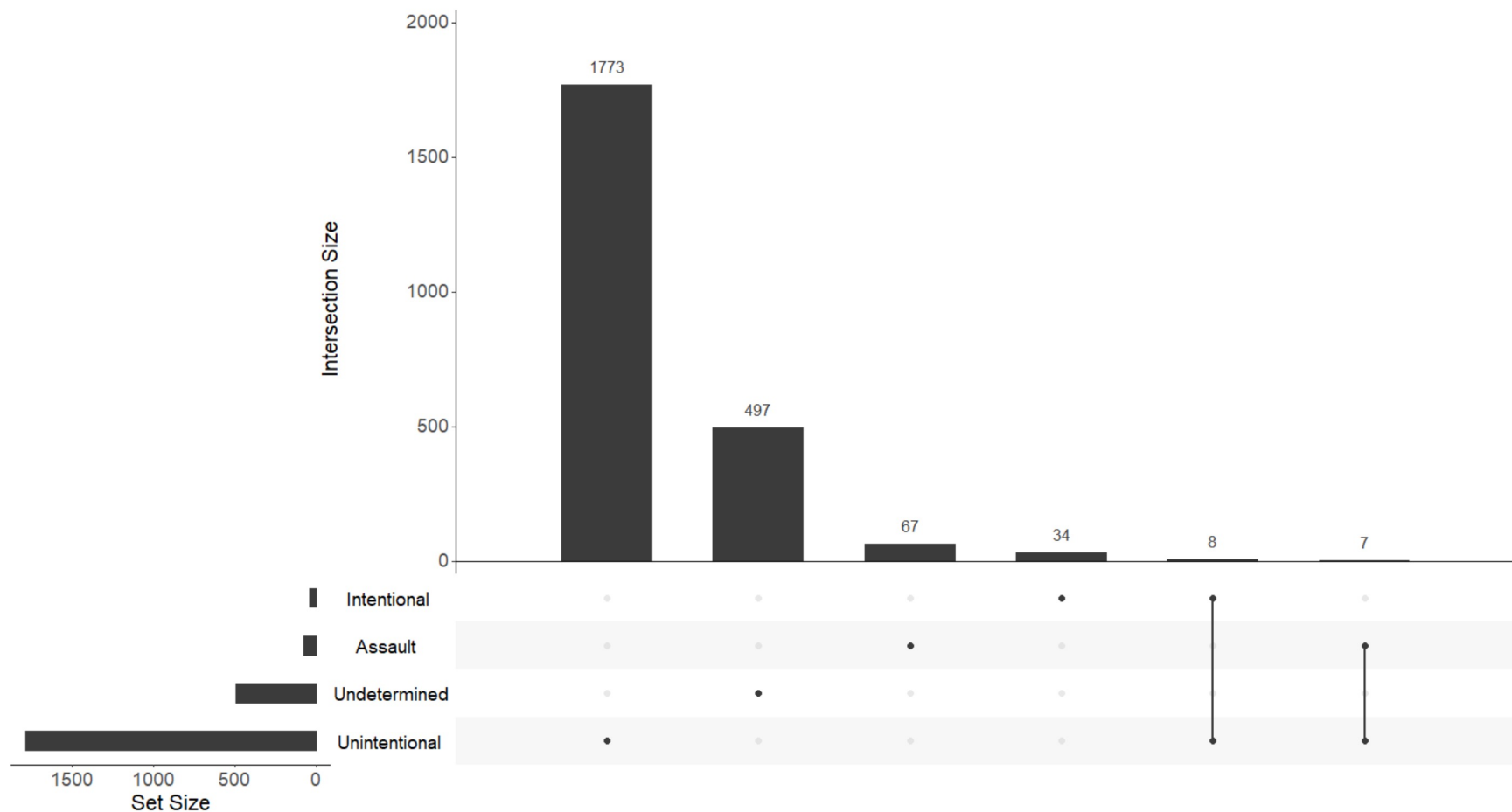


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Chief Complaint in the syndrome definition vs. Chief Complaint alone

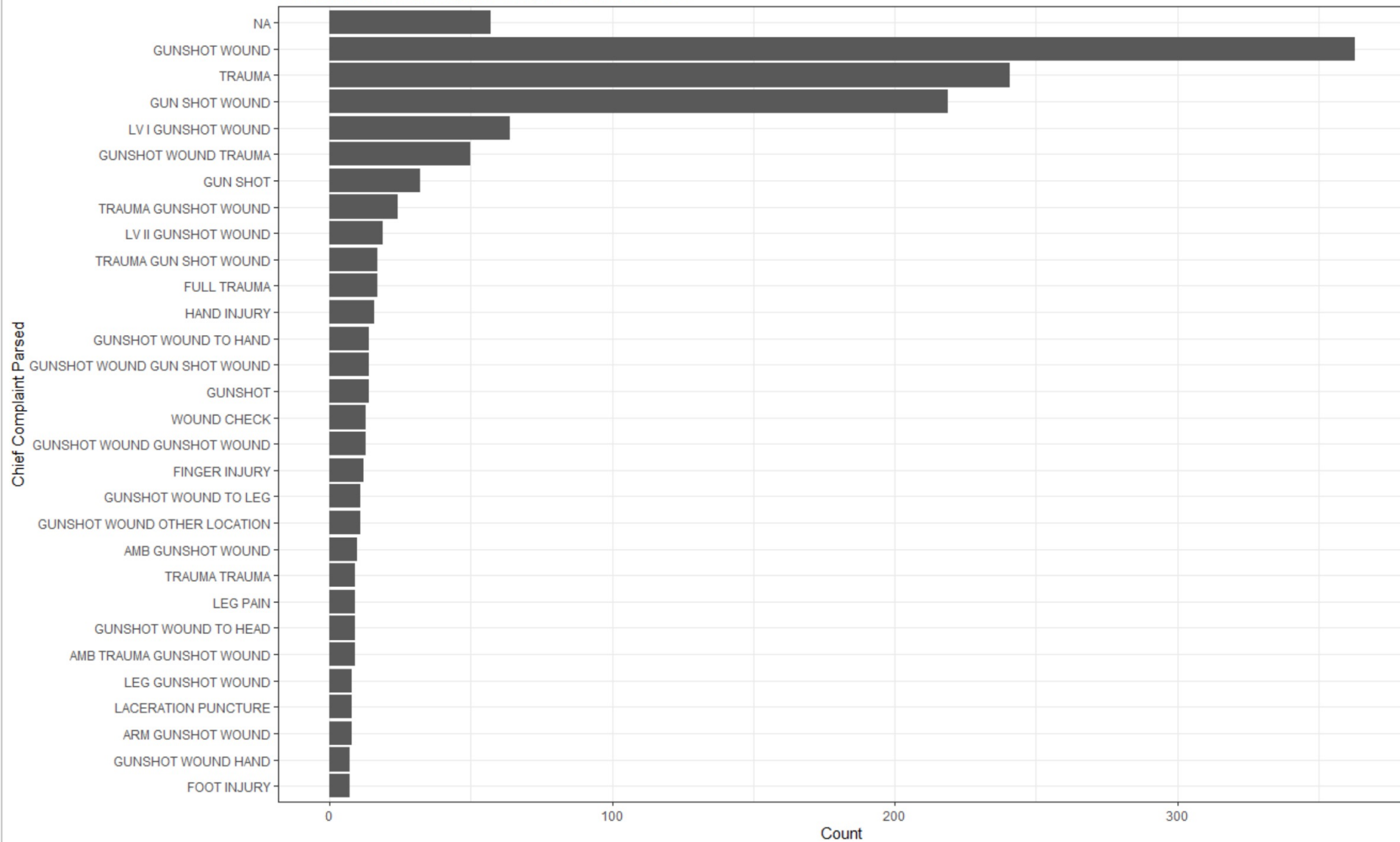
CDC Firearm Syndrome Definition	N Detected by Chief Complaint in Syndrome Definition	N Detected by Chief Complaint when not first considering Discharge Diagnosis
Unintentional	3	5
Intentional	2	2
Assault	1	1
Undetermined	495	496
More than one intent Syndrome Definition	1	1

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





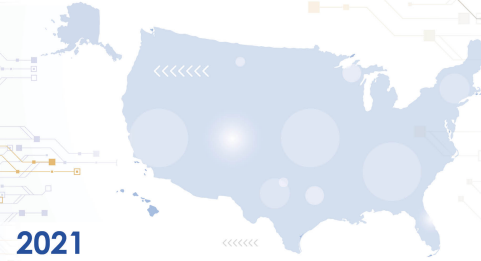
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National Syndromic Surveillance Program

Community of Practice

Resources that Advance the Science and
Practice of Syndromic Surveillance



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Syndromic Surveillance Symposium

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