Syndromic Surveillance Compared with Emergency Department Discharge Data: Evaluation, Interpretation, and Communication for Injury Surveillance

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Introduction

In 2003, the Centers for Disease Control and Prevention (CDC) created the BioSense Platform for the purpose of "establishing a national integrated public health surveillance system for early detection and assessment of bioterrorism-related illness."[1] Since 2011, the purpose has expanded to be more inclusive of all hazardous events, including disease outbreaks and injury and violence. The National Syndromic Surveillance Program (NSSP) hosts this secure, cloud-based platform which contains data processing and analytic programs (including ESSENCE, RStudio, and SAS Studio). Currently, NSSP collects data from more than 6,000 health care facilities around the United States[2] Syndromic data allows analysts access to timely and actionable data. ESSENCE, one of the programs hosted by BioSense, was created by Johns Hopkins Physics Laboratory and contains analytic and visualization tools for conducting surveillance and dissemination of public health data.

Syndromic data is reported in near real-time for the purpose of monitoring public health emergencies and emerging issues. These data can help identify an emerging issue (such as increased gastro-intestinal symptoms related to water contamination), spikes in illnesses (such as COVID-19) or injury (self-harm or firearm injuries, for example) before diagnoses are clinically- or lab-confirmed. However, the timeliness in which syndromic data is conveyed, and the fact that it is queried by the chief complaint and diagnoses at the time of the visit, means that the information is often based on preliminary assumptions/assessments and cases identified by syndromic queries should be considered "suspected."

In comparison, Emergency Department (ED) discharge data includes finalized and confirmed diagnoses and external cause codes based on information at the time of discharge. The weakness with discharge data is related to its timeliness which can lag by three to six months or even longer for some jurisdictions.

Objective and scope

The objective of this document is to provide guidance to injury epidemiologists using syndromic surveillance (SyS) data. We will describe a process for comparing and analyzing SyS data with the more commonly/widely used ED discharge dataset including: documenting differences between systems; reviewing ways to adjust and improve syndromic queries; and suggesting best practices for use, interpretation, and communication.

This evaluation is based on data from Wisconsin, however, the process and recommendations may be useful for other jurisdictions as well.

Differences between SyS data and ED discharge data

The following table details the main differences between SyS data and ED discharge data for the state of Wisconsin. We recommend that other jurisdictions complete a similar table as provided below based on their own systems/databases. For Wisconsin, ED discharge data simply refers to patients who are

admitted to an ED for a visit and later discharged. Their patient status at discharge could include: transfer to hospital, released from ED, deceased, or transfer to nursing care, supportive care or hospice. SyS data includes visits for emergency care, urgent care, inpatient, medical specialty, and primary care. The variable "Has Been Emergency" allows restriction to emergency visits. These include all visits that were ever seen in the ED (including subsequent transfer to hospital). Please see Step 3 below for more detail on the data that we compare throughout this document.

For this guidance document, ED visits in discharge data and SyS will hereafter be referred to as cases for the specific health indicator under review.

Table 1. Differences between SyS and ED discharge data (as of April 2023).

	Syndromic Surveillance System BioSense/ESSENCE	**Emergency Department Visits (Wisconsin Discharge Data)**
Statutory Requirement	Voluntary; collaborative program among local, state, and national public health programs.	Required by Wisconsin State Statute (Chapter 153)[3]; hospitals are required to submit discharge data to the Wisconsin Department of Health Services (DHS) for all discharges.
Data Coverage	128 out of 139 (92%) EDs in Wisconsin voluntarily report to BioSense (as of April 2023). Veterans Affairs and other federal hospitals do not report to SyS.	**All Hospitals and their EDs** must report to Wisconsin DHS (this includes EDs connected to acute care, general medical and surgical, psychiatric, rehabilitation, and alcoholism and other drug abuse hospitals). Data from Veterans Affairs and other federal hospitals are not included. Minnesota and Iowa bordering hospitals also report ED visits and hospitalizations of Wisconsin residents.
Data Route	EDs send de-identified data, including chief complaint, diagnosis codes, patient demographics, ED location, facility names, administrative information, and clinical signs (such as temperature and weight), directly to BioSense platform, or to the state health department through the Wisconsin Statewide Health Information Network (WISHIN). Wisconsin DHS submits data to the NSSP BioSense Platform.	Hospitals and their EDs submit data to the Wisconsin Hospital Association (WHA), which submits a de-identified dataset to the Wisconsin DHS. Though de-identified, there is a unique patient ID that allows for data linkages by authorized Wisconsin DHS staff.
Data Access Permissions	Access can be requested and granted to local and state public health staff who sign a Data Use Agreement with	Internal DHS employees and contractors must request access to

	the Wisconsin DHS describing how they will use the data and attesting that they will agree to follow guidelines for proper usage and sharing of data. For local public health ESSENCE users, these datasets will be filtered to include only data that are relevant to patients (Patient Location (Full Details)) and facilities (Facility Location (Full Details)) in their geographic area (as defined by zip code). State public health department ESSENCE users will generally be granted access to all of the visit data from all participating facilities in that state.	the discharge data for public health purposes. External data users may request aggregate data or record-level data through the Division of Public Health data request process. All requests are subject to review and approval by the Wisconsin DHS Data Governance Board.
Data Submission	Data are sent as early as possible after midnight and contain all visits from the previous 24 hours.	Data reports are sent in quarterly batches based on the discharge date. EDs have 3 months to submit the previous quarter (reports may be 3-6 months delayed).
Data Updates	An update message will be sent when any data are updated in the healthcare provider's system. Data are cumulative (in other words, the system retains previously entered data, whether correct or incorrect).	There are no updates once the submission has been made. WHA conducts quality assurance/quality control. Clinicians have 30 days to update the records if necessary.
Key Data Elements	Relies on chief complaint, reason for admission, diagnoses, clinical impressions, and/or triage notes.	Relies on discharge diagnoses (in the Wisconsin dataset there are 9 diagnosis fields and 2 external cause fields).
Timeliness	Real or near-real time	Three to six months delay
Diagnoses Quality	Diagnoses may not be finalized; these are based on initial impressions reported by patients, bystanders, or Emergency Medical Services (EMS) teams. Additional data may be updated but initial notes and codes are not corrected or deleted. Updates are reliant on facility reporting.	Finalized/confirmed diagnoses and external cause codes.

The counts for a specific health indicator will not match between data sources. The differences in coverage (92% of Wisconsin EDs submit data to SyS compared to 100% of Wisconsin EDs required to submit ED discharge data) and data used to determine diagnoses (SyS includes diagnoses and/or terms that indicate the presence of the illness, injury, exposure, or involvement in an event of interest, while ED discharge data collects finalized discharge diagnoses), will result in either small or significant differences between datasets depending on how well the syndromic query is constructed to include relevant cases and exclude those that are not relevant. Differences will also depend on accuracy and detail of syndromic reports provided by facilities.

We recommend reviewing the CSTE ICD-10-CM Injury Surveillance Toolkit (https://resources.cste.org/Injury-Surveillance-Methods-Toolkit) to create your ED discharge dataset, and a variety of injury indicators, for comparison with SyS data.

Guidance for Using Syndromic Surveillance Data

The Syndromic Surveillance Process

The NSSP promotes a Community of Practice (CoP) (https://nsspcommunityofpractice.org/about-the-nssp-community-of-practice/) for public health professionals to collaborate on syndromic best practices for contributing data and developing query definitions.

Data Collection

For Wisconsin facilities participating in SyS, the process for reporting data to the system begins with patient registration at an ED (this document focuses on ED registration though urgent care, primary care, hospital inpatient, and medical specialties also report). This triggers a message to BioSense with basic information in real or near real-time. Wisconsin DHS requires, at a minimum, that data be sent as early as possible after midnight and contain all visits from the previous 24 hours.[4,5] Based on the first quarter of 2023, 98% of participating Wisconsin EDs send reports within 24 hours of the visit. The remaining 2% may take up to 48 hours or longer.

The initial report to SyS will have basic patient demographic information and chief complaint, while details related to diagnostic codes and patient disposition may be delayed and reported more than a month after the initial admission. Timeliness of updates, corrections, or modifications to the record is based on a specific healthcare facility's workflow. An update message will be triggered when data are updated in the healthcare provider's system. The information is cumulative, including all previously sent information and any new or updated information. In other words, if any initially entered information was incorrect, it remains in the record. Additionally, if new information related to your indicator of interest is included in subsequent messages, you may get different counts for a specific time frame when re-running your query at a later date.

SyS data may include International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) diagnoses and external cause codes from October 1, 2015 forward, and ICD-9-CM before that, in addition to text fields such as chief complaint and triage notes. The chief complaint is the initial complaint provided within the first moments of admission and does not represent a final diagnosis.

Developing Queries

SyS data is queried by mining text fields for specific words and phrases in the clinical notes (chief complaints, discharge diagnosis, triage notes). ESSENCE uses free-text queries that are built using Boolean logical operators and regular expressions. For more details, review the NSSP free-text coding guidance: https://www.cdc.gov/nssp/tech-tips/free-text-coding/part1.html.

These type of queries allow analysts a great deal of flexibility when searching codes and key words from a wide variety of data sources. For instance, your query can include abbreviations or common misspellings to capture/identify a case meeting your health indicator criteria. However, caution is advised as these adjustments can also result in overestimation of disease or injury burden if your query captures unintended terms that are too broad and all-encompassing. On the other hand, making a query too specific can exclude cases where a facility uses imprecise language, abbreviations, or acronyms.

A syndrome definition (sometimes referred to as a query, definition, syndrome, or subsyndrome) can contain discharge diagnosis codes, key words and phrases, and negation/exclusion terms (diagnosis codes or keywords that should be excluded if found in the record). There are two coding systems commonly found in syndromic dataICD-10-CM/ICD-9-CM and Systematized Nomenclature of Medicine, Clinical Terms (SNOMED CT).

Recommended process for evaluating SyS data and determining appropriate usage

The recommended process for evaluating injury data from SyS includes the following steps:

1. Determine the health indicator to query using syndromic data.
2. Determine the SyS data source and time frame you will review.
3. Select the fields your SyS query will search.
4. Run the standard CDC/NSSP query definition for your indicator and compare it with ED discharge data. Review overall and by demographics to determine if certain populations reveal greater differences.
5. Complete a narrative review of cases identified by the SyS query definition to assess accuracy.
6. Adjust the SyS query definition based on alterations supported by your narrative review. Run the new query and compare with ED discharge data.
7. Compare monthly trends/patterns for 1-2 years to determine if your new SyS query and ED discharge data reveal the same pattern. Do this for subpopulations of interest as well.
8. Note differences between data systems and establish guidelines/expectations on appropriate use, communication, and dissemination of SyS data.

Step 1: Determine the health indicator

1. Determine the health indicator to query using syndromic data.

SyS provides public health professionals with near-real time data for detecting, monitoring, and analyzing health events, illnesses, and injuries. This allows for timely public health responses to outbreaks and spikes in certain health events.

Below are some questions to consider when determining a health topic to monitor using SyS data:

a) Is the topic I'm interested in monitoring potentially/possibly experiencing spikes or unusual changes or patterns?

   Many times, media, healthcare providers, or even the general public notice a surge of symptoms or conditions that alert public health authorities. For instance, increasing concerns with mental health and social isolation during the COVID-19 pandemic may have led to spikes in self-harming behaviors and injuries, especially among younger residents. Review of SyS data would alert public health officials of these spikes and the populations most at risk.

b) Was there a current event, natural disaster or wide-spread outbreak impacting this, or related, health outcomes?

   Sometimes an outbreak, such as COVID-19, might have an unexpected impact on your topic of interest; in other words, a seemingly unrelated event might have trickle-down impacts. For example, the COVID-19 pandemic has been associated with increased cases of suicide attempts, especially when social restrictions became policy/practice during the early stages of the pandemic.

c) Is timeliness of data important for your work and this topic? Do you need to respond to an immediate or emerging public health emergency? Is your area experiencing spikes or changes in patterns or trends that need more immediate attention? Do you need to continuously monitor this injury event for changes in real time?

   As an example, you may become aware of increasing firearm violence or other acts of violence in your area through media coverage or police reports. Syndromic data would allow you to obtain timely information on firearm injuries and support a more rapid public health and safety response, whereas ED discharge data would lag by up to six months or longer. Additionally, noticing spikes in the data may assist with understanding broader contextual issues that may contribute to violence.

Step 2: Determine data source and time frame

2. Determine the SyS data source and time frame you will review.

Two key elements, "Datasource" and "Time Resolution," should be determined before you run a query in ESSENCE. The following are options in the Query Wizard tab/portal:

- **Datasource:** For this option, you may select from the following: Patient Location, Facility Location, Laboratory, Weather Data, Air Quality Data, Veterans Affairs Data, and ASPR EMR--Administration for Strategic Preparedness and Response, Electronic Medical Records. The two most commonly used sources are: "Patient Location (Full Details)," which reviews data based on patient residence, and "Facility Location (Full Details)," which collects data based on the treatment location. A more complete description of all options can be found at: https://www.cdc.gov/nssp/biosense/docs/biosense-platform-quick-start-guide-for-essence.pdf.

  We recommend checking with your SyS administrators about the accuracy and completeness of information for your jurisdiction. For instance, some jurisdictions may have missing geographic data by patient location, so, facility location may be more useful. Based on our review of Wisconsin records in SyS, both "Facility Location" and "Patient Location" were >99% complete with valid values.

- **Time Resolution:** Select the time frame for your review: daily, weekly, monthly, quarterly, or yearly.

Step 3: Select query fields

3. Select the fields your SyS query will search.

This step focuses on defining the population of visits you wish to query and reviewing your data quality.

a) Before selecting an existing query or creating a new query, you need to determine the fields that will serve as filters for your population of interest. These fields are selected in the ESSENCE Query Wizard portal.

For the two injury indicators we review in this document (Self-harm and Firearm injuries), we limited our analyses to non-fatal ED visits. Injury surveillance methodology often uses ED discharge data that restricts visits to non-fatal, treated and released (i.e., not transferred immediately to a hospital inpatient setting or other health facility). In Wisconsin, we typically perform our surveillance in this manner. In SyS, the "Has Been Admitted" field would allow for a similar comparison, however, for Wisconsin, the reliability and validity of this field is uncertain/unknown as of June 2023 (this field was added in 2020). SyS data quality can vary from facility to facility, and some may not accurately record the path a patient makes to another facility, to another unit within the same facility, or release to home. SyS data is not finalized at time of discharge so these fields (such as "Has Been Admitted") may be less accurate or complete. We recommend discussing the completeness and quality (reliability and validity) of the fields you choose to filter your data with your state's SyS administrator to determine if their use is appropriate and recommended. Based on our discussion with the Wisconsin SyS administrator and NSSP staff, we decided not to use the "Has Been Admitted" field and focused our comparison on *all* non-fatal ED visits in discharge data and in SyS (i.e., any visit seen in the ED and the patient is not coded as deceased). In Wisconsin, our ED discharge data refers to all admissions to the ED regardless of patient outcome (e.g., deceased, transfer within hospital, transfer to other hospital, nursing care, hospice or supportive care, or treated and released). This allows us to expand our comparison to all non-fatal visits. Not all jurisdictions have access to ED data or access to all ED admissions regardless of patient outcome. If your jurisdiction is limited, you will need to assess the comparisons you are able to conduct and their appropriateness. If comparison with ED discharge data is not possible, you may choose to assess the accuracy of a SyS query by following this guidance without a comparison to another data source. In the future, once validated in our jurisdiction, the "Has Been Admitted" field may prove extremely useful for injury surveillance.

We selected the following fields in the Query Wizard to limit our review to non-fatal ED visits:

- **C_Death**=No. This field will be "Yes" if the death indicator, date of death, or discharge disposition indicate death. Otherwise, the value will be "No." This is a calculated field based on direct input from health care facilities to the SyS system (ESSENCE). Though approximately one-quarter of visits (based on a one-month sample for 2020) appear to be missing data to inform this variable (which would result in C_Death=No), we determined that it would still be useful to remove the fatal cases from our review.

- **Has Been Emergency**=Yes. The options for this field are Yes and No. "Yes" refers to patients who received care in an ED (at any time for the visit under review). It is a calculated field if an "E" is found anywhere in the "Calculated Patient Class History" list. Patient Class History is a list of all of the patient classes directly entered by facilities (or assigned by BioSense if the patient class entered by facilities is invalid).

- **Facility Type**=Emergency Care. The facility type is determined based on how it was originally onboarded into BioSense (in Wisconsin). Selection of "emergency care" indicates that the facility includes an ED, though a facility may also include other types of care. In addition to Emergency Care, the other options are: Urgent Care, Medical Specialty, Primary Care,

Inpatient practice setting, and Other. We used this field to match more closely with our ED discharge data. This selection excludes facilities that have no emergency services.

b) Review Chief Complaint and Discharge Diagnosis data quality. After you have defined your population, run a quick data quality check on two key data elements. ESSENCE provides a "Data Quality Filters" field developed by the NSSP team to monitor the data quality of Chief Complaint and Discharge Diagnosis; the two most significant fields for any query to search.

- **Chief Complaint Informative:** This is a data quality measure developed by the NSSP Community of Practice. A systematic list of uninformative chief complaint terms was created (e.g., n/a, ED visit, ill, referral, null). The list is available at https://www.cdc.gov/nssp/dqc/articles/essence-data-quality-filter.html). The acronym used to describe terms with no relevance to SyS is "NICC" (Non-Informative Chief Complaint). When the ChiefComplaints field is solely populated with NICC terms, ESSENCE will flag the Chief Complaint Informative field as uninformative and set it to 0 (No).

  We reviewed this field for our 2020 non-fatal emergency visits and found that 85% of records contained informative data in the ChiefComplaints field.

- **Discharge Diagnosis Informative:** This data quality measure assesses the informative value of the Discharge Diagnosis field which should be populated with ICD-9-CM, ICD-10-CM, or SNOMED codes. As with the Chief Complaint Informative field, the Discharge Diagnosis Informative field was created to distinguish between records with valuable information in the Discharge Diagnosis field versus those with no analytic value. ESSENCE uses the same list of NICC terms as it does for Chief Complaint Informative.

  We reviewed this field for our 2020 non-fatal emergency visits and found that 88% of records contained informative data in the Discharge Diagnosis field.

  Based on the above, the data quality/completeness of Wisconsin's non-fatal emergency visit records appears quite good, but there is still room for improvement. NSSP currently recommends using an average weekly percentage cutoff of >= 75%.

c) After you have selected your population of records and reviewed the overall data quality of the ChiefComplaints and Discharge Diagnosis fields, you will select a field(s) to apply your query definition to and run against the records you have selected in step 3a. There are several fields within ESSENCE where you can either select a standard CDC/NSSP query, alter a query, or create your own query. The "CC and DD" field (this is a combination field in SyS) and "CC and DD Category" field are the most commonly used fields. More detail on these 2 options, in addition to Discharge Diagnosis, Admit Reason Combo, Chief Complaint History, Discharge Diagnosis History, and Triage Notes Orig are provided below.

- **CC and DD** (ChiefComplaints and Discharge Diagnosis): Selection of this field means that both the ChiefComplaints field and Discharge Diagnosis field will be searched. The ChiefComplaints field includes the first instance of non-null data from the Chief Complaint Original field. The Discharge Diagnosis field includes the last non-null data for that record. When you select the CC and DD field (from the list of Available Query Fields on the left-side

of the screen in the Query Wizard), you will notice a blank text box in the center screen. You will enter your query definition here. Below the blank space for the query string, you can select specific fields to query. The system will automatically search the ChiefComplaints and Discharge Diagnosis fields and you can select additional fields from the list (such as Triage Notes Orig). The query will review each field separately and apply the query definition. If the query finds the key words, phrases, or codes in any of the selected fields, ESSENCE will select the record as a case.

- **CC and DD Category**: This field contains the complete list of all current query definitions available through NSSP for syndromic surveillance (available by selecting the "More" tab in ESSENCE, under Syndrome Definitions in CC and DD Category). If you choose to use the "CC and DD Category," you will not be able to view the details of the query narrative or adjust it in any way. Using this field will make your query run faster than using the CC and DD field above. The system will automatically search the specific fields that have been identified by each query. The ChiefComplaints and Discharge Diagnosis fields are the most common ones searched, but you can see which additional fields may be searched by reviewing the query details using the "More" tab.

- **Discharge Diagnosis:** this field stores the last non-null de-duplicated data for a record. This field provides a blank text box to enter and adjust your query definition. Below the blank space for the narrative string, you can select additional fields to query. The query will review each field separately and apply the query definition. If the query finds the key words, phrases, or codes in any of the selected fields, ESSENCE will select the record as a case.

- **Admit Reason Combo:** this field stores diagnosis codes and admission code descriptions, including the null values. Proceed with entering your query in the blank text box and select all relevant fields to query (as detailed in the Discharge Diagnosis explanation above).

- **Chief Complaint History**: this is different from ChiefComplaints within the CC and DD field as it stores all de-duplicated information entered as chief complaint, including all information from the first and subsequent messages (i.e., it is often more extensive than the ChiefComplaints field). Proceed with entering your query in the blank text box and select all relevant fields to query.

- **Discharge Diagnosis History:** this is different from Discharge Diagnosis (based on last non-null data) as it this stores all de-duplicated information entered as discharge diagnoses, including all information from the first and subsequent messages. Proceed with entering your query in the blank text box and select all relevant fields to query.

- **Triage Notes Orig:** this field contains detailed notes surrounding the event. This field often contains a significant amount of text and searching this may make your query run less efficiently. However, if you want to review a health indicator that may be more prone to inaccurate or inconsistent ICD-9-CM/ICD-10-CM or SNOMED coding, or sparse chief complaint descriptions, this might be a useful field to search. If you choose to use this field, you may also want to review how often it is populated and how detailed the notes are. This

can vary greatly by jurisdiction and by facility. Proceed with entering your query in the blank text box and select all relevant fields to query.

Step 4: Run query definition and compare to ED data

4. Run the standard CDC/NSSP query definition for your indicator and compare it to ED discharge data. Review overall and by demographics to determine if certain populations reveal greater differences.

Once you have selected the health indicator for your surveillance evaluation, the following steps are recommended:

a) Review NSSP Community of Practice Knowledge Repository (https://knowledgerepository.syndromicsurveillance.org/search/syndrome). Check to see if there is a definition for your health indicator of interest and if it has been shared, used, and/or validated by other professionals and jurisdictions. You can also look for available query definitions under the "More" tab in ESSENCE.

b) Reach out to other professionals and colleagues to ask if they have developed or adjusted queries on your health indicator and what their findings reveal.

c) Run the query.

d) Assess the "missingness" of variables in your data. A data variable is of minimal interest or use if there is a large percentage of unknown/missing information. For instance, if reviewing data by race reveals that 50% of cases are missing race or indicate unknown race, that is unlikely to be useful or informative.

e) Compare results from your query to ED discharge data: review data by age group, sex, race, ethnicity, geography and other variables of interest for your jurisdiction. Compare percentage differences overall and by demographic subpopulations. There may be situations where overall counts for your state or jurisdiction are similar between the two data sources but much different when comparing by subpopulation. When comparing Wisconsin unintentional fall injuries for 2020 (based on all non-fatal ED visits), we found a 7% difference overall, and a 31% and 49% difference among those aged 65-74 and 75+, respectively.

f) Identify subpopulations with greater differences. Differences by count and percentage should be considered. Though you may discover large percentage differences between SyS and ED discharge data for certain subpopulations, the difference in number of cases might be relatively small. For example, for our comparison of self-harm/suicide attempt (all non-fatal ED visits), we noted a percentage difference of 112% among those 75 years and older (45 more cases identified by the SyS Suicide Attempt V1 query compared with ED discharge data). The percentage difference between those aged 45-54 was much less (62%) but the difference in number of visits was over 200. We recommend that you consider the percentage difference and count difference when comparing the data sources and determining the next steps for your review and analysis.

Step 5: Conduct narrative review

5. Complete a narrative review of SyS cases identified by the query definition to assess accuracy.

We recommend a 5-10% review of cases identified by your SyS query. Most jurisdictions should have access to the SyS text and code fields to conduct this review. Wisconsin does not have access to complete records in the ED discharge data so cannot assess the validity and reliability of ICD-9-CM/ICD-10-CM coding in this data system. The percentage we are suggesting for SyS narrative review may need to be adjusted based on the total number of cases identified. For instance, 10% of 50,000 is likely too labor intensive while 10% of 20 would not be sufficient. You will need to make adjustments to this based on staff time and effort, what you know about the query itself, if other jurisdictions have uncovered issues/concerns, and if certain subpopulations reveal greater differences which may suggest a focus for your narrative review. There is no guidance or standard recommendation for the percentage narrative review required to assess one's query. The NSSP Community of Practice suggests starting a review with the most recent records and continuing as much as practical and/or until you stop noticing patterns among the incorrectly identified records.

The purpose of this step is to determine if there are ways to revise the initial query to create a more reliable and valid count. Your narrative review can be done within the ESSENCE platform, or you can download the data and review using Excel, or any other statistical analysis software to which you have access or prefer.

- ESSENCE Platform: This platform will highlight keywords that were identified by the query for case selection. By reviewing the highlighted items, you can assess if the query correctly identified a case. However, a full review of all text may provide additional information on words or phrases that should be added or excluded from your query.

- Excel: You can download the data obtained from ESSENCE once you have run the query. Then review the informative fields within Excel.

Below are a few considerations that may assist with conducting your narrative review:

a) Expand the fields you review (beyond what is queried by the definition you are evaluating) to get a broader picture. We recommend reviewing the following fields during your narrative review: Discharge Diagnosis History (in SyS output this is labeled Discharge Diagnosis Updates), Chief Complaint History (in SyS output this is labeled Chief Complaint Updates), Triage Notes Orig, and Admit Reason Combo. Reviewing additional fields that your definition may not query could help you determine/assess how well the query works (especially if you use all the information you review to categorize a visit as valid or invalid for your health indicator of interest) and provide you with additional information to guide the adjustments you can make to your query. For instance, the Triage Notes Orig field provides more detailed information about a case, when available (though there may be wide variations on use across jurisdictions). During our narrative review of cases identified by the Assault Firearm Injury query definition, we were able to ascertain that the CC and DD field (the only field used to search for the query definition) was not particularly helpful in capturing information necessary to determine intent. The ChiefComplaints field only includes brief descriptions such as "gunshot wound" and the Discharge Diagnosis field only includes codes. With no description of the event, misuse of ICD-9-CM/ICD-10-CM codes (use of unintentional firearm injury codes even in the presence of narrative supporting assault) results in underestimation of assault firearm injuries. We discovered that the Triage Notes Orig and Chief Complaint History fields contained more information about the circumstances of the injury, including intention. We therefore adjusted our query to search the Triage Notes Orig field, as well

as the Chief Complaint History field, for keywords and phrases to identify these assault firearm injury cases (see Appendix B for more details).

b) Is there a specific population where you noted the difference was more extreme? Is this a population of interest where you could focus your narrative review? For our comparison of self-harm/suicide attempts, we identified a few populations with either larger percentage differences compared with ED discharge data or larger differences in case counts. Part of our narrative review included focus on these specific subpopulations.

c) Do you know something about your health topic that might impact certain populations more than others and may be misidentified by SyS data? For instance, we were concerned that drug overdose, especially where an unspecified code such as T50.902 was used, may often be misidentified as intentional self-harm. We reviewed cases identified by inclusion of the ICD-10-CM code T50.902A (intentional poisoning by unspecified drugs, medicaments, and biological substances) associated with keywords of Overdose, Accidental Overdose, Ingestion, and Drug Abuse to assess appropriate classification as self-harm. Based on a review of 300 cases, only 13% of these were determined to be accidental so we concluded that it was not appropriate to exclude those with a T50.902A code from our self-harm query.

d) What are the exclusions in the query code (i.e., which terms or codes or key phrases are identified for exclusion as a case) and are there any exclusions that should be included but are not? This refers to words, terms, or codes that should not be selected as cases by your query. For example, "unintentional" or "accidental harm" should not be selected by a self-harm injury query. See Appendices A and B for self-harm and firearm injury query exclusions.

e) Check the accuracy of ICD-10-CM codes or SNOMED codes if these are included in your query. Verify that ICD-9-CM codes are not listed in current queries or check for SNOMED codes that may or may not be reported by your jurisdiction's EDs.

f) Consider a variety of ways in which to spell keywords or write key phrases. Include any possible spelling, short words, acronyms, or abbreviations, if appropriate. However, because regions, facilities, and practitioners might have different practices, we suggest caution when using abbreviations or slang in query definitions. Additionally, inclusion of clinical terms or symptoms might be useful with identification of your health indicator.

g) Are there instances where Boolean logic identified cases that were not relevant for your health indicator? Because of the nature of the query code with Boolean logical operators **(**AND, OR, NOT, or ANDNOT) used as conjunctions to combine or exclude keywords in a search, we discovered some cases identified by our query were not valid. For example, during our review of the CDC Firearm Injury query definition, the inclusion of specific types of firearms (revolver, rifle, pistol, etc.) with no "AND" clause for "gunshot wound" resulted in capturing cases related to getting hit with or struck by a revolver, rifle, etc. We removed these references as the "gunshot wound" was the priority and type of gun was not.

Step 6: Adjust the query definition

6. Adjust the SyS query definition based on alterations supported by your narrative review. Run the new query and compare with ED discharge data.

The NSSP technical resource center (https://www.cdc.gov/nssp/resources.html) will provide you with technical support and training for query free-text development and links to the NSSP Knowledge Repository website for examples of queries from other jurisdictions.

We recommend the following when making adjustments to a standard/previously-developed query:

a) Review NSSP technical supports for any suggested alterations to your standard query.

b) Assess the fields that the standard CDC/NSSP queries search. For instance, the Suicide Attempts V1 query reviews Chief Complaint History and Admit Reason Combo in addition to the Discharge Diagnosis field. The Suicide Attempts V2 query definition searches Chief Complaint History and Discharge Diagnosis History.

   There is/are no "right" field(s) to search. Instead, you should consider the fields used by the agencies in your jurisdiction and the information provided in these fields to determine which will be most appropriate to query. During our review of the additional fields queried using the Suicide Attempts V1 query definition, we found that, in Wisconsin, not all of these proved necessary/informative. Upon review of the Admit Reason Combo field, we determined that no new information was gathered, and we removed this field for our query to search. However, Chief Complaint History contained subsequent/updated reports, some of which contained new information on self-harming behavior or suicide attempt. We decided to keep this field for our new/adjusted query definition.

c) Modify, adjust, add, or remove keywords or codes in the query, based on your narrative review. For an example related to our self-harm indicator, the standard query included ^hang^ and ^shoot^ which also identified cases that were not related to an injury for self-harm; for instance, this included cases where the keywords “c**hang**e” and “up**shoot**ing” were found. We adjusted our query to include a new expression: ^ hang^ and ^ shoot^ (note the space after the first caret), thus removing invalid cases.

d) Once you have adjusted the query, run this in the system and spot check narratives to confirm inclusion or exclusion of cases based on your criteria. Pay particular attention to syntax, misspellings, Boolean operators (and their order), commas, and carets.

e) Rerun the adjusted query and compare again with ED discharge data. Conduct the same comparison as before including by a variety of patient demographics.

f) Conduct another narrative review based on the cases identified by the new query to verify accuracy of your new query definition.

g) Review overall percentage differences and differences by subpopulations. If you still find large differences by subpopulations, perform a more targeted narrative review of those groups.

Step 7: Compare monthly trends and patterns

7. Compare monthly trends/patterns for 1-2 years to determine if your new SyS query and ED discharge data reveal the same pattern. Do this for subpopulations of interest as well.

Based on the new query you have developed, compare monthly counts for 1-2 years for the 2 data sources. A line graph is likely the easiest way to visually compare and review trends/patterns. We would also suggest conducting a statistical analysis to determine if the slopes of your two trend lines are statistically significantly different or not.

When reviewing trends using ESSENCE data, it is important to consider possible changes in ESSENCE data quality over time. For example, you might run a query that shows an increase in the number of visits meeting the definition of a particular syndrome over time. This could be a real increase in the syndrome, or the increase could be due to more facilities reporting visits to ESSENCE over time and/or the improved data quality by the facilities that were already reporting to ESSENCE, especially in regard to ChiefComplaints and/or Discharge Diagnosis fields.

To account for the variability of facility reporting and the data quality during a specific time period (perhaps a month, a year, or several years), use of data quality filters are recommended when assessing trends. This action will "smooth" out the data by limiting to facilities with consistent reporting and consistently high data quality to allow for a more accurate assessment of shifts, patterns, or trends. However, we do not suggest using these filters when reviewing counts, and developing rates from these counts, when comparisons across time *are not* being made. The reason for this is because the filters will likely remove cases in an effort to "smooth" out the data.

We recommend the following when comparing and assessing trends over time once you have adjusted and finalized your query definition:

a) Limit your query to include only facilities that consistently report visits with informative chief complaints and/or discharge diagnosis codes for a specified period of time. Use the CCI Avg Weekly Percent and DDI Avg Weekly Percent filters below (these are the field names in ESSENCE which stand for Chief Complaint Informative and Discharge Diagnosis Informative). Both types of filters range from 0% to 100% and higher values are associated with higher quality data. NSSP recommends a cutoff of >=75%, however, depending on your site, you may use another cutoff point. We suggest you check your jurisdiction's data quality and consistency by visiting the following website: https://www.cdc.gov/nssp/documents/HowtoUseNSSPESSENCECCIandDDIDataQualityFilters.pdf. For Wisconsin (2020-2022), we had a score of 90% or greater for the CCI and DDI Avg Weekly Percent filters.

    - The CCI Avg Weekly Percent filter limits your query to only include facilities that had an average weekly percent of visits with an informative chief complaint above the cutoff.
    - The DDI Avg Weekly Percent filter limits your query to only include facilities that had an average weekly percent of visits with an informative discharge diagnosis above the cutoff.

    The CCI Avg Weekly Percent filter is not typically used unless there have been substantial shifts in completeness or quality of chief complaints. DDI Avg Weekly Percent filter is more widely used since changes in completeness of diagnoses are more common than with chief complaints.

b) Limit your query to include only facilities that sent data consistently over a specified period of time by using one of the Data Quality CoV fields (these fields are listed in this manner in ESSENCE and CoV stands for Coefficient of Variation). As this evaluation is focused on ED visits only (Has Been Emergency=yes), we suggest using one of the Data Quality CoV HasBeenE fields. Coefficient of variation is the standard deviation (STD) divided by the mean (STD/Mean*100) of weekly visit volume over the time period associated with the filter. The time window will be from January 1 of the specified year to current date (selections include: "current year to date", "last year to date", "last two years to date", "last five years to date"). The Data Quality CoV HasBeenE filter measures the underlying variation in overall daily ED visit volume (HasBeenE = Yes) for each facility.

   The CoV filters have values that are greater than 0 and lower values are associated with higher data quality. NSSP recommends using a cutoff of <=35 (per informal conversation with NSSP staff).

c) Perform a comparison for your total population and for any subpopulations of interest. Comparison of trend lines and their slopes may support use of SyS data for monitoring spikes and trends.

Step 8: Establish guidelines on appropriate use and communication of SyS data

8. Note differences between data systems and establish guidelines/expectations on appropriate use, communication, and dissemination of SyS data.

Below are a few key take-aways and considerations for use, interpretation, and communication of syndromic data:

- SyS data and ED discharge data do not provide the same counts and sometimes they do not reveal the same patterns or trends. Differences are to be expected because of the nature of SyS data. SyS offers near real-time data, including initial impressions in ED, which has significant advantages, but it is also not finalized/clean data and cases should be considered "suspected" (while ED discharge data is considered finalized/confirmed). In order to compare data from different data sources, it is important to thoroughly understand the differences in data collection, inclusion and quality. Additionally, it is important to assess the appropriateness of your comparison (can you restrict to the same population of interest, for example).

- It is also important to understand the differences related to your topic of interest before determining which data source to use and how to communicate the data to the public, media, legislators, and others. A comparative analysis and thorough understanding of the differences between SyS and ED discharge data will allow you to confidently communicate the data along with any necessary caveats. Additionally, your analysis may reveal large variations between injury indicators. For instance, the difference between SyS and ED discharge data may be slight for one health topic (for instance, falls) and rather large for another health topic. Don't assume that your findings for a specific injury indicator will be repeated for a different one.

- Our results (based on examples discussed in the appendices) support use of SyS for monitoring spikes and describing percentage changes or patterns/trends (with less focus on exact counts). Alternatively, considering the results of your comparison, if data are similar between sources

and the indicator is less subject to large differences by subpopulation, communicating counts and rates may be appropriate.

- During our evaluation, we noted greater and lesser differences by subpopulation. When conducting your own review of the data sources for your specific health indicator, pay attention to populations/communities experiencing greater burden in your jurisdiction (revealed by either or both data sources). Discussion of disparities may be useful for securing resources and targeting appropriate prevention and intervention strategies, however, highlighting these can also be stigmatizing and/or harmful. We would encourage providing context about how some communities may be impacted by systemic discriminatory factors (for instance, implicit bias among health professionals or first responders and institutional racism) that contribute, at least in part, to the disparities you may note with your health indicator (regardless of the data source you use).

- The comparisons we have detailed in this document focus on all non-fatal ED visits (regardless of patient status after the patient has left the ED; for instance, transferred to hospital or nursing care, treated and released, or other). If you want to consider a proxy for severity, discharge data would likely be best. Typically, injury surveillance is conducted on ED treated and released visits and non-fatal hospitalizations separately. This distinction serves as a proxy for severity as those patients requiring admission to a hospital setting are assumed to have more severe conditions requiring greater care. However, if you can confirm the reliability and validity of a comparable field in the syndromic system ("Has Been Admitted") with your SyS administrators, SyS data may offer some information related to severity as well. If your jurisdiction can confirm the quality of "Has Been Admitted," it would be useful to compare ED discharge data (treated and released only) with SyS "Has Been Emergency"=yes and "Has Been Admitted"=no. The next step could include a comparison of your Hospital discharge data with SyS data "Has Been Admitted"=yes.

Additional Resources

- NSSP Technical Resource Center: https://www.cdc.gov/nssp/resources.html

- NSSP Community of Practice Knowledge Repository. Developing, evaluating, and disseminating definitions for syndromic surveillance in public health practice: a guidance document; https://kr-drupal.syndromicsurveillance.org/developing-evaluating-and-disseminating-definitions-syndromic-surveillance-public-health-practice.

- National Syndromic Surveillance Program (NSSP) free-text coding for ESSENCE: https://www.cdc.gov/nssp/tech-tips/free-text-coding/part1.html.

- Centers for Disease Control and Prevention (CDC). National Syndromic Surveillance Program (NSSP). *How Data Quality Filters Work.* https://www.cdc.gov/nssp/dqc/articles/how-data-quality-filters-work.html. Published 2023.

- Examples of how syndromic data has been used for monitoring change:

- Zwald ML, Van Dyke ME, Chen MS, et al. Emergency Department Visits for Firearm Injuries Before and During the COVID-19 Pandemic — United States, January 2019–December 2022. MMWR Morb Mortal Wkly Rep 2023;72:333–337. DOI: http://dx.doi.org/10.15585/mmwr.mm7213a2
- Radhakrishnan L, Leeb RT, Bitsko RH, et al. Pediatric Emergency Department Visits Associated with Mental Health Conditions Before and During the COVID-19 Pandemic — United States, January 2019–January 2022. MMWR Morb Mortal Wkly Rep 2022;71:319–324. DOI: http://dx.doi.org/10.15585/mmwr.mm7108e2

- ESSENCE User Guide: this provides documentation on spike and anomaly detection (the document can be accessed by ESSENCE users by clicking on the Users Guide within the "More" tab on the main page; "More" tab --> Detector Algorithms: https://essence2.syndromicsurveillance.org/nssp_essence/servlet/DetectorAlgorithmsServlet. Alternatively, go to page 91 of the following document: https://www.cdc.gov/nssp/documents/essence-training-presentation-phi-conference.pdf.

- Councilof State and Territorial Epidemiologists (CSTE) Injury Surveillance Toolkit: https://resources.cste.org/Injury-Surveillance-Methods-Toolkit. This toolkit includes guidance on developing ED injury data subsets and injury indicators.

References

1. Gould DW, Walker D, Yoon PW. The Evolution of BioSense: Lessons Learned and Future Directions. *Public Health Rep*. 2017;132(1_suppl):7S-11S. doi:10.1177/0033354917706954

2. Centers for Disease Control and Prevention (CDC). National Syndromic Surveillance Program (NSSP). *What is Syndromic Surveillance?* https://www.cdc.gov/nssp/overview.html. Accessed May 22, 2023.

3. Wisconsin State Legislature. Wisconsin Statutes, Chapter 153. https://docs.legis.wisconsin.gov/statutes/statutes/153. Accessed May 22, 2023.

4. Wisconsin Department of Health Services, Division of Public Health, Office of Health Informatics. *Wisconsin Implementation Guide for Syndromic Surveillance*. https://www.dhs.wisconsin.gov/publications/p02290.pdf. Published 2018. Accessed May 22, 2023.

5. Wisconsin Department of Health Services, Division of Public Health. Wisconsin *Messaging Guide for Syndromic Surveillance: HL7 2.5.1 Messaging Guide for Emergency, Inpatient, Non-urgent Ambulatory, and Urgent Care Settings.* https://www.dhs.wisconsin.gov/publications/p02231.pdf. Published 2022. Accessed May 22, 2023.

Appendix A: Self-Harm Example

Step 1. Determine the health indicator to query using syndromic data.

a) Is self-harm injury experiencing spikes or unusual changes or patterns?

   Though Wisconsin overall had similar annual rates of self-harm ED visits from 2017 to 2021, some populations experienced increases. Additionally, this health issue may experience seasonal changes/spikes for which syndromic data could be valuable with more immediate recognition of changes.

b) Was there a current event, natural disaster or wide-spread outbreak impacting this, or related, health outcomes?

   COVID-19 led to significant changes in behaviors and policies which impacted mental health and self-harm/suicidal actions and thoughts for many. Review of SyS data could alert public health officials of spikes in self-harm/suicide attempts and the populations most at risk.

c) Is timeliness of data important for your work preventing self-harm injuries and suicide attempts? Do you need to respond to an immediate or emerging public health emergency? Is your area experiencing spikes or changes in patterns or trends that need more immediate attention? Do you need to continuously monitor self-harm injuries for changes in real time?

   As self-harm/suicide attempts may experience spikes or increasing trends due to other (sometimes more global) circumstances, the timeliness of syndromic data can help identify these changes quicker and programs addressing self-harming behaviors can adjust their activities or expand their target populations to respond to these changes.

Step 2. Determine the SyS data source and time frame you will review.

We selected 2020 for our review and "Patient Location" as the Datasource to focus on patient residency.

- Datasource: Patient Location (Full Details)
- Time Resolution: Monthly
- Start Date: January 2020; End Date: December 2020

Step 3. Select the fields your query will search.

For our evaluation of self-harm injury, we reviewed SyS non-fatal, emergency department visits in 2020.

a) Below are the fields we used [these were selected using the Query Wizard within the query portal tab]:

   - Patient State: Wisconsin
   - Facility Type: Emergency Care
   - Has been Emergency: Yes
   - C_Death: No

   If you choose to filter out visits admitted to inpatient care (by use of the "Has Been Admitted" field), we recommend discussing the validity and reliability of this field with your SyS administrator. For our evaluation, we focused on all non-fatal emergency visits.

b) Review ChiefComplaints and Discharge Diagnosis data quality.

For Wisconsin, based on the filters in 3a above, 85% of records had analytic data in the ChiefComplaints field and 88% had analytic data in the Discharge Diagnosis field based on a review of the Chief Complaint Informative and Discharge Diagnosis Informative fields.

c) Select a field to apply your query definition.

Our evaluation of self-harm/suicide attempt will focus on the CDC Suicide Attempts V1 query definition. This definition is applied to the following fields: Discharge Diagnosis (last non-null, de-duplicated list of diagnosis codes for a record); Admit Reason Combo (diagnosis codes and admission code descriptions, including the null values); and Chief Complaint History (all de-duplicated information entered as chief complaints, including all information from the first and subsequent messages).

Step 4. Run the standard CDC/NSSP query definition for your indicator and compare it to ED discharge data. Review overall and by demographics to determine if certain populations reveal greater differences.

a) Review NSSP Community of Practice Knowledge Repository.

As of April 2023, CDC had developed and validated two query definitions for syndromic surveillance of Suicide Attempts.

Suicide Attempts V1:

This query is intended to capture all instances of self-harm, regardless of suicidal intention or ideation. The code includes all relevant self-harm ICD-10-CM codes (and some ICD-9-CM codes), as well as SNOMED codes, keywords indicating self-harm, and relevant exclusions.

To run the V1 query, use the CC and DD Category field and select the Suicide Attempts V1 query definition. This definition is intended to query Discharge Diagnosis, Admit Reason Combo, and Chief Complaint History fields (this is different from the ChiefComplaints field as it stores all de-duplicated information entered as chief complaint, including information from subsequent messages; the ChiefComplaints field only contains the first non-null chief complaint and is often not as extensive as the Chief Complaint History field). If a code is found in the Discharge Diagnosis field *or* key words are found in the Chief Complaint History or Admit Reason Combo fields, the case will be selected.

(,^[;/]T14.91^,or,^[;/]T1491^,or,^[;/]X7[1-9]^,or,^[;/]X8[0-3]^,or,^[;/]T3[6-9].[X0-9][X0-9]2^,or,^[;/]T3[6-9][X0-9][X0-9]2^,or,^[;/]T[4-5][0-9].[X0-9][X0-9]2^,or,^[;/]T[4-5][0-9][X0-9][X0-9]2^,or,^[;/]T6[0-5].[X0-9][X0-9]2^,or,^[;/]T6[0-5][X0-9][X0-9]2^,or,^[;/]T71.[X0-9][X0-9]2^,or,^[;/]T71[X0-9][X0-9]2^,or,^[;/]T3[6-9].[X0-9]2X[ADS]^,or,^[;/]T3[6-9][X0-9]2X[ADS]^,or,^[;/]T[4-5][0-9].[X0-9]2X[ADS]^,or,^[;/]T[4-5][0-9][X0-9]2X[ADS]^,or,^[;/]T6[0-5].[X0-9]2X[ADS]^,or,^[;/]T6[0-5][X0-9]2X[ADS]^,or,^[;/]T71.[X0-9]2X[ADS]^,or,^[;/]T71[X0-9]2X[ADS]^,or,^ [;/]T50.[ABZ][129]2^, or,^ [;/]T50[ABZ][129]2^,or,^[;/]E95[0-9]^,or,^82313006^,or,^55554002^,or,^287181000^,or,^891003^,or,^44301001^,or,^53846008^,or^274228002^,or,^86849004^,or,^287182007^,or,^287190007^,or,^269725004^,or,^287181000^,or,^460991000124106^,or,^59274003^,),or,(,(,(,^ATTEMPT^,ANDNOT,^NO ATTEMPT^,),OR,^[;/]TRY^,OR,TRY^,OR,^TRIED TO^,OR,(,^INTENTIONAL^,ANDNOT,(,^UNINTENTIONAL^,OR,^ACCIDENTAL^,),),),AND,(,^KILL^,OR,(

,^HANG^,ANDNOT,^CHANG^,),OR,^SHOOT^,OR,^OVERDOSE^,OR,^[/ ;.]OD[/ ;.]^,OR,OD,OR,OD[/ ;.]^,OR,^[/ ;.]OD,OR,^
END^LIFE^,OR,^SUICIDE^,OR,^SUIC^,OR,^SUCI^,OR,(,^SUSCI^,ANDNOT,^RESUSCI^,),OR,^SUISID^,),or,SUICIDE,),ANDNOT,(,^END OF LIFE^,OR,^END OF BATTERY LIFE^,OR,^DENIE[SD] SELF HARM^,OR,^NO SELF HARM^,OR,^ACCIDENT^,OR,^HOMICI^,OR,^DENIE[SD] SI[\/;.]^,OR,^DENIE[SD] SI,OR,^DENIE[SD] ANY SI[\/;.]^,OR,^DENIE[SD] ANY SI,OR,^DENIE[SD] CURRENT SI[\/;.]^,OR,^DENIE[SD] CURRENT SI,OR ^NO SI[\/;.]^,OR,^NO SI,OR,^NOT SI[\/;.]^,OR,^NOT SI,OR,^DENIE[SD] SUIC^,OR,^DENIE[SD] CURRENT SUIC^,OR,^DENIE[SD] ANY SUIC^,OR,^DENIE[SD] S/H^,OR,^RT SI[\/;.]^,OR,^RT SI,OR,^RIGHT SI[\ /;.]^,OR,^RIGHT SI,OR,^NOT SUIC^,)

Suicide Attempts V2:

This query captures only those instances where a discharge diagnosis or chief complaint specifically references suicide attempt, or suicidal ideation is noted in the record (either in key words, ICD-10-CM, or SNOMED codes) in addition to self-harm codes or key words (see the Definition Factsheet and Technical Brief at: https://cdn.ymaws.com/www.cste.org/resource/resmgr/pdfs/CDC_Suicide_Attempt_v2.pdf). There are also codes and key words that are used as exclusions. Exclusions attempt to remove cases erroneously captured by the query code inclusion terms. For instance, the inclusion terms ^intentional^ AND ^overdose^ would capture cases with chief complaint phrases of “intentional overdose.” However, it would also capture cases with “un**intentional overdose**.” Adding ANDNOT,^unintentional overdose^, will exclude those cases.

To run the V2 query, use the CC and DD Category field and select the Suicide Attempts V2 query definition. This definition is intended to query the Discharge Diagnosis History and Chief Complaint History fields. If a code or key word is found in either field, the case will be selected.

(,(,^[;/]T14.91^,or,^[;/]T1491^,or,^[;/]82313006^,OR,^[;/]891003^,OR,^[;/]44301001^,OR,^[;/]53846008^,OR,^[;/]55554002^,OR,^[;/]461211000124103^,OR,^[;/]86849004^,OR,^[;/]269725004^,OR,^[;/]274228002^,OR,^[;/]287181000^,OR,^[;/]287182007^,OR,^[;/]287190007^,OR,^[;/]460991000124106^,OR,^[;/]288311002^,OR,^[;/]287185009^,OR,^[;/]287183002^,OR,^[;/]287184008^,OR,^[;/]287186005^,OR,^[;/]36153001^,OR,^[;/]269808005^,OR,^[;/]460981000124108^,OR,^[;/]461181000124102^,OR,^[;/]461201000124101^,OR,^[;/]461131000124103^,OR,^[;/]461161000124107^,OR,^[;/]461111000124109^,OR,^[;/]461151000124105^,OR,^[;/]440144004^,OR,^[;/]370908002^,OR,^[;/]287194003^,OR,^[;/]287188006^,OR,^[;/]287192004^,OR,^[;/]287193009^,OR,^[;/]287195002^,OR,^[;/]287191006^,OR,^[;/]78070009^,OR,^[;/]287189003^,OR,^[;/]23546003^,OR,^[;/]461271000124107^,),OR,(,(,^[;/]X7[1-9]^,or,^[;/]X8[0-3]^,or,^[;/]T3[6-9].[X0-9][X0-9]2^,or,^[;/]T3[6-9][X0-9][X0-9]2^,or,^[;/]T[4-5][0-9].[X0-9][X0-9]2^,or,^[;/]T[4-5][0-9][X0-9][X0-9]2^,or,^[;/]T6[0-5].[X0-9][X0-9]2^,or,^[;/]T6[0-5][X0-9][X0-9]2^,or,^[;/]T71.[X0-9][X0-9]2^,or,^[;/]T71[X0-9][X0-9]2^,or,^[;/]T3[6-9].[X0-9]2X[ADS]^,or,^[;/]T3[6-9][X0-9]2X[ADS]^,or,^[;/]T[4-5][0-9].[X0-9]2X[ADS]^,or,^[;/]T[4-5][0-9][X0-9]2X[ADS]^,or,^[;/]T6[0-5].[X0-9]2X[ADS]^,or,^[;/]T6[0-5][X0-9]2X[ADS]^,or,^[;/]T50.[ABZ][129]2^,or,^[;/]T50[ABZ][129]2^,or,^[;/]248073004^,or,^[;/]225045006^,or,^[;/]307578000^,or,^[;/]225050000^,or,^[;/]225049000^,or,^[;/]224946001^,or,^[;/]224945002^,or,^[;/]224947005^,or,^[;/]284759005^,or,^[;/]224949008^,or,^[;/]224948000^,),AND,(,^R45.851^,or,^R45851^,or,^[;/]6471006^,or,^[;/]247650009^,or,^[;/]225457007^,or,^[;/]425104003^,or,^[;/]304594002^,or,^[;/

]225444004^,or,^[;/]267073005^,),),),OR,(,(,(,(,(,^R45.851^,or,^R45851^,),OR,(,^[;/]6471006^,or,^[;/]247650009^,or,^[;/]225457007^,or,^[;/]425104003^,or,^[;/]304594002^,or,^[;/]225444004^,or,^[;/]267073005^,),),AND,(,^suicidal attempt^,or,^SI attempt^,or,(,(,^attempt^,or,^try^,or,^tried^,or,^intentional^,or,^commit^,or,^comit^,),and,(,^kill^sel[FV]^,or,^end life^,or,^SU[SC]CIDE^,OR,^SUI[SC]IDE^,OR,^SIU[CS]IDE^,OR,^SU[SC][IU]DE^,),),OR,(,(,(,^attempt^,or,^try^,or,^tried^,or,^intentional^,),AND,(,hang^,or,^shoot^,or,^overdose^,or,^drug overdose^,or,^[;]OD[;]^,or,^drug ingestion^,or,^poisoning^,or,^poison ingestion^,),),or,(,^self-injury^,or,^self-inflicted harm^,or,^harm to self^,or,^Self-Directed Violence^,or,^Self-harm^,),),),),OR,^suicidal attempt^,or,^SI attempt^,or,(,(,^attempt^,or,^try^,or,^tried^,or,^intentional^,or,^commit^,or,^comit^,),and,(,^kill^sel[FV]^,or,^end life^,or,^SU[SC]CIDE^,OR,^SUI[SC]IDE^,OR,^SIU[CS]IDE^,OR,^SU[SC][IU]DE^,),),or,(,(,(,(,^attempt^,or,^try^,or,^tried^,or,^intentional^,),AND,(,hang^,or,^shoot^,or,^overdose^,or,^drug overdose^,or,^[;]OD[;]^,or,^drug ingestion^,or,^poisoning^,or,^poison ingestion^,),),or,(,^self-injury^,or,^self-inflicted harm^,or,^harm to self^,or,^Self-Directed Violence^,or,^Self-harm^,),),AND,(,^suicidal^,or,^suicide ideation^,or,(,^want,and,^die^,),or,(,^want,and,(,^life^,and,^end^,),),or,(,(,^plan^,or,^want^,or,^going to^,),and,(,^self^,),and,(,^harm^,or,^hurt^,or,(,^hang^,andnot,^chang^,),or,^inflict^,or,^kill^sel[fv]^,or,^lacera^,or,^mutilat^,or,^shoot^,or,^stab^,or,^cut^,),),),),OR,(,(,(,^[;/]X7[1-9]^,or,^[;/]X8[0-3]^,or,^[;/]T3[6-9].[X0-9][X0-9]2^,or,^[;/]T3[6-9][X0-9][X0-9]2^,or,^[;/]T[4-5][0-9].[X0-9][X0-9]2^,or,^[;/]T[4-5][0-9][X0-9][X0-9]2^,or,^[;/]T6[0-5].[X0-9][X0-9]2^,or,^[;/]T6[0-5][X0-9][X0-9]2^,or,^[;/]T71.[X0-9][X0-9]2^,or,^[;/]T71[X0-9][X0-9]2^,or,^[;/]T3[6-9].[X0-9]2X[ADS]^,or,^[;/]T3[6-9][X0-9]2X[ADS]^,or,^[;/]T[4-5][0-9].[X0-9]2X[ADS]^,or,^[;/]T[4-5][0-9][X0-9]2X[ADS]^,or,^[;/]T6[0-5].[X0-9]2X[ADS]^,or,^[;/]T6[0-5][X0-9]2X[ADS]^,or,^[;/]T50.[ABZ][129]2^,or,^[;/]T50[ABZ][129]2^,),OR,(,^[;/]248073004^,or,^[;/]225045006^,or,^[;/]307578000^,or,^[;/]225050000^,or,^[;/]225049000^,or,^[;/]224946001^,or,^[;/]224945002^,or,^[;/]224947005^,or,^[;/]284759005^,or,^[;/]224949008^,or,^[;/]224948000^,),),AND,(,^suicidal attempt^,or,^SI attempt^,or,(,(,^attempt^,or,^try^,or,^tried^,or,^intentional^,or,^commit^,or,^comit^,),and,(,^kill^sel[FV]^,or,^end life^,or,^SU[SC]CIDE^,OR,^SUI[SC]IDE^,OR,^SIU[CS]IDE^,OR,^SU[SC][IU]DE^,),),OR,(,^suicidal^,or,^suicide ideation^,or,(,^want,and,^die^,),or,(,^want,and,(,^life^,and,^end^,),),or,(,(,^plan^,or,^want^,or,^going to^,),and,(,^self^,),and,(,^harm^,or,^hurt^,or,hang^,or,^inflict^,or,^kill^sel[fv]^,or,^lacera^,or,^mutilat^,or,^shoot^,or,^stab^,or,^cut^,),),),),),),),ANDNOT,(,^D[EN][EN]IE[SD] ^ [HS]I^,or,^nonsuicidal^,or,^DENY^ [HS]I^,or,^NO ATTEM[PT]^,or,^NO ATEM[PT]^,or,^NOT ATTEM[PT]^,or,^NOT ATEM[PT]^,or,^previous attem[pt]^,or,^past atem[pt]^,or,^history of attem[pt]^,or,^history of atem[pt]^,or,^history of suicid^,or,^end of life^,or,^end of battery life^,or,^D[EN][EN]IE[SD] ^ attem[pt]^,or,^deny^ attem[pt]or,^D[EN][EN]IE[SD] ^ atem[pt]^,or,^deny^ atem[pt],or,^previous^suicid^,or,^past ^suicid^,or,^suicide^ past^,or,^history of suicid^,or,^deny^ suicid^,or,^D[EN][EN]IE[SD] ^ suicid^,or,^deny^ ideation^,or,^D[EN][EN]IE[SD] ^ ideation^,or,^D[EN][EN]IE[SD] ^ now^,or,^D[EN][EN]IE[SD][-]self harm^,or,^deny^ self[-]harm^,or,^no self[-]harm^,or,^not self[-]harm^,or,^unintentional suicid^,or,^accidental suicid^,or,^non-suicid^,or,^non suicid^,or,^no suicid^,or,^not suicid^,or,^not a suicid^,or,^not want^ die^,or,^not try^ die^,or,^not want^ kill^sel[fv]^,or,^D[EN][EN]IE[SD] ^ kill^sel[fv]^,or,^DENY^

kill^sel[fv]^,or,^not try^ kill^sel[fv]^,or,^not try^ end^life^,or,^didn^t try^ die^,or,^didn^t try^ kill^sel[fv]^,or,^didn^t try^ end^life^,or,^wasn^t try^ die^,or,^wasn^t try^ kill^sel[fv]^,or,^wasn^t try^ end^life^,or,^didn^t want^ die^,or,^didn^t want^ kill^sel[fv]^,or,^didn^t want^ end^life^,or,^not want^ die^,or,^not want^ kill^sel[fv]^,or,^not want^ end^life^,or,^D[EN][EN]IE[SD]^ harm^self^,or,^deny^ harm^self^,),)

We reviewed the V2 query definition in order to determine if changes to the ICD-10-CM or SNOMED codes, keywords, or exclusions were more extensive than V1 or improved upon V1. However, we did not focus our comparison on the V2 results as the requirement for suicidal intention/attempt would exclude a large number of self-harm cases. Self-harm behavior is more likely to lead to repeat instances of self-harm and potential suicide, therefore, we focused on a more inclusive definition to describe the burden. Additionally, suicidal ideation or attempt may not be consistently recorded in SyS records (or discharge records, for that matter). Without knowledge of the reliability and validity of the use of these codes, we could underestimate suicidal intent by requiring the existence of these within the record.

For comparison purposes, we did run the V2 query which produced a case count for 2020 that was 41% less than ED discharge data and 46% less than SyS Suicide Attempts V1. A lesser count based on V2 was expected due to the requirement of suicidal ideation/intention noted in the record. However, this reduction is quite significant, and we are unable to determine if it is reasonable to assume this kind of distribution between self-harm with and without suicidal attempt or ideation.

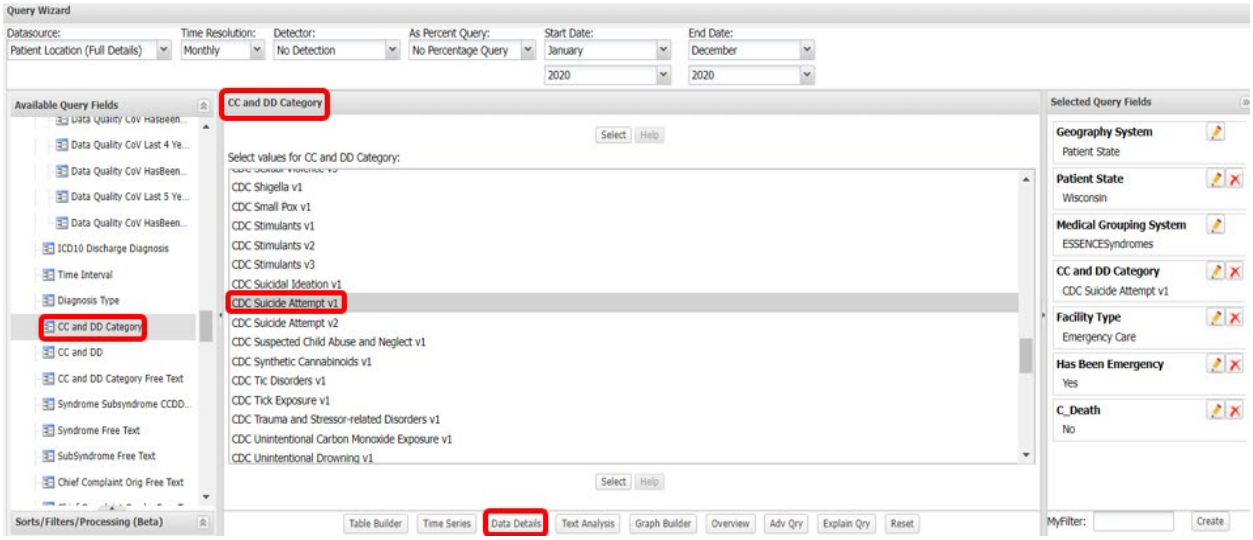
b) Reach out to other professionals and colleagues to ask if they have developed or adjusted queries on the topic and what their findings reveal.

During our review, we received advice from the Kansas Health Department, NSSP staff, and the Syndromic Surveillance Data Analysis team at the Wisconsin Department of Health Services.

c) Run the query.

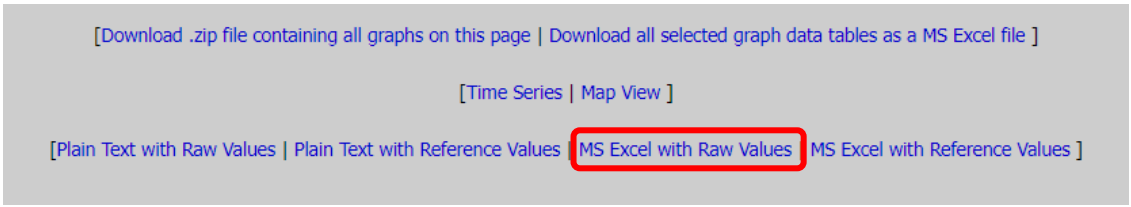
Once you have selected a standard query definition, first assess the number of records your query will return by choosing Time Series or Table Builder from the options at the bottom of your screen. This will help you assess whether or not your counts look correct and will run quicker then choosing “Data Details.” If the count appears appropriate or reasonable, you can then run the query by clicking the “Data Details” button.

Figure 1A. ESSENCE query wizard screenshot.



The data output can be downloaded for further analysis (see screenshot below).

Figure 2A. ESSENCE data download screenshot.



d) Assess the "missingness" of variables in your data.

Below are the variables we reviewed for completeness in ED Discharge Data and SyS data for Suicide Attempt V1 query definition.

Table 1A. Variable "missingness" for self-harm injury by data source; 2020.

Variable	Wisconsin ED Discharge Data (N=6465)		SyS Suicide Attempt V1 (N=7054)	
	N	%	N	%
Date	0	0	0	0
Age in years	0	0	100	1
Hispanic ethnicity	126	2	636	9
Patient county	0	0	0	0
Race	262	4	482	7
Sex	<5	0	<5	<1

As evident in Table 1A, race and Hispanic ethnicity has a greater percentage of "missingness" in SyS.

In addition to the variables above, we conducted a quick review of DOB (date of birth) and "age in years" to determine if there were any outliers. We noticed 8 cases had age values over 110 years. These were noted as unusual, and we discovered that DOB was missing for these cases. We also noted an illegal age value of -1 for 92 cases. Before conducting step 4e below, we recategorized these as "missing/unknown" in SAS (this cannot be done within ESSENCE). We recommend that you take a quick look at key variables to assess outliers or illegal values within your dataset.

e) Compare results from your query to ED discharge data: review data by age group, sex, race, ethnicity, geography, and other variables of interest for your jurisdiction. Compare percentage differences overall and by demographic subpopulations.

Table 2A. Wisconsin ED discharge data and Syndromic (SyS) Suicide Attempts V1 comparison by demographics; 2020.

	Wisconsin ED Discharge		**SyS Suicide Attempt V1**		
	N	**Percent (%)**	**N**	**Percent (%)**	**% Difference**
Total	6465	100	7054	100	9.1
Subpopulations subject to focused prevention efforts in Wisconsin					
Females, 10-19 years	2084	32.2	1711	24.3	-17.9
Rural males aged 25+	394	6.1	372	5.3	-5.6
Age Group					
0-9	21	0.3	13	0.2	-38.1
10-14	961	14.9	705	10.0	-26.6
15-19	1778	27.5	1552	22.0	-12.7
20-24	922	14.3	933	13.2	1.2
25-34	1295	20.0	1421	20.1	9.7
35-44	690	10.7	993	14.1	43.9
45-54	444	6.9	720	10.2	62.2
55-64	249	3.9	368	5.2	47.8
65-74	65	1.0	164	2.3	152.3
75+	40	0.6	85	1.2	112.5
Missing/Unknown*	0	0.0	100	1.4	-
Sex					
Female	4115	63.7	4391	62.3	6.7
Male	2349	36.3	2662	37.7	13.3
Missing/Unknown	#	0.0	#	0.0	-
Race					
American Indian	219	3.4	173	2.5	-21.0
Asian or Pacific Islander	62	1.0	90	1.3	45.2
Black	856	13.2	880	12.5	2.8
White	5063	78.3	5199	73.7	2.7

Other	#		230	3.3	
Missing/Unknown	262	4.1	482	6.8	84.0
Ethnicity					
Hispanic	470	7.3	489	6.9	4.0
Non-Hispanic	5869	90.8	5929	84.1	1.0
Missing/Unknown	126	2.0	636	9.0	404.8
Geographic Region					
Northeastern	1434	22.2	1697	24.1	18.3
Northern	610	9.4	589	8.3	-3.4
Southeastern	1951	30.2	2372	33.6	21.6
Southern	1520	23.5	1589	22.5	4.5
Western	950	14.7	807	11.4	-15.1
Geographic Area					
Rural	1936	30.0	1717	24.3	-11.3
Urban	4529	70.1	5337	75.7	17.8

*Missing age for SyS is based on recategorized cases with illegal age values or missing DOB information. # Indicates a value less than 5 that has been suppressed to protect confidentiality.
[1]Percentage column represents the percentage of the total number of cases for each focus population.

f) Identify subpopulations with greater differences.

Compared to ED discharge data, V1 identified 9% more cases overall. Older subpopulations had higher percentage differences (with more cases identified by SyS). Visits with self-harm injury among younger age groups appear to be underestimated by SyS data.

Step 5. Complete a narrative review of SyS cases identified by the query definition to assess accuracy.

We initially reviewed 360 cases (5%). Though we found the largest percentage differences among populations older than 65 years, the greatest number of cases were identified among the younger age groups. This is a good example of the need for a narrative review that considers where the largest percentage differences appear (such as the older populations) as well as the need to conduct a wider narrative review of all cases.

a) Expand the fields you review in order to get a broader picture.

We recommend reviewing the following fields during your narrative review: ChiefComplaints, Discharge Diagnosis, Chief Complaint History, Discharge Diagnosis History, Triage Notes Orig, and Admit Reason Combo. Reviewing all of these fields will provide you with more information to determine if the query is selecting cases appropriately or if there is a pattern of misidentification. It will also help you asses which fields are most appropriate to include in your adjusted query definition.

Based on our review of 360 cases, 283 (79%) were confirmed as intentional self-harm by supportive narrative with and without corresponding self-harm codes; 30 (8%) had a self-harm code without narrative to support confirmation; 4 (1%) were undetermined due to conflicting ICD-

10-CM codes and/or conflicting narrative; and 43 (12%) were not related to self-harm injury (this included: follow-up visits for previous self-harm; visits not related to any type of injury; mental health visits with no action or injury related to self-harm; and visits identified due to SyS inappropriately parsing keywords or phrases). If we assume that the 8% with only a self-harm code and no supportive narrative were indeed valid cases, our narrative review would suggest an upper range of identification of 87% valid cases by this query.

In addition to the narrative review discussed above, we conducted a few other targeted narrative reviews based on some of our findings and assumptions (see steps 5b and 5c for more details).

b) Is there a specific population where you noted the differences were more extreme? Is this a population of interest where you could focus your narrative review?

We noted a 137% greater number of cases among those 65 years and older based on Suicide Attempts V1 compared to ED discharge data. For cases identified by V1, we reviewed narratives for 45% (112). We confirmed that 64% (72) were self-harm (with supporting narrative or the suicide attempt code T1491), 13% (15) had only a self-harm code but no supporting narrative, 1% (1) was undetermined (contradictory intent codes or unclear narrative), and 21% (24) had no self-harm injury. The query appears to be less accurate for the older age groups compared to our overall narrative review findings. During this review, we noted several invalid cases were due to follow-up/sequelae visits for self-harm (rather than initial encounters). Based on this, we specified the encounter type in our list of ICD-10-CM codes (A in the 7th character) for our new query definition. Though we were able to adjust our code based on this review, this age group only accounted for 3.5% of overall cases, so we conducted additional targeted reviews of 2 other subpopulations.

One subpopulation of interest in Wisconsin includes females ages 10-19; accounting for 32% of overall ED discharge visits and 24% of SyS visits. SyS identified 373 fewer visits compared with ED discharge data (18% less). We reviewed 86 visits in SyS (5% identified for this subpopulation). Of the visits we reviewed, 83% (71 cases) were self-harm (there was supporting narrative or the suicide attempt code T1491), 12% (10) had only a self-harm code but no supporting narrative, 5% (4) were undetermined (contradictory intent codes or unclear narrative), and 1% (1) had no self-harm injury. Based on this review, the query appears to perform well by identifying 95% valid cases (if assuming the 12% identified by code alone were also valid), though, based on the discrepancy with discharge data, it appears to miss (or underestimate) valid cases of self-harm as well. In other words, the query is specific but perhaps not sensitive.

We also reviewed visits among patients 45-54 years of age due to the large difference with ED discharge data and greater representation of overall visits among this subpopulation. We reviewed 40 cases (5%): 28 (70%) were confirmed by narrative or T1491 code, 10 (25%) had a self-harm code without supportive narrative, and 2 (5%) were categorized as undetermined. No cases were categorized as “no self-harm injury.” As with the females ages 10-19, it appears that the query is working well identifying valid cases based on the information available/included in the record. Unlike females 10-19, the query identified a greater number of cases compared with ED discharge data.

c) Do you know something about your health topic that might influence certain subpopulations more than others and may be misidentified by SyS data.

We suspected that cases identified by keywords and codes related to overdose might be misidentified as intentional. We focused a targeted narrative review on cases with chief complaints of “accidental overdose,” “ingestion,” “overdose,” and "drug abuse” with an ICD-10-CM code of T50.902A (Poisoning by unspecified drugs, medicaments and biological substances, intentional self-harm). We identified 804 cases with one of these keywords and the ICD-10-CM code T50.902A. We reviewed the ChiefComplaints, Discharge Diagnosis, and Triage Notes Orig fields for 300 of these cases. Based on our review, 184 cases (61%) were intentional self-harm, 81 (27%) had a self-harm code with no supporting narrative, 5 (2%) were undetermined (contradictory intent codes or unclear narrative), and 30 (10%) were categorized as “no self-harm injury.” Based on this review, the evidence does not support excluding these cases from a self-harm definition.

d) What are the exclusions in the query code (i.e., which terms, codes, or key phrases are identified for exclusion as a case) and are there any exclusions that should be included but are not?

The exclusions are noted by the ANDNOT section. We reviewed the list of keywords, terms, and phrases identified as exclusions in both Suicide Attempts V1 and V2 query definitions.

The V1 exclusions include:

```
ANDNOT,(,^END OF LIFE^,OR,^END OF BATTERY LIFE^,OR,^DENIE[SD] SELF HARM^,OR,^NO SELF HARM^,OR,^ACCIDENT^,OR,^HOMICI^,OR,^DENIE[SD] SI[ \/;.]^,OR,^DENIE[SD] SI,OR,^DENIE[SD] ANY SI[ \/;.]^,OR,^DENIE[SD] ANY SI,OR,^DENIE[SD] CURRENT SI[ \/;.]^,OR,^DENIE[SD] CURRENT SI,OR ^NO SI[ \/;.]^,OR,^NO SI,OR,^NOT SI[\/;.]^,OR,^NOT SI,OR,^DENIE[SD] SUIC^,OR,^DENIE[SD] CURRENT SUIC^,OR,^DENIE[SD] ANY SUIC^,OR,^DENIE[SD] S/H^,OR,^RT SI[ \/;.]^,OR,^RT SI,OR,^RIGHT SI[\ /;.]^,OR,^RIGHT SI,OR,^NOT SUIC^,).
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As an example, the exclusion ^DENIE[SD] SUIC^ will remove cases initially captured by the inclusion of: ^SUIC^,OR,^SUCI^,OR,(,^SUSCI^,ANDNOT,^RESUSCI^,),OR,^SUISID^,),or,SUICIDE. In other words, cases with ChiefComplaints indicating “denies or denied suicide” will not be identified as a case by the query definition. [V2 includes similar code.]

The V2 exclusions contain more terms than V1 (we used this list of exclusions as the starting point for our new self-harm query definition):

Note: the blue text below refers to codes or key words that were later adjusted based on our narrative review.

```
ANDNOT,(,^D[EN][EN]IE[SD] ^ [HS]I^,or,^nonsuicidal^,or,^DENY^ [HS]I^,or,^NO ATTEM[PT]^,or,^NO ATEM[PT]^,or,^NOT ATTEM[PT]^,or,^NOT ATEM[PT]^,or,^previous attem[pt]^,or,^past atem[pt]^,or,^history of attem[pt]^,or,^history of atem[pt]^,or,^history of suicid^,or,^end of life^,or,^end of battery life^,or,^D[EN][EN]IE[SD] ^ attem[pt]^,or,^deny^ attem[pt]or,^D[EN][EN]IE[SD] ^ atem[pt]^,or,^deny^ atem[pt],or,^previous^suicid^,or,^past ^suicid^,or,^suicide^ past^,or,^history of suicid^,or,^deny^ suicid^,or,^D[EN][EN]IE[SD] ^ suicid^,or,^deny^ ideation^,or,^D[EN][EN]IE[SD] ^ ideation^,or,^D[EN][EN]IE[SD] ^ now^,or,^D[EN][EN]IE[SD][ -]self harm^,or,^deny^ self[ -]harm^,or,^no self[ -]harm^,or,^not self[ -]harm^,or,^unintentional suicid^,or,^accidental suicid^,or,^non-suicid^,or,^non
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suicid^,or,^no suicid^,or,^not suicid^,or,^not a suicid^,or,^not want^ die^,or,^not try^ die^,or,^not want^ kill^sel[fv]^,or,^D[EN][EN]IE[SD] ^ kill^sel[fv]^,or,^DENY^ kill^sel[fv]^,or,^not try^ kill^sel[fv]^,or,^not try^ end^life^,or,^didn^t try^ die^,or,^didn^t try^ kill^sel[fv]^,or,^didn^t try^ end^life^,or,^wasn^t try^ die^,or,^wasn^t try^ kill^sel[fv]^,or,^wasn^t try^ end^life^,or,^didn^t want^ die^,or,^didn^t want^ kill^sel[fv]^,or,^didn^t want^ end^life^,or,^not want^ die^,or,^not want^ kill^sel[fv]^,or,^not want^ end^life^,or,^D[EN][EN]IE[SD]^ harm^self^,or,^deny^ harm^self^,),)

As an example, the V2 exclusion: ^DENY^ kill^sel[fv]^, will remove cases with phrases in the Chief Complaint History field of "deny wanted to kill him/herself" that would have been initially captured by the inclusion criteria of ^kill^sel[FV]^.

- The V2 query definition excludes visits with a reference to a history of self-harm or suicide attempt. We decided to remove these keyword exclusions from our new query definition as a patient can have a history of self-harm/suicide attempt *in addition to* a current event related to self-harm or suicide attempt. Based on running the V2 query as intended, a removal of these exclusion phrases resulted in 10 additional cases identified by the query.

- Based on our narrative review, we also noted several key words/phrases that should be used to exclude cases. Cases were identified with the following key words in the Chief Complaint History field for both V1 and V2 with no other ICD-10-CM or SNOMED code or key word indicating self-harm injury: "accidentally cutting himself or herself," "unintentional cutting himself or herself," "unintentional hurting himself or herself," "shooting pain," "attempting to hang a deer," "trying to hang picture/clothes/robe/curtains," or "unintentional/accidental overdose." These terms were added as exclusions for our Wisconsin self-harm query definition.

e) Check the accuracy of ICD-10-CM codes and SNOMED codes if these are used in the query. Verify that ICD-9-CM codes are not listed in current queries or check for SNOMED codes that may or may not be reported by your jurisdiction's emergency departments.
    - V1 and V2 ICD-10-CM codes included subsequent and sequelae cases (with D or S in the 7th position) instead of limiting to first encounter (A in the 7th position).
    - Suicide attempt V1 uses the code ^[;/]E95[0-9]^, which is a code associated with ICD-9-CM.
    - Compared to Version 1, V2 has more SNOMED codes, which complies with NSSP intention to add these to new queries.

f) Consider a variety of ways to spell or write key words or phrases (including additional clinical terms or symptoms).

For example, the original code had inclusion terms of "self-inflicted" and "self-harm." These precise key words meant that the query would fail to recognize cases with key words "self inflicted" and "self harm" (note the missing hyphens). We noted that a number of valid self-harm cases were not captured by the more restrictive, original code.

g) Are there instances where Boolean logic identified cases that were not relevant for our health indicator?

Unlike V1, where query narrative captures all self-harm injury regardless of intent, V2 captures only self-inflicted injuries associated with suicidal attempt or ideation. For the new Wisconsin self-harm query definition, the association with ICD-10-CM R45.851 (suicidal ideation) or SNOMED codes indicating suicidal planning, feelings, behavior, or intention, was removed in order to capture not only suicide cases, but a broader spectrum of self-harm injuries.

Step 6. Adjust the SyS query definition based on alterations supported by your narrative review. Run the new query and compare with ED discharge data.

a) NSSP technical supports were reviewed for suggested alterations; none were available.

b) Next, we assessed the fields that we wanted to search/query.

The Chief Complaint History field contains updated information from facilities, and we include this in our new query definition, as well as the Discharge Diagnosis field.

Based on our narrative review, we did not find that the Admit Reason Code field yielded new information and the Triage Notes Orig helped us confirm findings in the Chief Complaint History and/or Discharge Diagnosis History fields. Though we tested our new query definition by searching the Chief Complaint History and Discharge Diagnosis History fields initially, we compared the cases removed from our count when we restricted to the Chief Complaint History and Discharge Diagnosis fields (based on last, non-null, de-duplicated diagnoses codes) and discovered that including the Discharge Diagnosis History field in our definition led to over-identification of invalid cases (85%; see Table 5A below for more detail).

c) Modify, adjust, add, or remove keywords or codes in the query, based on your narrative review.

- For the new query, we used V2 as our starting point as this code was more recently developed and tested.
- For the Wisconsin self-harm query definition, we included all ICD-10-CM codes from V1 and V2 indicating self-harm injury.
- Due to a more complete, and more updated list of SNOMED codes contained in V2, we kept these in the new query.
- Adjustments to the ICD-10-CM codes were made to focus on initial encounters (A in the 7th character). The way the query is currently written, subsequent and sequelae encounters (D or S in the 7th character) would also be included.
- Keywords ^intentional^, ^hang^, and ^shot^ were adjusted to ^ intentional^, ^ hang^, and ^ shoot^ to avoid pulling cases such as “un**intentional**”, “c**hang**e”, or “up**shoot**ing.” [Note: a space was added before each word in the adjusted version.]
- Keywords ^intentional ^ hurt^ h^sel[vf]^ were added to capture cases referring to a general injury expression.
- Adjustments were made to the expressions: ^self[-]injury^, ^self[-]inflicted harm^, ^Self[-]Directed Violence^, and ^Self[-]harm^. We added “[-]” to capture different spelling possibilities with a hyphen or a space between words.

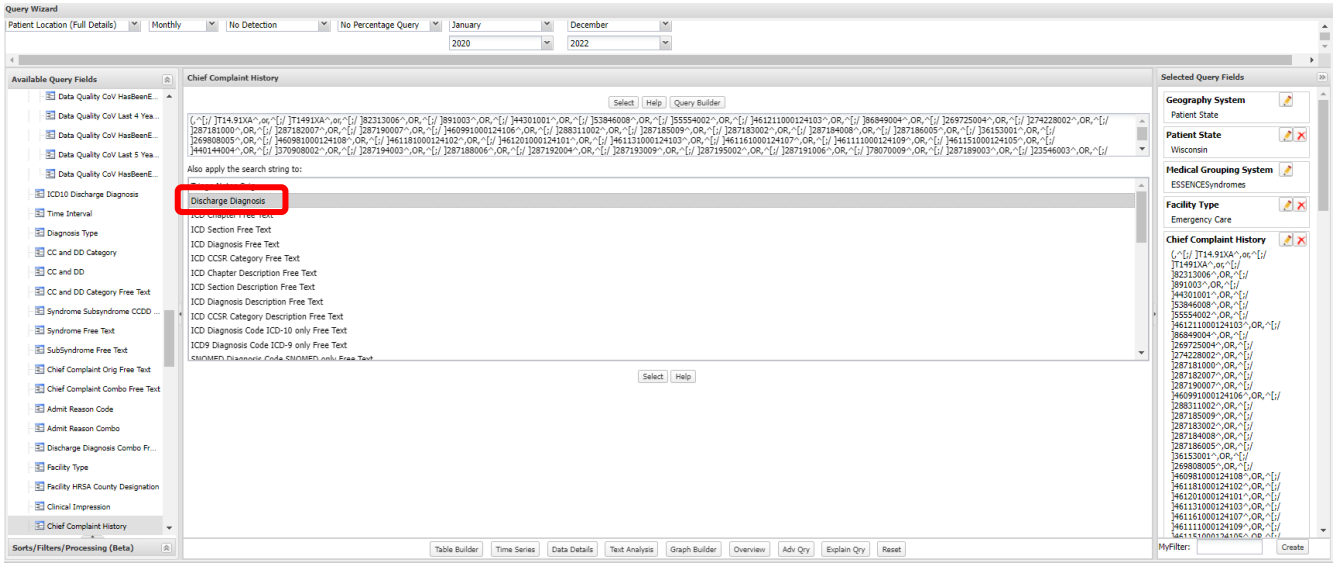
- We removed the requirement (Boolean logic code) of a suicide attempt or suicidal ideation ICD-10-CM code or SNOMED code related to suicidal feelings/planning/ideation. Coding for suicidal ideation or attempt may prove too restrictive; it also requires the determination of ideation/attempt that may not be made or asked of the patient. Self-harm behavior is still a concern for future suicide attempts and death by suicide, so we decided it was not appropriate to use the restrictive logic of V2.
- We removed exclusion keywords indicating past history of self-harm or suicide attempt (these were part of the V2 code) as this does not account for instances where this exists in tandem with a current event.
- Exclusion clauses related to denying self-harm were adjusted to account for instances where self-harm was written without a space or hyphen (i.e., selfharm).
- Exclusions were added to remove cases related to accidental/unintentional cutting or hurting oneself, "shooting pain," or "hanging" items (such as clothes or pictures).

d) Once you have adjusted the query, run this in SyS and spot check narratives to confirm inclusion or exclusion of cases based on your criteria. Pay particular attention to syntax, misspellings, Boolean operators (and their order), commas, and carets.

Wisconsin Self-harm SyS Query: Below is the query string to be applied to the Chief Complaint History and Discharge Diagnosis fields.

The query should be pasted in the blank text box within the Chief Complaint History field. Additionally, the Discharge Diagnosis field should be selected from the list of options below this text box (Note: this will function as an "OR" qualifier. If any of these terms or codes are found either in the Chief Complaint History or Discharge Diagnosis field, the case will be captured)**.**

Figure 3A. ESSENCE query wizard screenshot (Wisconsin Self-harm SyS query).



The code in blue below represents adjustments or additions made based on our narrative review.

<u>Wisconsin self-harm SyS query definition</u>

(,^[;/]T14.91XA^,or,^[;/]T1491XA^,or,^[;/]82313006^,OR,^[;/]891003^,OR,^[;/]44301001^,OR,^[;/]53846008^,OR,^[;/]55554002^,OR,^[;/]461211000124103^,OR,^[;/]86849004^,OR,^[;/]269725004^,OR,^[;/]274228002^,OR,^[;/]287181000^,OR,^[;/]287182007^,OR,^[;/]287190007^,OR,^[;/]460991000124106^,OR,^[;/]288311002^,OR,^[;/]287185009^,OR,^[;/]287183002^,OR,^[;/]287184008^,OR,^[;/]287186005^,OR,^[;/]36153001^,OR,^[;/]269808005^,OR,^[;/]460981000124108^,OR,^[;/]461181000124102^,OR,^[;/]461201000124101^,OR,^[;/]461131000124103^,OR,^[;/]461161000124107^,OR,^[;/]461111000124109^,OR,^[;/]461151000124105^,OR,^[;/]440144004^,OR,^[;/]370908002^,OR,^[;/]287194003^,OR,^[;/]287188006^,OR,^[;/]287192004^,OR,^[;/]287193009^,OR,^[;/]287195002^,OR,^[;/]287191006^,OR,^[;/]78070009^,OR,^[;/]287189003^,OR,^[;/]23546003^,OR,^[;/]461271000124107^,),OR,(,^[;/]X7[1-9]___A^,or,^[;/]X7[1-9].___A^,or,^[;/]X8[0-3]___A^,or,^[;/]X8[0-3].___A^,or,^[;/]T3[6-9].[X0-9][X0-9]2A^,or,^[;/]T3[6-9][X0-9][X0-9]2A^,or,^[;/]T[4-5][0-9].[X0-9][X0-9]2A^,or,^[;/]T[4-5][0-9][X0-9][X0-9]2A^,or,^[;/]T6[0-5].[X0-9][X0-9]2A^,or,^[;/]T6[0-5][X0-9][X0-9]2A^,or,^[;/]T71.[X0-9][X0-9]2A^,or,^[;/]T71[X0-9][X0-9]2A^,or,^[;/]T3[6-9].[X0-9]2XA^,or,^[;/]T3[6-9][X0-9]2XA^,or,^[;/]T[4-5][0-9].[X0-9]2XA^,or,^[;/]T[4-5][0-9][X0-9]2XA^,or,^[;/]T6[0-5].[X0-9]2XA^,or,^[;/]T6[0-5][X0-9]2XA^,or,^[;/]T50.[ABZ][129]2A^,or,^[;/]T50[ABZ][129]2A^,or,^[;/]248073004^,or,^[;/]225045006^,or,^[;/]307578000^,or,^[;/]225050000^,or,^[;/]225049000^,or,^[;/]224946001^,or,^[;/]224945002^,or,^[;/]224947005^,or,^[;/]284759005^,or,^[;/]224949008^,or,^[;/]224948000^,),OR,(,^suicidal attempt^,or,^suicide attempt^,or, (,(,^attempt^,or,^ try^,or,^ tried^,or,^ intentional^,or,^commit^,or,^comit^,),and,(,^kill^sel[FV]^,or,^end life^,or,^SU[SC]CIDE^,OR,^SUI[SC]IDE^,OR,^SIU[CS]IDE^,OR,^SU[SC][IU]DE^,),),OR,(,(,(,^attempt^,or,^ try^,or,^ tried^,or,^ intentional^,),AND,(,^ hang^,or,^ shoot^,or,^overdose^,or,^drug overdose^,or,^[;]OD[;]^,or,^drug ingestion^,or,^poisoning^,or,^poison ingestion^,or,^ cut^,or,^ lacera^,),),or,(,^intentional ^ hurt^ h^sel[vf]^,or,^self[-]injury^,or,^self[-]inflicted harm^,or,^harm to self^,or,^Self[-]Directed Violence^,or,^Self[-]harm^,or,^selfharm^,),),),ANDNOT,(,^D[EN][EN]IE[SD] ^ [HS]I^,or,^nonsuicidal^,or,^DENY^ [HS]I^,or,^NO ATTEM[PT]^,or,^NO ATEM[PT]^,or,^NOT ATTEM[PT]^,or,^NOT ATEM[PT]^,or,^ end of life^,or,^ end of battery life^,or,^D[EN][EN]IE[SD] ^ attem[pt]^,or,^deny^ attem[pt]or,^D[EN][EN]IE[SD] ^ atem[pt]^,or,^deny^ atem[pt],or,^deny^ suicid^,or,^D[EN][EN]IE[SD] ^ suicid^,or,^deny^ ideation^,or,^D[EN][EN]IE[SD] ^ ideation^,or,^D[EN][EN]IE[SD] ^ now^,or,^D[EN][EN]IE[SD] self[-]harm^,or,^deny^ self[-]harm^,or,^no self[-]harm^,or,^not self[-]harm^,or,^D[EN][EN]IE[SD] selfharm^,or,^deny^ selfharm^,or,^no selfharm^,or,^not selfharm^,or,^unintentional suicid^,or,^accidental suicid^,or,^non-suicid^,or,^non suicid^,or,^no suicid^,or,^not suicid^,or,^not a suicid^,or,^not want^ die^,or,^not try^ die^,or,^not want^ kill^sel[fv]^,or,^D[EN][EN]IE[SD] ^ kill^sel[fv]^,or,^DENY^ kill^sel[fv]^,or,^not try^ kill^sel[fv]^,or,^not try^ end^life^,or,^didn^t try^ die^,or,^didn^t try^ kill^sel[fv]^,or,^didn^t try^ end^life^,or,^wasn^t try^ die^,or,^wasn^t try^ kill^sel[fv]^,or,^wasn^t try^ end^life^,or,^didn^t want^ die^,or,^didn^t want^ kill^sel[fv]^,or,^didn^t want^ end^life^,or,^not want^ die^,or,^not want^ kill^sel[fv]^,or,^not want^ end^life^,or,^D[EN][EN]IE[SD]^ harm^self^,or,^deny^ harm^self^,or,DENIE[SD] BEING SUICIDAL^,or,^DID NOT INTENT TO KILL H^SEL[VF]^,or,(,^ hang^,AND,(,^ picture^,or,^ robe^,or,^ cloth^,or,^ deer^,or,^ curtain^,),),or,^accidental^ ^ cut^ h^sel[vf]^,or,^accidental^ ^ hurt^

h^sel[vf]^,or,^unintentional^ cut^ h^sel[vf]^,or,^unintentional^ hurt^ h^sel[vf]^,or,^unintentional overdose^,or,^shooting pain^,)

e) Rerun the adjusted query and compare with ED discharge data. Conduct the same comparison as before in step 4e and 4f.

Table 3A. Wisconsin ED discharge data, Syndromic (SyS) Suicide Attempt V1, and Wisconsin self-harm SyS query comparison by demographics; 2020.

	Wisconsin ED Discharge		SyS Suicide Attempt V1			Wisconsin self-harm SyS query		
	N	**%**	**N**	**%**	**% Diff**	**N**	**%**	**% Diff**
Total	6465	100	7054	100	9.1	7359	100	13.8
Subpopulations subject to focused prevention efforts in Wisconsin[1]								
Females, 10-19 years	2084	32.2	1711	24.3	-17.9	1775	24.1	-14.8
Rural males aged 25+	394	6.1	372	5.3	-5.6	395	5.4	0.3
Age Group								
0-9	21	0.3	13	0.2	-38.1	34	0.5	61.9
10-14	961	14.9	705	10.0	-26.6	746	10.1	-22.4
15-19	1778	27.5	1552	22.0	-12.7	1602	21.8	-9.9
20-24	922	14.3	933	13.2	1.2	981	13.3	6.4
25-34	1295	20.0	1421	20.1	9.7	1491	20.3	15.1
35-44	690	10.7	993	14.1	43.9	1002	13.6	45.2
45-54	444	6.9	720	10.2	62.2	748	10.2	68.5
55-64	249	3.9	368	5.2	47.8	382	5.2	53.4
65-74	65	1.0	164	2.3	152.3	165	2.2	153.8
75+	40	0.6	85	1.2	112.5	98	1.3	145.0
Missing/Unknown*	0	0.0	100	1.4	-	110	1.5	-
Sex								
Female	4115	63.7	4391	62.3	6.7	4550	61.8	10.6
Male	2349	36.3	2662	37.7	13.3	2808	38.2	19.5
Missing/unknown	#	0.0	#	0.0	-	#	0.0	-
Race								
American Indian	219	3.4	173	2.5	-21.0	179	2.4	-18.3
Asian or Pacific Islander	62	1.0	90	1.3	45.2	92	1.3	48.4
Black	856	13.2	880	12.5	2.8	905	12.3	5.7
White	5063	78.3	5199	73.7	2.7	5452	74.1	7.7
Other	#	-	230	3.3	-	243	3.3	-
Missing/Unknown	262	4.1	482	6.8	84.0	488	6.6	86.3
Ethnicity								
Hispanic	470	7.3	489	6.9	4.0	509	6.9	8.3
Non-Hispanic	5869	90.8	5929	84.1	1.0	6203	84.3	5.7

Missing/Unknown	126	2.0	636	9.0	404.8	647	8.8	413.5
Geographic Region								
Northeastern	1434	22.2	1697	24.1	18.3	1729	23.5	20.6
Northern	610	9.4	589	8.3	-3.4	606	8.2	-0.7
Southeastern	1951	30.2	2372	33.6	21.6	2455	33.4	25.8
Southern	1520	23.5	1589	22.5	4.5	1704	23.2	12.1
Western	950	14.7	807	11.4	-15.1	865	11.8	-8.9
Geographic Area								
Rural	1936	30.0	1717	24.3	-11.3	1803	24.5	-6.9
Urban	4529	70.1	5337	75.7	17.8	5556	75.5	22.7

*Missing age for SyS data is based on recategorized cases with illegal age values or missing DOB information. # Indicates a value less than 5 that has been suppressed to protect confidentiality.
[1]Percentage column represents the percentage of the total number of cases for each focus population.

f) Conduct another narrative review based on the cases identified by the new SyS query in order to verify accuracy of the new query definition.

We reviewed 370 cases (5%) identified by the new Wisconsin Self-harm query definition. Results of this review are shown in Table 4A below.

Table 4A. Wisconsin Self-harm SyS query definition narrative review.

Narrative determination	N	%
Self-harm confirmed (Supportive narrative with or without corresponding self-harm codes)	332	90
Self-harm code only (no supporting text)	11	3
Undetermined (contradictory intent codes or unclear narrative)	6	2
No self-harm injury	21	5
Total	370	100

Compared with CDC Suicide Attempts V1, the new Wisconsin Self-harm query has identified a larger proportion of valid cases (87% vs 93% confirmed self-harm cases, inclusive of those identified by self-harm code alone, respectively).

Additionally, we wanted to assess the impact that searching the Discharge Diagnosis History field had on identification of cases compared with searching the more limited Discharge Diagnosis field (last non-null codes only). There were an additional 61 cases identified by use of the Discharge Diagnosis History field. See results of our narrative review of these 61 cases in Table 5A below.

Table 5A. Narrative review of cases added by the Discharge Diagnosis History field.

Narrative determination	N	%
No self-harm injury	52	85
Self-harm confirmed	5	8
Undetermined (contradictory intent codes or unclear narrative)	4	7

Total	61	100

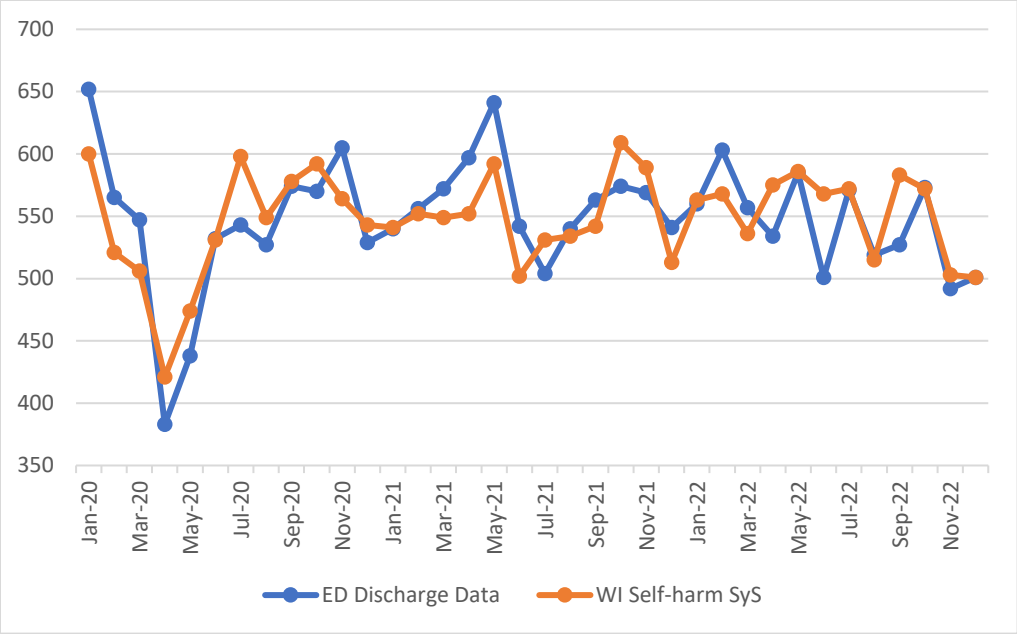
Eighty-five percent (85%) of cases captured by the Discharge Diagnosis History field, and eliminated when replaced by the Discharge Diagnosis field, were not related to a self-harm injury. Only eight percent (5 cases) could be confidently confirmed as self-harm. Based on this review, we determined that searching this field was not appropriate and would result in overidentification of invalid cases. Our comparison of the Discharge Diagnosis History and Discharge Diagnosis fields included searching the Chief Complaint History field which was likely influential in identification of cases in instances where the Discharge Diagnosis field did not contain a self-harm code.

g) Review overall percentage differences and differences by subpopulations. If you still find large differences by subpopulations, perform a more targeted narrative review of those groups.
   - Overall, there is a 14% difference between ED discharge data and the Wisconsin self-harm SyS query definition.
   - Sex, race, ethnicity, geographic area, and urbanicity exhibit relatively similar distributions between data sources. The distribution by age group reveals more variation between data sources.
   - Syndromic data appears to underestimate the burden of self-harm for some of the younger age groups (10-14 and 15-19 year-olds, in particular). A review of cases that should have been identified is not possible within the syndromic system unless all ED visits (or a random sample of all ED visits) are reviewed (which is quite burdensome).
   - Missing Hispanic ethnicity information is much greater for syndromic data which could be part of a conversation about improving data collection.

Step 7. Compare monthly trends/patterns for 1-2 years to determine if your new SyS query and ED discharge data reveal the same pattern. Do this for subpopulations of interest as well.

As noted by the CCI and DDI average weekly percent filters, Wisconsin had relatively complete data in the ChiefComplaints and Discharge Diagnosis fields (both over 85%). Because of this, we did not need to include these filters in our trend analysis. Instead, we simply applied the Data Quality CoV HasBeenE filter and compared monthly data for our new query to ED discharge data. Below are 3 trend graphs: 1) comparison of monthly data for Wisconsin overall; 2) comparison for females aged 10-19; and 3) comparison of rural males aged 25 and older. We present data for 3 years in total though 1-2 years is likely sufficient.

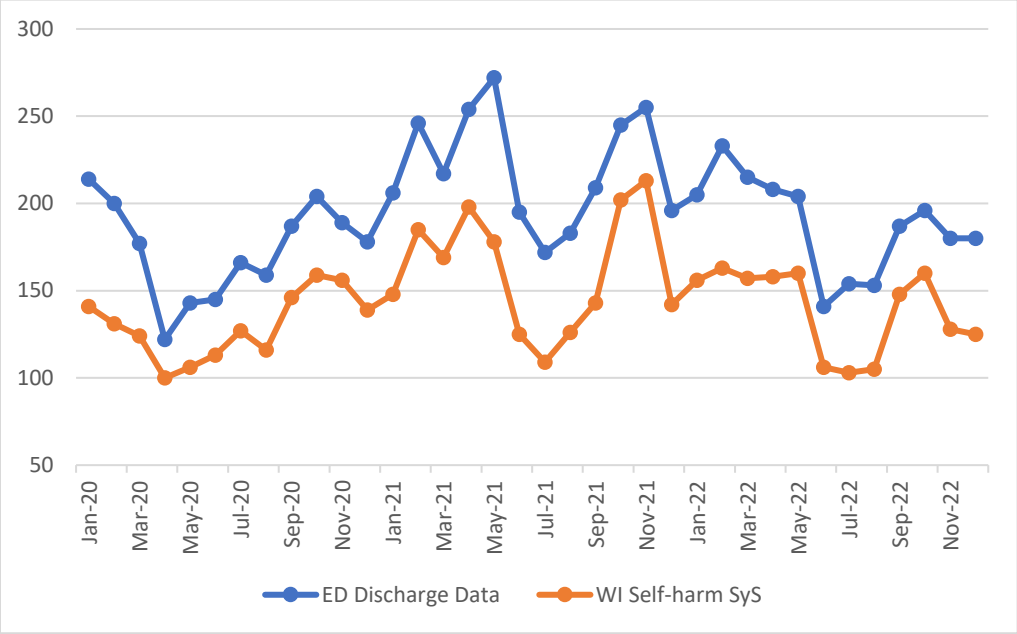
Figure 4A. Wisconsin monthly non-fatal ED visits with self-harm injury; 2020-2022*



* With Data Quality CoV HasBeenE Last 3 Years to Date filter.

Overall, monthly data reveal similar trends/patterns for the two trend lines and the slopes are not significantly different.

Figure 5A. Wisconsin monthly non-fatal ED visits with self-harm injury among females aged 10-19; 2020-2022*

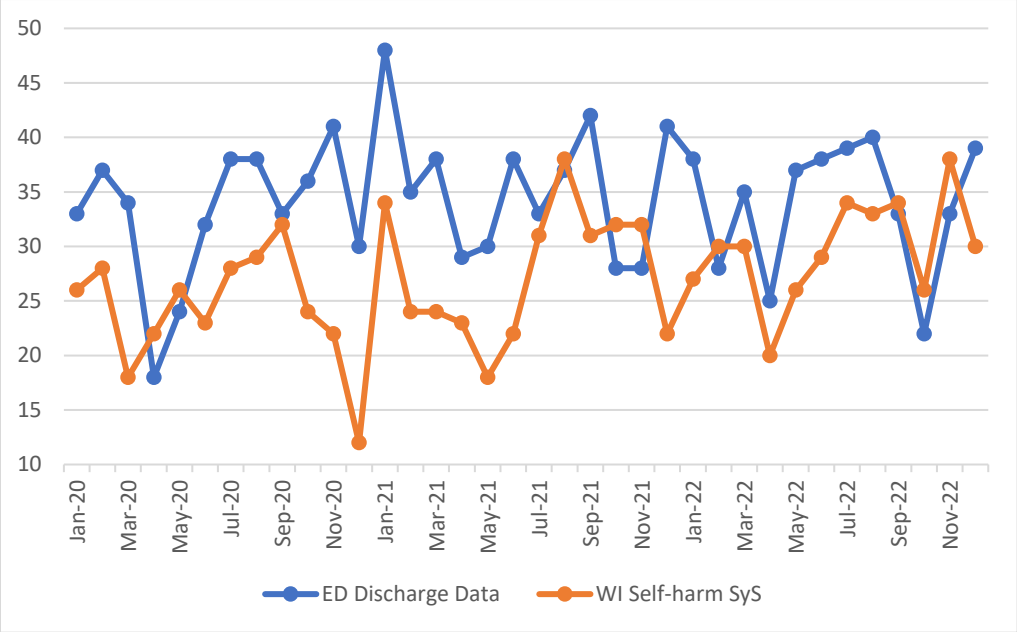


* With Data Quality CoV HasBeenE Last 3 Years to Date filter.

Among females aged 10-19, the new Wisconsin query reveals similar patterns. However, there are differences in case counts with the new SyS definition revealing fewer cases compared to ED discharge

data. Reporting trends/spikes/patterns is more suitable for this population rather than a focus on exact counts. The slopes for the two trend lines appear similar and are not statistically significantly different.

Figure 6A. Wisconsin monthly non-fatal ED visits with self-harm injury among rural males aged 25 and older; 2020-2022*



* With Data Quality CoV HasBeenE Last 3 Years to Date filter.

For rural males aged 25 and older, the trend lines do not seem to match as well, though a comparison of slopes does not indicate a statistically significant difference between the data sources.

Step 8. Note differences between data systems and establish guidelines/expectations on appropriate use, communication, and dissemination of SyS data.

- There were large differences between the two CDC Suicide Attempt queries (V1 and V2) due to the difference in selection criteria. V1 focused on identifying all self-harm while V2 focused on self-harm injury with suicidal attempt or ideation. Both versions produced counts that were different than ED discharge data: V1 produced greater counts while V2 produced fewer counts.
- We focused on a modification of both queries to best capture self-harm injury regardless of confirmed suicidal attempt/ideation (as all instances of self-harm are concerning for future suicide attempts and possible death by suicide). Additionally, we are concerned about the data quality and consistent inclusion of the suicide ideation or attempt text or codes in the SyS records.
- We believe that V1 does a very good job of identification of self-harm cases, though we did find opportunities to adjust the current code to achieve greater reliability and validity. As we wanted to focus on incidence, we determined that it was critical to specify initial encounters in the ICD-10-CM code list. In addition to this, we made minor adjustments to a few key phrases and incorporated improvements from V2 related to additional codes and keywords. And though the difference between V1 and our new query definition has created a wider gap between the

counts identified by ED discharge data and SyS, based on our narrative review, we believe we have created a more accurate syndrome definition for monitoring burden/impact of self-harm. We removed 194 cases that were identified by the Suicide Attempts V1 query and added 499 new cases (not previously identified by Suicide Attempts V1). These gains and losses were not evenly distributed by demographics.

- Our new query altered the overall percentage difference between ED discharge data and SyS; the new query identified approximately 14% more cases compared with ED discharge data. The result was a difference of 894 more cases identified by SyS compared with discharge data.
- Monthly trends/patterns looked similar for the state overall and for females aged 10-19 and rural males aged 25+ (based on comparison of trend slopes for a 3-year period).
- Wisconsin SyS data (based on our new query definition) and ED discharge data do not produce the same counts in spite of all of the adjustments made to the SyS query definition. However, Wisconsin overall trends match well with ED discharge data. It may, therefore, be appropriate to communicate trends/patterns and discuss counts and rates as "suspected cases" of self-harm. An important point to make with potential data users is that ED discharge data is considered finalized and confirmed and syndromic data identifies "suspected" instances and, as a result, these numbers will not be a perfect match. Depending on the population of interest, you may also want to caution syndromic users of either suspected overestimation or underestimation of the health issue.
- Timeliness is the most valuable asset of syndromic surveillance data, but reliability and validity may not be as robust as discharge data. As a result of our evaluation and discussion of the differences, we recommend using syndromic data to monitor and alert our programs and staff to spikes and upward trends. ED discharge data is still the most reliable for counts and rates.
- Finally, though our review focused on all non-fatal ED visits, syndromic offers the opportunity to restrict analysis to "treated and released" visits and separately review inpatient visits (hospitalizations). This could be useful as a proxy for severity and for a closer "fit" with injury surveillance methods (ED discharge data is generally restricted to non-fatal, treated and released visits and a separate count and rate is created based on non-fatal hospitalizations). However, if this type of review is conducted, it is essential to assess the reliability and validity of the SyS filter "Has Been Admitted." For Wisconsin, we could not confirm reliability or validity of this and therefore, we included all non-fatal ED visits in this review.

Appendix B: Firearm Injury Example

Step 1. Determine the health indicator to query using syndromic data.

a) Are firearm injuries experiencing spikes or unusual changes or patterns?

Between 2017 and 2019, Wisconsin had similar annual rates of firearm injuries, based on non-fatal ED discharge data, before experiencing a sustained increase in 2020 and 2021. Some populations (teens and young adults in particular) experienced greater increases in rates of firearm injuries.

b) Was there a current event, natural disaster or wide-spread outbreak impacting this, or related, health outcomes?

COVID-19 led to significant changes in behaviors and policies which impacted mental health, political and social unrest, and financial stability, potentially contributing to increased violence and firearm use (see Zwald et.al., 2023 in *References* at the end of this appendix). Review of SyS data could alert public health officials to spikes in firearm injuries and their associations with other events preceding or potentially triggering a widespread spike or change.

c) Is timeliness of data important for your work with firearm injuries? Do you need to respond to an immediate or emerging public health emergency? Is your area experiencing spikes or changes in patterns or trends that need more immediate attention? Do you need to continuously monitor firearm injuries for changes in real time?

As firearm injuries may experience spikes or increasing trends due to other (sometimes global) circumstances, the timeliness of syndromic data can help identify these trends or activating events quicker, and programs and policies addressing violent responses can adjust their efforts to respond to these changes. Continuous monitoring of this violence indicator, which could escalate quickly, would likely be a worthwhile endeavor to support more immediate responses by a variety of agencies (such as community outreach organizations, mental health providers, law enforcement, and legislative/political advocacy groups).

Step 2. Determine the SyS data source and time frame you will review.

We selected 2020 for our review and "Patient Location" as the Datasource to focus on patient residency.

- Datasource: Patient Location (Full Details)
- Time Resolution: Monthly
- Start Date: January 2020; End Date: December 2020

Step 3. Select the fields your SyS query will search.

For our firearm injury evaluation, we reviewed SyS data for non-fatal emergency department visits in 2020.

a) Below are the fields we used [these were selected using the Query Wizard within the query portal tab]:

    - Patient State: Wisconsin
    - Facility Type: Emergency Care
    - Has been Emergency: Yes

- C_Death: No

If you choose to filter out visits admitted to inpatient care (by use of the "Has Been Admitted" field), we recommend discussing the validity and reliability of this field with your SyS administrator. For our evaluation, we focused on all non-fatal visits.

b) Review ChiefComplaints and Discharge Diagnosis data quality.

For Wisconsin, based on the filters in 3a above, 85% of records had analytic data in the ChiefComplaints field and 88% had analytic data in the Discharge Diagnosis field based on a review of the Chief Complaint Informative and Discharge Diagnosis Informative fields.

c) Select a field to apply your query definition.

Our evaluation of firearm injuries will focus on the CDC Firearm Injury V2 and Assault Firearm Injury V1 query definitions. These definitions are applied to the CC and DD field.

Step 4. Run the standard CDC/NSSP query definition for your indicator and compare it to ED discharge data. Review overall and by demographics to determine if certain populations reveal greater differences.

a) Review NSSP Community of Practice Knowledge Repository.

As of April 2023, CDC had developed and validated two query definitions for overall firearm injuries (Firearm Injury V1 and Firearm Injury V2) as well as one for assault (Assault Firearm Injury V1), one for unintentional (Unintentional Firearm Injury V1) and one for self-harm (Intentional Firearm Injury V1). Our focus for this evaluation is limited to the overall firearm injury (specifically Firearm Injury V2) and Assault Firearm Injury V1 queries. There is significant concern with ICD-10-CM coding for unintentional firearm injuries (see *References* provided at end) and, in addition to this, unspecified/undetermined intent is often lumped into this "accidental" category without the necessary evidence to support such a categorization. Therefore, we decided to focus our attention on: 1) the overall firearm injury count, as this speaks to widespread impact of firearm injuries on public health and the burden on the health care system, and 2) assault firearm injury count, as this allows more targeted review of violence and injuries and can provide information to support public health and community safety responses focused on reducing violence.

Firearm Injury V2:

This query is an updated version of Firearm Injury V1, intended to capture all instances of firearm injury, regardless of intention. The code includes all relevant ICD-10-CM codes, as well as SNOMED codes, keywords indicating firearm injuries, and exclusions. In this appendix, we focus on Firearm Injury V2 as this is the most recent and updated version for identification of overall firearm injuries. Compared with Firearm Injury V1, this version has additional ICD-10-CM and SNOMED codes and exclusions.

To run the Firearm Injury V2 query, use the CC and DD Category field and select the Firearm Injury V2 query definition. This definition is intended to query the CC and DD field. If a code or key word is found in either the ChiefComplaints or Discharge Diagnosis field, the case will be selected.

```
(,(,^[;/ ]W3[23]^,andnot,(,^[;/ ]W3[23]___[DS]^,or,^[;/ ]W3[23].___[DS]^,),),or,(,(,^[;/
]W34[01][09]^,or,^[;/ ]W34.[01][09]^,),andnot,(,^[;/ ]W34[01][09]_[DS]^,or,^[;/
```

]W34.[01][09]_[DS]^,),),or,(,^[;/]X7[23]^,andnot,(,^[;/]X7[23]___[DS]^,or,^[;/]X7[23].___[DS]^,),),or,(,(,^[;/]X74[89]^,or,^[;/]X74.[89]^,),andnot,(,^[;/]X74[89]__[DS]^,or,^[;/]X74.[89]__[DS]^,),),or,(,^[;/]X9[34]^,andnot,(,^[;/]X9[34]___[DS]^,or,^[;/]X9[34].___[DS]^,),),or,(,(,^[;/]X95[89]^,or,^[;/]X95.[89]^,),andnot,(,^[;/]X95[89]__[DS]^,or,^[;/]X95.[89]__[DS]^,),),or,(,^[;/]Y2[2-3]^,andnot,(,^[;/]Y2[2-3]___[DS]^,or,^[;/]Y2[2-3].___[DS]^,),),or,(,(,^[;/]Y24[89]^,or,^[;/]Y24.[89]^,),andnot,(,^[;/]Y24[89]__[DS]^,or,^[;/]Y24.[89]__[DS]^,),),or,(,^[;/]Y350[0129]^,andnot,^[;/]Y350[0129]_[DS]^,),or,(,^[;/]Y35.0[0129]^,andnot,^[;/]Y35.0[0129]_[DS]^,),or,(,^[;/]Y38.4^,andnot,^[;/]Y38.4__[DS]^,),or,(,^[;/]Y384^,andnot,^[;/]Y384__[DS]^,),or,^[;/]E922.[012389]^,or,^[;/]E922[012389]^,or,^[;/]E955.[012349]^,or,^[;/]E955[012349]^,or,^[;/]E965.[01234]^,or,^[;/]E965[01234]^,or,^[;/]E970^,or,^[;/]E979.4^,or,^[;/]E9794^,or,^[;/]E985.[01234]^,or,^[;/]E985[01234]^,or,^[;/]41430008^,or,^[;/]56768003^,or,^[;/]63409001^,or,^[;/]69861004^,or,^[;/]77301004^,or,^[;/]86122002^,or,^[;/]111050005^,or,^[;/]219257002^,or,^[;/]283545005^,or,^[;/]218081007^,or,^[;/]218086002^,or,^[;/]218082000^,or,^[;/]218087006^,or,^[;/]218088001^,or,^[;/]269796009^,or,^[;/]242869008^,or,^[;/]219199009^,or,^[;/]219200007^,or,^[;/]219201006^,or,^[;/]219204003^,or,^[;/]219205002^,or,^[;/]219203009^,or,^[;/]219198001^,or,^[;/]219142001^,or,^[;/]219143006^,or,^[;/]219144000^,or,^[;/]219145004^,or,^[;/]219146003^,or,^[;/]287184008^,or,^[;/]287193009^,),or,(,(,!gsw!,or,^gunshot^,or,^gun shot^,or,^gunshout^,or,^gunshot^,or,^buckshot^,or,^buck shot^,or,^revolver^,or,^riffle^,or,^rifle^,or,^shotgun^,or,^shot gun^,or,^firearm^,or,^fire arm^,or,^pistol^,or,^handgun^,or,^hand gun^,or,^been shot^,or,^I was shot^,or,^I got shot^,or,(,(,^hit^,or,^ricochet^,or,^graze^,),and,(,^bullet^,),),or,(,^gun^,and,^wound^,),),ANDNOT,(,^no gun^,or,^remove gun^,or,^heard gun^,or,^hearing gun^,or,^hit head^,or,^hit my head^,or,^kickback^,or,^kick back^,or,^kicked back^,or,^water gun^,or,^watergun^,or,^pelle^,or,^pellt^,or,^ bb ^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee^,or,^beebe^,or,^rubber bullet^,or,^paint^,or,^nerf^,or,^nurf^,or,^airgun^,or,^air gun^,or,^airsoft^,or,^air soft^,or,^spring^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,(,^nail^,andnot,^damage to nail^,),or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun^,or,^ta[sz]er^,or,^la[sz]er^,or,(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,),or,^bloodshot^,or,^blood shot^,or,^scope^,or,^fake^,or,^allergy shot^,or,^injection^,or,^follow-up^,or,^follow up^,or,^followup^,or,^chronic^,or,(,^wound^,and,(,^check^,or,^care^,or,^recheck^,or,^infection^,or,^infected^,),),or,^drainage^,or,^gswel^,or,^gswol^,or,(,(,!gsw!,or,^gunshot^,or,^gun shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,),),or,^[;/]Z51.89^,or,^[;/]Z5189^,),)

For comparison purposes, we ran the Firearm Injury V1 query which produced a case count for 2020 that was 16% greater than ED discharge data (1,451 compared with 1,245, respectively) and 15% lower than V2 (1,451 compared with 1,711, respectively). The lower case count in comparison with V2 was expected due to the missing codes in the V1 query.

Assault Firearm Injury V1

This query focuses on initial encounter of an assault-related firearm injury. To run the Assault Firearm Injury V1 query, use the CC and DD Category field and select the Assault Firearm Injury V1 query definition. This definition is intended to query the CC and DD field. If a code or key word is found in either the ChiefComplaints or Discharge Diagnosis field, the case will be selected.

(,(,^[;/]X9[34]^,andnot,(,^[;/]X9[34]___[DS]^,or,^[;/]X9[34].___[DS]^,),),or,(,(,^[;/]X95[89]^,or,^[;/]X95.[89]^,),andnot,(,^[;/]X95[89]__[DS]^,or,^[;/]X95.[89]__[DS]^,),),or,^[;/]E965.[01234]^,or,^[;/]E965[01234]^,or,^[;/]242869008^,or,^[;/]219199009^,or,^[;/]219200007^,or,^[;/]219201006^,or,^[;/]219204003^,or,^[;/]219205002^,or,^[;/]219203009^,or,^[;/]219198001^,),or,(,(,^ass[au][au]lt^,),AND,(,!gsw!,or,^gunshot^,or,^gun shot^,or,^gunshout^,or,^gunshoot^,or,^buckshot^,or,^buck shot^,or,^revolver^,or,^riffle^,or,^rifle^,or,^shotgun^,or,^shot gun^,or,^firearm^,or,^fire arm^,or,^pistol^,or,^handgun^,or,^hand gun^,or,^been shot^,or,^I was shot^,or,^I got shot^,or,(,(,^hit^,or,^ricochet^,or,^graze^,),and,(,^bullet^,),),or,(,^gun^,and,^wound^,),),),AND NOT,(,(,^no gun^,or,^remove gun^,or,^heard gun^,or,^hearing gun^,or,^hit head^,or,^hit my head^,or,^kickback^,or,^kick back^,or,^kicked back^,or,^water gun^,or,^watergun^,or,^pelle^,or,^pellt^,or,^ bb ^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee^,or,^beebe^,or,^rubber bullet^,or,^paint^,or,^nerf^,or,^nurf^,or,^airgun^,or,^air gun^,or,^airsoft^,or,^air soft^,or,^spring^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,(,^nail^,andnot,^damage to nail^,),or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun^,or,^ta[sz]er^,or,^la[sz]er^,or,(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,),or,^bloodshot^,or,^blood shot^,or,^scope^,or,^fake^,or,^allergy shot^,or,^injection^,or,^follow-up^,or,^follow up^,or,^followup^,or,^chronic^,or,(,^wound^,and,(,^check^,or,^care^,or,^recheck^,or,^infection^,or,^infected^,),),or,^drainage^,or,^gswel^,or,^gswol^,or,(,(,!gsw!,or,^gunshot^,or,^gun shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,),),or,^[;/]Z51.89^,or,^[;/]Z5189^,),)

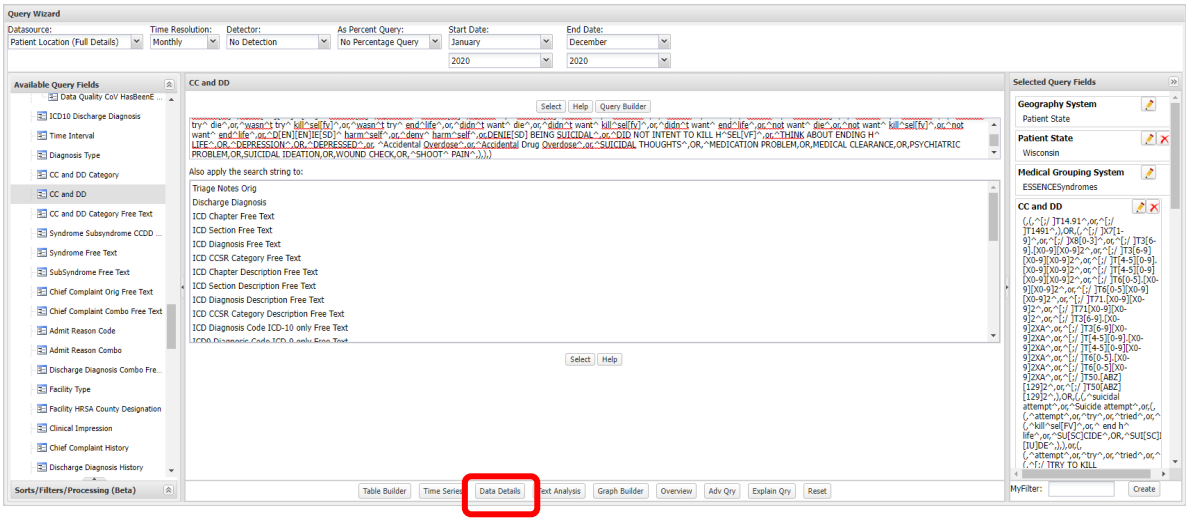
b) Reach out to other professionals and colleagues to ask if they have developed or adjusted queries on the topic and what their findings reveal.

During our review, we received advice from NSSP staff and the Syndromic Surveillance Data Analysis team at the Wisconsin Department of Health Services.

c) Run the query.

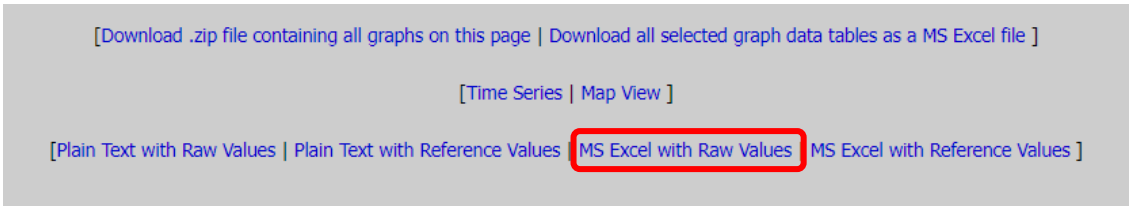
Once you have selected your standard query definition, first assess the number of records your query will return by choosing Time Series or Table Builder from the options at the bottom of your screen. This will help you assess whether or not your counts look correct and will run quicker then choosing “Data Details.” If the count appears appropriate or reasonable, you can then run the query by clicking the “Data Details” button. As there were 2 queries we were interested in, we ran the data for each one based on the original query definition.

Figure 1B. ESSENCE query wizard screenshot.



The data output can be downloaded for further analysis (see screenshot below).

Figure 2B. ESSENCE data download screenshot.



d) Assess the "missingness" of variables in your data.

Below are the variables we reviewed for completeness in ED Discharge Data and SyS data for Firearm Injury V2 and Assault Firearm Injury V1.

Table 1B. Variable "missingness" for overall firearm injuries by data source; 2020.

Variable	Wisconsin ED Discharge Data (N=1245)		SyS Firearm Injury V2 (N=1711)	
	N	%	N	%
Date	0	0	0	0
Age in years	<5	<1	88	5
Hispanic ethnicity	33	3	55	3
Patient county	0	0	0	0
Race	76	6	48	3
Sex	<5	<1	0	0

Table 2B. Variable "missingness" for assault firearm injuries by data source; 2020.

Variable	Wisconsin ED Discharge Data (N=322)		SyS Assault Firearm Injury V1 (N=51)	
	N	%	N	%
Date	0	0	0	0
Age in years	<5	1	<5	2
Hispanic ethnicity	6	2	<5	4
Patient county	0	0	0	0
Race	32	10	<5	4
Sex	0	0	0	0

Age in years has a greater percentage of missing data in SyS for overall firearm injuries (Table 1B). Patient race appears to be missing for a greater percentage of ED discharge visits for overall firearm injuries and assault firearm injuries as well (Table 1B and 2B).

In addition to the variables above, we conducted a quick review of DOB and "age in years" to determine if there were any outliers. We noticed 82 cases identified by Firearm Injury V2, and <5 cases identified by Assault Firearm Injury V1, had age values over 110 years. Six (6) identified by Firearm Injury V2 had an illegal value of -1. These outlier and illegal values were due to missing DOB data. Before conducting step 4e, we recategorized these as "missing/unknown" in SAS (this cannot be done within ESSENCE). We recommend that you take a quick look at key variables to assess outliers or illegal values within your dataset.

e) Compare results from SyS to ED discharge data: review data by age group, sex, race, ethnicity, geography, and other variables of interest for your jurisdiction. Compare percentage differences overall and by demographic subpopulations.

Table 3B. Overall Firearm Injuries: Wisconsin ED discharge data and Syndromic (SyS) Firearm Injury V2 comparison by demographics; 2020.

	Wisconsin ED Discharge		SyS Firearm Injury V2		
	N	Percent (%)	N	Percent (%)	% Difference
Total	1245	100	1711	100	37.4
Age Group					
0-9	13	1.0	16	0.9	23.1
10-14	21	1.7	23	1.3	9.5
15-19	173	13.9	206	12.0	19.1
20-24	266	21.4	355	20.8	33.5
25-34	435	34.9	566	33.1	30.1
35-44	167	13.4	247	14.4	47.9
45-54	97	7.8	128	7.5	32.0
55-64	49	3.9	55	3.2	12.2
65-74	17	1.4	22	1.3	29.4
75+	5	0.4	5	0.3	0.0
Missing/Unknown*	#	-	88	5.1	-
Sex					
Female	192	15.4	247	14.4	28.6
Male	1052	84.5	1464	85.6	39.2
Missing/Unknown	#	0.0	0	0.0	-
Race					
American Indian	8	0.6	8	0.5	0.0
Asian or Pacific Islander	5	0.4	6	0.3	20.0
Black	864	69.4	1205	70.4	39.5
White	291	23.4	361	21.1	24.1
Other	#	-	83	4.9	-
Missing/Unknown	76	6.1	48	2.8	-36.8
Ethnicity					
Hispanic	86	6.9	113	6.6	31.4
Non-Hispanic	1126	90.4	1543	90.2	37.0
Missing/Unknown	33	2.7	55	3.2	66.7
Geographic Region					
Northeastern	69	5.5	99	5.8	43.5
Northern	27	2.2	45	2.6	66.7
Southeastern	1000	80.3	1373	80.3	37.3
Southern	95	7.6	158	9.2	66.3
Western	54	4.3	36	2.1	-33.3
Geographic Area					
Rural	98	7.9	113	6.6	15.3
Urban	1147	92.1	1598	93.4	39.3

*Missing age for SyS is based on recategorized cases with illegal age values or missing DOB information. # Indicates a value less than 5 that has been suppressed to protect confidentiality.
[1]Percentage column represents the percentage of the total number of cases for each focus population.

Table 4B. Assault Firearm Injuries: Wisconsin ED discharge data and Syndromic (SyS) Assault Firearm Injury V1 comparison by demographics; 2020.

	Wisconsin ED Discharge		SyS Assault Firearm Injury V1		
	N	**Percent (%)**	**N**	**Percent (%)**	**% Difference**
Total	322	100	51	100	-84.2
Age Group					
0-9	0	0.0	0	0.0	-
10-14	0	0.0	0	0.0	-
15-19	38	11.8	10	19.6	-73.7
20-24	70	21.7	13	25.5	-81.4
25-34	120	37.3	14	27.5	-88.3
35-44	53	16.5	9	17.7	-83.0
45-54	23	7.1	#	-	-
55-64	13	4.0	0	0.0	-100.0
65-74	#	-	0	0.0	-
75+	0	0.0	0	0.0	-
Missing/Unknown*	#	-	#	-	-
Sex					
Female	56	17.4	14	27.5	-75
Male	266	82.6	37	72.6	-86.1
Race					
American Indian	#	0.9	0	0.0	-
Asian or Pacific Islander	0	0.0	0	0.0	-
Black	238	73.9	39	76.5	-83.6
White	48	14.9	6	11.8	-87.5
Other	#	0.3	#	-	-
Missing/Unknown	32	9.9	#	-	-
Ethnicity					
Hispanic	31	9.6	#	-	-
Non-Hispanic	285	88.5	48	94.1	-83.2
Missing/Unknown	6	1.9	#	-	-
Geographic Region					
Northeastern	10	3.1	6	11.8	-40.0
Northern	6	1.9	0	0.0	-100.0
Southeastern	282	87.6	40	78.4	-85.8
Southern	16	5.0	#	-	-
Western	8	2.5	#	-	-

Geographic Area					
Rural	14	4.4	#	-	-
Urban	308	95.7	50	98.0	-83.8

*Missing age for SyS is based on recategorized cases with illegal age values or missing DOB information. # Indicates a value less than 5 that has been suppressed to protect confidentiality.
[1]Percentage column represents the percentage of the total number of cases for each focus population.

f) Identify subpopulations with greater differences.

Compared to ED discharge data, Firearm Injury V2 identified 37% more cases and Assault Firearm Injury V1 identified 84% fewer cases.

For overall firearm injuries, those 35-44 years old exhibited the greatest difference between data sources (48% more cases in SyS). However, the greatest number of cases were among those 25-34 years old (with SyS identifying 30% more cases). Based on the small number of assault firearm injuries identified by SyS, we did not assess subpopulation differences as we considered this result to be unreasonable.

Step 5. Complete a narrative review of SyS cases identified by the query definition to assess accuracy.

We reviewed 170 cases (10%) identified by Firearm Injury V2 and 51 cases (100%) identified by Assault Firearm Injury V1.

a) Expand the fields you review in order to get a broader picture.

We recommend reviewing the following fields during your narrative review: ChiefComplaints, Discharge Diagnosis, Chief Complaint History, Discharge Diagnosis History, Triage Notes Orig, and Admit Reason Combo. Reviewing all of these fields will provide you with more information to determine if your query is selecting cases appropriately or if there is a pattern of misidentification. It will also help you asses which fields are most appropriate to include in your adjusted/new query definition.

All of the CDC firearm injury queries use the CC and DD field; however, this field often does not contain enough information to determine the injury intent. The Triage Notes Orig (and sometimes the Chief Complaint History field) were much more helpful with identification of intent; these often contained information related to the events surrounding the injury.

Based on our review of 170 cases for the overall firearm injuries, we discovered that 149 (88%) of these cases were identified by ICD-10-CM codes and the remaining 12% were identified only by key words. Seventy-three percent (73%; 124 cases) were confirmed as firearm injuries by text narrative and ICD-10-CM code; 11% (19) had a firearm injury ICD-10-CM code in the record and no supportive text or key words; <1% (1) had text/key word only confirming firearm injury; and 15% (26) were not related to an initial firearm injury (including cases of wound care and sequelae secondary to the gunshot wound, such as long-term pain treatment). Based on these findings, the query definition identified approximately 85% valid cases.

For Assault Firearm Injury V1, our narrative review (51 cases; 100%) revealed that 19 (37%) were confirmed as firearm assault injury based on inclusion of ICD-10-CM assault codes *and* key words indicating assault in the narrative; an additional 31 (61%) were identified as assault firearm injuries based on an ICD-10-CM code with no supporting narrative; and 1 case (2%) was determined unintentional (though the record contained both unintentional and assault ICD-10-CM codes). If we assume accuracy of coding for assault when an assault firearm injury ICD-10-CM code appears in the record, this query definition identified approximately 98% valid cases. Though it appears the query is specific, we are concerned with its sensitivity. What is most striking, based on comparison with ED discharge data, is the underestimation of assault cases.

Though we do not review the Unintentional Firearm Injury V1 query in this appendix, we did run the data for Wisconsin residents (2020) and performed a cursory review to see how it well it compared with ED discharge data and how well it performed selecting unintentional cases. In SyS, the query definition identified 66% more cases compared with ED discharge data. As an exercise, we performed a 10% narrative review (140 cases) of the cases selected by the SyS Unintentional Firearm Injury V1 query to assess if this performed well and selected valid unintentional cases. Our findings suggest that it does not (see Table 5B below). Most notably, only 10% of the cases we reviewed were confirmed unintentional by code and supporting text, while 33% were confirmed assault and 11% were not related to an initial firearm injury.

Table 5B. Unintentional Firearm Injury V1 narrative review.

Narrative determination	N	%
Unintentional	14	10
Assault	46	33
Self-harm	4	3
Undetermined	61	44
No Firearm injury	15	11
Total	140	100

For those cases where intent was not determined (61 cases), all of these had an accidental ICD-10-CM code (W3400XA, or W34.00XA) in the record but no other narrative information to confirm intent. If the above codes were condensed as “unintentional+undetermined” and “assault+self-harm+no firearm injury”, the best that this query performed based on Wisconsin data would be 54% identification of valid cases.

In addition to the narrative review discussed above, we conducted other targeted reviews based on some of our findings and assumptions (see step 5c for more details).

b) Is there a specific population where you noted the differences were more extreme? Is this a population of interest where you could focus your narrative review?

We did note a few subpopulations (for certain age groups in particular) that exhibited greater differences between SyS and ED discharge data. However, we focused our review on a representative sampling of all cases.

c) Do you know something about your health topic that might influence certain subpopulations more than others and may be misidentified by SyS data.

We suspected that cases identified (or in this case, not identified) by the Assault Firearm Injury V1 query definition would be affected by incorrect use of unintentional firearm injury ICD-10-CM codes. There is much debate about the coding of intent for firearm injuries using the ICD-10-CM codes (see *References* provided at end for more detail). Currently, the Alphabetic Index for External Causes defaults to the code W34 (accident by unspecified firearm). Though most injuries default to unintentional/accidental codes, this may not be appropriate for firearm injuries (falls and motor vehicle crashes are far more likely to be accidental in comparison to firearm injuries and events). The ED discharge data are subject to this potential miscoding as well.

Based on the SyS Assault Firearm Injury V1 query, use of the ICD-10-CM code W3400XA leads to missed identification of assaults, even with supporting evidence in Triage Notes Orig that the injury was due to an assault. The current query only searches the ChiefComplaints field for keywords associated with assault by firearm and/or an assault code in the Discharge Diagnosis field. Assault-related language in combination with gunshot reference is often lacking in the ChiefComplaints field and we found evidence that the W34 code was often misused. On a related note, we noticed during our narrative review that the Discharge Diagnosis field had several cases (6 of the 51 reviewed; 12%) with both an accidental and an assault firearm injury code in the record (further evidence of confusion around coding for intent).

d) What are the exclusions in the query code (i.e., which terms or codes or key phrases are identified for exclusion as a case) and are there any exclusions that should be included but are not?

We reviewed the list of keywords, terms, and phrases identified as exclusions (ANDNOTs).

Both firearm injury queries use the same list of exclusions. Based on our narrative review, we identified additional exclusions that should be added, as well as the need for slightly different exclusions for the overall Firearm Injury versus Assault Firearm Injury queries.

- Cases were identified with the following key words or codes in the CC and DD field (for both firearm injury queries): “assault”, “dressing change”, “wound complication”, “wound care”, “wound infection”, “wound check”, Z5189 (ICD-10-CM code for after care), and R45.851 (ICD-10-CM code for suicidal ideation). These terms or codes were often (73% of the 26 cases with these codes/key words) associated with the code W3400XA (accident by unspecified firearm). However, our narrative review using Triage Notes Orig revealed that these cases were unrelated to any firearm injury. We added these key words and codes as exclusions for the Wisconsin Firearm Injury and Wisconsin Assault Firearm Injury query definitions. Learn more about the specifics in step 6c below.
- Review of the Chief Complaint History field revealed that the W3400 code was used for instances associated with pain secondary to a gunshot wound or puncture wound. We added an exclusion for this in the Wisconsin Firearm Injury query. Specifically, we exclude cases with keywords related to gunshot wound AND pain.
- For both the Wisconsin Firearm Injury and Wisconsin Assault Firearm Injury queries, we added “assault” as an exclusion term in the CC and DD field. Though this seems counterintuitive, we had noticed that when this non-descript term was used in CC and DD, it was not associated with a firearm injury (referencing hitting/striking with a firearm or sexual assault), including when ICD-10-CM assault firearm injury codes were

used. The term (assault), however, was critical and informative in the Triage Notes Orig in combination with reference to gunshot/gunshot wounds for identification of assault firearm injuries.

- The ICD-10-CM code T14.91 (suicide attempt) was added to the exclusion terms for the new Wisconsin Assault Firearm Injury query.

e) Check the accuracy of ICD-10-CM codes or SNOMED codes if these are used in the query. Verify that ICD-9-CM codes are not listed in current queries or check for SNOMED codes that may or may not be reported by your jurisdiction's emergency departments.
   - Firearm Injury V2 query definition contains an updated list of ICD-10-CM and SNOMED codes. We included these in our new queries.
   - Both CDC queries contain ICD-9-CM codes. These were removed from our newly developed queries.

f) Consider a variety of ways to spell or write key words or phrases (including additional clinical terms or symptoms).
   For example, the keyword ^hit^ captured cases not associated with any injury, such as "w**hit**e." This was adjusted to ^ hit^ (note: we added a space before the caret).

g) Are there instances where Boolean logic identified cases that were not relevant for our health indicator?

   - With the inclusion of a variety of keywords related to type of gun (revolver, rifle, shotgun, firearm, pistol), we found many cases identified by the query that were unrelated to gunshot, but instead due to injury from use of a gun as a weapon for hitting, punching, pistol whipping or similar. As these keywords had no code logic to connect them with a gunshot wound or firing of a gun, we removed the specific gun type references from the inclusion criteria. The inclusion criteria of "gsw" and similar would capture these instances regardless of type of firearm used.
   - The expression "(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,)" as part of the exclusions in overall firearm injury queries was not functioning appropriately due to two missing parenthesis (which meant the Boolean logic was not performing as it should). We corrected this in our new queries. Additionally, the inclusion of the word "with" didn't remove all invalid cases. For instance, it didn't exclude: "a gun was used to hit her in the head." We removed "with" in our new query.

Step 6. Adjust the SyS query definition based on alterations supported by your narrative review. Run the new query and compare with ED discharge data.

a) NSSP technical supports were reviewed for suggested alterations; none were available.

b) Next, we assessed the fields that we wanted to search/query.

   As we discovered in the narrative review, Firearm Injury V2 and Assault Firearm Injury V1 queries are applied to the CC and DD field. We determined that this field is sufficient and efficient for capturing overall firearm injuries due to the consistent and global use of firearm-

related ICD-10-CM codes (88% based on narrative review) and/or a brief description in the ChiefComplaints field including terms such as “gunshot/gun shot wound/gun wound.” However, this field was not ideal for capturing information associated with intent. Because of this, we decided to run our newly developed Assault Firearm Injury query using the Triage Notes Orig, Discharge Diagnosis, and Chief Complaint History fields.

Based on findings from our narrative reviews, we also decided that using another field(s) to exclude cases identified by the main query would create a better, more accurate count of valid cases (see details in step 6c below).

c) Modify, adjust, add, or remove keywords or codes in the query, based on your narrative review.

Wisconsin Firearm Injury SyS query:

- For the new query, we used SyS Firearm Injury V2 as our starting point.
- We kept all ICD-10-CM and SNOMED codes from V2.
- The only inclusion key words kept in our new query specifically reference “gunshot.” All other key word inclusions were removed (see other bullets below for an explanation of key word removals).
- Specification of gun types were removed from the inclusion list because, without the qualifier of “gunshot wound,” reference to gun type alone did not prove useful in identification of injuries related to firing a gun. Instead, this identified cases where a specific gun type was used as a weapon to hit and cause injury. Additionally, the CC and DD field has very little detail about the event (at least based on Wisconsin records) so these additional inclusion key words produced more invalid cases than valid ones. For similar reasons (lack of detail in the CC and DD field), the inclusion terms “been shot,” “I got shot,” and “I was shot” were also removed.
- We adjusted the exclusion of a variety of “other” gun types to specify “gun” or “bullet” (for instance, “nerf gun,” “toy gun”) and we added CO2 gun to this list after finding reference to this in our narrative review.
- ^Ass[au][ua]lt^,or,^assault^ exclusions were added as our narrative review revealed that, when used in the ChiefComplaints field, it had no association with firearm injury (this term was only useful with identifying intent when used in the Triage Notes Orig).
- The exclusion of the key words ^injection^ and ^allergy shot^ were removed as these were not found in the ChiefComplaints field and it would not be captured as a stand-alone term (“gunshot” is a required key word term when searching the ChiefComplaints field).
- To avoid past medical history or sequelae pain from a gunshot wound, the expression (,^chronic^,and,^pain^,), ^post^, and ^since^ were added as exclusions.
- Keyword ^hit^ was adjusted to ^ hit^, to avoid pulling cases such as “w**hit**e color”. [Note: a space was added before the word in the adjusted version.]
- The exclusion of “hit with” and “gun” or “pistol” was altered to “^ hit ^” to exclude those cases with slightly different phrasing (such as “hit by a pistol”).
- Wound care and medical clearance phrases were added as exclusions as our narrative review revealed these terms used in the ChiefComplaints field were not related to initial firearm injury.
- The following expression was added as an exclusion:

(,^[;/]Z51.89^,or,^[;/]Z5189^,or,(,(,^[;/]W3400^,or,^[;/]W34.00^,),and,^puncture wound^,),or,(,(,^[;/]W3400^,or,^[;/]W34.00^,),and,(,^gunshot wound^,or,^gun shot wound^,or,^gsw^,),and,^pain^,),or,(,(,^[;/]W3400^,or,^[;/]W34.00^,),and,^pain^,),). This was done to remove cases that were only identified based on the use of W34 for complaints related to pain from a wound/puncture and not an initial gunshot wound. The Z-codes were removed as these were related to after care.

- We created two additional exclusionary clauses to be applied as separate query code to Triage Notes Orig and Chief Complaint History (see the instructions for the new code below on how to apply this within ESSENCE):
  1) Query code to apply to Chief Complaint History field**:** ISNULL,or,^,ANDNOT,(,^water gun^,or,^watergun^,or,^pellet gun^,or,^pellet bullet^,or,^CO2 gun^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee gun^,or,^beebe gun^,or,^rubber bullet^,or,^paint ball^,or,^nerf gun^,or,^nerf bullet^,or,^nurf gun^,or,^nurf bullet^,or,^airgun^,or,^air gun^,or,^airsoft gun^,or,^air soft gun^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun gun^,or,^ta[sz]er^,or,^la[sz]er gun^,or,^fake gun^,or,^toy gun^,or,(,(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,),),or,(,^wound^,and,(,^complication^,or,^check^,or,^care^,or,^recheck^,or,^infection^,or,^infected^,or,^drainage^,or,^eval^,),),or,^medical clearance^,or,^gswel^,or,^gswol^,or,(,(,^gsw^,or,^gunshot^,or,^gun shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,or,^ post^,or,^ since ^,),),),).
     This code removes unrelated injuries due to other “gun” types (i.e., toy, nail, water), use of a gun as a weapon (strike, hit, whip) without firing, gunshot wound after care, medical clearance, and past medical history of a gunshot injury. [Note: the ISNULL clause at the beginning of the code is intended to prevent the automatic removal of cases with no information in the Chief Complaint History field].
  2) Query code to apply to Triage Notes Orig field**:** ISNULL,or,^,ANDNOT,(,^water gun^,or,^watergun^,or,^pellet gun^,or,^pellet bullet^,or,^CO2 gun^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee gun^,or,^beebe gun^,or,^rubber bullet^,or,^paint ball^,or,^nerf gun^,or,^nerf bullet^,or,^nurf gun^,or,^nurf bullet^,or,^airgun^,or,^air gun^,or,^airsoft gun^,or,^air soft gun^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun gun^,or,^ta[sz]er^,or,^la[sz]er gun^,or,^fake gun^,or,^toy gun^,or,(,(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,),),).
     This code removes unrelated injuries due to other “gun” types or the use of a gun as a weapon without firing when found within the triage notes narrative. [Note: the ISNULL clause at the beginning of the code is intended to prevent the automatic removal of cases with no information in the Triage Notes Orig].

Wisconsin Assault Firearm Injury SyS query:

- For the new query, we used SyS Assault Firearm Injury V1 as our starting point.
- We included all ICD-10-CM codes indicating assault firearm injury (X93, X94, X958, X959 first encounter) and SNOMED codes listed in the CDC query.

- The words ^assailant^,or,^victim^ were added as inclusion key words in combination with gunshot or bullet wound.
- We removed some of the inclusions related to type of firearm as these were not associated (by Boolean logic in the query) with “shot” or “gsw” (in other words, any mention of the type of gun would include the visit but narrative may indicate the presence of a riffle without the firing of this riffle or a gsw as a result of the riffle being discharged).
- As with the Wisconsin Firearm Injury SyS query, we adjusted the exclusion of a variety of “other” gun types to specify “gun” or “bullet” (for instance, “nerf gun,” “toy gun”) and we added CO2 gun to this list after finding reference to this in our narrative review.
- Our main query was used to search Triage Notes Orig, Discharge Diagnosis, and Chief Complaint History fields. Our review revealed that language related to intent was most often included in the Triage Notes Orig and not in the ChiefComplaints field. We also found support that if assault/victim terminology was used, all supporting evidence indicated that, regardless of the ICD-10-CD code, the case was a valid assault case (often, the W34 codes were used in the Discharge Diagnosis field even when all evidence supported “assault” designation). By including all 3 of these fields, our query will search for inclusion based on any one of these 3 fields meeting inclusion criteria.
- We created an additional exclusionary clause to be applied as separate query code to the CC and DD field (see the instructions for the new code below on how to apply this within ESSENCE):

  Query code to apply to CC and DD:
  ^,ANDNOT,(,^Ass[au][ua]lt^,or,^assult^,or,(,^pain^,andnot,(,^pain^,and,(,^[;/]X9[34]^,or,^[;/]X958^,or,^[;/]X95.8^,or,^[;/]X959^,or,^[;/]X95.9^,),),),or,^[;/]Z51.89^,or,^[;/]Z5189^,or,^[;/]R45.851^,or,^[;/]R45851^,or,^[;/]T1491^,or,^[;/]T14.91^,or,^wound eval^,or,^medical clearance^,or,^dressing change^,or,^redressing^,or,^wound care^,or,^wound complication^,or,^wound check^,or,^wound recheck^,or,^wound infect^,or,^wound drain^,or,(,(,^gsw^,or,^gunshot^,or,^gun shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,),),).

  This removes chief complaints of assault, wound care (and similar phrases), medical clearance, and mention of pain when not associated with a firearm assault ICD-10-CM code. Upon narrative review, we noted that where “assault” was referenced in the ChiefComplaints field (33 cases), these were not associated with a gunshot wound but rather with assault by hitting/striking with a firearm. Only 1 out of the 33 cases were determined to be assault by firing of a gun (3%). We had also reviewed cases identified by wound care and chief complaints of pain and determined these were also unrelated to a current firearm injury (though exclusion of “pain” is restricted to cases where the firearm injury assault code is not present; when these assault firearm injury ICD-10-CM codes were used, the narrative supported an assault firearm injury).

d) Once you have adjusted the query, run this in SyS and spot check narratives to confirm inclusion or exclusion of cases based on your criteria. Pay particular attention to syntax, misspellings, Boolean operators (and their order), commas, and carets.

Wisconsin Firearm Injury SyS Query: Query string to be applied to the CC and DD field. This query also uses the Triage Notes Orig and Chief Complaint History fields separately for additional exclusionary clauses.

The query code in blue below represents adjustments or additions we made that were supported by our narrative review.

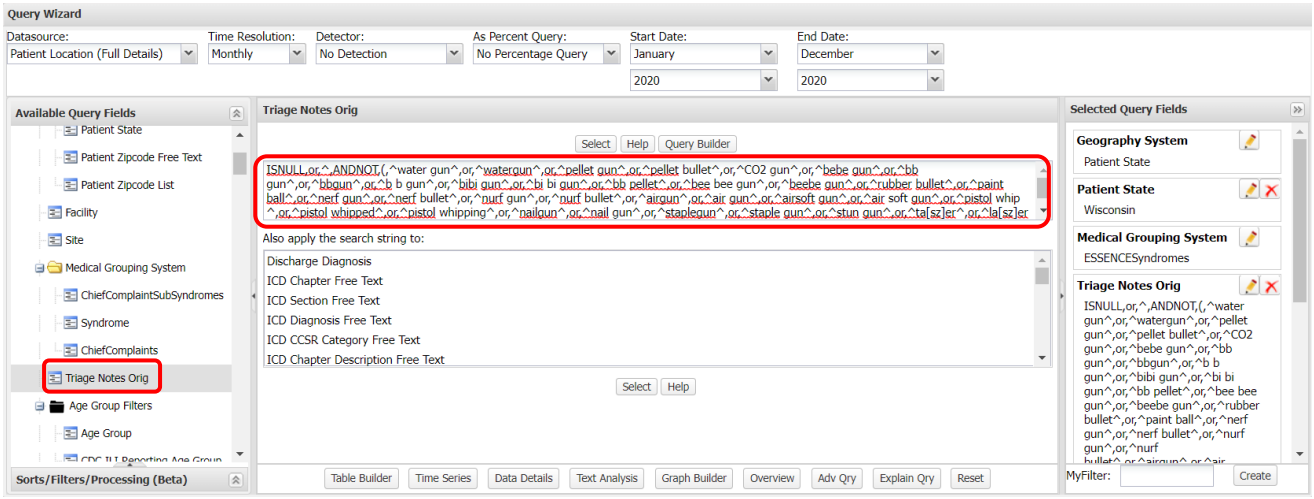
Wisconsin Firearm Injury query definition

This string should be pasted in the CC and DD field:

(,(,(,^gsw^,or,^gunshot^,or,^gun shot^,or,^gunshout^,or,^gunshoot^,),andnot,(,(,(,^gunshot wound^,or,^gun shot wound^,),and,^pain^,),or,(,^pain^,and,(,^gunshot wound^,or,^gun shot wound^,),),),or,(,^chronic^,and,^pain^,),or,^water gun^,or,^watergun^,or,^pellet gun^,or,^pellet bullet^,or,^CO2 gun^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee gun^,or,^beebe gun^,or,^rubber bullet^,or,^paint ball^,or,^nerf gun^,or,^nerf bullet^,or,^nurf gun^,or,^nurf bullet^,or,^airgun^,or,^air gun^,or,^airsoft gun^,or,^air soft gun^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun gun^,or,^ta[sz]er^,or,^la[sz]er gun^,or,(,(,^struck^,or,^ hit ^,),and,(,^gun^,or,^pistol^,),),or,^fake gun^,or,^follow-up^,or,^toy gun^,or,^follow up^,or,^followup^,or,^ass[au][ua]lt^,or,^assult^,or,(,^wound^,and,(,^complication^,or,^check^,or,^care^,or,^recheck^,or,^infection^,or,^infected^,or,^drainage^,or,^eval^,),),or,^med^ clear^,or,^gswel^,or,^gswol^,or,(,(,^gsw^,or,^gunshot^,or,^gun shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,or,^ post^,or,^ since ^,),),),),OR,(,^[;/]W3[23]^,andnot,(,^[;/]W3[23]___[DS]^,or,^[;/]W3[23].___[DS]^,),),or,(,(,^[;/]W34[01][09]^,or,^[;/]W34.[01][09]^,),andnot,(,^[;/]W34[01][09]_[DS]^,or,^[;/]W34.[01][09]_[DS]^,),),or,(,^[;/]X7[23]^,andnot,(,^[;/]X7[23]___[DS]^,or,^[;/]X7[23].___[DS]^,),),or,(,(,^[;/]X74[89]^,or,^[;/]X74.[89]^,),andnot,(,^[;/]X74[89]__[DS]^,or,^[;/]X74.[89]__[DS]^,),),or,(,^[;/]X9[34]^,andnot,(,^[;/]X9[34]___[DS]^,or,^[;/]X9[34].___[DS]^,),),or,(,(,^[;/]X95[89]^,or,^[;/]X95.[89]^,),andnot,(,^[;/]X95[89]__[DS]^,or,^[;/]X95.[89]__[DS]^,),),or,(,^[;/]Y2[2-3]^,andnot,(,^[;/]Y2[2-3]___[DS]^,or,^[;/]Y2[2-3].___[DS]^,),),or,(,(,^[;/]Y24[89]^,or,^[;/]Y24.[89]^,),andnot,(,^[;/]Y24[89]__[DS]^,or,^[;/]Y24.[89]__[DS]^,),),or,(,^[;/]Y350[0129]^,andnot,^[;/]Y350[0129]_[DS]^,),or,(,^[;/]Y35.0[0129]^,andnot,^[;/]Y35.0[0129]_[DS]^,),or,(,^[;/]Y38.4^,andnot,^[;/]Y38.4__[DS]^,),or,(,^[;/]Y384^,andnot,^[;/]Y384__[DS]^,),or,^[;/]41430008^,or,^[;/]56768003^,or,^[;/]63409001^,or,^[;/]69861004^,or,^[;/]77301004^,or,^[;/]86122002^,or,^[;/]111050005^,or,^[;/]219257002^,or, ^[;/]283545005^,or,^[;/]218081007^,or,^[;/]218086002^,or,^[;/]218082000^,or,^[;/]218087006^,or,^[;/]218088001^,or,^[;/]269796009^,or,^[;/]242869008^,or,^[;/]219199009^,or,^[;/]219200007^,or,^[;/]219201006^,or,^[;/]219204003^,or,^[;/]219205002^,or,^[;/]219203009^,or,^[;/]219198001^,or,^[;/]219142001^,or,^[;/]219143006^,or,^[;/]219144000^,or,^[;/]219145004^,or,^[;/]219146003^,or,^[;/]287184008^,or,^[;/]287193009^,),ANDNOT,(,^[;/]Z51.89^,or,^[;/]Z5189^,or,(,(,^[;/]W3400^,or,^[;/]W34.00^,),and,^puncture wound^,),or,(,(,^[;/]W3400^,or,^[;/]W34.00^,),and,(,^gunshot wound^,or,^gun shot wound^,or,^gsw^,),and,^pain^,),or,(,(,^[;/]W3400^,or,^[;/]W34.00^,),and,^pain^,),)

Next step:
After you have selected CC and DD and added the code above for that field, you will perform two additional steps. First, select the Triage Notes Orig field from the list of fields on the left. Then add your new query text (which will serve as an "AND" to your code above) to the box in the center screen as shown in Figure 3B. Then repeat this instruction for the second exclusion code to be applied to the Chief Complaint History field.

Figure 3B. ESSENCE query wizard screenshot (Triage Notes Orig exclusions).



The code below should be pasted in the Triage Notes Orig field:

ISNULL,or,^,ANDNOT,(,^water gun^,or,^watergun^,or,^pellet gun^,or,^pellet bullet^,or,^CO2 gun^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee gun^,or,^beebe gun^,or,^rubber bullet^,or,^paint ball^,or,^nerf gun^,or,^nerf bullet^,or,^nurf gun^,or,^nurf bullet^,or,^airgun^,or,^air gun^,or,^airsoft gun^,or,^air soft gun^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun gun^,or,^ta[sz]er^,or,^la[sz]er gun^,or,^fake gun^,or,^toy gun^,or,(,(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,),),)

The code below should be pasted in the Chief Complaint History field:

ISNULL,or,^,ANDNOT,(,^water gun^,or,^watergun^,or,^pellet gun^,or,^pellet bullet^,or,^CO2 gun^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee gun^,or,^beebe gun^,or,^rubber bullet^,or,^paint ball^,or,^nerf gun^,or,^nerf bullet^,or,^nurf gun^,or,^nurf bullet^,or,^airgun^,or,^air gun^,or,^airsoft gun^,or,^air soft gun^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun gun^,or,^ta[sz]er^,or,^la[sz]er gun^,or,^fake gun^,or,^toy gun^,or,(,(,^struck^,or,^hit with^,),and,(,^gun^,or,^pistol^,),),or,(,^wound^,and,(,^complication^,or,^check^,or,^care^,or,^recheck^,or,^infection^,or,^infected^,or,^drainage^,or,^eval^,),),or,^med^clear^,or,^gswel^,or,^gswol^,or,(,(,^gsw^,or,^gunshot^,or,^gun

shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,or,^ post^,or,^ since ^,),),)

(Note: application of these two exclusion codes will function as an "AND" qualifier. If any of these exclusions are found either in the Triage Notes Orig or Chief Complaint History field, the case will be rejected/excluded. The ISNULL clause at the beginning of the code is intended to prevent the automatic removal of cases with no information in the Triage Notes Orig or Chief Complaint History field; possibly a significant concern for some jurisdictions).

Wisconsin Assault Firearm Injury SyS query

This string should be pasted in the Discharge Diagnosis field, and Triage Notes Orig and Chief Complaint History should also be selected from the "fields" list below the query box *(Note: if any one of these 3 fields meets inclusion criteria, the case will be selected)*:

(,(,(,^ass[au][ua]lt^,or,^assailant^,or,^victim^,),AND,(,^gsw^,or,^gunshot ^,or,^gun shot^,or,^gunshout^,or,^gunshoot^,or,^buckshot^,or,^buck shot^,or,^been shot^,or,(,(,^ hit ^,or,^ricochet^,or,^graze^,),and,(,^bullet^,),),or,(,^gun^,and,^wound^,),),),or,(,(,^[;/]X9[34]^,andnot,(,^[;/]X9[34]___[DS]^,or,^[;/]X9[34].___[DS]^,),),or,(,(,^[;/]X95[89]^,or,^[;/]X95.[89]^,),andnot,(,^[;/]X95[89]__[DS]^,or,^[;/]X95.[89]__[DS]^,),),or,^[;/]242869008^,or,^[;/]219199009^,or,^[;/]219200007^,or,^[;/]219201006^,or,^[;/]219204003^,or,^[;/]219205002^,or,^[;/]219203009^,or,^[;/]219198001^,),ANDNOT,(,^water gun^,or,^watergun^,or,^pellet gun^,or,^pellet bullet^,or,^CO2 gun^,or,^bebe gun^,or,^bb gun^,or,^bbgun^,or,^b b gun^,or,^bibi gun^,or,^bi bi gun^,or,^bb pellet^,or,^bee bee gun^,or,^beebe gun^,or,^rubber bullet^,or,^paint ball^,or,^nerf gun^,or,^nerf bullet^,or,^nurf gun^,or,^nurf bullet^,or,^airgun^,or,^air gun^,or,^airsoft gun^,or,^air soft gun^,or,^pistol whip ^,or,^pistol whipped^,or,^pistol whipping^,or,^nailgun^,or,^nail gun^,or,^staplegun^,or,^staple gun^,or,^stun gun^,or,^ta[sz]er^,or,^la[sz]er gun^,or,(,(,^struck^,or,^hit ^,),and,(,^gun^,or,^pistol^,),),or,^fake gun^,or,^toy gun^,or,^gswel^,or,^gswol^,),)

This string should be pasted in the CC and DD field (follow the same steps as in the Wisconsin Firearm Injury SyS query above which detailed the additional query code added to Triage Notes Orig and Chief Complaint History). *(Note: this will function as an "AND" qualifier. If any of these exclusions in the CC and DD field are present, the case will be rejected/excluded.)*:

^,ANDNOT,(,^Ass[au][ua]lt^,or,^assult^,or,(,^pain^,andnot,(,^pain^,and,(,^[;/]X9[34]^,or,^[;/]X958^,or,^[;/]X95.8^,or,^[;/]X959^,or,^[;/]X95.9^,),),),or,^[;/]Z51.89^,or,^[;/]Z5189^,or,^[;/]R45.851^,or,^[;/]R45851^,or,^[;/]T1491^,or,^[;/]T14.91^,or,^wound eval^,or,^med^ clear^,or,^dressing change^,or,^redressing^,or,^wound care^,or,^wound complication^,or,^wound check^,or,^wound recheck^,or,^wound infect^,or,^wound drain^,or,(,(,^gsw^,or,^gunshot^,or,^gun shot^,or,^bullet^,),and,(,^hx^,or,^history^,or,^history of^,or,(,^ago^,andnot,^minutes ago^,),or,^past^,or,^prior^,or,^previous^,or,^old^,),),)

e) Rerun the adjusted query and compare again with ED discharge data. Conduct the same comparison as before.

Table 6B. Overall Firearm Injuries: Wisconsin ED discharge data, Syndromic (SyS) Firearm Injury V2 query, and Wisconsin Firearm Injury SyS query comparison by demographics; 2020.

	Wisconsin ED Discharge		SyS Firearm Injury V2			Wisconsin Firearm Injury SyS		
	N	%	N	%	% Difference	N	%	% Difference
Total	1245	100	1711	100	37.4	1416	100	13.7
Age Group								
0-9	13	1.0	16	0.9	23.1	14	1.0	7.7
10-14	21	1.7	23	1.3	9.5	17	1.2	-19.0
15-19	173	13.9	206	12.0	19.1	164	11.6	-5.2
20-24	266	21.4	355	20.8	33.5	290	20.5	9.0
25-34	435	34.9	566	33.1	30.1	462	32.6	6.2
35-44	167	13.4	247	14.4	47.9	198	14.0	18.6
45-54	97	7.8	128	7.5	32.0	109	7.7	12.4
55-64	49	3.9	55	3.2	12.2	48	3.4	-2.0
65-74	17	1.4	22	1.3	29.4	21	1.5	23.5
75+	5	0.4	5	0.3	0.0	5	0.4	0.0
Missing/Unknown*	#	-	88	5.1	-	88	6.2	-
Sex								
Female	192	15.4	247	14.4	28.6	206	14.5	7.3
Male	1052	84.5	1464	85.6	39.2	1210	85.5	15.0
Missing/Unknown	#	0.0	0	0.0	-	0	0.0	-
Race								
American Indian	8	0.6	8	0.5	0.0	8	0.6	0.0
Asian or Pacific Islander	5	0.4	6	0.3	20.0	6	0.4	20.0
Black	864	69.4	1205	70.4	39.5	966	68.2	11.8
White	291	23.4	361	21.1	24.1	317	22.4	8.9
Other	#	-	83	4.9	-	77	5.4	-
Missing/Unknown	76	6.1	48	2.8	-36.8	42	3.0	-44.7
Ethnicity								
Hispanic	86	6.9	113	6.6	31.4	100	7.1	16.3
Non-Hispanic	1126	90.4	1543	90.2	37.0	1265	89.3	12.3
Missing/Unknown	33	2.7	55	3.2	66.7	51	3.6	54.5
Geographic Region								
Northeastern	69	5.5	99	5.8	43.5	91	6.4	31.9
Northern	27	2.2	45	2.6	66.7	41	2.9	51.9
Southeastern	1000	80.3	1373	80.3	37.3	1119	79.0	11.9
Southern	95	7.6	158	9.2	66.3	133	9.4	40.0
Western	54	4.3	36	2.1	-33.3	32	2.3	-40.7
Geographic Area								
Rural	98	7.9	113	6.6	15.3	104	7.3	6.1
Urban	1147	92.1	1598	93.4	39.3	1312	92.7	14.4

*Missing age for SyS data is based on recategorized cases with illegal age values or missing DOB information.
# Indicates a value less than 5 that has been suppressed to protect confidentiality.
[1]Percentage column represents the percentage of the total number of cases for each focus population.

Table 7B. Assault Firearm injuries: Wisconsin ED discharge data, Syndromic (SyS) Assault Firearm Injury V1 query, and Wisconsin Assault Firearm Injury SyS query comparison by demographics; 2020.

	Wisconsin ED Discharge		SyS Assault Firearm Injury V1			Wisconsin Assault Firearm Injury SyS query		
	N	Percent (%)	N	Percent (%)	% Difference	N	Percent (%)	% Difference
Total	322	100	51	100	-84.2	294	100	-8.7
Age Group								
0-9	0	0.0	0	0.0	-	0	0.0	-
10-14	0	0.0	0	0.0	-	0	0.0	-
15-19	38	11.8	10	19.6	-73.7	27	9.2	-28.9
20-24	70	21.7	13	25.5	-81.4	51	17.4	-27.1
25-34	120	37.3	14	27.5	-88.3	99	33.7	-17.5
35-44	53	16.5	9	17.7	-83.0	45	15.3	-15.1
45-54	23	7.1	#	-	-	31	10.5	34.8
55-64	13	4.0	0	0.0	-100.0	6	2.0	-53.8
65-74	#	-	0	0.0	-	#	-	-
75+	0	0.0	0	0.0	-	0	0.0	-
Missing/Unknown*	#	-	#	-	-	34	11.6	-
Sex								
Female	56	17.4	14	27.5	-75	46	15.7	-17.9
Male	266	82.6	37	72.6	-86.1	248	84.4	-6.8
Race								
American Indian	#	0.9	0	0.0	-	0	0.0	-
Asian or Pacific Islander	0	0.0	0	0.0	-	#	-	-
Black	238	73.9	39	76.5	-83.6	231	78.6	-2.9
White	48	14.9	6	11.8	-87.5	30	10.2	-37.5
Other	#	-	#	-	-	25	8.5	-
Missing/Unknown	32	9.9	#	-	-	7	2.4	-78.1
Ethnicity								
Hispanic	31	9.6	#	-	-	20	6.8	-35.5
Non-Hispanic	285	88.5	48	94.1	-83.2	268	91.2	-6.0
Missing/Unknown	6	1.9	#	-	-	6	2.0	0.0
Geographic Region								
Northeastern	10	3.1	6	11.8	-40.0	11	3.7	10.0

Northern	6	1.9	0	0.0	-100.0	#	-	-
Southeastern	282	87.6	40	78.4	-85.8	271	92.2	-3.9
Southern	16	5.0	#	-	-	9	3.1	-43.8
Western	8	2.5	#	-	-	#	-	-
Geographic Area								
Rural	14	4.4	#	-	-	5	1.7	-64.3
Urban	308	95.7	50	98.0	-83.8	289	98.3	-6.2

*Missing age for SyS data is based on recategorized cases with illegal age values or missing DOB information. # Indicates a value less than 5 that has been suppressed to protect confidentiality.
[1]Percentage column represents the percentage of the total number of cases for each focus population.

f) Conduct another narrative review based on the cases identified by the new SyS query in order to verify accuracy of your new query definition.

As we modified our code, we continually "tested" the results to verify that invalid cases were not included and that we didn't inadvertently remove valid cases.

Our final review of the Wisconsin Assault Firearm Injury SyS query (45 reviews; approximately 15%) revealed 96% confirmed assaults by firearm, 1 case of unintentional firearm injury, and 1 case of "no firearm-related injury." We feel confident with our new query which also more closely matches ED discharge data.

Our final review of the Wisconsin Firearm Injury SyS query (145 reviews; 10%) revealed that 97% were confirmed by code or keyword while 3% had no firearm injury noted. Of the 97% confirmed as firearm injury, this included 16 cases (11% of the total reviewed) that had an appropriate ICD-10-CD code (W3400) but no supporting evidence in keywords (for instance, key words may have indicated "urgent care"). We feel confident this new query more accurately captures valid firearm injury cases though the total case count is still higher (15%) than the total cases identified by ED discharge data.

g) Review overall percentage differences and differences by subpopulations. If you still find large differences by subpopulations, perform a more targeted narrative review of those groups.

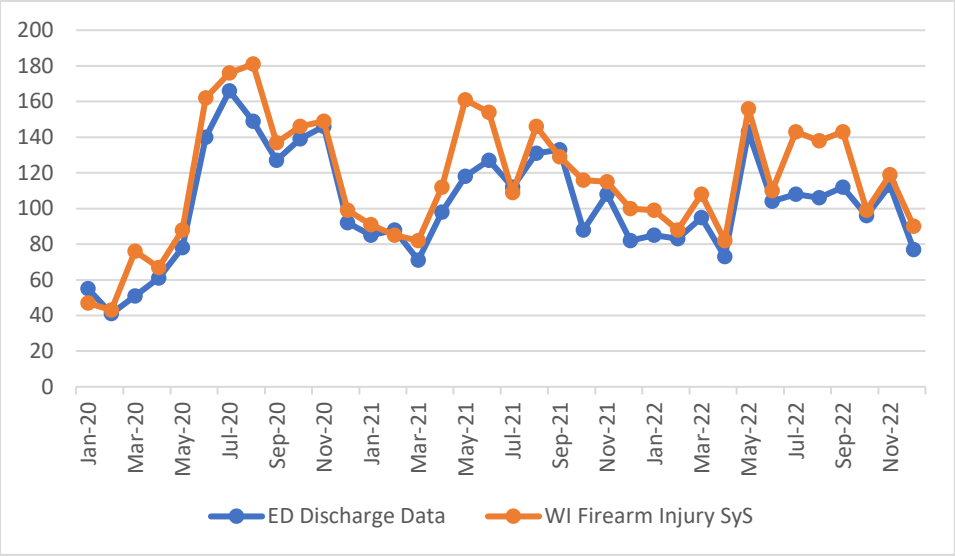
- There is a 14% difference overall between ED discharge data and the Wisconsin Firearm Injury SyS query definition (with syndromic identifying 171 more cases) and a -9% difference for the Wisconsin Assault Firearm Injury SyS query definition (with syndromic identifying 28 fewer cases).
- Age group, sex, race, ethnicity, geographic area, and urbanicity exhibit similar distributions between data sources for the overall Wisconsin Firearm Injury query and Wisconsin Assault Firearm Injury query.

Step 7. Compare monthly trends/patterns for 1-2 years to determine if your new SyS query and ED discharge data reveal the same pattern. Do this for subpopulations of interest as well.

As noted in the CCI and DDI average weekly percent filters, Wisconsin had relatively complete data in the ChiefComplaints and Discharge Diagnosis fields (both over 85%). Because of this, we did not need to include these filters in our trend analysis. Instead, we simply applied the Data Quality CoV HasBeenE filter and compared monthly data for our new queries to ED discharge data. Below are 2 trend graphs: 1)

comparison of monthly data for overall firearm injuries, and 2) comparison of monthly data for assault firearm injuries. We present data for 3 years in total though 1-2 years is likely sufficient.

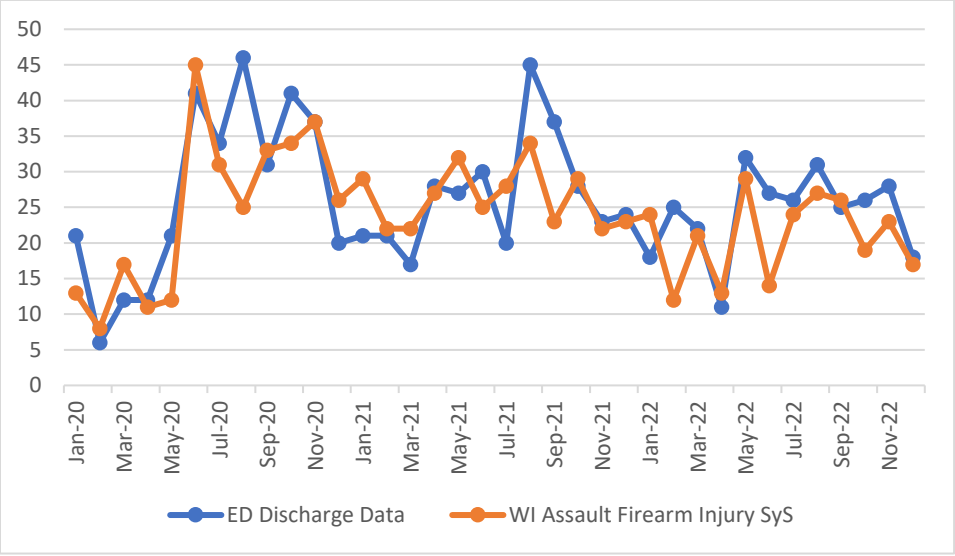
Figure 4B. Wisconsin monthly non-fatal ED visits with firearm injury; 2020-2022.*



* With Data Quality CoV HasBeenE Last 3 Years to Date filter.

Overall, monthly data reveal similar trends/patterns for the two trend lines and the slopes are not statistically significantly different.

Figure 5B. Wisconsin monthly non-fatal ED visits with assault firearm injury; 2020-2022.*



* With Data Quality CoV HasBeenE Last 3 Years to Date filter.

For monthly assault firearm injuries, the trend lines do not appear to match as well, however, the slopes are not statistically significantly different. An added complication with visual comparison is that the smaller case counts for this injury event may make differences in dips and spikes appear greater.

Adjustments to our SyS query improved our counts though it would be important to note the underestimation of SyS cases compared with ED discharge data when/if communicating these results.

Step 8. Note differences between data systems and establish guidelines/expectations on appropriate use, communication, and dissemination of SyS data.

- Firearm Injury V2 and Assault Firearm Injury V1 queried information from the CC and DD field. We discovered that this functions reasonably well for the overall firearm injury query (Firearm Injury V2) though it does not work well for the Assault Firearm Injury V1 query. The ChiefComplaints field contains limited information about the event which is necessary to determine the intention (unintentional, assault, self-harm, undetermined). The Triage Notes Orig field contains far greater detail (when used) and we determined that it was necessary to use this field for both of our newly created firearm injury queries.

- There is a well-known concern regarding the use of unintentional ICD-10-CM codes for firearm injuries. Our narrative review confirmed this concern with overuse of unintentional codes even with clear narratives indicating assault. Additionally, the unintentional codes were used for describing after care treatment, pain associated with past gunshot wounds, wound care and dressing changes, and injuries sustained from being hit with a firearm (not as a result of firing of a bullet). All of this suggests a need to educate medical personnel and coders on the use of these codes in order to better conduct surveillance on firearm injuries.

- Our new queries reduced the difference between ED discharge data and SyS data. For overall firearm injuries, the Wisconsin Firearm Injury SyS query identified 14% more cases compared with ED discharge data (the difference between the SyS Firearm Injury V2 query was 37% compared with ED discharge data). The new Wisconsin Assault Firearm Injury query reduced the difference between SyS and ED discharge data from -84% to -9%.

- Monthly trends/patterns looked similar for overall and assault firearm injuries.

- Timeliness is the most valuable asset of SyS data, but accuracy is not always reliable. As a result of our evaluation and discussion of the differences, we recommend using SyS to monitor and alert our programs and staff to spikes and upward trends. ED discharge data is still the most reliable for counts and rates, however, with the debate around appropriate coding for intent, there are likely weaknesses with ED discharge data as well.

- Compared with ED discharge data, both new query definitions produce different counts in spite of all of the adjustments made to the CDC query definitions. However, Wisconsin overall firearm injury trends, based on SyS data, match well with ED discharge data. It may, therefore, be appropriate to communicate trends/patterns and discuss counts and rates as “suspected cases” of firearm injuries. An important point to make with potential data users is that ED discharge data is considered finalized and confirmed and SyS data identifies “suspected” instances and, as a result, these numbers will not be a perfect match. If data users are interested in reviewing unintentional or assault firearm injuries, you may want to caution SyS data users of suspected overestimation of unintentional and underestimation of assault. It may also be useful to caution users about the default use of unintentional ICD-10-CM codes for firearm injury events.

References:

1. Zwald ML, Van Dyke ME, Chen MS, et al. Emergency Department Visits for Firearm Injuries Before and During the COVID-19 Pandemic — United States, January 2019–December 2022. *MMWR Morb Mortal Wkly Rep*. 2023;72:333–337. https://www.cdc.gov/mmwr/volumes/72/wr/mm7213a2.htm

2. Barber C, Goralnick E, Miller M. The Problem With *ICD*-Coded Firearm Injuries. *JAMA Intern Med.* 2021;181(8):1132–1133. doi:10.1001/jamainternmed.2021.0382. https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2777964

3. Centers for Disease Control and Prevention (CDC). ICD-10 Coordination and Maintenance Committee Meeting March 7-8, 2023. Published March 2023. https://www.cdc.gov/nchs/data/icd/Topic-packet-March-7-8-final-3-6-23.pdf.