
NarxCare Application

I.1 Introduction to NarxCare

NarxCare is an application that provides a set of tools to support clinicians' analysis of controlled substance data from government managed and regulated Prescription Drug Monitoring Programs (PDMPs)¹.

Informed prescribing practices must be part of a multi-dimensional response to the ongoing opioid epidemic. The NarxCare application automatically analyzes PDMP data and delivers scores and visualizations of usage patterns based on the data, to further enable informed prescribing and dispensing practices. The NarxCare application is user-friendly, easily integrated into a patient's electronic medical record, and interoperable with other PDMPs. This document provides an overview of the NarxCare application and a breakdown of the report and analytics tools.

I.2 Why NarxCare?

NarxCare offers a representation of PDMP data in an interactive format to help clinicians² and care teams efficiently and easily access and interpret data to aid in their controlled substance³ therapy management.

With the NarxCare application, clinicians have access to all the features and functions of NarxCare enabled by their PDMP Administrator with a consistent look and feel for all users who access the solution. Furthermore, NarxCare delivery is enabled within Electronic Health Records (EHRs) and Pharmacy Management Systems for those prescribers and dispensers who choose to access NarxCare through integrations within their healthcare IT system.

In addition to analytics support, PDMP administrators have the option to enable the Care Notes Module, the Communications Module, and Resources Module with the NarxCare application enhancements.

Note: For additional information on the Care Notes, Communications, or Resources Modules, please contact the appropriate PDMP administrator.

I.3 Who Has Access to NarxCare?

NarxCare is available to all authorized end users, whether they are accessing NarxCare via the web portal, an integrated EHR system, or pharmacy software.

I.4 How is NarxCare Used in Therapy Management?

The information provided in NarxCare is intended to support clinicians'-controlled substance therapy management activities. For example, with respect to information provided in NarxCare that indicates increased overdose risk potential, the information may

¹ When used in this document, unless the context requires otherwise, "PDMP" refers to the applicable state, territory, locality, or other government PDMP for the authorized user.

² When used in this document, the term "clinician" refers to any prescriber or dispenser authorized user.

³ When used in this document, the term "controlled substance" refers to any federal or state-controlled substance, as well as any other PDMP-reportable drugs.

be helpful in prompting consideration of strategies to mitigate risk of an overdose, if warranted, based on the specific patient context and the clinician's professional judgement. However, none of the information presented should be used as sole justification for providing or not providing medications.

1.5 NarxCare Layout

The NarxCare application displays PDMP data in the form of tiles on a **Patient Report**. The following layout provides common tiles you may see on your **Patient Report**. For more information on how to run a Patient Request, please refer to the [Making Patient Requests](#) help section in the NarxCare Support Center.

Note: *The tiles displayed to you may vary from the above layout depending on the configurations established by your PDMP administrator. For example, the PDMP administrator may request additional tiles for display in the interface for their PDMP that are not displayed in the above layout.*

An overview of each tile can be found in the [NarxCare Overview](#) section of this document.

CAUTION//IMPORTANT REMINDER: *NarxCare is an application that provides a set of tools to support clinicians' analysis of controlled substance data from government managed and regulated Prescription Drug Monitoring Programs (PDMPs). NarxCare is intended to aid, not replace, medical decision making. None of the information presented in the NarxCare application should be used as sole justification for providing or not providing medications.*

2 NarxCare Overview

NarxCare was designed to provide an intuitive view of dispensing information for a patient. This information is presented as tiles on a **Patient Report**, many of which are interactive, allowing the user to click or hover over links and graphs within a tile to access additional information.

Note: The list of tiles described below is not comprehensive. This is a list of the most commonly activated tiles by PDMP administrators. You may not see all of the tiles described below and you may see additional tiles in your layout that are not described below. The tiles displayed to you are configured by your PDMP administrator.

2.1 Header and Patient Identifying Information

The NarxCare header contains patient identifying information in the first line above the tiles. Additional patient information, such as date of birth and address, can be found directly below the header. This information will remain visible at the top of your screen as you scroll through the **Patient Report**.

You can click [View Link Records](#) to display all records linked to the selected patient.

2.2 Prescription Detail

Each prescription dispensed to a patient is presented in the **Prescriptions** tile. If desired, you can use the arrows next to each column header (↕) to sort the table by that column. You can also hover your cursor over a prescriber or pharmacy to view additional information, such as the prescriber or pharmacy's full name, address, and DEA number.

2.3 Provider and Pharmacy Detail

Provider and pharmacy information, including full name, address, and DEA number, if applicable, are presented in the **Providers** and **Pharmacies** tile.

2.4 Rx Graph

The **Rx Graph** tile displays prescribing information and allows you to see important patterns and levels of use. The Rx Graph displays information in reverse chronological order; meaning the most recent prescriptions are displayed on the left side of the graph and the oldest are displayed on the right.

Prescriptions are color coded and can be selected or deselected at the top of the graph.

Color coding is as follows:

- Narcotics (opioids) = red
- Buprenorphines = purple
- Sedatives (benzodiazepines, sleep aids, etc.) = blue
- Stimulants = green
- Other = grey*

***Note:** Other prescriptions can include anesthetics, cannabinoids, GI narcotics, steroids, and medications used to treat neuropain (e.g., gabapentin).

Each pixel in the graph represents one day. Therefore, a 30-day prescription is represented by a rectangle about 1 cm wide and a 1–3-day prescription appears as a narrow vertical bar.

The Rx Graph is interactive. You can click on a prescription to view information for that prescription, or you can click and drag over multiple prescriptions to view information for the selected prescriptions.

2.5 Other Graphs

If configured by your PDMP administrator, the **Rx Summary** and **Rx Summary Expanded** tiles may also be included in your **Patient Report**.

The Rx Summary tile includes:

- **Morphine Milligram Equivalent Prescribed Over Time**
- **Buprenorphine (mg) Prescribed Over Time**
- **Lorazepam MgEg (LME) Prescribed Over Time**

These tiles contain graphs that provide a longitudinal view of daily MME, buprenorphine, and LME.

Note: Abrupt changes in trends may be due to overlapping prescriptions. Clinicians can review detailed information on the prescriptions in the **Prescriptions, Providers, and Pharmacies** tiles.

You can customize the length of time for which you wish to view information by clicking **Last 30 Days** (displayed by default), **Last 60 Days**, **Last 90 Days**, **Last 1 Year**, or **Last 2 Years** at the top of each graph.

Note: You can hover over the timeline in any of these graphs to display information for a specific day.

2.6 Download Options

If you need to download a PDF or CSV version of the **Patient Report**, click the **Export** dropdown menu, then click **Download PDF** or **Download CSV**.

2.7 Other/Tools Metrics

To view Other/Tools Metrics available to you, click on the dropdown menu located at the top right-hand side of the page to display your additional options.

2.7.1 OD Insights (Non-Fatal Overdose Events)

Clinicians currently view a patient's controlled substance use history at the point of care via Patient Reports. OD Insights ingests non-fatal overdose death data and displays these events in a new tile on the Patient Report within the NarxCare application under the Other Tools/Metrics section.

Each NFOD event displays the following information within the tile on the Patient Report:

- Admittance date and time
- Facility name
- Facility city
- ICD – 10 code
- ICD – 10 description

2.7.2 Resources

The **Resources** dropdown menu contains an easy access link to *MOUD Providers* and *PDMP & CDC Resources* that may be useful to coordinate care or review CDC guidelines.

2.7.2.1 MOUD Providers

The **MOUD Providers** pop-up window allows users to locate the 30 closest providers who are listed in the Substance Abuse and Mental Health Services Administration (SAMHSA) buprenorphine treatment locator database.

The patient's zip code is pre-populated but can be edited. After entering the desired Zip Code, click Submit to generate a PDF that can be viewed and printed.

Note: These resources are provided by the Substance Abuse and Mental Health Services Administration (SAMHSA). View more information about the treatment locator [here](#).

2.7.2.2 PDMP & CDC Resources

The **State & CDC Resources** pop-up window provides a series of PDMP & CDC documents pertaining to both providers and patients.

Note: Your PDMP may not have additional resources available under the Resources link as this is a supplemental feature. Please contact your PDMP administrator if you would like additional information on CDC resources.

To assist providers in educating their patients, printable pamphlets are also available from the CDC. In addition to CDC-provided resources, and in coordination with the Bureau of Substance Addiction Services ([BSAS](#)), specific resources, as selected by the applicable PDMP administrator, are also available. More information about CDC resources can be found [here](#).

3 State Indicators

The NarxCare application includes a series of indicators that may be automatically returned to the requesting system as discrete data.

The indicators that may display on a **Patient Report** are:

- **Additional Indicators** – these are configured by the applicable PDMP administrator. They are used to identify when a patient has met or exceeded an additional risk indicator selected by the PDMP administrator. For additional information on State Indicators, please refer to the [State Indicators](#) help article in the [PMP AWARe Support Center](#).
- **Patient Alerts** – these are default indicators commonly referred to as “Clinical Alerts” that, if enabled by the PDMP, provide notifications and/or present on the **Patient Report** to indicate that a patient has met or exceeded a threshold as determined by the PDMP. There are 6 different types of Patient Alerts the PDMP may have enabled for their clinicians. For additional information on State Indicators or Patient Alerts, please refer to the [State Indicators](#) or [Patient Alerts](#) help articles in the [PMP AWARe Support Center](#).
- **Below Threshold Indicators** – If enabled by the PDMP, these indicators are presented on the **Patient Report** to indicate when a patient is below a Patient Alert threshold as determined by the PDMP. For additional information on State Indicators or Patient Alerts, please refer to the [State Indicators](#) or [Patient Alerts](#) help articles in the [PMP AWARe Support Center](#).
- **Custom State Indicators** – these are enabled by the applicable PDMP administrator and may include flags for deceased patients, opioid antidote (naloxone) administrations, marijuana registration cards, opioid treatment, etc. For additional information on Custom State Indicators, please refer to the [Custom State Indicators](#) help article in the [PMP AWARe Support Center](#).

Note: The state indicators available to you, and any thresholds associated with them, are configured by your PDMP administrator. PDMPs can submit a request for additional indicator types (e.g., death data) that are felt to espouse high correlations with adverse patient outcomes and are relevant to their jurisdiction’s population.

CAUTION / IMPORTANT REMINDER: Clinicians use State Indicators to further review details in the patient’s prescription history while attending to their patients. State Indicators are intended to aid, not replace, medical decision-making. None of the information presented should be used as sole justification for providing or not providing medications.

4 Narx Scores

The NarxCare application includes a series of scores that may be automatically returned to the requesting system as discrete data. One of the scores that may be returned is Narx Scores. Requesting systems receiving such data can choose to display it within the native electronic health record (EHR) or pharmacy management system. However, many systems choose to display the data within the NarxCare application as tiles on the **Patient Report**.

The NarxCare application provides three substance-specific (i.e., Narcotics, Sedatives, Stimulants) exposure scores for prescribing and dispensing of controlled substances as it relates to a patient called Narx Scores.

4.1 How are Narx Scores Used?

Narx Scores are intended to be automatically delivered into the clinical workflow as discrete data and be easily viewable within a patient's record. Many systems choose to place Narx Scores in the patient header or alongside the patient's vital signs.

Narx Scores were designed to increase provider awareness of a patient's controlled substance exposure. Thus, in order for the provider to derive the greatest informational utility from the scores, we encourage their viewing early during the patient encounter.

Note: Workflows may vary by organization. Please contact your organization administrator for additional information.

4.2 Narx Score Calculations and Metrics

Each Narx Score has a numerical value based on a synthesis of key patient metrics derived from the PDMP.

Narx Scores are calculated for narcotics, sedatives, and stimulants and have the following characteristics:

1. Each score consists of three digits ranging from 000–999.
2. The first two digits represent a relative scoring system for a given patient's exposure to a controlled substance compared to the rest of the PDMP population (described in detail below).
3. The last digit of each score represents the number of active prescriptions of that type. For example, a Narcotic Narx Score of 504 indicates the patient has four active narcotic prescriptions according to information obtained from the PDMP on dispensations.
4. The scores correspond to the prevalence and timing of literature-based risk factors⁴ that exist within the PDMP data for that specific patient.
 - There are four metrics used in Narx Score calculations. They are as follows:

⁴ Hall AJ, Logan JE, Toblin RL, et al. Patterns of Abuse Among Unintentional Pharmaceutical Overdose Fatalities. *JAMA*. 2008;300(22): 2613–2620. doi:10.1001/jama.2008.802.
Yang Z, Wilsey B, Bohm M, et al. Defining Risk of Prescription Opioid Overdose: Pharmacy Shopping and Overlapping Prescriptions Among Long-Term Opioid Users in Medicaid. *The Journal of Pain*. 16(5): 445–453.
Paulozzi L, Kilbourne E, Shah N, et al. A History of Being Prescribed Controlled Substances and Risk of Drug Overdose Death. *Pain Medicine*. 2012;13(1): 87–95. doi: 10.1111/j.1526-4637.2011.01260.x.
<https://www.ncbi.nlm.nih.gov/books/NBK458661/>

1. The number of controlled substance prescribers.
2. The number of pharmacies where controlled substance prescriptions were filled.
- 3a. The total dosage of prescriptions (opioids and sedatives only).
- 3b. The number of days supply for prescriptions (stimulants only).
4. The number of overlapping days for each drug type.
- Each metric is tallied across 4 timeframes of reference:
 1. Most recent 2 months
 2. Most recent 6 months
 3. Most recent 1 year
 4. Most recent 2 years
5. The time elapsed for any literature-based risk factor serves to decrease its contribution to the score. For example, 1,000 MME dispensed within the last month will elevate the score more than 1,000 MME dispensed one year ago.
6. The distribution of Narx Scores for patients found in a PDMP is approximated as follows⁵:
 - a. 78% score between 0 and 200
 - b. 6.7% score between 200 and 299
 - c. 5.3% score between 300 and 399
 - d. 6.5% score between 400 and 499
 - e. 3.4% score between 500 and 599
 - f. ~1% score between 600 and 999

The Narx Scores were designed such that:

1. Patients who are exposed to small amounts of medication with limited provider and pharmacy usage will have lower scores (e.g., scores below 199).
2. Patients who are exposed to large amounts of medications in accordance with recommended guidelines⁶ (single provider, single pharmacy, etc.) will have mid-range scores (e.g., scores between 200 and 500).
3. Patients who are exposed to large amounts of medications while using many providers and pharmacies, and with frequently overlapping prescriptions, will have higher scores (e.g., scores above 500).

4.3 Narx Score Algorithm

4.3.1 Relative Scoring

Narx Scores represent a relative scoring system for a given patient's exposure to a controlled substance compared to the rest of the PDMP population. The literature-based risk factors listed above in the introduction of this section are quantified and

⁵ This distribution is based on data obtained from a single state between 2017 – 2023 and may vary slightly depending on a patient's state of residence.

⁶ <https://www.cdc.gov/mmwr/volumes/71/rr/rr7103a1.htm#Recommendation9>

then converted to a reference value, which ranges from 0–99. These reference values correlate with a percentile measurement of that exposure within the specified PDMP population.

The Narx Score algorithm establishes boundaries of exposure by converting all measured variables, such as 60-day MME, to a scaled value between 0 and 99. This was done by evaluating each variable across each PDMP population and measuring the 60-day MME value for every patient with available data in the PDMP.

This set of data was then used to create a reference table roughly equating to a percentile in the population. If we add the scaled value to each example patient's 60-day MME, the result is:

If we apply these new scaled values to our percentile-ranked risk diagram and create a left and right boundary of 0 and 99, the result is:

The percentile-ranked scaled values indicate that Patient B and C are closer to each other than might otherwise be suspected. In this case, we can also say that Patient B has used more MME in the last 60 days than 90% of the rest of the PDMP population in the PDMP where the patient resides.

4.3.2 Time Periods

The NarxCare algorithm evaluates a PDMP data record using four different, overlapping time periods. In each time period, the factor being evaluated is tabulated and then converted to a percentile-ranked scaled value. These reference tables exist for all the factors being evaluated and cover all four time periods. In general, as the raw value count (i.e., number of prescribers) increases, so does the reference value (up to 99 maximum). As the time period increases, the scaled value decreases, so older records contribute less to the score than more recent records with the same drug content.

Weighting

A Narx Score is calculated as a weighted average of the scaled values. A 50% weighting is applied to the milligram equivalencies with the remaining factors making up the other 50%⁷.

This type of weighting results in several relationships. If we think of milligram equivalency as consumption and the combination of providers, pharmacies, and overlaps collectively as behaviors, we can create the following score categories.

It is important to understand that there are several different patterns of use that can result in the same score. It is always necessary to look at the actual PDMP data to determine what use patterns exist that have resulted in the Narx Score presented.

⁷ <https://www.ncbi.nlm.nih.gov/books/NBK458661/>

CAUTION / IMPORTANT REMINDER: Narx Scores can be used by a clinician as indicators to guide further review of details in the patient's prescription history while attending to their patients. Narx Scores are intended to inform medical decision-making and should not be used to replace a clinician's independent clinical judgment. None of the information presented should be used as sole justification for providing or not providing medications.

4.3.3 Score Computation

The following steps are involved in calculating a Narx Score:

1. Determine the raw values for all time periods for all variables.
2. Convert all raw values to scaled values.
3. Average the scaled values for each factor for all time periods.
4. Determine the weighted average.

Note: Dividing **by** the sum of the weights is necessary to normalize the weighted average. The weights used to calculate the average reflect the importance or significance of each feature, but they may not necessarily add up to 1.0 or 100%. By dividing the sum of the weighted features by the sum of the weights, we are essentially calculating the weighted average as a percentage of the total weight. This normalization ensures that the resulting average is on a scale of 0 to 1, or 0% to 100%, which makes it easier to compare the average across different datasets or to interpret it in a meaningful way. Without normalization, the weighted average could be misleading, especially if the weights are not proportional to each other or if the sum of weights is significantly different from the expected value of 1.0 or 100%.

5. Sum the number of active prescriptions and then concatenate to the two-digit percentile score.

Using the sample patient for a hypothetical scaled value to illustrate the calculation of a Narcotic score:

1. Determine the raw values for all time periods for all variables.
2. Convert all raw values to scaled values.
3. Average the scaled value for each factor for all time periods.
4. Calculate the weighted average.
5. Sum the number of active prescriptions and then concatenate to the two-digit percentile score.

4.3.1 General Considerations for Narx Scores

Just as there is no single blood pressure that can be considered normal for all people, there is no single Narx Score that is considered normal. A Narx Score must be applied to the clinical scenario by the clinician. For example, a blood pressure of 120/80 can simultaneously be:

- Inappropriate for a 2-month-old infant
- Appropriate for a 20-year-old woman

- Inappropriate for an elderly patient with an average daily blood pressure of 200/100

4.3.2 Example Use Cases⁸

How Narx Scores, used in concert with additional information, can help to support discussions with patients:

- **Case A** – An 18 – year – old male basketball player with other significant history presents with a severe ankle sprain. His Narx Scores are:

Important consideration: If considered for a controlled substance due to the severity of injury, this may be the patient’s first exposure to the effects of a controlled substance. The clinician would typically conduct a thorough review of the risks and benefits with the patient.

- **Case B** – An 81 – year – old female presents with decreased level of consciousness following a fall where she suffered a closed head injury. Her Narx Scores are:

Important Consideration: Many elderly patients are on chronic opioids and benzodiazepines. The physician may want to consider whether this patient’s use of opioids and benzodiazepines contributed to her fall. Alternatively, the physician may want to consider whether the patient may be taking too much medication and has potentially developed anxiety seizures due to benzodiazepine withdrawal, complicating the patient’s medical picture.

- **Case C** – A 36 – year – old male patient with mild chronic back pain frequently treated with controlled substances presents for a medication refill. Upon review of the patient’s PDMP record, the patient has been to 17 different prescribers in the last year. His Narx Scores are:

Important Consideration: Many patients obtain medications through multiple different providers. This can be due to the patient being seen in a clinic that is staffed by different providers, or it can be due to access to care issues requiring visits to urgent care centers or emergency departments.

- **Case D** – A 46 – year – old female patient with chronic anxiety, frequently treated with benzodiazepines, presents for a medication refill. On review of the PDMP record, the attending physician notes that her Narcotic score is non-zero, yet her PDMP history does not show that narcotics were ever dispensed. Her Narx Scores are:

Important Considerations:

- If a provider were to focus on the Narcotic score in isolation, this could lead to an incomplete view of a patient’s current medication regimen. Therefore, with this type of patient in mind, Narx Scores incorporate an ‘awareness value’ for attending providers. For example, the literature is clear on the association between adverse events such as respiratory

⁸ [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6917208/#:~:text=Similarly%2C%20the%20greatest%20share%20of.%E2%89%A565%20years%20\(34.6%25\)](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6917208/#:~:text=Similarly%2C%20the%20greatest%20share%20of.%E2%89%A565%20years%20(34.6%25))

depression, sedation and drowsiness, central nervous system depression, as well as an increased risk of falls and injuries due to the concomitant use of narcotics and sedatives (which includes benzodiazepines).

- Thus, patients who only use narcotics (i.e., opioids) will receive a Sedative score to increase provider awareness that prescribing the latter drug type might elevate the likelihood of an adverse event. Similarly, patients who only use sedatives receive a Narcotic score to increase provider awareness that prescribing controlled substances might elevate the likelihood of an adverse event.
- Appropriate prescribing practices encourage this more holistic view.

CAUTION / IMPORTANT REMINDER:

Narx Scores can be used by a clinician as indicators to guide further review of details in the patient's prescription history while attending to their patients. Narx Scores are intended to inform medical decision-making and should not be used to replace a clinician's independent clinical judgment. None of the information presented should be used as sole justification for providing or not providing medications.

5 Overdose Risk Score

The NarxCare application also provides a composite index of discrete data obtained from the PDMP called an Overdose Risk Score (ORS). The ORS is comprised of three digits ranging from 000–999.

5.1 ORS Intended Use

ORS was developed with a logistic regression model using PDMP data as an input and is intended to provide an indicator, along with other patient-centric factors outlined below, for clinicians to evaluate when making prescribing and dispensing decisions. ORS does not predict whether a patient will experience an unintentional overdose death now, or in the future, but rather provides a score and highlights characteristics of a patient and the patient's prescription drug history that correlate with characteristics of individuals who experienced an unintentional overdose death due to overexposure. The ORS numeric value represents a measure of correlation or association between the dataset used to develop the ORS model and the characteristics of a patient and the patient's prescription drug history identified in PDMP data.

Note: ORS is meant to aid in independent clinical decision-making by clinicians and is not intended for use by law enforcement agencies or activities, or any other uses.

5.2 ORS Algorithm Development

The ORS algorithm was derived using a common machine learning model (i.e., logistic regression) with a case-control study design. The model was originally trained using data obtained from over 5,000 autopsy adjudicated unintentional overdose deaths, which were age- and gender-matched to 500,000 patients using prescribed controlled substances during the same time frame who did not experience an overdose death.

The training dataset was acquired from a state in the Midwest and spanned the years from 2013 to 2016. It included cases from both males (68%) and females (32%), with ages from 18 to 85, from both urban (94.38%) and rural (5.2%) demographics.

The training dataset produced the following validation statistics, odds ratios and score distribution.

5.2.1 Validation Statistics

- Precision (i.e., positive predictive value/true positive rate): 77%
- Recall (i.e., sensitivity): 71%
- Specificity (i.e., true negativity rate): 79%
- Negative predictive value: 73%

5.2.2 Score Distributions

- 000 – 199: 32.2%
- 200 – 299: 21%
- 300 – 399: 37.2%
- 400 – 499: 6.8%
- 500 – 599: 2.1%
- 600 – 999: 0.7%

5.3 Additional External Validation

Additional validation of the model has been completed using decedent data from a different state than the training data state. The additional validation dataset spanned the years from 2017 to 2023 and contained ~ 400 decedents and ~ 32,000 non-decedents⁹ whose patient attributes were similar to those in the original training dataset. The validation data is a meaningfully smaller dataset, which can have a significant impact on the results in ORS bands with a small number of decedents. Thus, the smaller sample size resulted in a very small number of patients with a score ≥ 500 .

The additional validation dataset produced the following validation statistics, odds ratios and score distribution.

5.3.1 Validation Statistics

- Precision (i.e., positive predictive value/true positive rate): 73%
- Recall (i.e., sensitivity): 75%
- Specificity (i.e., true negativity rate): 73%
- Negative predictive value: 74%

Note: We plan to update these metrics with additional data from other PDMPs with larger sample sizes.

5.3.1 Score Distribution

- 000 – 199: 17.5%
- 200 – 299: 18.3%
- 300 – 399: 42%
- 400 – 499: 16.7%
- 500 – 999: 5.5%

5.4 ORS Data Inputs

Data quality of ORS data inputs is maintained by having the PDMP data renormalized with the most up-to-date source data. ORS inputs the most current information available from the PDMP. Data quality is maintained by re-running a number of fields against the source files. To create labels for the training and validation data, decedent records were matched to PDMP data using a proprietary patient name matching system that connects dispensation records to each deceased patient.

The accuracy of any predictive model is impacted by the data input. In the case of ORS, the data is pulled from government managed and regulated PDMPs. Therefore, the data input for ORS is the same data that a user can access by reviewing the details in the PDMP report. The data used in ORS is matched to the patient using the same processes employed throughout NarxCare.

The data inputs into the ORS algorithm are listed below and are all obtained from PDMP data. All data inputs are required for analysis, and are listed in order of their weighted relevance, with the top two having the highest relevance at approximately 49% total and the last three weighted less than 1% each.

⁹ Rounded to the nearest 100.

	Key Contributing Factors	Weighted Relevance
1	History of Medication for Opioid Use Disorder (MOUDs) use (excluding Buprenorphine formulations for pain management) ¹⁰ ¹¹	30.41%
2	Number of high-risk dispensations in the most recent year ¹² a) Any OxyContin prescription b) Fentanyl patches c) Methadone (if reported to PDMP) d) Buprenorphine (including dispensations for pain management ¹³) e) Morphine (i.e., extended-release formulations) f) Any opioid prescription with a daily MME > 120	18.92%
3	Male gender, as reported by pharmacies ¹⁴	15.82%
4	Number of pharmacies where opioids/sedatives were filled in the most recent year ¹⁵	10.10%
5	Age, weighted based on age range ^{16, 17}	<1 to 6.28%
6	Number of overlapping opioid/sedative dispensations in the most recent year ¹⁸	6.05%
7	Greater than 6 opioid dispensations in the most recent year ¹⁹	4.92%
8	Number of overlapping opioid/benzodiazepine prescriptions in the most recent year ²⁰	<1%
9	Total day's supply of short-acting opioid prescriptions in the most recent year ²¹	<1%
10	Pattern of chronic opioid use ²²	<1%

¹⁰ Designation made by the FDA

¹¹ Williams AR, Samples H, Crystal S, Olsson M. Acute care, prescription opioid use, and overdose following discontinuation of long-term Buprenorphine treatment for opioid use disorder. *Am J Psychiatry*. 2019; 177(2): 117-24.

¹² National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Sciences Policy; Committee on Pain Management and Regulatory Strategies to Address Prescription Opioid Abuse; Phillips JK, Ford MA, Bonnie RJ, editors. *Pain Management and the Opioid Epidemic: Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use*. Washington (DC): National Academies Press (US); 2017 Jul 13.4, Trends in Opioid Use, Harms, and Treatment.

¹³ Designation made by the FDA

¹⁴ National Institute on Drug Abuse. Overdose Death Rates. National Institute on Drug Abuse. Published February 9, 2023. <https://nida.nih.gov/research-topics/trends-statistics/overdose-death-rates>

¹⁵ Chua K, Brummet CM, Ng S, Bohnert ASB. Association Between Receipt of Overlapping Opioid and Benzodiazepine Prescriptions From Multiple Prescribers and Overdose Risk. *JAMA Netw Open*. 2021;4(8):e2120353. doi:10.1001/jamanetworkopen.2021.20353

¹⁶ Products – Data Briefs – Number 457 – December 2022. [www.cdc.gov](https://www.cdc.gov/nchs/products/databriefs/db457.htm#:~:text=In%202020%20and%202021%2C%20rates%20were%20highest%20for%20adults) Published December 21, 2022.

¹⁷ <https://www.cdc.gov/nchs/products/databriefs/db457.htm#:~:text=In%202020%20and%202021%2C%20rates%20were%20highest%20for%20adults>

¹⁸ The weightings for age range follows an inverted u-shaped curve, where the lowest weighting is for the youngest and oldest age groups and highest weighting is for the middle age groups.

¹⁹ Cho J, Spence MM, Niu F, Hui RL, Gray P, Steinberg S. Risk of Overdose with Exposure to Prescription Opioids, Benzodiazepines, and Non-Benzodiazepine Sedative-Hypnotics in Adults: a Retrospective Cohort Study. *J Gen Intern Med*. 2020 Mar;35(3):696-703. doi: 10.1007/s11606-019-05545-y. Epub 2020 Jan 9. PMID: 31919729; PMCID: PMC7080944.

²⁰ Deyo, R.A., Hallvik, S.E., Hildebran, C. *et al*. Association Between Initial Opioid Prescribing Patterns and Subsequent Long-Term Use Among Opioid-Naïve Patients: A Statewide Retrospective Cohort Study. *J GEN INTERN MED* 32, 21-27 (2017). <https://doi.org/10.1007/s11606-016-3810-3>

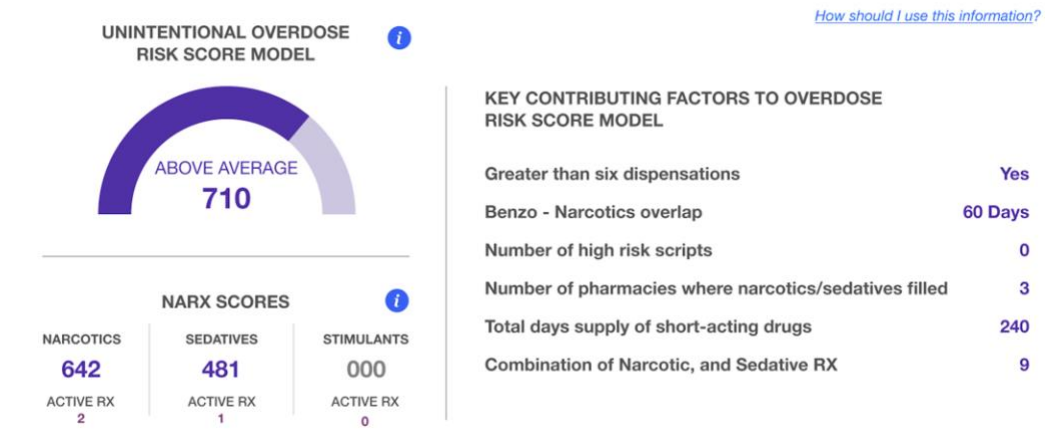
²¹ Sun E C, Dixit A, Humphreys K, Darnall B D, Baker L C, Mackey S, *et al*. Association between concurrent use of prescription opioids and benzodiazepines and overdose: retrospective analysis *BMJ* 2017; 356:j760 doi:10.1136/bmj.j760

²² Shah A, Hayes CJ, Martin BC. Characteristics of Initial Prescription Episodes and Likelihood of Long-Term Opioid Use – United States, 2006–2015. *MMWR Morb Mortal Wkly Rep* 2017;66:265–269. DOI: http://dx.doi.org/10.15585/mmwr.mm6610a1external_icon

²³ Busse JW, Craigie S, Juurlink DN, Buckley DN, Wang L, Couban RJ, Agoritis T, Akl EA, Carrasco-Labra A, Cooper L, Cull C, da Costa BR, Frank JW, Grant G, Iorio A, Persaud N, Stern S, Tugwell P, Vandvik PO, Guyatt GH. Guideline for opioid therapy and chronic noncancer pain. *CMAJ*. 2017 May 8;189(18):E659–E666. doi: 10.1503/cmaj.170363. PMID: 28483845; PMCID: PMC5422149.

Note: If one or more of these elements are not available for a patient, the ORS score is not calculated. Instead, a “000” score will be presented to the clinicians. This is not an indicator of the absence of correlation/association, but rather the absence of data necessary to deliver a score. Furthermore, stimulants are not included within the inputs.

5.5 Key Contributing Factors



Note: The arc displayed above the ORS is a visual indication of where the patient’s score falls on the 000-999 scale.

On the standard user interface, the key contributing factors displayed in the ORS tile are:

- Greater than six dispensations (please refer to # 7 in the [Data Inputs](#) section of this document for additional information).
 - Displays a “yes” or “no” answer (e.g., “yes” if more than six opioid dispensations in the most recent year)
- Benzo – Narcotics overlap (please refer to #8 in the [Data Inputs](#) section of this document for additional information).
 - Display as “X” days of overlapping prescriptions in the most recent year.
- Number of high-risk dispensations (please refer to #2 in the [Data Inputs](#) section of this document for additional information).
 - Displays a count of high-risk dispensations in the most recent year.
- Number of pharmacies where narcotics/sedatives filled (please refer to #4 in the [Data Inputs](#) section of this document for additional information).
 - Displays a count of pharmacies in the most recent year.
- Total days supply of short-acting drugs (please refer to #9 in the [Data Inputs](#) section of this document for additional information).
 - Displays a count of days supply in the most recent year.
- Combination of Narcotic and Sedative RX (please refer to #6 in the [Data Inputs](#) section of this document for additional information).
 - Displays a count of combination of RXs in the most recent year.

Note: History of MOUD use and gender are not among the inputs identified in the key contributing factor display. However, these remain important weighted inputs for the score, as described above.

The “below average,” “average,” and “above average” text indicator for ORS within the tile is based on the distribution of scores obtained from a large PDMP patient population in 2020/2021 (i.e., the reference PDMP population). The below and above average thresholds currently represent the scores at the 25th and 75th percentiles from the reference PDMP population. For example, if a patient’s score is less than the score at the 25th percentile from the reference PDMP population, it is categorized as below average. If a patient’s score is greater than the score at the 75th percentile from the reference PDMP population, it is categorized as above average.

5.6 Additional Information on the Overdose Risk Score Model

The ORS algorithm does not incorporate any data other than what is available in the PDMP. This aligns the clinical application of the score with other exposure indicators based on PDMP data such as number of pharmacies visited in the last 90 days or daily morphine equivalent dose (MED).

CAUTION / IMPORTANT REMINDER: *ORS can be used by a clinician as an indicator to guide further review of details in the patient’s prescription history while attending to their patients. ORS is intended to inform medical decision-making and should not be used to replace a clinician’s independent clinical judgment. Other patient-centric factors, such as mental health conditions (e.g., depression, anxiety, bipolar disorder, dementia), substance use conditions, respiratory conditions, hepatic and renal conditions, and history of overdose, may influence unintentional overdose death but are not incorporated in the PDMP data used to calculate the ORS. ORS does not provide a specific preventive, diagnostic, or treatment output or directive, is not intended to support time-critical decision-making, and should not be used as sole justification for providing or not providing medications.*