# Predictive models to assess risk of developing opioid use disorder: a systematic review

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## Background

Opioid use disorder (OUD):
- affects more than 16 million people worldwide [1]
- costs the US more than 78 billion dollars/year [1]
- contributes greatly to opioid overdose (OD) and death [2]

Predictive analytics can help develop accurate clinical decision support systems to identify high-risk individuals and facilitate access to care.

## Objective

This systematic review aims to consolidate evidence on the feasibility, efficacy, and accuracy of using predictive models to assess risk of OUD and OD in adults to inform clinical decision making.

## Methods

Using PRISMA guidelines [3], we conducted a search of 8 online databases (PubMed, CINAHL, PsycINFO, SociINDEX, Embase, CENTRAL, ACM Digital Libraries, and Xplore) for studies that developed models to predict risk of opioid misuse, abuse, or overdose in adult from inception until July 1, 2020. Abstract screening, full-text review, and data extraction were completed by two independent reviewers in Covidence, with disagreements arbitrated by the senior author. Risk of bias was assessed using the PROBAST [4] tool for predictive model studies.

### Table 1: Sample of included articles

<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>Study design</th>
<th>Outcome</th>
<th>Data source</th>
<th>Sample size</th>
<th>Model(s)</th>
<th>Most predictive variables</th>
<th>Accuracy metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrospective cohort study</td>
<td>Opioid use disorder</td>
<td>1. Deep learning model of EHR data; 2. Logistic regression</td>
<td>46,526 patients</td>
<td>1. Deep learning model of EHR data; 2. Logistic regression</td>
<td>1. Respiratory provider, behavioral health / social service provider,效能 (aAUC), mental health diagnosis, trauma brain injury</td>
<td>AUC = 0.79, AUC = 0.70</td>
<td></td>
</tr>
<tr>
<td>Retrospective cohort study</td>
<td>Opioid use disorder</td>
<td>1. Logistic regression &amp; LASSO regression</td>
<td>3,993,880 patients</td>
<td>1. Logistic regression &amp; LASSO regression</td>
<td>1. Age 15-29, medical history of substance abuse, mental disorder, anxiety disorder, low socioeconomic status, opioid dependence, psychosis, depression</td>
<td>AUC = 0.81</td>
<td></td>
</tr>
<tr>
<td>Retrospective cohort study</td>
<td>Opioid overdose</td>
<td>CLINICAL DATA (source:</td>
<td>1,872 patients</td>
<td>1. Logistic regression</td>
<td>1. Respiratory provider, behavioral health / social service provider,效能 (aAUC), mental health diagnosis, trauma brain injury</td>
<td>AUC = 0.79</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Characteristics of included studies (n = 22)

- Study types: retrospective cohort study (n = 11), prospective cohort study (n = 7), observational study (n = 3), case-control study (n = 1)
- Primary input variables: opioid use disorder (n = 10), opioid overdose (n = 6), persistent opioid use (n = 5), fatal opioid overdose (n = 2), opioid-induced respiratory depression (n = 1)
- Data source: databases (n = 9), electronic health records (n = 7), insurance claims (n = 2), patient-reported data (n = 1), prescription drug monitoring programs (n = 1)
- Sample size: range: 752 patients – 5,293,880 patients
- Accuracy metrics: AUC or c-statistic (n = 16), Area under the curve (n = 1), Receiver operating characteristic (n = 3)
- Models: logistic regression (n = 9), multiple models (n = 6), random forest (n = 1), deep learning model (n = 1), LASSO regression (n = 2), neural network (n = 1), decision tree (n = 1), support vector machine (n = 1)

## Results

### Table 2: PRISMA Flow Diagram

- Records identified through database search (n = 2180)
- Records screened (n = 2000)
- Full-text articles assessed for eligibility (n = 120)
- Studies included in analysis (n = 22)
- Full-text articles excluded (n = 98)

### Table 3: Characteristics of included studies (n = 22)

- Study types: retrospective cohort study (n = 11), prospective cohort study (n = 7), observational study (n = 3), case-control study (n = 1)
- Primary input variables: opioid use disorder (n = 10), opioid overdose (n = 6), persistent opioid use (n = 5), fatal opioid overdose (n = 2), opioid-induced respiratory depression (n = 1)
- Data source: databases (n = 9), electronic health records (n = 7), insurance claims (n = 2), patient-reported data (n = 1), prescription drug monitoring programs (n = 1)
- Sample size: range: 752 patients – 5,293,880 patients
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## Conclusions & Future Directions

- Stratify findings by model type and evaluate the most predictive input variables
- Many models examine associations but are not predictive; fewer models are implemented as real-time clinical decision support tools

## References