

California Fatal Opioid Overdose and HIV or Hepatitis C Virus (HCV) Vulnerability Assessment

Technical Notes

ANALYSIS DESIGN

This analysis used methods adapted from previous county-level HIV or HCV vulnerability assessments.^{1,2} For a California-specific analysis, regression models were built to determine county-level, independent factors associated with two outcomes: 1) fatal opioid overdoses bloodborne; and 2) chronic HIV or hepatitis C infection related to injection drug use in young adults among each of 58 counties in California. Two separate models were deemed necessary due to differences in the epidemiology of fatal opioid overdoses and blood borne infections (HCV or HIV). Model results were used to calculate the relative association of independent factors with each outcome and calculate a vulnerability score for both outcomes for each county. Counties with the highest vulnerability scores produced by the opioid overdose model were considered at highest risk for a fatal opioid overdose(s) associated with injection drug use. Counties with the highest vulnerability scores produced by the HCV or HIV model were considered at highest risk for a rapid increase of HCV or HIV infections associated with injection drug use. Data sources included both state public health surveillance and publicly available data. All variables considered and data sources used are listed in Figure 1.

OUTCOME VARIABLES

“Fatal Opioid Overdose” outcome: County-level vulnerability to rapid increase in fatal opioid overdose(s) was defined as the number of drug overdose deaths caused by acute poisonings that involve any opioid as a contributing cause of death, regardless of intent, excluding deaths related to chronic use of drugs (e.g., damage to organs from long-term use), 2016 (source: California Comprehensive Death Files).

The measure for all fatal opioid overdose includes overdose related to any opioid and provided a more robust measurement than either heroin or prescription opioid overdose alone. Because people who overdose from heroin may be different than those who overdose from prescription drugs, separate statistical models were tested for fentanyl/heroin and prescription overdose. However, reliable models could not be built for either outcome due to a large number of zero outcomes and collinearity in the models. All opioid overdose was used in the final model.

“HIV or HCV” outcome: County-level vulnerability to a rapid increase of HIV or HCV infection associated with injection drug use was indicated by the number of chronic HCV cases among those 15-39 years of age with either evidence of past or present hepatitis C infection (indicated by HCV antibody or HCV ribonucleic acid (RNA)), excluding cases from state prisons, newly reported to California Department of Public Health (CDPH) in 2016 and 2017 (source: California statewide laboratory-based surveillance). Cases from state prisons were excluded as they reflect the location of the prison facility rather than the individual’s county of residence, which would disproportionately impact counties with state prisons. The outcome was restricted to hepatitis C infections among persons 15-39 years of age as the best proxy of injection drug use.^{3,4,5} State and national surveillance data have linked new hepatitis C infections among young adults to injection drug use.^{3,4} HCV is much more transmissible by injection drug use than HIV; therefore, reported HCV infections can indicate non-sterile injection drug use practices that increase vulnerability to HIV transmission by

injection drug use. Identification of HCV transmission has been identified as an important step to for preventing and interrupting HCV and HIV transmission.⁶ Chronic HCV was determined as a better measure than acute HCV in California due to the fact that acute hepatitis C infections are vastly underreported because people with recent hepatitis C infection often do not have symptoms; PWID often do not seek care due to fear of stigma; and clinicians who diagnose acute hepatitis C infection may be unaware that they are required to report these infections to the local health department.^{7,8}

INDICATOR VARIABLES

Internal and external subject matter experts and published literature were consulted, and potential indicators were identified that are plausibly associated with fatal opioid overdose, HIV infection, HCV infection, and/or injection drug use. Indicators identified as meaningful in previous models of county-level HIV or HCV vulnerability, County Health Rankings, and Social Vulnerability Index were considered.^{1,2,9,10,11}

Indicator variable data were numeric and continuous or binary (yes/no), and considered for inclusion if the data were available without missing (non-zero) points for all counties, and available for recent years (2016 or later). Variables with large ranges (i.e., income; rate of heroin overdose hospitalizations; and rate of patients prescribed prescription opioids greater than 90 morphine milligram equivalents (MMEs) were log-transformed to better fit a normal distribution. Sixty-seven county-level indicator variables were identified (Figure 1).

DIMENSION REDUCTION

Sixty-seven indicator variables were grouped into six domains for consideration in a variable cluster analysis. The six domains included Care/Prevention, Demographics, Socioeconomics, Drug-related criminal activity, Drug/Overdose, Infectious disease (used only in the HCV or HIV model), and Prison (used only in the fatal opioid overdose model) (Figure 1). This step grouped variables theoretically associated with each other into domains to allow for selection of the most independent indicator among highly correlated variables in the same domain. Variable cluster analysis using SAS 9.4 PROC VARCLUS was used to identify the variable or variables that best represented the domain. The variable(s) with the lowest R-square ratio of the cluster was kept for inclusion in the model.¹² This strategy was used to retain representation from each domain empirically related to the outcome, but reduce the number of variables entered into each regression model in order to prevent overdispersion and multi-collinearity during the model building process.

MULTIVARIATE REGRESSION MODELING

Two years' worth of data for each outcome and indicator variable (when available) were obtained and then split into a model building dataset (2016 data) and a model testing dataset (2017 data). This approach of separating two years' data allowed the analysis team to conclude an association modeled with one year of data held true when applied to the subsequent year of data.

SAS 9.4 PROC GENMOD was used to build a multivariable negative binomial regression model containing a parsimonious set of indicators with the strongest association with the outcome variable for each model. A class statement was used for any categorical variables using the lowest level as the reference value. The negative binomial regression model requires the outcome to be represented as count data; therefore, the offset option of the model was used to specify each county population size, control for differences in county population size, and generate outcome rates. As required by

negative binomial regression, the natural logarithm (log) of the county population (excluding those incarcerated in the state prison for the HIV or HCV model) for the corresponding year of the outcome variable was used as the population offset.

A forward selection method was conducted with the indicators that remained after the dimension reduction process. Indicators from a single domain were entered into the model at the same time. Indicators with the highest p-values were removed until all remaining indicators had a p-value <0.10. Additional indicators from each domain were added in this process and evaluated using p-values of 0.10 and assessing for model fit. Once all indicators for all six domains were entered, indicators with the highest p-value were removed in descending order until all remaining were significant at a p value of < 0.05 or the inclusion of the indicator improved model fit determined by Akaike information criterion (AIC) value. As a final step to address interaction, any indicator that had been dropped was added back in and assessed at a <0.05 level. CDPH staff used this approach to identify the best fitting model using a combination of indicators with the strongest association with the outcome.

The final model was then validated with 2017 data. If an indicator was not significant at a $p < 0.05$ level in both 2016 and 2017 datasets, then the model was rebuilt using 2016 data and an alternative set of indicators. If there were multiple variables in a cluster, the variable least correlated with the other variables (and thus the most independent in that cluster) was kept. Final models were assessed for overall model fit by comparing the reported count and model-estimated count for each outcome variable using 2017 data. Deviance scores, p-value, and AIC scores were used to assess the models ability to accurately predict 2017 reported cases.

The final model(s) included indicators that were significant in models built using 2016 as well as 2017 data, suggesting the indicators provide a robust fit for two years.

MODEL RESULTS, MODEL FIT, AND SENSITIVITY ANALYSIS

In both the final fatal opioid overdose model and the final HIV or HCV model, five indicator variables were significantly associated with the outcome variables, although they differed between the two models (Table 1 and Table 2).

Measured by deviance statistic, the final models (fatal opioid overdose and HIV or HCV infection) are good fits to the data and neither is under or over-dispersed (deviance statistic of the HCV or HIV model was 1.23 and opioid model was 1.16). The estimated counts produced with 2017 data closely matched the reported counts for each corresponding outcome, further indicating an overall good model fit. Figure 2 illustrates the reported and model-estimated count of opioid overdose death, 2017. Figure 3 illustrates the reported and model-estimated count of chronic hepatitis C infection among people age 15-39 years.

A sensitivity analysis was conducted to consider the impact of the large number of outcome events, both HCV counts and fatal opioid overdoses, from Los Angeles County relative to other counties. Each final model was run using 2017 data without Los Angeles County. Impact on indicator p-values, model fit, and vulnerability score were assessed. Indicators in each final model remained significant without Los Angeles County. The exclusion of Los Angeles County did not change the vulnerability risk levels of the counties produced with each model. The sensitivity analysis revealed that Los Angeles County alone is not driving the indicators, model fit, or vulnerability score for either model.

VULNERABILITY INDEX CATEGORIES

Consistent with previous vulnerability score methods, regression coefficients of each indicator included in the final model(s) were used to calculate the relative contribution of each indicator to HCV cases and opioid overdoses for each county.^{1,2} The score (S) for the j th county was calculated using the regression coefficients (β) and indicators (X) as given by:

$$S_j = \beta_1 X_1 + \dots + \beta_p X_p$$

The vulnerability score for each outcome modeled was a sum of each coefficient applied to the counties' observed indicator value. To account for uncertainty in the model, SAS 9.4 PROC SURVEY SELECT was used to create a normal distribution sample of 10,000 values generated for each indicator that were within the standard error of the indicator's coefficient. This allowed for calculation of score quantiles using SAS 9.4 PROC UNIVARIATE, including the median score (the 50th percentile) and standard confidence intervals (i.e.; the 10th percentile and the 90th percentile) to represent confidence intervals around the score. Scores were calculated for both the HCV or HIV outcome and the fatal opioid overdose outcome. Counties were categorized into three groups using ArcGIS Jenks Natural Breaks of the scores: (High vulnerability, Medium vulnerability, Some vulnerability) of the mean score for the corresponding outcome (Figure 4). To determine the top ten percent vulnerable counties, the analysis team calculated ten percent of 58 ($0.10 \times 58 = 6$), then ranked the counties by descending median score and picked the top six with the highest score (Figure 4).

LIMITATIONS AND CONSIDERATIONS

Indicators were selected based on strong association with each outcome for two recent and consecutive years. Evolving conditions of both the opioid overdose and HCV epidemics—including changing transmission networks, availability of treatment and prevention resources and programs, and changes in the opioid and other drug supply—may limit the accuracy of the models for predicting vulnerability into future years.

This analysis assigns a level of risk at a county-level and may not reflect sub-county vulnerability. Examples of sub-county vulnerability are networks of people experiencing homelessness, people newly-released from jail or prison, or people released from abstinence based residential drug treatment living within a county considered to be less vulnerable. Similarly, counties considered highly vulnerable may have well-established services to prevent opioid overdose as well as HIV and HCV infection, that have evidence of efficacy at an individual patient-level, but may not yet be to scale to affect vulnerability at the population level.

The number of chronic HCV cases newly reported among people 15-39 years of age in 2017 does not necessarily measure infections acquired in 2017. This is because the majority of chronic HCV infections are asymptomatic and those with infection may not immediately seek medical care or HCV testing. In addition, transmission may not have occurred in the same county in which the case was reported. Newly reported hepatitis C cases among persons 15-39 years of age is considered a relatively recent proxy for HCV infection associated with injection drug use.^{4,13,14} Since the majority of people with chronic hepatitis C infection do not have symptoms, the HCV outcome used in the model may represent a capacity of a county to detect and diagnose HCV among young adults, rather than increased HCV activity. Low HCV prevalence in a county does not necessarily mean there is no active HCV transmission within the county.

Indicators that represent care and prevention, demographics, socioeconomics, drug-related criminal activity, and drug overdose measures in 2016 and 2017 may not coincide with the timing of HCV infection. Indicators were selected for inclusion based on a process of empirical review, dimension reduction, and significant association with the outcome in a regression model, regardless of strength or direction of association with the outcome. For these reasons, and overall limitations of an ecologic analysis, the association of indicators and the outcomes should not be considered causal. Individual indicators cannot be considered directly actionable.

TABLES AND FIGURES

TABLE 1: Regression Coefficient Estimates, Standard Errors, and P-Values for Final Fatal Opioid Overdose Variables Used in Vulnerability Index Categories, California, 2017

Variable	Estimate	Standard Error	P-Value
Percentage male	0.0737	0.0338	0.0291
Percentage of population that lives in a 1-person household	0.0426	0.0171	0.0127
Rate of heroin hospitalizations (log)	0.4094	0.1445	0.0046
Rate of residents on >90 mg of MMEs (log)	0.3901	0.2226	0.0797
High intensity drug trafficking area (Y/N)	0.4046	0.1647	0.0140

Abbreviations: mg, milligram; MME, morphine milligram equivalent; log, logarithm

TABLE 2: Regression Coefficient Estimates, Standard Errors, and P-Values for Final HIV or HCV Variables Used in Vulnerability Index Categories, California, 2017

Variable	Estimate	Standard Error	P-Value
Percentage White Non-Hispanic	0.0076	0.0025	0.0028
Rate of heroin emergency department visits, 15-39 years of age	0.0024	0.0006	<0.0001
HCV prevalence among people ages 40+	0.0002	0.0000	<0.0001
Number of felony drug arrests	0.0001	0.0000	0.0208
Percentage of households with no vehicle access	0.0223	0.0086	0.0093

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017

Model	Domain	Indicator Variables	Description
Opioid and HIV or HCV	Care/Prevention	Buprenorphine prescriptions by patient location per 1,000 population	Buprenorphine prescriptions per 1,000 residents by patient location. Measures relative number of buprenorphine prescriptions dispensed.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			
Opioid and HIV or HCV	Care/Prevention	Buprenorphine-waivered prescribers with a 30 patient limit, (n)	The number of DATA-waived practitioners newly certified per year by state who are eligible to provide buprenorphine treatment for opioid dependency as of February 2018, with a 30 patient limit.
<i>Source: Urban Institute, California County Fact Sheets: Treatment Gaps in Opioid-Agonist Medication Assisted Therapy (OA-MAT) and Estimates of How Many Additional Prescribers Are Needed, March 2018</i>			
Opioid and HIV or HCV	Care/Prevention	Buprenorphine-waivered prescribers with a 100 patient limit, (n)	The number of DATA-waived practitioners newly certified per year by state who are eligible to provide buprenorphine treatment for opioid dependency as of February 2018, with a 100 patient limit.
<i>Source: Urban Institute, California County Fact Sheets: Treatment Gaps in Opioid-Agonist Medication Assisted Therapy (OA-MAT) and Estimates of How Many Additional Prescribers Are Needed, March 2018</i>			
Opioid and HIV or HCV	Care/Prevention	Buprenorphine-waivered prescribers with a 275 patient limit, (n)	The number of DATA-waived practitioners newly certified per year by state who are eligible to provide buprenorphine treatment for opioid dependency as of February 2018, with a 275 patient limit.
<i>Source: Urban Institute, California County Fact Sheets: Treatment Gaps in Opioid-Agonist Medication Assisted Therapy (OA-MAT) and Estimates of How Many Additional Prescribers Are Needed, March 2018</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid and HIV or HCV	Care/Prevention	Methadone patients at Opioid Treatment Programs per 100,000 population	The estimated number of methadone patients at Opioid Treatment Programs per 100,000 population.
<i>Source: Substance Abuse and Mental Health Services Administration (SAMHSA) 2016 Opioid Treatment Program directory (Calculated by Lisa Clemans-Cope, Marni Epstein, and Doug Wissoker of the Urban Institute)</i>			
Opioid and HIV or HCV	Drug-related criminal activity	High intensity drug trafficking area (Y/N)	County identified as a high intensity drug trafficking area (HIDTA) by the United States Drug Enforcement Administration (DEA) (Y/N) as of Feb 2017.
<i>Source: U.S. Drug Enforcement Agency, High Intensity Drug Trafficking Areas Program Counties as of February 2017</i>			
Opioid and HIV or HCV	Drug-related criminal activity	Number of felony drug offenses	The number of felony drug arrests in a county. Includes all felony drug classifications.
<i>Source: California Attorney General Crime Statistics, 2016 & 2017</i>			
Opioid and HIV or HCV	Demographics	Percent Male	Percentage of population that is male.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			
Opioid and HIV or HCV	Demographics	Percent White	Percentage of population that is White.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			
Opioid and HIV or HCV	Demographics	Percent Hispanic or Latino	Percentage of population that is Hispanic or Latino.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid and HIV or HCV	Demographics	Percent Black or African American	Percentage of population that is Black or African American.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			
Opioid and HIV or HCV	Demographics	Percent American Indian or Alaska Native	Percentage of population that is American Indian or Alaska Native.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			
Opioid and HIV or HCV	Demographics	Percent Asian	Percentage of population that is Asian.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			
Opioid and HIV or HCV	Demographics	Percent Native Hawaiian or Pacific Islander	Percentage of population that is Native Hawaiian or Pacific Islander.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table DP05</i>			
Opioid and HIV or HCV	Drug/Overdose	Opioid use disorder (OUD) rate per 100 population	Urban Institute used 2016 estimated national share of OUD among those who misuse opioids to calculate county OUD rates. This estimate was produced by SAMHSA, using 2016 data from the National Survey on Drug Use and Health. OUD is defined as self-report of heroin use or opioid abuse or dependence consistent with Diagnostic and Statistical Manual of Mental Disorders-IV criteria.
<i>Source: Urban Institute, California County Fact Sheets: Treatment Gaps in Opioid-Agonist Medication Assisted Therapy (OA-MAT) and Estimates of How Many Additional Prescribers Are Needed, March 2018</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid and HIV or HCV	Socioeconomics	Education	The number of persons 25 years of age and older with less than a 12th grade education (including individuals with 12 grades but no diploma) divided by the estimated county population 25 years of age and older.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table S1501</i>			
Opioid and HIV or HCV	Socioeconomics	Homeless population	Point-in-Time counts. Number of homeless people per 10,000 people in the general population. A point-in-time count is an unduplicated count on a single night of the people in a community who are experiencing homelessness that includes both sheltered and unsheltered populations. Some counties were grouped.
<i>Source: National Alliance to End Homelessness, State of Homelessness Report, California, 2017</i>			
Opioid and HIV or HCV	Socioeconomics	Income	The mean income per person in the county in the past 12 months (inflation-adjusted dollars) for persons 15 years of age and older divided by the total county population.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table B19301</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid and HIV or HCV	Socioeconomics	Labor force participation rate	The labor force participation rate represents the proportion of the population that is in the labor force. Labor Force – All people classified in the civilian labor force plus members of the U.S. Armed Forces (people on active duty with the United States Army, Air Force, Navy, Marine Corps, or Coast Guard).
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table S2301</i>			
Opioid and HIV or HCV	Socioeconomics	No vehicle	Percentage of households with no vehicle available. The number of households without a vehicle available divided by the total estimated number of households per county.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table B08201</i>			
Opioid and HIV or HCV	Socioeconomics	Poverty	Percentage of the population living below poverty level. The total number of persons below poverty divided by the total estimate of the population for whom poverty status is determined. Includes all ages.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table S1701</i>			
Opioid and HIV or HCV	Socioeconomics	Unemployment	Percentage of the population that is unemployed and actively seeking work. Includes all civilians 16 years of age and older.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table S2301</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid and HIV or HCV	Socioeconomics	Percent Uninsured	Percentage of the population without health insurance. The number of persons without health insurance coverage was divided by total civilian noninstitutionalized population.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table S2701</i>			
Opioid and HIV or HCV	Socioeconomics	Urban/Rural	Counties were categorized into one of six categories based on Office of Management and Budget's 2013 delineation of metropolitan statistical areas and micropolitan statistical areas. Categories include: (1) Large central metro, (2) Large fringe metro, (3) Medium metro (4) Small metro, (5) Metropolitan, and (6) Noncore.
<i>Source: 2013 National Center for Health Statistics Urban-Rural Classification</i>			
HIV or HCV	Care/Prevention	Syringe distribution (n)	The total number of syringes distributed by syringe service programs (SSPs) each year by county.
<i>Source: California Department of Public Health, Office of AIDS, Clearinghouse Data, 2016 & 2017</i>			
HIV or HCV	Care/Prevention	Syringe distribution per 100,000	The number of syringes distributed by syringe service programs (SSPs) each year by county per 100,000 population.
<i>Source: California Department of Public Health, Office of AIDS, Clearinghouse Data, 2016 & 2017</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
HIV or HCV	Demographics	Percent of population age 15-39	Percentage of the population 15-39 years of age.
<p><i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018.</i></p>			
HIV or HCV	Drug/Overdose	Amphetamine poisoning deaths, 15-39	Acute poisoning deaths involving amphetamines among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. California Department of Public Health Vital Statistics Multiple Cause of Death Files.
<p><i>Source: California Comprehensive Death File, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i></p>			
HIV or HCV	Drug/Overdose	Amphetamine poisoning emergency department visits, 15-39	Emergency department visits caused by non-fatal acute poisonings due to the effects of amphetamines among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. Emergency Department Data.
<p><i>Source: Office of Statewide Health Planning and Development, Emergency Department Data, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i></p>			
HIV or HCV	Drug/Overdose	Amphetamine poisoning hospitalizations, 15-39	Hospitalizations caused by non-fatal acute poisonings due to the effects of amphetamines among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. Inpatient discharge data.
<p><i>Source: Office of Statewide Health Planning and Development, Patient Discharge Data, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i></p>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
HIV or HCV	Drug/Overdose	Heroin poisoning deaths, 15-39	Acute poisoning deaths involving heroin among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. California Department of Public Health Vital Statistics Multiple Cause of Death Files.
<i>Source: California Comprehensive Death File, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i>			
HIV or HCV	Drug/Overdose	Heroin poisoning emergency department visits, 15-39	Emergency department visits caused by non-fatal acute poisonings due to the effects of heroin among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. Emergency Department Data.
<i>Source: Office of Statewide Health Planning and Development, Emergency Department Data, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i>			
HIV or HCV	Drug/Overdose	Opioid poisoning deaths, 15-39	Drug overdose deaths caused by acute poisonings that involve any opioid as a contributing cause of death among persons 15-39 years of age. Opioids include both prescription opioid pain relievers such as hydrocodone, oxycodone, and morphine, as well as heroin and opium. California Department of Public Health Vital Statistics Multiple Cause of Death Files.
<i>Source: California Comprehensive Death File, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
HIV or HCV	Drug/Overdose	Opioid poisoning emergency department visits (excluding heroin), 15-39	Emergency department visits caused by non-fatal acute poisonings due to the effects of all opioids, excluding heroin among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. Emergency Department Data.
<i>Source: Office of Statewide Health Planning and Development, Emergency Department Data, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i>			
HIV or HCV	Drug/Overdose	Opioid poisoning hospitalizations (excluding heroin), 15-39	Hospitalizations caused by non-fatal acute poisonings due to the effects of all opioids drugs, excluding heroin, regardless of intent among persons 15-39 years of age. Counts and annual crude rate per 100,000 residents. Inpatient discharge data.
<i>Source: Office of Statewide Health Planning and Development, Patient Discharge Data, 2016 & 2017 - prepared by California Department of Public Health, Safe and Active Communities Branch</i>			
HIV or HCV	Infectious Disease	Rate of early syphilis among women	Rate of early syphilis among women in California.
<i>Source: California Department of Public Health, Sexually Transmitted Diseases Control Branch, Surveillance Data, 2016 & 2017</i>			
HIV or HCV	Infectious Disease	HCV prevalence	Rate of all chronic hepatitis C cases reported during 1994-2016 in California, all ages, presumed to be alive as of December 31, 2016, excluding people incarcerated in state prisons. Rate is per 100,000 population.
<i>Source: California Department of Public Health, Office of Viral Hepatitis Prevention, Surveillance Data, 2016 & 2017</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
HIV or HCV	Infectious Disease	HCV prevalence, 40+ years of age	Rate of all chronic hepatitis C cases reported during 1994-2016 in California, among persons 40 years of age and older, presumed to be alive as of December 31, 2016, excluding people incarcerated in state prisons. Rate is per 100,000 population.
<i>Source: California Department of Public Health, Office of Viral Hepatitis Prevention, Surveillance Data, 2016 & 2017</i>			
HIV or HCV	Infectious Disease	HIV cases related to injection drug use	New diagnosis of HIV infection, by injection drug use (IDU) and male-to-male sexual contact/IDU and county of residence. Includes all cases diagnosed with HIV infection whose last known residence was in California.
<i>Source: California Department of Public Health, Office of Viral Hepatitis Prevention, Surveillance Data, 2016 & 2017</i>			
HIV or HCV	Infectious Disease	HIV prevalence rate	Persons living with diagnosed HIV infection, by year of diagnosis and county of current residence. Rates are per 100,000 population. All counts are based on the availability of resident county in the database at the time of diagnosis.
<i>Source: California Department of Public Health, Office of AIDS, Surveillance Data, 2016 & 2017</i>			
HIV or HCV	Socioeconomics	Crowded housing	Percentage of occupied housing units (rented or owned) that have greater than 1.5 persons per room for a given residence.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table S2501</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
HIV or HCV	Socioeconomics	Group quarters	Estimated number of individuals in a county living in group quarters. The Census Bureau classifies all people not living in housing units (house, apartment, mobile home, rented rooms) as living in group quarters. There are two types of group quarters: Institutional, such as correctional facilities, nursing homes, or mental hospitals; Non-Institutional, such as college dormitories, military barracks, group homes, missions, or shelters. Anyone residing for at least two months at an address is included in the sample.
<i>Source: American Community Survey, 2016 & 2017-5 year estimates - Table B26001</i>			
Opioid	Care/Prevention	Fentanyl test strip distribution (n)	The number of fentanyl test strips ordered by syringe service programs each year by county.
<i>Source: California Department of Public Health, Office of AIDS, Clearinghouse Data, 2018</i>			
Opioid	Care/Prevention	Fentanyl test strips per 100,000	The number of fentanyl test strips ordered by syringe service programs each year by county per 100,000 population.
<i>Source: California Department of Public Health, Office of AIDS, Clearinghouse Data, 2018</i>			
Opioid	Care/Prevention	Naloxone kits distributed (n)	The total number of naloxone kits distributed by syringe service programs each year by county.
<i>Source: California Department of Public Health, Office of AIDS, Clearinghouse Data, 2016 & 2017</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid	Care/Prevention	Naloxone kits distributed per 100,000	The total number of naloxone kits distributed by syringe service programs each year by county, per 100,000 population.
<i>Source: California Department of Public Health, Office of AIDS, Clearinghouse Data, 2016 & 2017</i>			
Opioid	Demographics	Percent age 0-10	Percentage of the population 0-10 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 11-14	Percentage of the population 11-14 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 15-24	Percentage of the population 15-24 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 25-34	Percentage of the population 25-34 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 35-44	Percentage of the population 35-44 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid	Demographics	Percent age 45-54	Percentage of the population 45-54 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 55-64	Percentage of the population 55-64 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 65-74	Percentage of the population 65-74 years of age.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Percent age 75+	Percentage of the population 75 years of age and older.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Demographics	Median age	Median age of persons living in the county.
<i>Source: State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060, Sacramento, California, February 2018</i>			
Opioid	Drug/Overdose	Heroin emergency department visits	Emergency department visits caused by non-fatal acute poisonings due to the effects of heroin. Counts and annual crude rate per 100,000 residents. Emergency Department Data.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid	Drug/Overdose	Heroin hospitalizations	Hospitalizations caused by non-fatal acute poisonings due to the effects of heroin. Counts and annual crude rate per 100,000 residents. Inpatient discharge data.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			
Opioid	Drug/Overdose	Opioid emergency department visits (excluding heroin)	Emergency department visits caused by non-fatal acute poisonings due to the effects of all opioids drugs. Counts and annual crude rate per 100,000 residents. Emergency Department Data.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			
Opioid	Drug/Overdose	Opioid hospitalizations (excluding heroin)	Hospitalizations caused by non-fatal acute poisonings due to the effects of all opioids drugs, excluding heroin. Counts and annual crude rate per 100,000 residents. Inpatient discharge data.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			
Opioid	Drug/Overdose	Residents on >90 morphine milligram equivalents (MMEs) of opioids	Residents per 1,000 on greater than 90 mg of MMEs daily in the quarter. Measures relative number of people on high-dose opioids. Counts and annual crude rate per 1,000 residents.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid	Drug/Overdose	Residents with overlapping opioids	Residents per 1,000 with at least two overlapping opioid prescriptions for at least 30 days in the quarter. Measures relative number of people on a high-risk opioid prescription regimen. Crude rate per 1,000 residents.
<i>Source: California Department of Public Health, Safe and Active Communities Branch, California Opioid Dashboard Data, 2016 & 2017</i>			
Opioid	Prison	Prison in county (Y/N)	Y = prison in the county, N = no prison in the county.
<i>Source: California Department of Corrections and Rehabilitation Institutions Map (2018)</i>			
Opioid	Prison	Prison population by county	The number of people in California state prisons (adult), by county. This is a point in time count as of midnight January 31, 2017.
<i>Source: California Department of Corrections and Rehabilitation, Monthly Population report. Jan 31, 2017. Report created by the Office of Research. For California City Correctional Facility, total number of people in state prisons was taken from the quarterly statistical report (SB601) for 2017.</i>			
Opioid	Prison	Prison release	The number of people released from California state prisons in the past year to the county. County of release data includes people released to parole and released to post-release community supervision.
<i>Source: Prepared by Kimberly Lucas/Justine Hutchison of California Correctional Health Care Services</i>			

FIGURE 1: Indicator Variables (including Variable Descriptions) and Data Sources Considered for Statistical Analysis, by Statistical Model and Domain; California Fatal Opioid Overdose, HIV, and Hepatitis C Virus Vulnerability Assessment, California, 2017 (continued)

Model	Domain	Indicator Variables	Description
Opioid	Socioeconomics	Percent of one-person household	Percentage of the population that lives in a one-person household. A household includes all the persons who occupy a housing unit as their usual place of residence. A housing unit is a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied as separate living quarters.

Source: American Community Survey, 2016 & 2017-5 year estimates - Table S2501

FIGURE 2: Final Fatal Opioid Overdose Model: Reported Count and Model-Estimated Count of Opioid Overdose Death, California, 2017

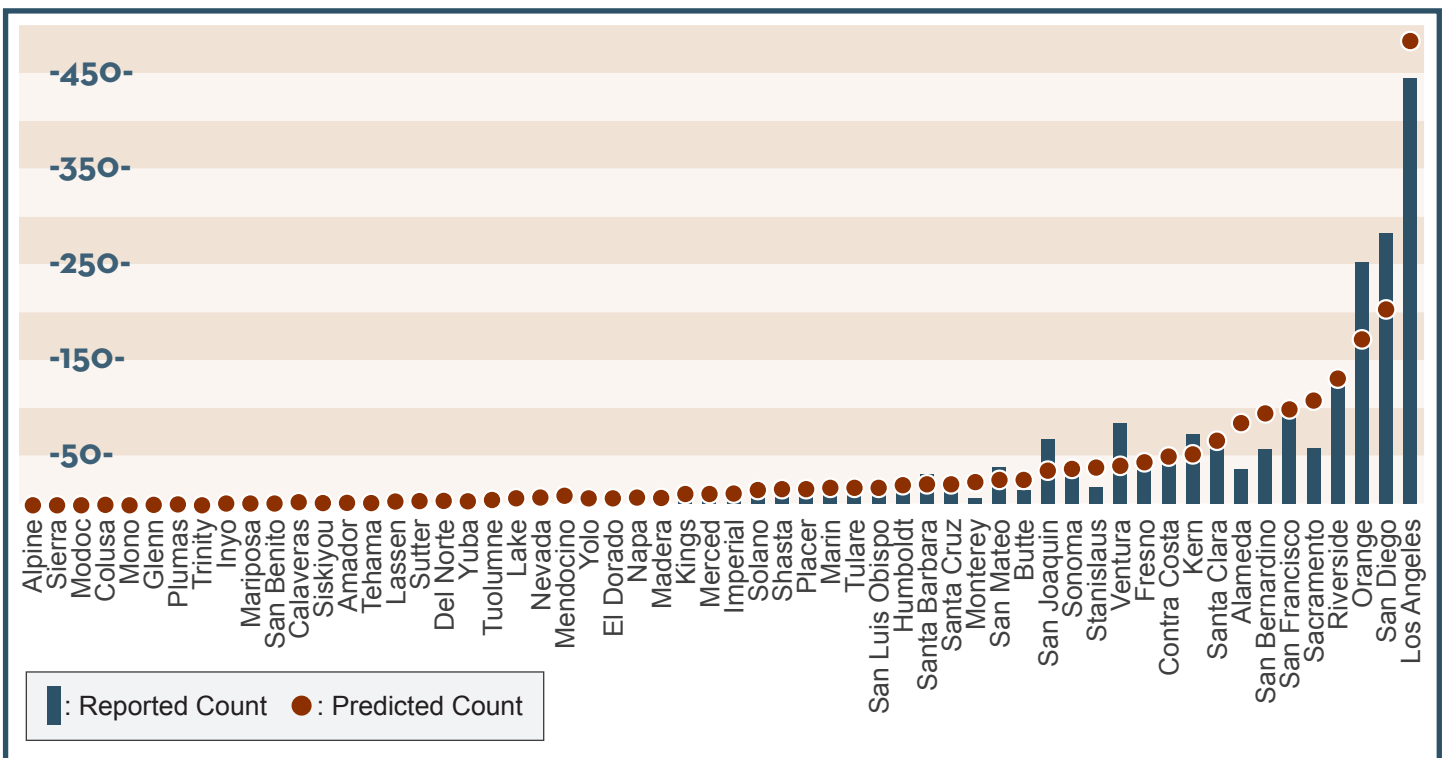


Figure 2: Model fit statistics: Value/Degrees of freedom = 1.16, 1 indicates good model fit. P-value for dispersion p=0.17, indicates model not over dispersed.

FIGURE 3: Final HIV or HCV Model: Reported Count and Model-Estimated Count of Chronic HCV Infection among People 15-39 Years of Age, California, 2017

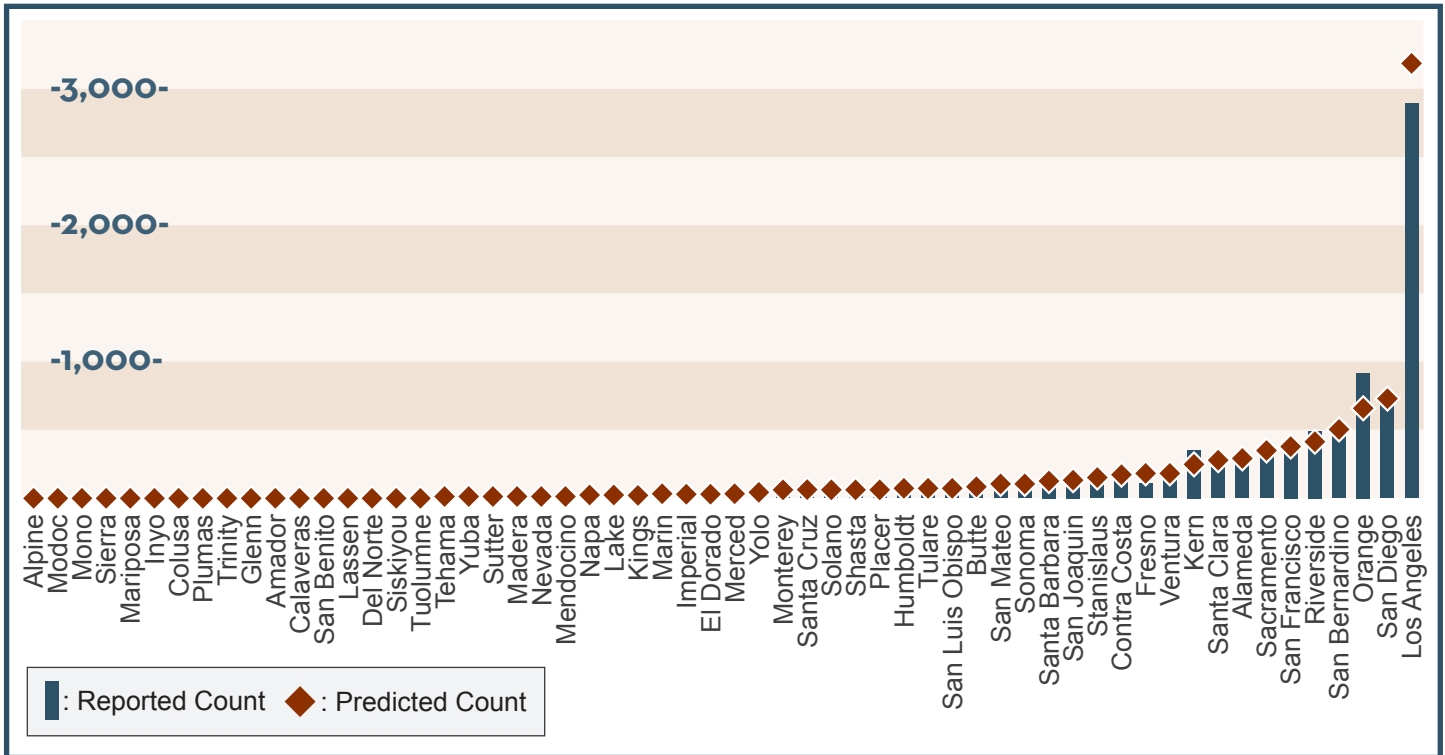


Figure 3: Model fit statistics: Value/Degrees of freedom = 1.23, 1 indicates good model fit. P-value for dispersion $p=0.12$, indicates model not over dispersed.

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