

# A Predictive Model of Homelessness and its Relationship to Fatal and Nonfatal Opioid Overdose

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# Overview

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# Chapter 55 Authority

This work was mandated by law, and conducted by a public health authority. All parties conducting participating in this work did so on behalf of the Commonwealth of Massachusetts and the Massachusetts Department of Public Health.

# Background and Aims

# Background

- Homelessness has been a persistent problem in Massachusetts and nationwide for decades
- Homelessness can be difficult to accurately measure using administrative data
- Accurate prevalence estimates of homeless people are needed to better serve the population.
- A 2003-2008 study of homeless adults in Boston found that drug overdose was the leading cause of death for this population.
- A more comprehensive and updated assessment of mortality and opioid overdose deaths among people experiencing homelessness in Massachusetts is warranted.

# Project Aim

To develop and test a predictive model of homelessness, test its validity, and relate it to fatal and nonfatal opioid overdoses

# Methods

# Chapter 55 Data Sets

- Making use of population level data from 2011–2015 linked as part of the Chapter 55 project, 16 administrative datasets including:
  - All Payer Claims Database (APCD), Case Mix (hospital discharge records), Death Certificates, Massachusetts Ambulance Trip Record Information System (MATRIS), Prescription Monitoring Program (PMP), Bureau of Substance Addiction Services (BSAS), Department of Corrections (DOC), Department of Mental Health (DMH) and Houses of Correction (HOC)
- We created a cross-sectional measure of whether individuals were identified as experiencing homelessness at any point over the course of the 5-year observation period



# Specific Homelessness Data

Data set	Type of data collected	Homelessness Defined By:
<b>APCD</b>	Medical claims	Diagnosis codes (ICD 9 & 10)
<b>Case Mix</b>	Inpatient, emergency department, or outpatient hospital records	Diagnosis codes (ICD 9 & 10)
<b>DMH</b>	Services provided to specific Department of Mental Health client groups	Record indicating loss of housing in at least 1 month
<b>MATRIS</b>	Massachusetts Ambulance Trip Reporting Information System (MATRIS) records of emergency medical services	The word “homeless” or “shelter” appeared in the narrative report
<b>PDMP</b>	Prescription Drug Monitoring Program Data with data on filled prescriptions for schedule II through V medications	Address for filled prescription matched a known address of an emergency homeless shelter

# Sampling Approaches

- Sample limited to include individuals who met the following criteria:
  - MA residents
  - At least one record other than APCD
- Split the full sample into a training and a test set
  - 75% in training set & 25% in test set
- To train the model, we used three different approaches:
  - Model 1 included full sample
  - Model 2 used “down-sampling” to account for class imbalance between those identified as homeless and those with no record of homelessness. In this approach, we retained 100% of individuals identified as homeless and then randomly selected an equivalent number of non-homeless cases for inclusion
  - Model 3 also used “down-sampling” but maintaining a 2:1 ratio (non-homeless to homeless).

# Analytic Method

- Used binary logistic regression to estimate predicted probabilities of homelessness and develop a more reliable prevalence estimate for the homeless population in state
- Predictors: More than 100 predictors that have been shown to be/are hypothesized to be related to homelessness:
  - Sociodemographic predictors (e.g. age, gender, race, MassHealth receipt)
  - Drug/alcohol use predictors (e.g. presence of drug/alcohol diagnoses, use of substance abuse treatment services)
  - Mental health predictors (e.g. presence of mental health diagnoses, use of mental health services)
  - Physical health predictors (e.g. skin disorders)
  - Other predictors(e.g. history of incarceration in DOC, use of emergency department services)

# Method for Calculating Rate of Homelessness

- Probabilities from the logistic model were used to estimate the overall number (and prevalence) of homelessness in the state.
  - Records with hard-coded homelessness were summed (probability assumed to 1.0)
  - All records with an estimated probability of homelessness of  $<0.5$  were discarded
  - Probabilities ( $>0.5$ ) for records without hard-codes were summed

# Results

# Distribution of Homelessness Codes

- A total of 41,457 (0.82%) of individuals in the sample were identified as homeless. The (non-mutually exclusive) breakdown of how these individuals were identified as homeless is:
  - 23,239 (56.1%) identified based on ICD codes from APCD
  - 21,722 (52.4%) identified based on ICD codes from Casemix
  - 300 (0.7%) identified based on DMH data
  - 3,237 (7.8%) identified based on MATRIS
  - 6,704 (16.2%) identified based on PMP
- A total of 13,745 (33.2%) individuals were identified based on multiple indicators from more than one data source

# Confusion Matrix for Models fit to Test Data (75/25 Split)

		<u>Predicted</u>		<u>Total</u>
		Homeless	Not Homeless	
<u>Observed</u>	Homeless	8,755	1,653	<b>10,408</b>
	Not Homeless	109,577	1,142,674	<b>1,252,251</b>
<u>Total</u>		<b>118,332</b>	<b>1,144,327</b>	<b>1,262,659</b>

Sensitivity: 84.1%

Specificity: 91.2%

Positive predictive value: 7.4% (vs. 0.82% observed homeless)

# Primary Results

- When relying exclusively on homeless-specific administrative codes, only 1% of the population was homeless between 2011 and 2015.
- By linking data sets together and modeling patterns that could be related to homelessness, it was estimated that 1 in 25 adults (3.7%) was likely to have been homeless at some point between 2011 and 2015.
  - Prior research: 5-year prevalence of homelessness between 3.1% (literal homelessness) and 4.6% (including doubled up)
- The opioid death rate was 16 to 23 times higher for individuals identified as homeless compared to those who were not.



# Validity Testing

- Several known correlates of housing instability and homelessness were excluded from our analysis in order to use them to validate the model estimates.
- The validation demonstrated that the estimated homelessness values were predictive of expected outcomes for:
  - Evidence of Hepatitis C virus
  - Manner of death
  - Evidence of self harm
  - Evidence of skin infection
  - Evidence of HIV
  - Evidence of endocarditis

# Conclusions

# Conclusions

- It was estimated that 1 in 25 adults (3.7%) was likely to have been homeless at some point between 2011 and 2015.
- Compared to people who are not homeless, homeless people are:
  - More likely to be males, younger, more likely to be homemakers, and more likely to receive public insurance
  - More likely to have a history of incarceration, and have evidence of co-occurring psychiatric illness and substance abuse disorders
  - More likely to have an opioid overdose transport in MATRIS
  - More likely to be veterans

# Limitations

- Use of administrative and billing data
- Chapter 55 database does not currently include data for children
- Predictive models based on variables that are highly correlated with opioid overdose
- Analysis does not include data from family shelter system

# Next Steps

- Build on this initial analysis of the relationship between homelessness and opioid overdose to:
  - examine whether homeless status modifies (either positively or negatively)
  - examine the effectiveness of naloxone;
  - assess whether persons experiencing homelessness are more likely to experience fatal overdoses in which fentanyl is present;
  - examine health care utilization patterns among persons experiencing homelessness to identify potential intervention points.
- Examine fatal and non-fatal opioid overdose specifically among families who use the DHCD EA family shelter system

# Thank You

Questions....