

# **Bending the Curve: A Mathematical Model to Predict the Impact of a Novel Approach to Mitigate the Opioid Crisis**

**Neha Skandan, 11th Grade  
Moravian Academy - Bethlehem, PA**

# Opioid Crisis

- ❖ Every day, around 130 lives are lost in the United States to opioid overdoses
  - Amounts to 47,000+ lives lost every year
- ❖ More than 10 million individuals misuse prescription opioids in the US every year
- ❖ 1 in 3 people in the US knows someone struggling with an opioid use disorder
- ❖ PA has the 4th highest rate in the US in terms of opioid use disorders
- ❖ More than 1,000 lives were lost since 2015 to opioid overdose in Lehigh and Northampton counties

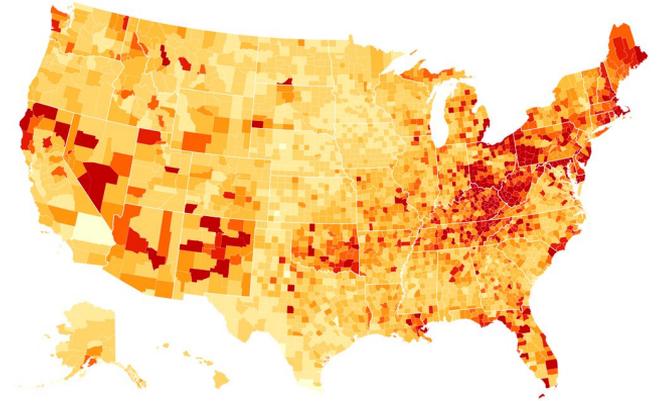


Photo Credit: The New York Times

# Objectives

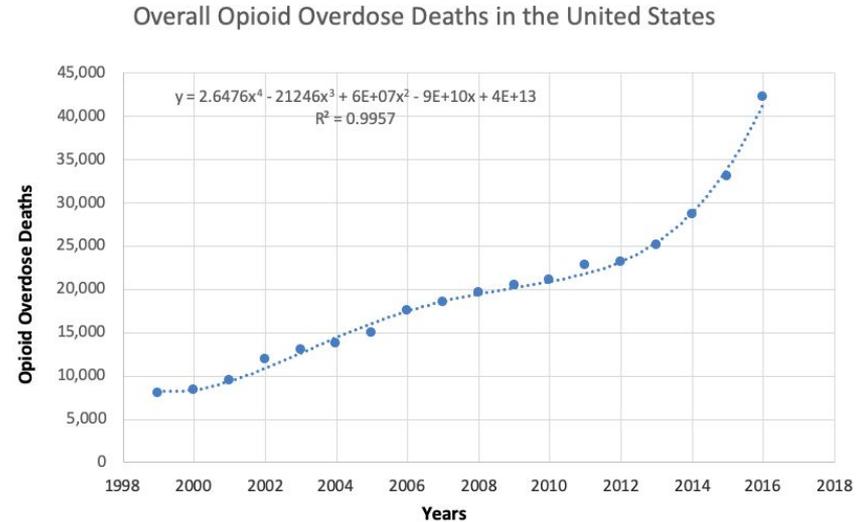
- ❖ Opioid crisis has always been considered as an adult problem that only adults can solve
  - Teenagers currently passive bystanders
- ❖ Adult efforts have *flattened the curve* (at 47,000+ lives lost to opioid overdose) but society needs more action to *bend the curve* and save even more lives
- ❖ **Focus:** predict how additional intervention can further change the trajectory of the crisis by devising mathematical models to prove and put into perspective the extent to which the current initiatives have affected the opioid crisis

# Hypothesis

- ❖ **Hypothesis:** Society can bend the curve faster if methods exist for teenagers to actively intervene and help adults combat the opioid crisis
  - Not about teenagers avoiding opioids
  - *Premise is that society can empower teenagers to assist friends and family members struggling with opioid use disorders*
  - Novel idea as teenagers are currently not involved in trying to mitigate the opioid crisis

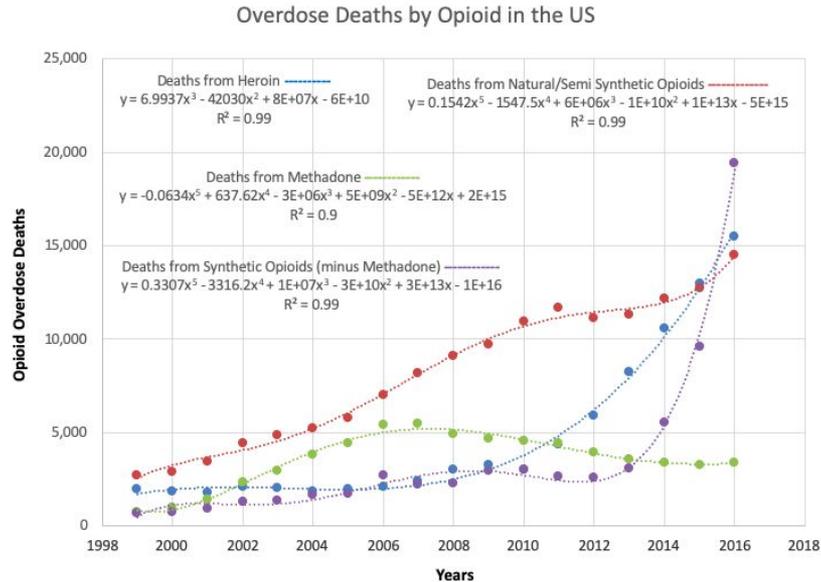
# Methods - Fitting Equations and Trendlines

- ❖ Major initiatives to address the opioid crisis not taken until after 2017
- ❖ Trendlines formed to measure the effectiveness of current interventions
  - Measured the number of lives lost from opioid overdose from 1999 to 2017
  - All polynomial equations as they best account for the inflection points found in the data
  - $R^2$  value indicates the relative accuracy of the model (1.00 is most accurate)

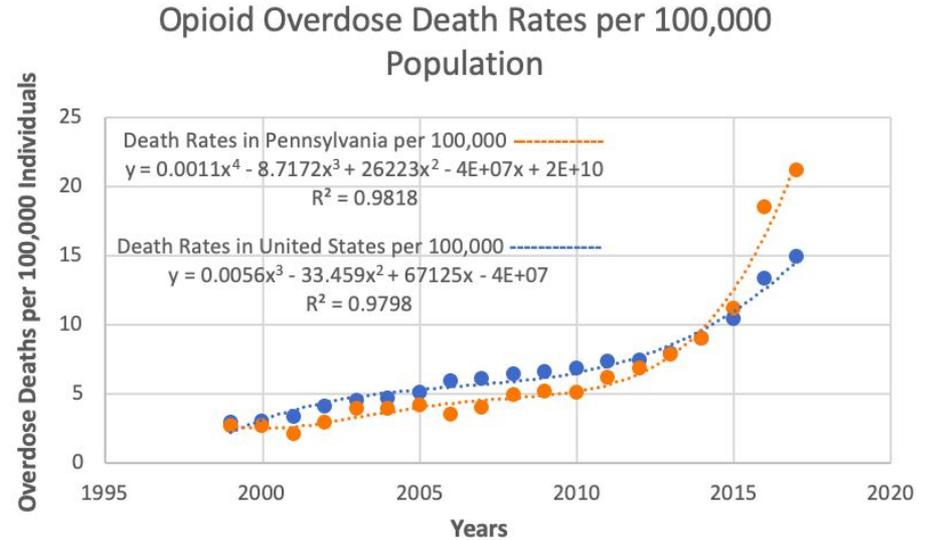


The above graph indicates that the national opioid crisis peaked in more recent years, with a general increasing trend affecting more lives

# Methods - Fitting Equations and Trendlines



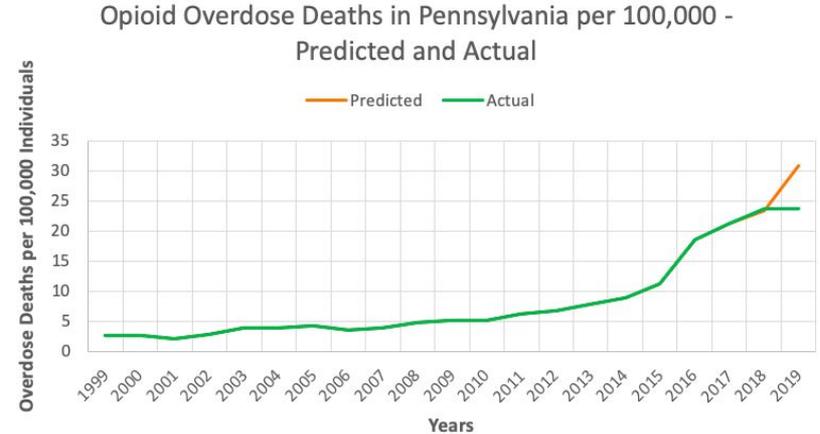
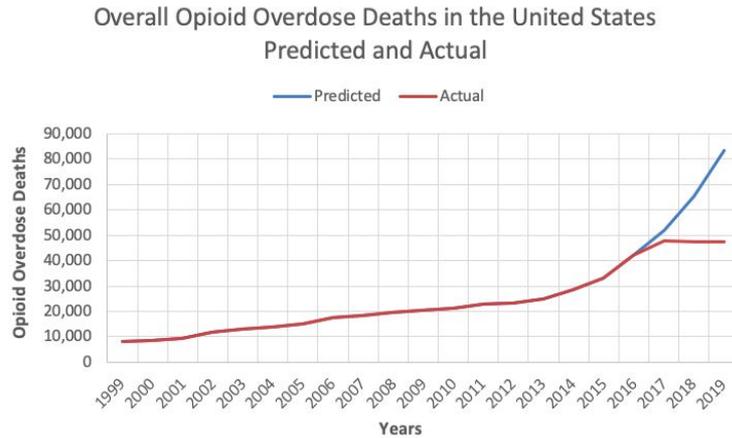
The above graph is specific to each opioid - demonstrates that because each opioid had its own peak in the crisis, the graph with the number of overall overdoses takes into account the patterns of each opioid to generate an overall trend



PA has the 4th highest rate in the country in terms of opioid use disorders - graph compares the national rate of deaths from opioid use disorders with Pennsylvania's rate. This graph is per 100,000 individuals in the respective populations

# Effect of Current Intervention

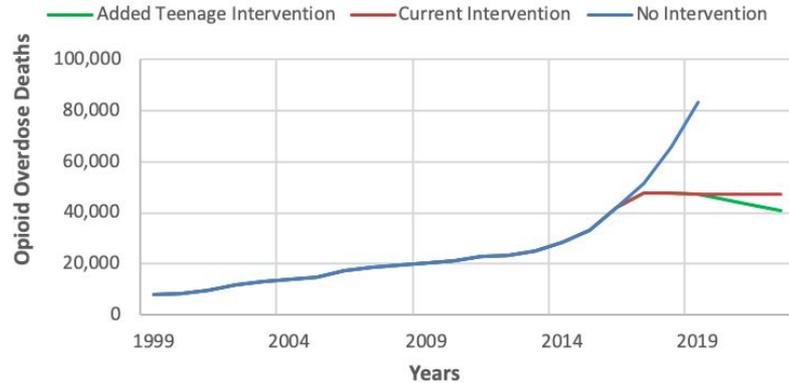
- ❖ Trendline equations used to predict the number of opioid overdose deaths for the subsequent years had there not been any interventions



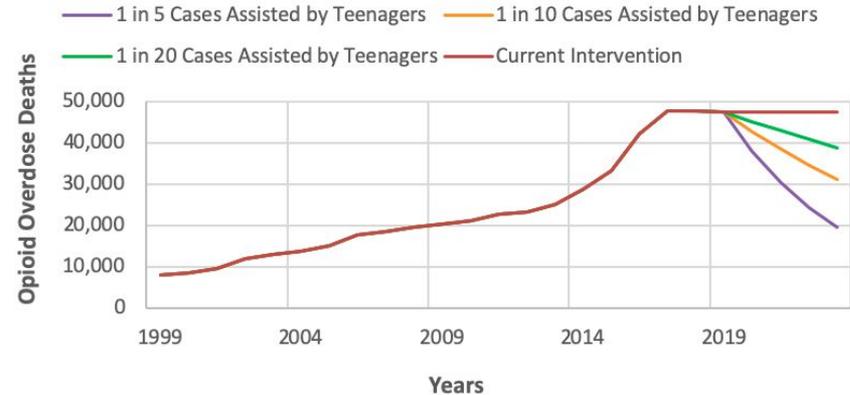
- ❖ These models indicate that while a significant number of lives from opioid overdoses have been saved since 2017, those numbers have remained flat
  - Additional intervention is then needed to bend the curve

# Results - The Power of Teenage Intervention

Overall Opioid Overdose Deaths in the United States: Before and After Current Intervention and the Power of Teenagers



Overall Opioid Overdose Deaths in the United States



These graphs highlight that if teenagers were to intervene by helping a loved one battle an opioid use disorder, more lives would be saved and the opioid crisis curve would be significantly bent. Note that these values already take into account the continual implementation of already existing initiatives.

# Opioid Crisis Toolkit for Teenagers

## How to Help a Loved One Struggling with an Opioid Use Disorder

### A TOOLKIT FOR TEENAGERS

Written by a Teenager  
Written for a Teenager

## Opioids and the Opioid Crisis

For the past 20 years, millions have developed opioid use disorders after initial use. This has become a nationwide epidemic that continues to bring devastation to society.



Photo Credit: National Institute of Health

### Opioids

- Powerful drugs prescribed for injuries, surgeries, or illnesses
  - can be addictive and cause dependence
- Common opioids: prescription drugs (morphine, hydrocodone - Vicodin, oxycodone - Oxycontin), illegal drugs (heroin), fentanyl

### Opioid Use Disorder (OUD)

- Dangerous cycle where people need to constantly use opioids to relieve pain even if they have good intentions to stop

*Illness like any other medical disease that does NOT happen by choice and can be professionally treated*

### Fast Stats

Every day, around 130 lives are lost in the United States to opioid overdoses

23.5 million people in the US are currently in long term recovery from a substance use disorder

1 out of 3 people in the US knows someone with an opioid use disorder

Economy has taken a huge toll: opioid crisis cost \$321 billion from 2015-2019, and \$188 billion in 2019

Data from the Centers for Disease Control and Prevention (CDC) and American Psychiatric Association (APA)

## Opioid Use Disorders

### Causes of Opioid Use Disorders

- 80% of individuals who use heroin first misused prescription opioids
- Family history of OUD and other substances
- Social and other medical factors
  - Psychiatric disorders like depression
  - Childhood abuse and neglect

1 out of 10 individuals reporting pain medications for chronic pain develop an OUD

### How to Tell if One May Have an OUD

- Change in behavior
- Mood swings
- Social isolation
- Loss of interest in activities
- Poor-decision making

### Signs and Responding to Opioid Overdose

- Withdrawal symptoms
  - Vomiting, hallucinations, anxiety, severe fatigue
  - Taking opioids more often
  - Receiving many prescriptions
  - Abnormal sleep problems

### Signs and Responding to Opioid Overdose

- Unconscious
- Limp body
- Very pale skin
- Erratic heartbeat
- Slow, shallow breathing
- Choking, gurgling, snore-like sounds
- Administer *naloxone* if available
  - Medication to reverse an opioid overdose
  - Sprayed into nose or injected into muscle
- Lay person on side to prevent choking
- Stay with them until emergency workers arrive
- Perform CPR and rescue breaths if necessary

Be a Good Samaritan and act right away! Your prompt actions CAN save a life!

call 911 immediately if you think someone is experiencing an overdose!

## The Power of Teenagers

### Why Should Teenagers Help?

- Opioid crisis has always been considered as an adult problem that only adults can solve
  - But teenagers HAVE a role to play
- Adult efforts have done enough to flatten the curve but more initiatives are needed to save more lives

Overall Opioid Overdose Deaths in the United States: Before and After Current Interventions and The Power of Teenagers

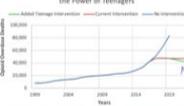


Photo Credit: CDC, based on data from the National Drug Use and Mental Health Survey (NDHMS)

This predictive graph shows that due to current intervention, many lives are saved and OUD cases have not exponentially increased

The younger population itself is a support group, so we need to support one another

### Erase the Stigma

- Stigma: regarding OUD as a moral issue instead of a treatable medical condition
  - evokes guilt and fear in those with OUD
  - exists in older population

teenagers starting to learn about these issues without the stigmatizing perspectives
 

- better positioned to help both friends and family

| stigmatizing phrases | non-stigmatizing phrases (use instead) |
|----------------------|--|
| addiction            | opioid use disorder                    |
| addict or junkie     | individual with opioid use disorder    |
| clean or dirty       | person in recovery                     |

call 911 immediately if you think someone is experiencing an overdose!

stigmafree

Photo Credit: National Institute of Health (NIH)

## What Teenagers Can Do To Help

### Initiate the Conversation

can help both friends and family members (including adults) with OUD

- Ask questions
  - You don't seem like your usual self. Is everything alright?
  - its everything okay?
  - How can I help? Don't worry, I'm here to support you!

- Emphasize that you are there to listen and offer help as needed - **support exists**
- Chances exist that the individual will not open up immediately
  - be empathetic - creates a more comfortable atmosphere for the individual

- Teenagers not always comfortable opening up to adults - rather talk to another teenager

- Can sometimes lead to an uncomfortable situation
  - Detach yourself and look at the story from an objective lens
  - Find a coping mechanism - best way is to not be the only individual listening to the story
  - Remember, your initiative to help can have the end result of turning someone's life around

Find a trusted individual that the individual with the OUD can turn to (e.g. parent, doctor, teacher, therapist, etc.)

### Mirror the Conversation

- Avoid providing instructions such as 'go get help'
  - Offer **supportive statements** instead
    - based on what you said, what do you feel is best for you to receive help?
- Center the conversation around health effects from the disease instead of making the individual feel at fault

people are willing to help; communicate your needs

## General Resources and Hotlines

Report to a trusted individual if a friend or family member is battling an opioid or other substance use disorder

- Call a hotline - confidential, free, 24/7, 365 days a year
  - provides treatment information service for individuals and families facing mental health and/or substance use disorders

### National Hotline

1-800-662-HELP (4357)  
Hotline provided by the Substance Abuse and Mental Health Services Administration (SAMHSA)

There is HOPE - people will get better when they receive the support they need

The power lies in teenagers - you have the potential to help and save a loved one's life

Created by Noha Staudan

Website link: [www.toolkitforteens.wixsite.com/opioidcrisis](http://www.toolkitforteens.wixsite.com/opioidcrisis)

# Opioid Crisis Toolkit for Teenagers

Website link: [www.toolkitforteens.wixsite.com/opioidcrisis](http://www.toolkitforteens.wixsite.com/opioidcrisis)

- ❖ Bethlehem Press Article:  
<http://bethlehem.thelehighvalleypress.com/2020/02/11/reshaping-conversation-discussing-opioid-use-disorders-holiday-season>
- ❖ La Razón Spanish Article (on p.22): [https://issuu.com/larazonews/docs/la\\_razon\\_316](https://issuu.com/larazonews/docs/la_razon_316)
- ❖ TEDx Talk: <https://www.youtube.com/watch?v=dhjD7eD57Go>

# Acknowledgments

- ❖ **Mr. Leon Galitsky** - Math teacher and mentor of project
- ❖ **Dr. Brian Crowe** - English teacher and mentor of project
- ❖ **Dr. Gillian Beauchamp** - Emergency Room Physician and Medical Toxicologist at Lehigh Valley Health Network
- ❖ **Mr. Layne Turner and Mr. Joe Martellucci** - Lehigh County Drug and Alcohol Administration
- ❖ **Ms. Emily Leonardo** - Certified Recovery Specialist for Lehigh County
- ❖ **Ms. Erica Panella** - Certified Recovery Specialist for Lehigh County
- ❖ **Ms. Paige Roth** - Physician Assistant at Lehigh Valley Health Network
- ❖ **Ms. Mindy Cronk** - Manager of *Battling Opioids, A Project of the Pennsylvania Public Media*
- ❖ **Ms. Lisa Wolff** - manager at Center for Humanistic Change
- ❖ **Mr. George Taylor** - *Bethlehem Press* Editor and part of Opioid Education Task Force in the Lehigh Valley
- ❖ **Ms. Lisa Getzler** - Curator of TEDx Lehigh River
- ❖ **Ms. Isa Pereya** - Editor of *La Razón Lehigh Valley Newspaper*
- ❖ **Ms. Genesis Ortega** - Host of *Es Tiempo*, Spanish news show



---

# Thank you!

*The power lies in teenagers:* we can make a difference and we do have the potential to help save a loved one's life

Email: [skandann@mamail.net](mailto:skandann@mamail.net)

---