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Introduction and Significance

In the United States there has been a steady increase in the number of opioid-related deaths and the number of individuals who are being treated for opioid use disorder. The Centers for Disease Control and Prevention (CDC) found a 200% increase in opioid-related overdoses from 2000 to 2014 across the United States (Rudd, 2016). In 2015, Connecticut was within the highest range of deaths related to opioid overdose in the United States. Between 2012 and 2017 there were 3,583 drug-related deaths, 54% involved heroin (CT Open Data, 2017). Of all the drug-related deaths in Connecticut over one-third solely related to heroin and involved no other substance. The CDC found that Connecticut had a 25.6% increase in the number of overdose deaths from 2014 to 2015 (Rudd, 2016). In 2016, there were 25,599 individuals in treatment for heroin use disorder and 2,837 individuals in treatment for other opiates. The number of individuals in treatment for heroin in 2014 was 21,773; two years later there was approximately an 18% increase in individuals being treated for heroin use disorder with 3,826 more individuals requiring treatment (SAMHSA, 2016). Climbing rates in opioid-related overdoses and increasing numbers of individuals requiring treatment in Connecticut point to a need for public health research and interventions to decrease these numbers.

The purpose of this research is to map opioid-related overdose deaths as an indicator of need for opioid abuse related services in Connecticut’s communities. Geographic analysis will allow the identification of specific towns and cities in Connecticut that are in need of substance use services. In addition, areas of Connecticut that currently have opioid-related services will be mapped. Review of services could allow insight to gaps in services that should be introduced to the areas that have been identified as areas in need. A goal of this research is to provide
Connecticut with an analysis of where overdoses are occurring and where opioid related services should be available.

Understanding what heroin is and its effect on a user’s mind, body and social factors is important to understanding the complexity and magnitude of the heroin epidemic in the US and Connecticut. According to the U.S Drug Enforcement Administration (DEA), heroin is a Schedule I drug. Schedule I drugs are not accepted for medical use because of their ability to create serious substance dependence, physiological effects, and/or high potential for substance abuse (DEA, 2017). Heroin’s addictive properties lead to one in six first-time users becoming addicted after only one use (NIDA, 2017). Opioids that are Schedule II substances have high potential of abuse but are used for medical purposes to control pain (DEA, 2017). Fentanyl is a Schedule II drug but is often sold illicitly and is a rising cause of fatal opioid overdoses in Connecticut. According to the CDC, fentanyl is 50 times more potent than heroin, and a very small dose could cause a fatal overdose (Tomassoni, 2016). One day in June 2016, New Haven saw 12 fentanyl overdoses in only six hours (Tomassoni, 2016).

Connecticut’s increase in overdose-related deaths may be related to patients being prescribed addictive opioids for pain management of chronic illness or other medical reasons. Some researchers point to the medical use of prescription opioids as a major cause of the heroin epidemic. Calcaterra (2009) stated that in 2009 the amount of opioids being prescribed to patients increased by four times the amount that was prescribed in 1999. Analysis of the 2010 National Survey on Drug Use and Health (NSDUH) found that 22.6 million Americans age 12 or older had used illicit drugs in the past or were still using them (Manchikanti, 2012). Of these individuals, 5.1 million had reported misuse of pain medication (over-the-counter pain medications not included) and only one-sixth of those individuals reported having a prescription
for that pain medication (Manchikanti, 2012). This increase in patients being prescribed opioids is a probable contributor to the opioid epidemic but cannot be considered as the sole reason.

Overprescribing of opioids is considered to be the cause of the opioid epidemic because some individuals become dependent on opioids and start to seek other less expensive opioids to control their pain or to get high. Not all individuals with heroin dependence started using heroin due to prescription pills. Manchikanti’s (2012), comprehensive review of 2010 NSDUH data found that 66.4% of users obtained prescription drugs from friends or family by buying the drug from them, stealing it, or receiving it for free, and 79.4% got the drug from a doctor. Only 4.4% of users reported receiving their prescription drugs from a drug dealer or stranger (Manchikanti, 2012).

Heroin has been illegal in the US since 1924 (Sneader, 1998). Heroin is illegal under the Controlled Substance Act as a schedule I substance. The increase in opioid related overdoses has spawned questions on how the sale of heroin should be penalized. There are 20 states that have drug-induced homicide laws (LaSalle, 2017). Drug-induced homicide policy means that if the buyer of a substance has a fatal overdose then the person that sold them the substance can be charged with homicide. Three states have drug-induced homicide laws that only apply to individuals who have provided people under the age of 18 with a controlled substance. Punishments, which vary from state to state, can be as severe as the death sentence. In six states the minimum charge is life in prison. Even though drug-induced homicide policies are controversial and have been challenged to be unconstitutional, as the person selling the drug may not be in a healthy mental state (LaSalle, 2017). There was a 300% increase in drug-induced homicide persecutions from 2011 to 2016. States such as Wisconsin, Ohio, Illinois and Minnesota have had the most persecutions for drug-induced homicide (LaSalle, 2017).
Risk Factors Related to Opioid Misuse

A number of behavioral, social, economic, and psychological risk factors have been associated with opioid misuse (Brown, 2004). A risk factor can be anything that increases an individual’s likelihood of developing a disease. Risk of substance abuse is unique to each individual because of the variety of factors that interplay with substance use and misuse. Webster (2017) found that chronic pain managed by opioid therapy is a risk factor for opioid misuse because it introduces opioids to the patients’ environment and creates a need for opioids. Boscarino (2011) found that 21.7% of patients with lifelong opioid prescription have a moderate drug use disorder while 13.2% have a severe drug use disorder according to Diagnostic and Statistical Manual of Mental Disorders (DSM 5) criteria. To avoid misuse of opioids physicians should assess patients for apparent risk factors of potential misuse such as median age, family history and past use (Webster, 2017). Lovejoy (2017) suggested discontinuing long-term use of opioids for chronic pain treatment using a retrospective cohort study. The study of 300 participants found that 85% were diagnosed with SUD because of physician-prescribed long term opioid use for pain treatment. Of these individuals, 26% who attempted to discontinue opioid use found that they were unable to do so and had an opioid use disorder. Physicians should also assess patients for risk of overdose related to opioid. Risk of opioid overdose is present with any individual who misuses opioids because all opioids can be fatal if misused (Dasgupta, 2016). Risk factors of overdose include middle age, substance abuse history, chronic pain, mental disorders, and family history of substance use (Webster, 2017).

Genetics is a risk factor for substance use disorder (Goldman, 2005). Goldman (2005) evaluated the inheritance of addiction by looking at patterns between monozygotic (MZ) and dizygotic (DZ) twins. Individuals can have single genetic inheritance or polygenic influences
that create vulnerability or protection. Goldman concluded that depending on the type of substance use, heritability can be between 40 to 80%.

Certain demographic factors have been identified as opioid risk factors of addiction. Males were found to be more likely to have a substance use disorder than females (Fisher, 2014; Katz, 2013). It was also found that being black is a protective factor because a majority of study participants were found to be white. Mental health disorders have been strongly associated with addiction (Katz, 2013). Trull (2010) found that individuals with a personality disorder are 12% more likely to develop an substance use disorder than those who do not have a personality disorder. Fisher (2014) found that co-occurring mental health disorders were present in 70% of individuals with addiction. Of these mental health disorders, bipolar disorder and schizophrenia were the most common and anxiety the least commonly observed mental health problem. Having been incarcerated is a risk factor for opioid use and overdose, an estimated 24% to 36% of people addicted to heroin revolve through US jails each year (Boutwell, 2006). Re-entering society after incarceration increases risk of fatal overdose because the user’s body will be less tolerant of the substance (Brinkley, 2018).

Research has found that by senior year of high school 70% of students will have tried an illicit drug, 20% of which would be opioids (NIDA, 2014). During adolescence individuals experiment with drugs and seek new experiences. Experimenting with drugs could lead to overdose because of a general misunderstanding of the substances used. During this time of experimentation, individuals may become dependent or conversely, may never use the substance again. If substance use continues after initial use adolescents are at an increased risk of developing a substance use disorder than older age groups because adolescent brains are still developing (NIDA, 2014). Twenty-five percent of individuals who used prescription drugs 13
years of age or younger develop a substance use disorder at some time in their life (NIDA, 2014). Individuals ages 12 to 17 are more likely to use substances like alcohol, marijuana and prescription pills. NIDA (2014) found that 38.7% of individuals 12 to 17 years of age had used prescription drugs and .3% had reported use of heroin. This increase in heroin use with age increasing is seen in individuals ages 18 to 25, among whom 12.4% report having used heroin. Substance use in adolescents can affect social and educational development such as poor memory retention and communication skills. Potential lifetime consequences of early drug use call for early intervention and treatment (NIDA, 2014).

Interventions

Interventions for adolescents should be different than interventions used for adults. Adolescents may not need treatment for their drug use and may benefit more with early intervention efforts. Since there has been a short time that they have used drugs, they will probably have not experienced many negative consequences of use.

Only about 10% of individuals ages 12 to 17 that require treatment receive treatment (NIDA, 2014). Children ages 12 to 17 within the juvenile justice system are most likely to receive substance abuse treatment compared to other children in this age range. There are different approaches to treatment for adolescent substance abuse including: SBIRT, inpatient treatment, behavioral therapy, and family-based treatment. Screening, brief intervention and referral to treatment (SBIRT) is used to identify substance abuse, reduce the use and prevent substance abuse disorders (SAMHSA, 2018). Behavioral treatments teach individuals about how to cope with their feelings and with everyday life (NIDA, 2014). These coping skills can help reduce their chances of using drugs. Family-based approaches are important because adolescents are usually living with their families and can address problems within families that may be
leading to drug use. Recovery support and continuing care are important to make sure that drug use does not begin again and that adolescent know where they can get help if there is a problem (NIDA, 2014).

Drug take-back programs

Drug take-back programs are used for the safe disposal of controlled substances. The Food and Drug Administration (FDA), along with the Office of National Drug Control Policy (ONDCP), created a list of 27 medications that could be properly disposed of by flushing such as Abstral, Buprenorphine and Dilaudid (FDA, 2018; Fass, 2011). The ONDCP and DEA also recommended that drugs not safe to flush should be disposed through drug take back programs. This recommendation pushed the DEA to allow law enforcement agencies to collect controlled substances for disposal. The Secure and Responsible Drug Disposal Act of 2010 and the Safe Drug Disposal Act of 2010 modifying the Controlled Substances Act to make drug take-back programs accessible (Fass, 2011).

Lystlund (2014), in a study of 62 participants found that 61% reported a need for drug take-back programs. The most common disposal technique was to dispose of unused medications in household trash. Lystlund also found that about 19% of drugs that were returned to pharmacists were antibiotics. The study found interest and need for medication take-back programs however most participant were unaware of program availability. Perry (2014) performed a study in Ohio evaluating the quantity and type of medication waste over seven take-back days and found that 786,882 units were collected (Perry, 2014). Perry conducted a survey that found that half of participants disposed of medications because they were expired and 40% of participants disposed of medications because of discontinued use. The largest category of medications returned were antihypertensive agents, the second most common was
gastrointestinal medication, and the third most common were analgesic medications. If not for the drug take-back programs, 50% of participants said they would have continued to keep their medications at home rather than dispose of them (Perry, 2014). Keeping unnecessary medications at home, however, can increase risk of misuse by the prescription holder or by others in the household (SAMSHA, 2014). Drug take-back programs have been proven to be effective in overdose prevention (White, 2015). Effective disposal of unused medications reduces the amount of medications stolen by other people who have access to the medications. Drug take-back programs are important because, according to SAMHSA, 4% of medications are stolen by a friend or relative, close to 11% of prescriptions pills are purchased from a friend or relative and 54% are received from a friend or relative for no charge (SAMHSA, 2014). Drug take-back programs give people the opportunity to safely dispose of medications and reduce risk of the medications being misused. In Connecticut, there are 87 ongoing drug collection boxes in communities around the state. Data collected by Connecticut’s Department of Consumer Protection (DCP) shows an increase in collection amounts from 2012 to 2017 (DCP, 2018); ten times the amount of drugs were collected in 2017 than 2012. However, information about to the types of drugs collected in Connecticut isn’t available.

Naloxone

Naloxone is a medication used to reverse an overdose from opioids and its presence in communities helps reduce fatal overdoses (Handal, 1983; Kenney, 2018). Naloxone can be used at the first signs and symptoms of overdose, including cardiovascular and respiratory depression. Naloxone acts to reverse overdose by blocking the substance from reaching the opioid receptors in the brain. Naloxone can be administered as a nasal spray, or as intramuscular, intravenous, or subcutaneous injection. Heroin overdose has been observed to be the most common need for
naloxone administration (Kenney, 2018). Kenney (2018) found that 38.9% of study participants had an overdose, 41.5% reported witnessing a drug overdose and 34.5% of overdose bystanders had administered naloxone. The administration of naloxone was significantly associated with drug dependence and misuse. Large doses of naloxone can be administered if patients do not respond to the appropriate dose size or if patients need continuous naloxone. Naloxone can have irreversible side effects when used in large doses (Handal, 1983). Large doses of naloxone can cause liver damage or failure. While this potential danger does exist, it is uncommon. It can be argued that the life-saving effects of naloxone outweigh any potential negative side effects it may have.

In Connecticut, there are several laws that support the use of Naloxone. Public Act 11-210 was passed in 2011 as the Good Samaritan Law protecting individuals that call 911 in the case of an overdose from arrest for possession or illicit substances and paraphernalia (DMHAS, 2018). This policy was created because individuals observing an overdose situation were often afraid to call for help and risk arrest. In 2012, the Narcan Law was passed to allow prescribers to prescribe naloxone to individuals who they observe to be at risk of overdose. This law also protects prescribers under Public Act 14-61 from liability or persecution if naloxone administration or its use results in a negative consequence. Public Act 14-61 also protects any individual that administers naloxone to an individual experiencing an overdose by protecting them against civil liability and criminal prosecution. In 2015, Public Act 15-198 was passed to allow pharmacists to dispense naloxone. This law only applies to pharmacists who have been trained how to administer naloxone and continue their naloxone education. The pharmacist is required to educate any person they dispense naloxone to on its use. They are also required to check the Connecticut Prescription Monitoring and Reporting System before dispensing more
than the standard 72 hour supply of naloxone and before dispensing to individuals with long term opioid prescriptions (DMHAS, 2018). This intervention led to the development of 567 Naloxone dispensing pharmacies across Connecticut. In 2018, it became a requirement of all municipalities to have at least one medical services provider trained on naloxone administration and equipped with naloxone (DMHAS, 2018). Laypersons are also able to become trained in the use of naloxone and keep naloxone kits with them. In 2015, 152,283 persons in Connecticut received naloxone training and kit (Wheeler, 2015), of these people, 26,463 subsequently reported reversing an overdose with naloxone. Rapid saturation of Naloxone in Connecticut has made it difficult to know the exact amount of Naloxone used or the exact amount in the environment. In Connecticut there are currently 597 pharmacies that can distribute naloxone but information on the amount distributed was not available. The amount of naloxone used by Emergency Medical Services (EMS) in Connecticut could not be accessed either.

A study found that 56% individuals receiving treatment for opioid SUD reported having an overdose (Best, 2002). Naloxone is a harm reduction service that can reverse an opioid overdose and save the individual’s life. From 1996-2014 approximately 26,500 opioid overdoses were reversed using Naloxone (Wheeler, 2015). Knowledge of where individuals are dying from opioid overdoses can be used to determine where naloxone should be available. There is currently minimal information on how many EMTs across Connecticut are equipped with Naloxone. Pharmacies that are allowed to distribute to individuals with prescriptions for Naloxone could also give us some information on where Naloxone is available in Connecticut. Identifying the gaps in Naloxone dissemination could prevent further opioid overdose and save lives. Fears that introducing Naloxone to individuals that have SUD will increase opioid use have not been substantiated. Evaluation of program in Massachusetts found that naloxone
distribution reduced overdose deaths by 11% without increasing the number of individuals using opioids (Walley, 2013).

Needle Exchange Programs

Beyond the opioid overdose rates there is another serious public health concern related to the use of heroin and other opioids. Injection drug use is a public health concern because there is a risk that users who share needles with one another can unknowingly spread infections. Research from an ecological study of 200 countries found that the prevalence of HIV among injecting drug users is 20 to 40% depending on location. In the United States, the HIV prevalence rate among IV drug users could be as high as 22.4% (Mathers, 2007). Knowing the location of the individuals that are dying from heroin and other opioids, can identify sites where harm reduction services, such as needle exchange programs, should be located to help reduce the numbers of IV drug user at risk of being infected with HIV.

Rising overdose rates related to the opioid epidemic has been accompanied by the increasing spread of blood borne diseases (Weinmeyer, 2016). Increases of drug related HIV and Hepatitis B/C in the US calls for harm reduction programs. Needle exchange programs provide IV drug users access to clean needles and safe disposal of used needles. These programs can reduce HIV incidence from 15% to 33% (Green, 2012). As of 2014, there were 33 states where needle exchange programs were banned. A federal ban in needle exchange programs was lifted in 2010, allowing the use of federal funds for needle exchange programs (Green, 2012), however, accessibility of needle exchange programs continues to be limited by state and local laws. Bastos (2000) found that needle exchange programs around the world are generally effective in decreasing the spread of blood borne diseases. A study done in New York City after needle exchange programs were implemented found that needle exchange programs reduced
HIV incidence by 70% (Jarlais, 1996). The study also found that participants more frequently injected drugs over other kinds of ingestion because of the needle availability. Increase of IV drug use may possibly increase risk of drug related overdose, an unforeseen negative effect. Needle exchange programs also have indirect effects on society. Prevention of blood borne disease through IV drug use will also decrease the spread of blood borne diseases through unprotected sexual practices (Jarlais, 1996).

Medication-Assisted Treatment

Medication assisted treatment (MAT) uses medications and counseling together to treat for substance abuse. MAT for opioid use has been shown to be one of the most effective treatments for opioid use disorders (McElrath, 2017). The two primary forms for MAT are methadone and buprenorphine. Methadone and buprenorphine attach to the opioids receptors in the brain and cannot be replaced by other opioids (Woods, 2018). If a patient is receiving methadone treatments and they use another opioid they won’t achieve a high. This should deter their efforts to continue opioid use since no reward is achieved. Methadone maintenance programs were made available through the Food and Drug Administration in 1972 (McElrath, 2017). Use of methadone can only be accessed through Opioid Treatment Programs (OTP) and eligibility is limited to patients who have had an opioid addiction for at least one year.

Buprenorphine is usually combined with naloxone to eliminate the ability to abuse the substance. Buprenorphine became available through the Drug Addiction Treatment Act of 2000, allowing physicians to prescribe buprenorphine for patients with opioid use disorders (McElrath, 2017). However, physicians have been tentative about prescribing buprenorphine because of concerns for patients’ mental health (Netherland, 2009). Buprenorphine is available through OPT and physicians trained for treatment with buprenorphine (McElrath, 2017). MAT medications are
meant to help a person become abstinent and do not replace addiction of one drug with a new drug (Wood, 2018).

Research focusing on the social and health outcomes of patients receiving MAT for opioid abuse found that after three month of MAT patients experienced positive outcomes (Ali, 2018). The study population was mainly male, which is a reflection of the target population. Ali (2018) used an opioid treatment index (OTI) as a way to measure opioid use and related consequences at the beginning and end of the study. These index outcomes demonstrated a significant reduction in all substance use, reduction in risky behavior pertaining to HIV, and an increase in good health. Ali (2018) also found that there was an overall increase in the quality of life of study participants. This study demonstrates how MAT can be beneficial for people with opioid addiction by reducing substance use and improving their lives.

MAT is arguably the most effective way to treat opioid use disorders but there are gaps in access to treatment. Across the US the current capacity of OTP programs is being reached. Jones (2015) found that the rates of patients requiring MAT through OTPs has grown dramatically going from 95.5 per 100,000 in 2003 to 119.9 per 100,000 in 2012. This increase in patients needing care creates need to increase OTP centers and infrastructure for MAT services. Jones calculated that all OTP programs are operating with at least 80% capacity. Jones found that in 2012 Connecticut’s past year opioid use was 9.5 per 1000 population but capacity for buprenorphine treatment was at 7.4 per 1000 population. As the population of individuals using opioid increases, OTP will be unable to accommodate patients in need of treatment without concomitant service capacity increases.

Study Design
The research questions for this study are: Where have opioid related overdose deaths been occurring in Connecticut? Where, if any, are the gaps in opioid misuse services across Connecticut and where are areas with services? Are there resources available to meet the needs of opioid involved individuals in their resident towns? Secondary analysis of publicly available de-identified data available at the town level related to opioid use was used to identify high need communities. In this research, communities refer to towns and cities in Connecticut. The mortality data included cases that had opioids in their bloodstream at the time of death as reported by the Office of the Connecticut Medical Examiner (OCME). The mortality data was imported into an Esri ArcGIS program and geoplootted by the town that the individual lived in. Data on the individual’s specific address was not used for this analysis. After the risk level of the communities was mapped, the investigator mapped opioid prevention and treatment services. Through a review of directories of services that can be used to address this drug problem, the investigator evaluated the availability of resources to address the problem. Prevention and treatment services were plotted onto the map in individual layers. The services were plotted using their official address that the service is conducted in order to do a later analysis of geographic accessibility.

Treatment programs in Connecticut were also located and plotted as their own layer on the map. Treatment programs were designated as short-term, long-term, outpatient, and counseling. Treatment programs were only included in the analysis if they were opioid treatment programs (OTP); if the treatment facility did not have programs for opioid use, the facility was not included in the map or analysis. The number of people in treatment facilities was analyzed to assess treatment capacity. It should be noted that individuals in these treatment programs may not be Connecticut residents and Connecticut residents may receive treatment outside of
Connecticut. Medication-assisted treatment (MAT) dispensaries were geoplotted by address. MAT dispensaries included methadone treatment, Suboxone treatment, Vivitrol treatment, and Antabuse treatment. If it’s possible to obtain data on the number of persons receiving MAT, it will be analyzed to see the volume of individuals that are being served. Department of Mental Health and Addiction Treatment Services (DMHAS) data was used to locate all types of treatment facilities. Services that are supplied by the DOC were also reviewed. A harm reduction analysis was also conducted. Making sure that needle exchange programs are implemented in appropriate communities can assist in reducing and preventing the spread of HIV and other communicable diseases.

Choropleth maps were used to display quantitative overdose and service data by Connecticut town. Overdose data per town were shown by multiple hue progression in a single color depending on the number of deaths. Single hue progression of a chosen color from very light to dark was used to demonstrate low overdose rates to high overdose amounts.

Census Approach

For this research, mortality data from 2012-2016 was used to establish towns in Connecticut that are seeing high rates of opioid deaths. Individuals who were found by the OCME to have an opioid substance in their system at time of death were included in the study. There was no exclusion for type of opioid found in the system. Special attention was paid to individuals found with heroin and fentanyl. The mortality data included all people who died in Connecticut and had a Connecticut residence. Deaths were be plotted according to the individuals town of residence rather than place of death. Individuals that died in Connecticut and did not have a Connecticut address were excluded from the analysis because their death could
not be plotted on a map of Connecticut. There were no age, gender, race or other general demographic exclusion criteria. Using as many individuals’ mortality data as possible for the five year period being analyzed indicated communities at high risk of opioid misuse and overdose.

The choropleth maps created for this research study were designed to create an immediate visual understanding of how the opioid epidemic plagues Connecticut. A single color gradient is used to symbolize the number of drug-related deaths in each town. The breaks in symbol levels for all the maps are naturally created through a computer algorithm called Jenks optimization method. Classification through Jenks minimizes differences between data values in the same class while maximizing difference between classes.

Color graduated symbols are used in figures VII, VIII and IX to show the amount of drug-related deaths per substance type. The graduated symbol in this map services are naturally divided using Jenks. The location of the symbols on the maps is naturally located to fit into the center of the town polygon. The background on these maps is the total number of deaths years 2010-2016 to give perspective. The graduated symbols are designed so that the largest size symbols represent the largest amount of opioid-related deaths and the smallest symbol represents the lowest amount of opioid-related deaths.

Figures XIII to XVI show the opioid-related services per town in four separate maps the represent each service separately. The service points on the map were plotted using the X, Y coordinates of the exact service location. Since the map scale is large the service points show in the approximate area of the town but are plotted in their exact locations. The services are layered over the total number of opioid-related deaths from 2012-2015. Layering the services over the deaths helps determine if there are gaps in services where high numbers of opioid-related deaths.
Implications from OCME data

Analysis of OCME data gives insight to characteristics of individuals who have died from an overdose. As implied in this paper, overdose rates in Connecticut have been increasing rapidly with little relief. Connecticut’s overdose rates show an increase from 346 deaths in 2012 to 893 deaths in 2016 (Figure I). Substances that are represented in the drug-related deaths include: heroin, cocaine, fentanyl, oxycodone, oxymorphone, alcohol, hydrocodine, benzodiazepine, methadone, morphine, amphetamine and tramadol. Data in Figure I suggested that from 2013 to 2014 the rate seemed to slow down but then continued to increase there after. Figure II shows the total overdose number for each town from 2012 to 2016. The five towns with the largest number of overdoses were Hartford, New Britain, Waterbury, Bridgeport, and New Haven. These five communities are the major urban centers in Connecticut with the largest populations. Overdose may be higher in these areas because access to opioids and other substances might be easier. Hartford, Waterbury and New Haven consistently had the highest overdose amounts. Figures III and IV show how dramatic the increase in the number of overdoses from 2012 to 2016 is. The major cities in Connecticut had the largest number of overdose deaths but when the deaths were represented per 100,000 (see Figure V) death rates were much different. Adjusting death rates per 100,000 population show that the northwestern and mid-eastern parts of the state were experiencing higher deaths per 100,000 population. Areas of the state that appeared to experience a large number of overdoses in Figure V may actually have had some of the lowest number of deaths in Figure II. Representing the drug-related deaths by number of deaths rather than the per 100,000 population rate is better for this study because the number of deaths represent the number of people that potentially needed opioid misuse-
related services. The deaths seen on the map allow for the assumption of need for services in those towns in Connecticut.

Figure VI shows the drug use trend lines for heroin, fentanyl and prescription opioids for 2012 to 2016. Overdose rates from 2012-2014 were mostly related to heroin with prescription drug-related deaths being second. Then in 2015 fentanyl showed a large increase and by the presence of 2016 fentanyl in overdose victims more than doubled that of the previous year. Fentanyl is concerning because it is about 50 times more potent than heroin; if fentanyl use continues to grow, overdose rates are also likely to grow. The three drugs shows are the most commonly found drugs in Connecticut overdoses.

Figures VII, VIII and IX provide visuals for the density of heroin-related deaths, fentanyl-related deaths and prescription drug-related deaths in towns of Connecticut. The drugs that are included in the prescription drug-related deaths are: hydrocodine, methadone, morphine, oxycodone, oxymorphone, and tramadol because they are all prescription opioids. Fentanyl is excluded from this map because of the high number of fentanyl-related deaths and high potency of the drug. All three of these maps are consistent with the highest density of each drug being used in towns with the highest number of deaths. When comparing the maps, it is easy to see that heroin has the highest over-all density and that prescription opioids (excluding fentanyl) are not the largest reason for drug-related overdoses. Figures VII to IX show the popularity of specific opioids per each town with size gradient symbols. These maps focus on single drugs but poly-drug use was frequently present in overdoses. The symbols are not representative of the actually number of deaths in those areas since some of the deaths may include more than one type of the represented drugs. The map represents the impact of all opioids across Connecticut and provides visual proof of the opioid epidemic.
Overdose within certain age groups can be seen in Figure X. Figure X shows that each year every age group had an increase in overdoses. Age ranges were combined in 20 year increments. The greatest number of people who overdosed was aged 30 to 49, followed by those 50 and over. Overdose among persons 70 and over were lowest. It could also be that drug-using individuals in this age group died before they could reach this age. Age groups 10 to 29 steadily increase in overdose rates. People in this age group may be experimenting with opioids and may not know the potency of the substances they are using.

In Figure XI overdoses are broken down into four race/ethnicity categories: white, black, Hispanic and other. The categories were divided as such because of small numbers in many race categories. White and black are separate categories that already existed in the data and were kept as they were. Hispanic is a combination of Hispanic, Hispanic black, and Hispanic white. Other combined of Asian other, Asian Indian, Chinese, Native American, Hawaiian native, unknown, and other. The data shows that whites have the highest overdose numbers by far for all five years.

Males were more likely to die from an overdose than females are (Figure XII). This might suggest women are less likely to use opioid in general. There was a steady increase overdose deaths for both genders over this time period however, the most significant increases took place in 2014 for males and 2015 for females. Neither group had a reduction or plateau in overdose rates at any time over the five year period.

An examination of treatment and prevention services showed that services in Connecticut are present in areas that have the highest overdose numbers. However, services appeared to be lacking in areas outside the major cities in Connecticut. Figures XIII to XVI show the treatment
services, syringe exchange programs, drop box, and pharmacy locations. There are a total of 41 public treatment facilities located in 23 town of Connecticut with (Figure XIII). The five towns with the highest overdose numbers all have treatment services within their town boundaries. The towns with the most treatment services available were Bridgeport, Hartford and New Haven (Figure XIII to XVI).

Needle exchange programs were located in six towns at a total of seven locations (Figure XIV). Hartford has the more needle exchange locations of the other towns. Needle exchange locations should be increased. Towns that have high numbers of overdoses such as Waterbury and New Britain do not have needle exchange programs.

Drop Box locations can be found across the state (Figure XV). Towns with high amounts of overdoses have at least one drop box location. The town with the most drop box locations is Montville. As seen on the map, Montville had a moderately high overdose numbers. However there is no way to know the effects of the drop boxes without knowing the exact medications that are being received as well as the amount.

In Connecticut, naloxone is widely distributed to EMS, police and pharmacies also can dispense naloxone. Figure XVI shows the approximate locations and density of all pharmacies in Connecticut that distribute naloxone. In Connecticut, there are 567 pharmacies that distribute naloxone.

Gaps in Services

The findings of this research implicate that treatment programs for opioid misuse are lacking in much of the state. In the north western and eastern parts of the state there are the fewest amount of treatment facilities (Figure XIII). These areas of the state need treatment
centers because they are experiencing increasing numbers of opioid-related deaths, like most of the state. These parts of the states are relatively rural and likely have long travel times to services which could reduce accessibility. Meriden, East Hartford, New Milford and Norwich have high numbers of overdoses but no treatment services. Increased saturation of opioid abuse disorder services is necessary throughout Connecticut.

Syringe service programs are lacking in areas of the state that have high number of heroin-related overdoses (Figure XIV). Waterbury and New Britain have high numbers of heroin-related overdoses but no syringe service program which causes concern for spread of blood borne disease. With only 11 syringe service programs in Connecticut nearly the entire state is lacking in a service that would help reduce the spread of substance-related HIV.

There are a lot of drop boxes across Connecticut but some gaps in the north eastern, north western and central coastal areas of the state (Figure XV). The areas where the drop boxes are lacking the most are areas with low numbers of overdoses. Waterbury, Wallingford, Bridgeport and New Haven are cities of Connecticut that have one or no drop box locations.

Pharmacies that distribute naloxone are shown in Figure XVI to follow the main roads and highways throughout CT. Areas of the state that have fewer roads have fewer pharmacies that distribute naloxone because of the north and west corners of the state have the lowest density of these pharmacies.

Study Limitations

There are several data limitations that apply to this research. Analysis of mortality data has certain limitations. Individuals who lived in Connecticut but did not die in Connecticut were not be included in the analysis. Choosing to do the community needs analysis using the place of
residence rather than the place of death can limit the relevance of first responders administering naloxone in those areas. Substances not represented on the maps are cocaine, benzodiazepine, alcohol, amphetamine and other such as PCPs and inhalants. These substances were excluded from map series because they are not opioids. There is incomplete information available on the amount of naloxone distributed and used in of Connecticut. Not having the data to show specifically how much naloxone first responders are given and using in different communities limits the ability to know if communities that are seeing high rates of overdose need more naloxone distribution. Lag time in the data is another limitation. The opioid problem in Connecticut has been changing rapidly and accurate analysis would mean using the most up to date data available. The OCME data used in this analysis is currently the most up to date and reliable data available, but it still lags one to two years.

This research identified communities that have experienced high numbers of overdose and where services are in those communities. Services in communities may exist but that does not mean that the services are used. Overdose rates can show communities that are at risk but cannot define the actual need and demand of treatments. This research cannot quantify the number of individuals in need for services or the number of individuals that would present for services.

Conclusion

Opioid-related services in Connecticut are mostly located in towns with the highest number of overdoses. Services are thinly spread across the state and are not fully saturating areas that are in the highest need. Needle exchange program locations are lacking in areas where the highest density of heroin overdoses are occurring (Figures VII & XIV). High density of heroin overdose suggests high density of IV drug users which indicates the need of needle syringe
programs. Connecticut should increase the number of public opioid-related treatment programs, as well. Treatment programs are lacking in areas of the state that are more rural or less densely populated. Increasing treatment services across the state would make treatment more accessible for people with opioid use disorder.

Younger individuals have lower number of overdose deaths while middle aged individuals have high numbers of overdose deaths. People in the 50 and over age range that are lifelong users may be at a heightened risk of overdose because they have a higher tolerance for the drug and take more of it.

The opioid epidemic across the United States has been described as a white middle class epidemic and this data reflects that. It is important to know that Connecticut’s population in predominantly white. This could suggest that the data is reflecting the general population rather than proving an at risk race. Previous research suggests that be black or Hispanic can be protective from opioid-related deaths (Katz, 2013).

Future researchers should consider looking at different factors as indicators of overdose risk. This paper was originally intended to include analysis of Emergency Department data, however, because these data are not readily available the analysis could not be done. Emergency Department data on overdose visits would expand overdose information to include nonfatal overdoses as well as deaths. Knowing nonfatal overdose rates is important because people who have previously had an overdose are more likely to have a fatal overdose (SAMHSA, 2014). Emergency Department data can also show insight to people who were hospitalized or received treatment for substance use disorders. Another suggestion is to analyze trends in HIV rates. Substance-related HIV rates suggest changes in intravenous (IV) drug use. Drug arrests and crimes of robbery can also indicate the prevalence of drug use in the community. People with
substance use problems who have been incarcerated are at overdose risk because when they re-enter society and begin using again they may take too large of a dose that could lead to overdose. Researching the negative consequence of drug use should be expanded to include other impacts of opioid use including arrests, hospitalizations and associated disorders. Negative consequences of drug use could be reflected in communities and show sign of overdose risk. Looking at all of these factors together can point to community risk of opioid problems.

Future research should also focus on the economics of interventions. Costs of treatment can determine if an individual will have access to the interventions such as detox treatment, long term and short term treatment, MAT, and naloxone. If costs are too high or increase, saturation of services could decrease. Less access to services could lead to increased risk of overdoses. Researcher should compare the economic cost of interventions to the economic status of communities at high risk.

This research could be used by other public health professionals such as EMS and the treatment community. Implications for use for other professionals include implementing new service locations in areas with gaps. EMS could use this data to determine areas of Connecticut that should have higher distribution of naloxone among crews. The data from this research could also be used by public health entities that are referring patients to services.
Resources


non-cancer pain: American society of interventional pain physicians (ASIPP) 

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Figures

Figure I: Numbers of Overdose Deaths in Connecticut Towns, 2012 to 2016.

![Increase in Overdose Deaths](chart)

<table>
<thead>
<tr>
<th>Year</th>
<th># OF DEATHS</th>
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<tbody>
<tr>
<td>2012</td>
<td>346</td>
</tr>
<tr>
<td>2013</td>
<td>474</td>
</tr>
<tr>
<td>2014</td>
<td>539</td>
</tr>
<tr>
<td>2015</td>
<td>707</td>
</tr>
<tr>
<td>2016</td>
<td>893</td>
</tr>
</tbody>
</table>

Figure II: Total Number of Drug-related Deaths In Connecticut, 2012 to 2016.

![Total Number of Drug-related Deaths](map)
Figure III: Total Number of Drug-related Deaths in Connecticut, 2012.

Figure IV: Total Number of Drug-related Deaths in Connecticut, 2016.
Figure V: Drug-Related Deaths per 100,000 in Connecticut, 2012 to 2016.

Figure VI: Trends in the Number of Overdose Related to Heroin, Fentanyl and Prescription Drugs in Connecticut, 2012 to 2016.
Figure VII: Total Number of Heroin-related Deaths in Connecticut, 2012 to 2016.

Figure VIII: Total Number of Fentanyl-related Deaths in Connecticut, 2012 to 2016.
Figure VIX: Total Number of Prescription Opioid-related Deaths in Connecticut, 2012 to 2016.

Figure X: Age Distribution of Drug-Related Deaths in Connecticut, 2012 to 2016.

Age Distribution by Percent From 2012 to 2016

<table>
<thead>
<tr>
<th>Year</th>
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<th>10 to 29</th>
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<tbody>
<tr>
<td>2012</td>
<td>27.38</td>
<td>51.30</td>
<td>21.33</td>
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<td>2013</td>
<td>28.90</td>
<td>49.58</td>
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</tr>
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<td>2014</td>
<td>28.20</td>
<td>50.83</td>
<td>20.96</td>
</tr>
<tr>
<td>2015</td>
<td>34.18</td>
<td>44.40</td>
<td>21.42</td>
</tr>
<tr>
<td>2016</td>
<td>32.06</td>
<td>49.10</td>
<td>18.83</td>
</tr>
</tbody>
</table>
Figure XI: Ethnic Distribution of Drug-related Deaths in Connecticut, 2012 to 2016.

![Ethnicity Distribution by Percent from 2012 to 2016](image)

Figure XII: Sex Trends of Drug-related Deaths in Connecticut, 2012 to 2016.

![Sex (2012-2016)](image)
Figure XIII: Total Number of Drug-related Deaths, 2012 to 2016 and Locations of Opioid Use Disorder Treatment Programs, 2018

Figure XIV: Total Number of Drug-related Deaths, 2012 to 2016 and Syringe Service Programs, 2018
Figure XV: Total Number of Drug-related Deaths, 2012 to 2016 and locations of Drug Drop Boxes in Connecticut, 2018

Figure XVI: Total Number of Drug-related Deaths and locations of Naloxone Distributing Pharmacies in Connecticut, 2018