Drug and Alcohol Dependence Reports 8 (2023) 100187

Contents lists available at ScienceDirect

Drug and Alcohol Dependence Reports

journal homepage: www.elsevier.com/locate/dadr

A case study for local data surveillance in opioid overdose fatalities in Cuyahoga County, OH 2016-2020

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HIGHLIGHTS

- Decedents had an average of 3 drug type mixtures at time of death.
- Decedents in urban areas were at an increased risk of a carfentanil overdose.
- A bimodal spike was observed for carfentanil-related overdoses.
- Local data surveillance can detect regional variations in overdose deaths.

ARTICLE INFO

Keywords:
Fatal overdose
Surveillance
Fentanyl

ABSTRACT

Introduction: Fentanyl and fentanyl analogs have increased the overdose mortality rates in the United States, significantly impacting states like Ohio. We examined carfentanil overdose deaths, other contributing Cause of Death (COD) drugs, and drug seizure trends from 2016 to 2020 in Northeast Ohio.
Materials and methods: We studied death investigation data from the Cuyahoga County, Ohio Medical Examiner's Office (CCMEO) of all fatal accidental opioid overdoses as well as drug seizure data from Cuyahoga County Regional Forensic Science Laboratory (CCRFSL). We also compared decedents' race, gender, age, residential locality, drugs contributing to the COD in opioid cases, and for carfentanil, fentanyl, and cocaine seizures in Cuyahoga County from 2016 to 2020 ($N = 2948$).
Results: Decedents' had an average of three different drugs contributing to their COD. A bimodal carfentanil spike was observed in fatal accidental overdoses in Cuyahoga County for the years 2017 and 2019. Decedents in urban residency, who were Non-Hispanic, White and younger, significantly predicted the presence of carfentanil contributing to the COD. In 2020, decedents who were Black and older were significantly associated with cocaine contributing to the COD. Carfentanil and carfentanil-related overdoses were significantly correlated.
Discussion: The pervasiveness of illicitly manufactured fentanyl and fentanyl analog (e.g., carfentanil) mixtures with other drugs are changing the demographics of persons who fatally overdose in Cuyahoga County, OH. Significant trending shifts can also be observed for the presence of carfentanil in decedent and seizure county data.
Conclusions: Local data of drug-related overdose deaths and drug seizures from a medical examiner's office and affiliated forensic laboratory lab can be used for timely public health surveillance, and informing prevention, and intervention at the county level.

1. Introduction

In 2019, an estimated 62 million people globally had abused opioids at least once that year (WHO, 2021). Opioids may include heroin, codeine, morphine, fentanyl, and synthetic opioids such as oxycodone, which have led to over 120,000 fatal overdose worldwide per year (Dydik et al., 2022). Illicitly manufactured fentanyl and accompanying analogs have been one of the driving forces of fatal overdose increases in

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https://doi.org/10.1016/j.dadr.2023.100187
Received 21 March 2023; Received in revised form 24 August 2023; Accepted 25 August 2023
Available online 1 September 2023

the United States (U.S.) which has seen a 120% increase of fatal opioid overdoses between 2010 and 2018 (Arteaga and Barone, 2022; WHO, 2021). Since 2014, more than 200,000 Americans have died from illicitly manufactured fentanyl, which is a significant public health problem that has fueled a national overdose crisis (CDC 2022a; Commission on Combating Synthetic Opioid Trafficking; CCSOT 2022).

In 2020, Ohio ranked fourth highest in drug overdose deaths in the country, with 47.2 drug overdose-related deaths per 100,000 persons compared to 28.3 drug overdose deaths per 100,000 persons in the U.S. (CDC, 2022b; Hedegaard et al., 2020; ODH, 2021). Northeast Ohio (and Ohio, in general) experienced a rapid increases in opioid-related fatal overdoses in the past 6 years, particularly due to the presence of synthetic opioids, such as illicitly manufactured fentanyl, contributing to the Cause of Death (COD) (Gilson, 2018; Waite et al., 2017; Daniulaityte et al., 2019). Carfentanil, a fentanyl analog known to be 10,000 times more powerful than morphine was detected in the Midwest and confirmed in Northeast Ohio's drug supply in 2016 (O'Donnell et al., 2018). By 2017, the death rate in Cuyahoga County due to illicitly manufactured fentanyl and carfentanil rose to 55.1 drug overdose-related deaths per 100,000 persons. Carfentanil presence is a concern due to dramatic increases in overdose-related deaths in Cuyahoga County associated with this analog (Bhullar et al., 2022; Flannery et al., 2020).

An important tool to augment epidemiological surveillance of overdoes fatalities, including carfentanil and other drugs is through the analysis of drug seizure data from overdose death scenes, law enforcement seizures, and drug-related traffic stops (CCSOT, 2022; Rosenblum et al., 2020; Zibbell et al., 2022). Understanding fatal drug trend patterns in near real-time can increase effective overdose surveillance and can help improve public health efforts to prevent overdose deaths at a local level (Lowder et al., 2018; Mattson et al., 2018).

The purpose of this study was to describe fentanyl and carfentanil-related overdose fatalities and drug seizure data across 2016 to 2020 and examine demographic differences in the affected population in Cuyahoga County, OH (metropolitan Cleveland). We focused on carfentanil due to its presence in both decedents' cause of death and drug supplies in the county, measured through drug seizure testing. Our study had several aims: First, we described trends on how fentanyl and carfentanil are driving overdose deaths in Cuyahoga County; Second, we examined differences in the demographics of fatal overdose persons and their implications for prevention, treatment and policy; Third, we examined trends in drug seizures, as a proxy for the changing drug supply, to determine if this information can assist in a local overdose surveillance system and its utility in informing public health prevention.

2. Material and methods

The Cuyahoga County Medical Examiner's Office (CCMEO) is the statutory authority responsible for the investigation of all sudden and unnatural deaths in Cuyahoga County, including drug overdose deaths. Cuyahoga County is the second most populous county in Ohio, with 1.3 million residents which includes the city of Cleveland (Census, 2020). The CCMEO is fully accredited by the National Association of Medical Examiners (NAME). Medicolegal death investigation (death investigation) at the CCMEO consists of an initial death scene investigation, which comprises information regarding the circumstances of death, scene of death, body characteristics and history including historical medical records. All fatalities occurring outside the healthcare setting are investigated by an investigator certified by the American Board of Medico-legal Death Investigators (ABMDI). All death investigations include an internal or external examination (autopsy), scene investigation, review of decedent's history and relevant ancillary testing contribute to the determination of the cause and manner of death. At the CCMEO, death investigations are directed by board certified forensic pathologists, and death certification is their responsibility, in compliance with national guidelines (Davis et al., 2020; NCHS, 2019). The relevant ancillary testing such as toxicologic and drug seizure analysis is conducted by the Cuyahoga County Regional Forensic Science Laboratory (CCRFSL), an accredited office by the Society of Forensic Toxicologists (SOFT) and the ANSI National Accreditation Board (ANAB). The data collected as a part of death investigations is medicolegal death investigation data herein medicolegal data.

The CCMEO is well acclimated to the needs of the forensic science community and in its efforts to provide support and guidance for its citizens and public health. The CCMEO alongside the Begun Center for Violence Prevention Research and Education, a research institute that applies participatory action based strategies in public health efforts, investigated opioid-related deaths in Northeast Ohio using county-level overdose data (Flannery et al., 2022).

Medicolegal data from 2016 to 2020 was extracted from decedent case files into an electronic REDCap database to identify decedents who were over the age of 18 and whose Manner of Death (MOD) was ruled as an accidental overdose or undetermined with presence of drugs. Decedents' toxicology reports that positively detected fentanyl, carfentanil, and/or cocaine as drugs contributing to the cause of death (COD) were considered ($N = 2948$). This REDCap database consists of over 250+ variables pulling pertinent information from death scene investigations regarding overdose deaths. Death scene investigations are completed by a set of specialized investigators who primarily collect death scene information at an overdose site. Using these narratives, the county's forensic epidemiologist extracts both quantitative and qualitative form into a REDcap database which will also include individual level data of the death certificate information, autopsy report, demographics, and toxicology. Decedents' basic demographic characteristics such as age, gender, race/ethnicity, and residential zip codes (urban vs. non-urban) were analyzed within and across years. The age, gender, and race of decedents were recorded from decedents' death certificates. Residential zip codes were coded as urban vs. non-urban using previously published city classifications, where zip codes within the city of Cleveland city limits were considered "urban" and those outside of the city limits were considered "non-urban" (Bhullar et al., 2022). Frequencies and chi-square test were used to determine if there were statistically significant changes in demographic characteristics from 2016 to 2020.

Due to multiple drugs contributing to the COD of each decedent, additional analyses were conducted to understand how drug combinations varied across years. Combinations of drugs contributing to the COD were aggregated and reported per year. Drug seizure data reported by the CCRSFL were also tabulated based on counts of positive tests for drug seizures. The CCRSFL tests all drugs seized by Cuyahoga County public safety agencies including local law enforcement agencies and the prosecutor's office. Seized drugs are tested by Gas Chromatography/Mass Spectrometry (GC/MS) instrumentation and tabulated for local surveillance efforts and contribute to the National Forensic Laboratory Information System (NFLIS). Tabulations include the number of times each drug was present in a submitted product (positivity count). This can be in powder, pill, or other drug product or paraphernalia from death investigation or law enforcement seizures. We limited the counts across the study period to fentanyl/fentanyl analogs and carfentanil.

Chi-square tests were used to assess differences in decedent characteristics and drugs contributing to the COD across all years. To test the unique contributions of demographic variables to the presence of carfentanil as a drug contributing to the COD, a series of binary logistic regressions were conducted. Decedents' gender, age, race, and residency status (urban vs. non-urban) in Cuyahoga County were examined as predictors of carfentanil in the COD.

Linear trend testing was used to detect any significant changes across 2016–2020 for number of decedents and seizure counts. Jointpoint is a statistical software program used to understand trend analyses using a jointpoint model technique to demonstrate where different lines connect on inflection points (also known as joinpoints) (CDC, 2023). Joinpoint was used to determine if any of the inflection points during the trend analysis were statistically different in the number of decedents with carfentanil contributing to the COD and seizure numbers across time (2016 Quarter 1 to 2020 Quarter 4).

Finally, carfentanil COD drug counts were compared to CCRSFL's positive counts for fentanyl and carfentanil samples submitted to the county's laboratory for the years 2016 through 2020. A spearman correlation was used to examine whether drugs contributing to decedent deaths correlated similarly to those drugs seized in the county.

3. Results

The total population of decedents from accidental drug overdoses aged 18 years or older from 2016 to 2020 was 2948, where 71% were males, 73% were Non-Hispanic White, 67% lived in urban areas, and about two-thirds were between the ages of 25 to 54 (Table 1). When accounting for all accidental opioid overdoses, 64% had fentanyl contributing to the COD, followed by cocaine (42%) and carfentanil (19%). When observing the number of decedents who died of an opioid overdose between years, 2017 had the highest number of accidental fatal overdoses (24% of the total death cases), followed by 2016 at 22% and 2019 at 19%. Additionally, 55.1% of decedents in this sample had at least three drugs listed contributing to the COD.

The following drug combinations were present in the COD from 2016 to 2020. A cocaine-fentanyl combination was present in nearly 25% of all fatal overdose cases, followed by carfentanil-fentanyl combination at 12%, carfentanil-cocaine at 7%, and all three combined (carfentanil-fentanyl-cocaine) at 5%. In 2016, fentanyl-cocaine was the most common type of combination at 23% compared to carfentanil-cocaine (3%) and carfentanil-fentanyl combinations (5%). In 2017, fentanyl-cocaine combinations were at their lowest at 20% for the 697 reported deaths, while carfentanil combinations (with either fentanyl or cocaine) hovered between 10 and 12%. In 2018, the fentanyl-cocaine combination was at 27%, the highest count across all years, with carfentanil combinations (fentanyl or cocaine) dropping below 3%. In 2019, fentanyl-cocaine combinations were similar to 2018, however, carfentanil combinations drastically increased in 2019 with carfentanil-cocaine combination increasing to 16% and carfentanil-fentanyl combination to 33%. The carfentanil-fentanyl-cocaine combination was at its highest in 2019 and involved 12% of all fatal overdoses. For 2020, the fentanyl-cocaine combination dominated at 24% of the decedents' cases, followed by carfentanil-fentanyl at 10%, and carfentanil-cocaine at 5% respectively. We found significant differences for all four drug combinations across years (p <0.001), where cocaine (27%) and fentanyl (26%) combinations peaked in 2018 and 2019. Cocaine and carfentanil combinations were the highest in 2017 and 2019 (Table 1).

Table 2 shows the total number of carfentanil-related deaths for the years 2016–2020 (n = 2948). The binary logistic regression model for 2016 to 2020, was statistically significant χ^2 (4) = 30.40, $R^2_{N,}$ = 0.02, p < .001. Decedents' residence significantly predicted carfentanil presence in the COD, such that individuals living in urban, metropolitan areas were more likely to have carfentanil compared to those in non-urban areas (aOR=1.93, 95% CI[1.81–2.17]). The decedents' race was also a significant predictor, whereas decedents who were Non-Hispanic White were significantly more likely to have carfentanil contributing to their COD compared to Black, Other decedents (aOR=2.67, 95% CI [2.58–4.01]).

In 2017 (n = 190), the year with the highest number of overdose deaths recorded in Cuyahoga County, decedents who resided in urban areas (aOR=1.46, 95% CI[1.0–2.12]), were Non-Hispanic White (aOR=0.63, 95% CI[.41–0.95]), and younger (aOR=1.46, 95% CI

Table 2
Logistic Regressions for Carfentanil (2016 – 2020), N = 2948.

Variable		Adjusted Odds Ratio (95% CI)	P-value
Gender	Male	1	
	Female	1.35(1.12–1.61)	.12
Urbanicity	Urban	1	
	Non-Urban	1.93 (1.81–2.17)	.025*
Race	Black, Other	1	
	Non-Hispanic White	2.67 (2.58–4.01)	<0.001***
Age	Age in years	1.46(0.86–2.49)	.25

Note. * p < .05, ** p <. 05, *** p < .001.

Table 1
Characteristics of accidental overdose deaths at the Cuyahoga County Medical Examiner's Office (CCMEO), 2016–2020 (N = 2948).

	ALL CASES n(100%) N = 2948	2016 n(22%) N = 649	2017 n(24%) N = 697	2018 n(18%) N = 523	2019 n(19%) N = 554	2020 n(18%) N = 525	*P* value*
Demographic							
Age group, years							<0.001
18–24	152(0.05)	54(0.08)	33(0.05)	22(0.04)	19(0.03)	24(0.04)	
25–34	633(0.22)	145(0.22)	133(0.20)	129(0.25)	113(0.20)	113(0.22)	
35–44	648(0.22)	145(0.22)	144(0.21)	119(0.23)	118(0.21)	122(0.23)	
45–54	662 (0.23)	158(0.24)	191(0.27)	100(0.19)	102(0.18)	111(0.21)	
55–64	668(0.23)	117(0.18)	165(0.24)	119(0.28)	143(0.26)	124(0.23)	
≥ 65	185(0.06)	30(0.05)	31(0.04)	34(0.07)	59(0.11)	31(0.06)	
Sex							.43
Female	848(0.29)	179(0.28)	210(0.30)	160(0.31)	162(0.29)	137(0.26)	
Male	2100(0.71)	470(0.72)	487(0.70)	363(0.69)	392(0.71)	388(0.74)	
Race/Ethnicity							.02
White, Non-Hispanic	2141(0.73)	520(0.80)	502(0.72)	387(0.74)	370(0.67)	362(0.69)	
Black, Other	807(0.27)	129(0.20)	195(0.28)	136(0.26)	184(0.33)	163(0.31)	
Location							.58
Urban	1981(0.67)	422(0.65)	463(0.66)	340(0.65)	377(0.68)	334(0.64)	
Non-Urban	957(0.33)	226(0.35)	234(0.34)	183(0.35)	177(0.32)	191(0.36)	
COD Drugs							
Cocaine	1230(0.42)	257(0.40)	295(0.42)	238(0.46)	237(0.43)	203(0.39)	.16
Fentanyl	1873(0.64)	375(0.58)	349(0.50)	381(0.73)	371(0.67)	397(0.76)	<0.001
Carfentanil	570(0.19)	56(0.09)	190(0.27)	24(0.05)	237(0.43)	63(0.12)	<0.001
COD Drug Combinations							
Fentanyl + Cocaine	692(0.24)	135(0.23)	139(0.20)	150(0.27)	144(0.26)	124(0.24)	<0.001
Carfentanil + Cocaine	211(0.07)	21(0.03)	67(0.10)	8(0.02)	90(0.16)	25(0.05)	<0.001
Carfentanil + Fentanyl	366(0.12)	29(0.05)	83(0.12)	17(0.03)	183(0.33)	54(0.10)	<0.001
Carfentanil + Fentanyl + Cocaine	133(0.05)	10(0.01)	32(0.05)	4(0.01)	67(0.12)	20(0.04)	<0.001

Note. Drug categories are not mutually exclusive. All drugs tested can be found in the supplemental materials.
* Chi-square test was used to assess differences across and within the four years. Bold p-value were statistically significant at the 0.05 two-tailed level of significance.

[.97–1.0]), significantly predicted carfentanil contributing to the COD, χ^2 (4) = 16.25, $R^2_{N,}$ = 0.03, $p < .05$ (Table 3). For 2019 (n = 237), decedents who were Non-Hispanic White (aOR=0.32, 95% CI[.22–0.50]) was a significant predictor of carfentanil presence. For 2016 (n = 56), 2018 (n = 24) and 2020 (n = 63), no significant relationships were found between demographic variables and carfentanil as a contributing COD drug.

In regards to the trend data on number of decedents, the analysis yielded three joinpoints from 2016 Quarter 1 to 2020 Quarter 4, suggesting that the number of carfentanil overdose numbers exhibit three distinct segments with varying trends across time (Fig. 1). Starting on 2016 Quarter 4 (joinpoint one), followed by a significant change in trend in 2018 Quarter 4 (joinpoint two), and a final significant trend shift in 2019 Quarter 4 (joinpoint three). The joinpoint regression analysis with three joinpoints identified significant changes in the trend of the dataset over years by quarter, with a significant Annual Percent Change (APC) at 0.05 level (APC = 625.25) between 2016 Quarter 1 to 2016 Quarter 4, 2016 Quarter 4 to 2018 Quarter 4 (APC = -18.17), 2018 Quarter 4 to 2019 Quarter 4 (APC=47.27) and 2019 Quarter 4 to 2020 Quarter 4 (APC = 24.91). For seizure data, the trend analysis yielded only one significant joinpoint at 0.05 level from 2016 Quarter 1 to 2016 Quarter 4 (APC = 608.25) (Fig. 2).

Descriptive statistics found that fentanyl and carfentanil contributing to the COD significantly differed across years. For example, 2017 and 2019 recorded the highest numbers of carfentanil-related deaths, where 27% and 43% of cases, respectively, tested positive for carfentanil as a COD drug (Table 1). Fentanyl contributing to the COD also increased in 2016, 2018 and 2019. It was present in about three-fourths of all accidental opioid overdose cases in 2018 and 2020 compared to 58% of the cases in 2016, half of the cases in 2017 and 67% of the cases in 2019. Carfentanil positivity counts in fatal overdose were lowest in 2016 and 2018, with only 9–5% of decedents having carfentanil contribute to their COD.

Analysis of drug seizure data tested by CCRFSL further supports findings of the jointpoint analysis. There were 2355 carfentanil seizures and 12,617 fentanyl seizures from 2016 to 2020. In 2016, there were 101 carfentanil submissions with an increase of 905 carfentanil submissions by 2017. In 2018, there was a significant decrease to 122 submissions. However, by 2019, there was a second increase to 921 carfentanil submissions followed by a subsequent drop to 306 submissions in 2020. For fentanyl, there were 2843 submissions in 2016, followed by 1645 submissions in 2017, then an increase in 2018 of 3125. For 2019, there was a slight decrease to 2015 submissions and subsequently a 42% increase (2989 submissions) for 2020 (Table 4). The drug seizure numbers traced similarly for fentanyl and carfentanil fatal overdose counts across all years. A spearman correlation was used for number of decedents whose toxicology was positive for carfentanil and on carfentanil seizure counts for 2016 Quarter 1–2020 Quarter 4 (Table 5). The analysis revealed a strong positive correlation of 0.92 between the number of decedents with carfentanil as a COD drug and the number of carfentanil seizures ($p < .001$). The strength and the statistical significance, which supports the importance of understanding the relationship between carfentanil-related deaths and seizures in local data (Fig. 3).

Table 3
Carfentanil Overdose Deaths and Demographic Variables for 2017, n = 697.

Variable		Adjusted Odds Ratio (95% CI)	P-value
Gender	Male	1	
	Female	1.00 (0.70–1.45)	.98
Urbanicity	Urban	1	
	Non-Urban	1.46 (1.0–2.12)	.05*
Race	Non-Hispanic White	1	
	Black, Other	.63 (0.41–0.95)	.03*
Age	Age in years	1.46 (0.97–1.0)	.01*

Note. * $p < .05$, ** $p <. 05$, *** $p < .001$.

4. Discussion

The WHO (2021) estimates that 70% of all fatal drug overdoses worldwide are attributed to opioid abuse. Illicitly manufactured fentanyl and its analogs, such as carfentanil, significantly contribute to fatal drug overdoses in the U.S., Ohio, and Cuyahoga County (Jalal and Burke, 2021). Cuyahoga County experienced a large increase in carfentanil drug seizures, followed by carfentanil-related deaths in the years 2017 and 2019, a bimodal trend only observed in Northeast Ohio. Changes in demographics of decedents where carfentanil contributed to their COD were observed in these two years. During the first peak in 2017, decedents were more likely to be Non-Hispanic White, younger and reside in an urban, metropolitan setting. The subsequent carfentanil peak in 2019, Non-Hispanic White remained a significant association for carfentanil as a COD drug. Finally, in the year 2020, there was a demographic shift where an increase number of people of color (predominantly non-Hispanic Black) and older decedents, had a higher presence of cocaine and fentanyl combinations contributing to their COD.

4.1. *Shifting demographics*

Similar to previously published work that examined local trends from 2017 in Cuyahoga County, we also found significant relationships between decedents' demographics and the presence of carfentanil, cocaine, and/or fentanyl as drugs contributing to the COD across the years 2016 and 2020 (Bhullar et al., 2022; Deo et al., 2021). In 2017, carfentanil contributing to the COD in an accidental overdose was significantly associated with decedents residing in urban metropolitan areas, who were non-Hispanic White, and under the age of 45 years old. In contrast, cocaine presence was frequent among older, Black decedents across all years, which aligns with the increasing rates of fatal overdoses among Black individuals in the U.S. (Althoff et al., 2020; Bhullar et al., 2022; Gondré-Lewis et al., 2022; LaRochelle et al., 2021). The present study also supports that urban residence was significantly associated with carfentanil contributing to the COD. This has been observed in previous national research characterizing shifts in the opioid epidemic from rural to urban areas due to the introduction of illicitly manufactured fentanyl and fentanyl analogs (Gondré-Lewis et al., 2022; Spencer et al., 2022). This change in demographics can be identified by medical examiners/coroners' offices rapidly, compared to national trends and should be employed in other jurisdictions for public health planning purposes. It is important to detect these changes in local communities in order to implement focused risk reduction strategies. Furthermore, risk reduction strategies and public education campaigns will need to reach a wider audience including racial minority groups, such as African American and Hispanic populations, as observed in our findings on demographic shifts. It is important that prevention and education campaigns be shared through diverse outlets targeting all substance users that may encounter mixed drug supplies and use harm reduction strategies in multiple languages, such as English and Spanish.

4.2. *Overdose deaths and seizures – joint point+*

Although fentanyl was involved in 50-76% of all fatal overdose cases, the presence of carfentanil in drug seizure testing coincided with record-high years of fatal overdoses in Cuyahoga County. The bimodal trend was confirmed through jointpoint analysis for carfentanil overdose deaths only, however were significantly correlated with carfentanil drug seizures. In response to the bimodal trend of carfentanil in Cuyahoga County, the CCMEO instituted outreach to two major local overdose taskforces through the Cuyahoga County Board of Health and the U.S. Attorney's Office for the Northern District of Ohio. The CCMEO shared localized drug seizure findings, and fatal overdose deaths involving carfentanil. Public awareness campaigns were then facilitated by local media partners. The county Addiction and Mental Health Services

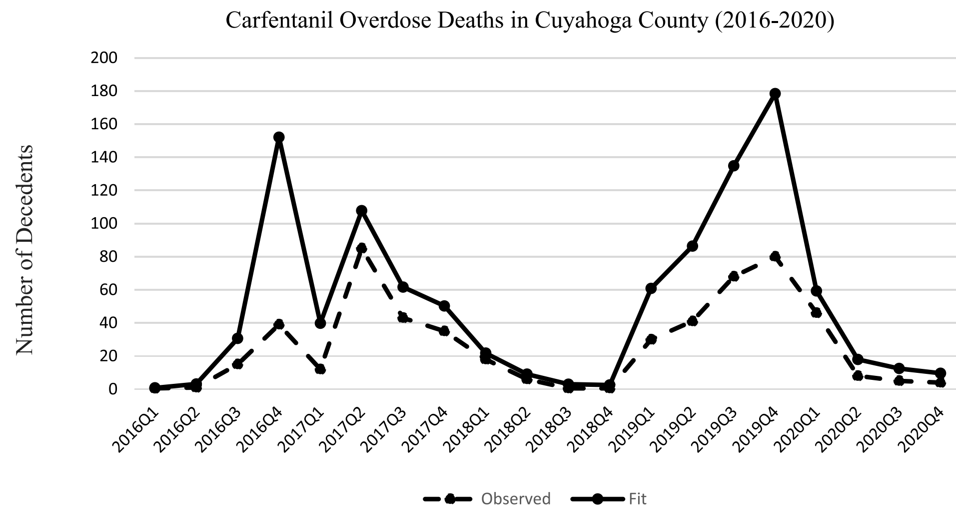

Fig. 1. Joinpoint analysis of carfentanil overdose related deaths from 2016 to 2020 with the observed and fit values.

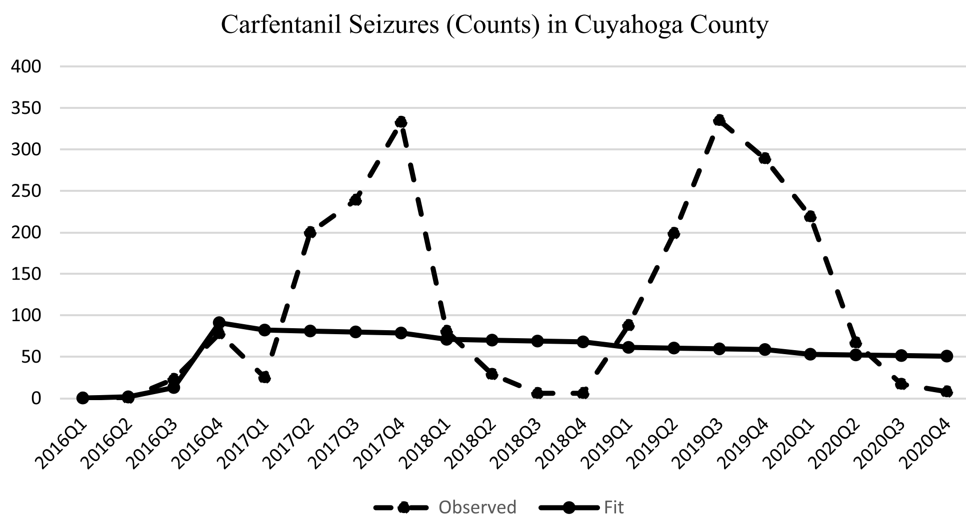

Fig. 2. Joinpoint analysis of carfentanil seizure rates from 2016 to 2020 with the observed and fit values.

Table 4
Accidental Drug OD Deaths and Drug Seizures by Year Totals.

	2016	2017	2018	2019	2020
Fentanyl Seizures	2843	1645	3125	2015	2989
Carfentanil Seizures	101	905	122	921	306
Total Seizures per year	2944	2550	3247	2936	3295
Total OD Deaths per year	649	697	523	554	525

Table 5
Correlations for Carfentanil Cause of Dead (COD) Drug and Seizures from 2016 Quarter 1 to 2020 Quarter 4 (*N* = 20).

Variables	1	2
1. Decedent Count Number	–	
2. Seizure Count Number	.92***	–

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

(ADAHMS) Agency began broader efforts to encourage fentanyl testing strip distribution and use. Fentanyl testing strips may offer people who choose to use drugs an early warning of the potential potency of their drugs and allow the individual to alter their behavior (Stoto et al., 2021). In addition to increased distribution of naloxone to urban areas and high-risk locations, the opioid antagonist is frequently given to reverse drug overdoses with opioid pain relievers, heroin, and illicitly manufactured fentanyl and its analogs.

Drug seizure findings are available in our jurisdiction approximately one week after the sample submission, and comprehensive toxicology testing takes longer but generally can be completed 60 to 90 days after the date of death. Medical examiner/coroners' offices provide an opportunity for local and speedier surveillance of overdose fatalities, an advantage that is not afforded through National Vital Statistics Systems (Vital Stats) surveillance which utilize death certificates and has about a two-year lag period (Spencer and Ahmad, 2016). This time lag can lead to a delay in understanding changes in trends and impede successful implementation of timely prevention strategies.

Our findings illustrate the importance of using local fatal drug overdose and seizure data to monitor drug compositions that may significantly cause fatal drug spikes as a way to improve public health surveillance efforts (Fliss et al., 2021; Rosenblum et al., 2020; Stoto et al., 2021; Zibbell et al., 2022, 2019). The consequence of failing to identify carfentanil or other emerging fentanyl analogs of concern in Cuyahoga County, other metropolitan cities in the U.S., as well as other affected countries abroad, may substantially impact risk reduction strategies (e.g., naloxone availability and applications) and lead to an increased risk of a fatal overdose.

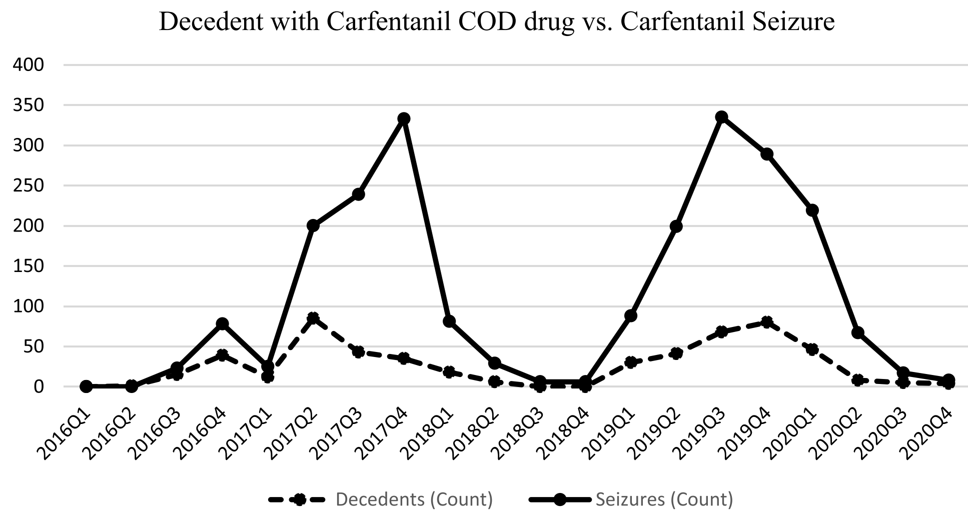

Fig. 3. Counts of decedents with carfentanil as COD drug and seizure counts from 2016 Quarter 1 –2020 Quarter 4.

4.3. 3+ drugs and describing combinations

Fentanyl involved overdose deaths are the vast majority of overdose cases in Cuyahoga County and the U.S. It is also important to implement policies and programs that educate emergency responders and bystanders of the importance of naloxone administration in a suspected overdose, as drug supplies may contain multiple mixtures including fentanyl and other major drugs. Three or more drugs in the COD may also be a by-product of polysubstance use, also highlighting the importance of naloxone education for people who use any drug and not just limit its issuance to individuals who report using opioids. Fentanyl testing strips used to detect fentanyl presence are another important risk reduction strategy in the fentanyl era of the opioid epidemic. As this study demonstrates, cocaine and fentanyl are present in 25% of fatalities making it imperative for individuals to use such testing strips to reduce the risk of a fatal overdose.

Detecting carfentanil and other synthetic opioid analogs in both the decedents' COD drug toxicology and drug seizure data can provide practical intervention in response to the carfentanil wave and teach important public health surveillance lessons for future emerging drugs (Papsun et al., 2022). It can also help allocate resources for emergency departments as well as availability of inpatient and outpatient services. Local law enforcement and public health authorities may also work together to develop timely overdose surveillance programs to detect spikes and fatality clusters caused by multi-drug mixtures and fentanyl analogs, such as carfentanil (Flannery et al., 2020).

4.4. Strengths and limitations

First, this analysis used overdose death data and drug seizure data from a large, single metropolitan county in Northeast Ohio, which may not reflect overdose deaths in other affected national and international regions. However, these data may be difficult to obtain in regions that lack a comprehensive death investigation system, particularly one with an integrated forensic laboratory. Further, this type of analysis is not possible at the national level due to the limitations of free-text analysis and misspellings of drugs. There has been significant efforts to improve the utility of national data (Warner and Hadgarrd, 2018).

Second, drug seizure data was based on confirmation count testing at the county's forensic laboratory but did not denote the purity, the drug presentation (e.g., pill-form versus powder), or weight. Future research should consider noting these characteristics of the drug reported by drug seizure operations to understand how the presentation, amount, and potential use of such drugs affect individuals in different demographic groups and relate to fatal overdose rates. Additionally, demographic variables such as race was limited to death certificate information. We recommend the use of higher quality, social determinants that can be more effective, by proxy, to identify potential risk for overdose. Future research should also explore direct measures of socioeconomic status and other indicators that may inform effects of the social determinants of health in order to provide clarity on demographic groups at higher risk.

Other limitations of the study is not knowing whether a decedent intentionally used a mixture of drugs, or if they were unaware of what was in their drugs. Future research should consider incorporating qualitative interviews of people who use drugs to have a more comprehensive understanding of intentional and non-intentional ingestion of multiple drugs during use. Finally, incorporating toxicology reports and first responder data from non-fatal overdoses, toxicologies of local drug supply seizures, and community supply testing could increase the likelihood of having access to a more near "real-time" overdose surveillance. Having access to comprehensive non-fatal overdose data and community-based drug testing such as syringe exchange testing could pave the way for more immediate public health intervention programs and services.

Despite these limitations, the study provides several valuable insights into Cuyahoga County's drug overdose trends between the years 2016 and 2020 and in particular the role of carfentanil in overdoses. Although fentanyl is a persistent and increasing problem in accidental fatal overdoses in Northeast Ohio, carfentanil spikes observed in decedents' COD and drug seizure data in 2017 and 2019, created a surge of accidental overdose deaths, particularly for younger, Non-Hispanic White, urban, males during these two years. Our findings using local regional data that reflect the national shifts and trends observed in recent years of racial and geographical characteristics due to the introduction and availability of synthetic opioids in the overdose epidemic. The detailed coding of drugs contributing to the COD in a local REDCap database, which consists of over 250+ variables pulling pertinent information from death investigations has strengthen this analysis. Our study, therefore, is among the few that examine high-quality, uniform data. Additionally, this surveillance strategy through death investigation data may be effective in detecting local variations and upcoming trends of other harmful and novice, non-opioid substances, and mixtures such as xylazine (Johnson et al., 2021).

5. Conclusions

This investigation demonstrates the importance of using local data to reduce the risk of overdose among a changing population of individuals struggling with substance use disorder, particularly exacerbated by illicitly manufactured fentanyl. This study helps to provide a framework for other jurisdictions to collaborate and partner with their local medical examiner/coroners' offices and law enforcement agencies to implement a localized surveillance system that may be more timely than national surveillance systems. The detection of novel substances in the fentanyl era of the epidemic is important and can be used to conduct surveillance due to increasing numbers of emerging drugs and its combinations.

Timely surveillance can help improve the applicability of public health interventions to regional and underserved populations, and on the evolution of the drug crisis (i.e. fentanyl era). This can include wider distribution of fentanyl testing strips and naloxone, not only to people who use opioids but all people who use drugs, due to the pervasiveness of fentanyl in the local drug supply. Finally, this can prepare local first responders and public health practitioners in providing treatment, implementing harm reduction programs, and educating the community and individuals who are at risk of experiencing a fatal overdose.

Role of funding source

This work was supported by the Clinical and Translational Science Award [Award Number UL1TR002548]; National Institute of Justice, Office of Justice Programs, U.S. Department of Justice [Grant No. 2017-DN-BX-0168]; and the Centers for Disease Control and Prevention [Grant No. 5-NU17CE925005–02–00]

CRediT authorship contribution statement

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Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Daniel J. Flannery reports financial support was provided by National Institutes of Health Clinical and Translational Science Awards Program. Daniel J. Flannery reports financial support was provided by National Institute of Justice. Daniel J. Flannery reports financial support was provided by Centers for Disease Control and Prevention.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dadr.2023.100187.

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