



Full length article

Examining opioid-involved overdose mortality trends prior to fentanyl: New York City, 2000–2015

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ABSTRACT

Background: Rates of overdose death in New York City (NYC) increased 26% from 2000 to 2015, with a notable decrease in rate from 2006 to 2010. Beginning in 2016, the synthetic opioid fentanyl entered the NYC illicit drug market and has been associated with large increases in overdose death. This study assessed NYC trends in opioid-involved overdose death prior to fentanyl to understand the contribution of specific opioids and inform overdose prevention strategies.

Methods: Data were derived from death certificates linked to postmortem toxicology testing. We stratified cases into three mutually exclusive groups: (1) heroin without opioid analgesics (OAs); (2) OAs without heroin; and (3) the combination of heroin and OAs. We calculated mortality rates by year, and compared rates by the demographic characteristics age, sex, and race/ethnicity. Joinpoint regression identified junctures in trends between 2000 and 2015.

Results: Rates of overdose death involving heroin without OAs decreased from 2006 to 2010, then increased from 2010 to 2015 among males, persons age 15 to 54, and Blacks and Whites. Rates of overdose death involving OAs with and without heroin increased from 2000 to 2015 across all demographic subgroups.

Conclusions: The identified trends in overdose death are suggestive of demographic shifts in drug use. In particular, the tamper-resistant reformulation of oxycodone 80 mg may have increased the use of heroin among primary OA users. Notably, older adults may have had established heroin use practices prior to the proliferation of OAs and thus may have been less likely to modify drug use practices.

1. Introduction

Unintentional drug poisoning (overdose) deaths remain at epidemic levels in the United States, with over 72,000 fatalities in 2017 (Ahmad et al., 2018). In New York City (NYC), the overdose mortality rate increased by 26% from 2000 to 2015 (Paone et al., 2017). However, NYC experienced decreases in the rate of overall drug overdose death from 2006 to 2010 (13.3 to 8.2 per 100,000, respectively), before the rate increased to 13.6 per 100,000 by 2015 (Paone et al., 2017). Fentanyl, a synthetic opioid 50 to 100 times stronger than morphine, permeated the US illicit drug market in 2015; large recent increases in overdose death rates have been attributed to the increased presence of illicitly manufactured fentanyl (IMF) in the drug supply (Seth et al., 2018). Although fentanyl testing among overdose deaths in NYC was inconsistent from 2013 to 2016 (Colon-Berezin et al., 2019), NYC-specific

Drug Enforcement Administration (DEA) and National Forensic Laboratory Information System (NFLIS) drug reports indicate that fentanyl accounted for fewer than 1% to 4% of drug seizures during this time period (National Drug Early Warning System, New York City Sentinel Community Site, 2015, 2016, 2017). Prior to the introduction of fentanyl into the US drug supply, studies suggest shifts in drug use patterns (Cicero et al., 2015) and new populations of heroin users, specifically those who transitioned from opioid analgesics to heroin (Cicero et al., 2014; Dasgupta et al., 2014).

The examination of demographic and drug-specific overdose mortality trends prior to the current phase in the epidemic, as marked by the introduction of fentanyl into the drug supply, is necessary to identify populations at risk of opioid overdose and develop public health responses to fentanyl that account for historical patterns in drug use. With respect to fentanyl, this includes the identification of

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overdose deaths involving both opioid analgesics and heroin. Prior research has identified populations that transitioned from opioid analgesics to heroin (Harocopos et al., 2016) and may be instructive of continued trends involving fentanyl.

The analysis of drugs involved in overdose deaths using death certificates are subject to bias, due to lack of drug specificity (Slavova et al., 2015). The NYC Department of Health and Mental Hygiene (DOHMH) uses post-mortem toxicology as part of standard overdose mortality surveillance, which allows for precision in drug type identification. By linking death certificates with medical examiner toxicology files, DOHMH abstracts drugs involved in overdose deaths, thereby minimizing bias from non-specific drug certificate reporting.

To better understand the contribution of opioid analgesics and heroin to overdose death prior to large increases driven by fentanyl, the present study examined overdose mortality data from 2000 to 2015. Our study examined mortality by opioid type. We report heroin- and opioid analgesic-involved deaths as three mutually exclusive trends: (1) heroin without opioid analgesics; (2) opioid analgesics without heroin; and (3) the combination of heroin and opioid analgesics. We assessed trends in overdose prior to this new phase of the epidemic to better understand the contribution of specific opioids and associated demographic profiles to inform public health overdose prevention strategies.

2. Materials and methods

2.1. Data source and case definition

Data were derived from death certificates from the NYC Bureau of Vital Statistics and linked to toxicology files from the NYC Office of the Chief Medical Examiner. For this analysis, we report only unintentional drug poisoning deaths; all other manners of death were excluded. We defined unintentional overdose using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10). We included underlying and multiple cause of death codes for unintentional drug poisoning, X40-X44, and the mental and behavioral disorder codes F11-16 and F18-19, excluding those with a fourth character position of 0"2" or "6". F codes were included in order to capture cause of deaths described as a result of exposures to acute or chronic substance use of drugs (Injury Surveillance Workgroup 7, 2012). We reviewed the multiple cause of death codes to be more inclusive of drug overdose deaths that were not clearly described as a "poisoning." If cases did not have an underlying poisoning cause of death code, we reviewed the multiple cause of death codes and literal text in Part 1 of the death certificate to identify if the death was due to unintentional drug overdose.

We obtained medical examiner case numbers from death certificates. With this information, we abstracted post-mortem alcohol and drug toxicology data from medical examiner files. We used the post-mortem toxicology data to report substances involved in overdose deaths instead of using codes listed on death certificates, which may be subject to underreporting (Slavova et al., 2015). Metabolites were grouped into drug categories. Heroin included any post-mortem toxicology results for heroin, morphine, monoacetyl morphine, diacetyl morphine, acetylmorphine, along with combinations of codeine and morphine, codeine and monoacetyl morphine, codeine and diacetyl morphine, or codeine and acetylmorphine. Opioid analgesics included codeine without heroin, hydrocodone, oxycodone, fentanyl without heroin, and other narcotics including buprenorphine and tramadol. The metabolites for methadone, a synthetic opioid analgesic, were grouped into a separate drug category from opioid analgesics. For the analysis, we limited the sample to overdose deaths with post-mortem toxicology indicating the presence of heroin or opioid analgesics. Data were stratified into three mutually exclusive groups: (1) heroin without opioid analgesics; (2) opioid analgesics without heroin; and (3) the combination of heroin and opioid analgesics.

For each of the three drug groups, we calculated mortality rates by

year (2000 through 2015) and compared rates by the demographic characteristics age, sex, and race/ethnicity. Rates for Asian, Other, or missing race/ethnicity were not calculated due to multiple years of unstable estimates by drug type. We categorized age in 20-year bands: 15–34, 35–54, and 55–84. Intercensal population estimates were used for population denominators to calculate age-specific rates, and age-adjusted rates standardized to Census 2000. Rates are reported per 100,000 persons.

2.2. Statistical analysis

We used Joinpoint Regression Software (Centers for Disease Control, Version 4.5.01) to examine trends between 2000 and 2015. We specified the grid search method, and specified a minimum of zero and maximum of two joinpoints due to the number of years under review (16 years of data). For the model selection method, we used Monte Carlo Permutation with an overall significance level of 0.05. Joinpoint regression software models trends utilizing grid-search methods and Monte Carlo permutation tests to detect points, or joinpoints, at which linear trends change significantly (Kim et al., 2000). Joinpoint regression tests the null hypothesis (i.e., a single linear trend) against the alternative hypothesis that there are trends across a specified number of joinpoints. We calculated age-specific and age-adjusted rates from data files containing counts of deaths stratified by demographic characteristics, population denominators, and standard population. We selected log transformation of the calculated age-adjusted rates to account for rates with small case numbers. We reported the trends by drug type and demographic characteristics using annual percent change, 95% confidence intervals, and p-values, which identified if the annual percent change differed from zero. We described these as percent increase or decrease per year between Joinpoint segments and reported statistically significant ($P < 0.05$) findings.

3. Results

3.1. Drug type

During the years 2000 through 2015, there were 11,615 unintentional drug poisoning deaths in NYC; 8581 (74%) involved opioids. More than half of these overdose deaths (59%; $n = 5024$) involved heroin without opioid analgesics, 16% ($n = 1406$) involved opioid analgesics without heroin, and 11% ($n = 963$) involved both heroin and opioid analgesics.

The rate of overdose death involving heroin without opioid analgesics declined significantly from 2006 to 2010, from 5.3 to 2.3 per 100,000 population, a 14.8% decrease per year ($p < 0.05$, Table 1 and Fig. 1). After 2010, the rate increased from 2.3 to 6.4 per 100,000 in 2015, an increase of 18.8% per year ($p < 0.001$). The rate of overdose death involving opioid analgesics without heroin increased from 0.6 to 1.5 per 100,000 from 2000 to 2006, an increase of 18.9% per year ($p = 0.001$). From 2006 to 2015, the rate of overdose death involving opioid analgesics without heroin increased 3.9% annually, from 1.5 to 2.1 per 100,000 ($p = 0.016$). The rate of overdose death involving a combination of opioid analgesics and heroin increased 9.3% per year from 2000 to 2015, from 0.4 to 1.7 per 100,000, respectively ($p < 0.001$) (Fig. 1).

3.2. Age

Among the youngest decedents, 15 to 34 year olds, the rate of overdose death involving heroin without opioid analgesics decreased 7.5% per year from 2000 to 2010 ($p < 0.001$, Table 2). From 2010 to 2015, the rate increased 23.7% per year ($p < 0.001$). Among decedents age 35 to 54, the rate increased 15.6% per year from 2010 to 2015 ($p = 0.003$). Among the oldest decedents, age 55 to 84, the rate of overdose death involving heroin without opioid analgesics increased

Table 1
Joinpoint regression results by drug type, New York City, 2000–2015.

Drug type	Trend 1				Trend 2				Trend 3			
	Years	APC	95% CI	p-value	Years	APC	95% CI	p-value	Years	APC	95% CI	p-value
Heroin no opioid analgesics	2000-2006	-2.21	-6.59, 2.37	0.292	2006-2010	-14.83	-27.40, -0.09	0.049	2010-2015	18.83	11.41, 26.74	< 0.001
Opioid analgesics no heroin	2000-2006	18.86	9.61, 28.89	0.001	2006-2015	3.92	0.89, 7.05	0.016				
Heroin and opioid analgesics	2000-2015	9.33	7.48, 11.22	< 0.001								

APC: Annual percent change; CI: confidence interval.

5.8% per year from 2000 to 2015 ($p < 0.001$).

Among decedents age 15 to 34, the rate of overdose death involving opioid analgesics without heroin increased from 2000 to 2015, 10% per year ($p < 0.001$). For decedents age 35 to 54, the rate of overdose death involving opioid analgesics without heroin increased 9.8% per year from 2000 to 2010 ($p < 0.001$). For the oldest age group age 55 to 84, this rate increased from 2000 to 2015, 12.5% per year ($p < 0.001$).

The rate of overdose death involving a combination of opioid analgesics and heroin increased for all age groups across the entire study period, 2000 to 2015. Rates increased 14.3% per year for decedents age 15–34, 6.4% per year for decedents age 35–54, and 14.2% per year for decedents age 55–84 ($p < 0.001$).

3.3. Sex

For males, the rate of overdose death involving heroin without opioid analgesics increased 18.7% per year from 2010 to 2015 ($p < 0.001$, Table 3). The rate of overdose death involving opioid analgesics without heroin increased for both males and females. This rate increased for males 18.2% per year from 2000 to 2006 ($p < 0.001$), and 4.1% per year from 2006 to 2015 ($p = 0.016$). For females, the rate increased 7.5% per year from 2000 to 2015 ($p < 0.001$). The rate of overdose death involving a combination of opioid analgesics and heroin increased from 2000 to 2015 for both males and females. For males, this rate increased 8.5% per year ($p < 0.001$), and for females 11.4% per year ($p < 0.001$).

3.4. Race/ethnicity

The rate of overdose death involving heroin without opioid analgesics for Latino decedents declined 5.3% per year from 2000 to 2011 ($p = 0.01$, Table 4). Among Black decedents, the rate of overdose death involving heroin without opioid analgesics declined 17.5% per year from 2006 to 2010 ($p = 0.031$). The rate for Blacks then increased

15.3% per year from 2010 to 2015 ($p = 0.001$). For White decedents, this rate increased from 2010 to 2015 by 21.5% per year ($p < 0.001$).

The rate of overdose death involving opioid analgesics without heroin increased for all race/ethnicity groups beginning in the year 2000. For Latino and Black decedents, the increase continued through 2015, 10.8% ($p < 0.001$) and 4.2% ($p = 0.004$) per year, respectively. For White decedents, the rate increased 15.2% annually until 2010 ($p < 0.001$).

The rate of overdose death involving a combination of opioid analgesics and heroin increased from 2000 to 2015 for Latino (11.6%), Black (9.9%), and White (8.9%) decedents ($p < 0.001$).

4. Discussion

4.1. Trends in opioid-involved mortality

Our findings suggest that the overall decrease in the rate of drug overdose death in New York City from 2006 to 2010 was driven by the sharp decline in overdose deaths involving heroin without opioid analgesics—a 56% relative decrease in rate—despite a 20% relative increase in the rate of overdose deaths involving opioid analgesics without heroin during the same time period. The increase in overall overdose deaths in New York City from 2010 to 2015 was driven by increases in overdose deaths involving heroin without opioid analgesics. Across the United States, heroin-involved overdose deaths increased steadily from 2002 to 2015; opioid analgesic-involved overdose deaths increased from 2002 to 2010 before flattening with more modest increases through 2015 (Dart et al., 2015). As in NYC, larger national increases in overdose death were noted after 2010 (O'Donnell et al., 2017).

New York City's overall rate of heroin-involved overdose death without opioid analgesics decreased from 2000 to 2010. Notably, however, the rate of heroin-involved overdose death increased for New Yorkers age 55 to 84 during this time period. Given that New York City has had a heroin market for many decades (Frank, 2000), it is possible

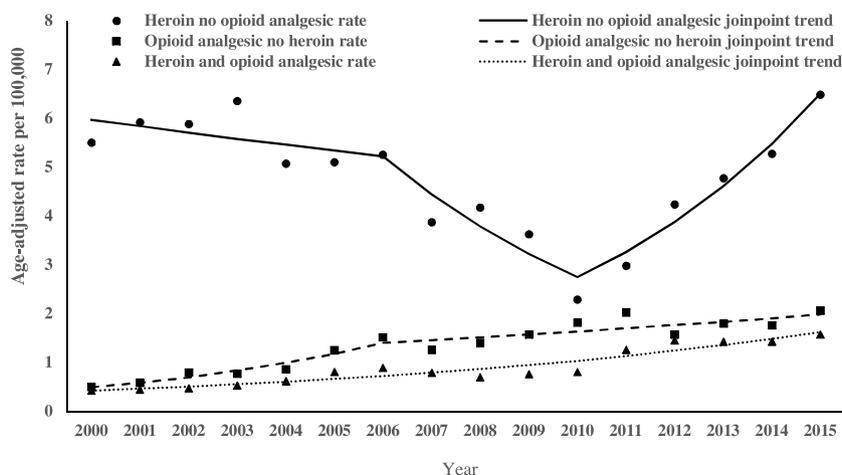


Fig. 1. Trends in heroin no opioid analgesic, opioid analgesic no heroin, and heroin and opioid analgesic involved overdose deaths, New York City, 2000 – 2015.

Table 2
Joinpoint regression results by age and drug type, New York City 2000-2015.

		Trend 1				Trend 2				Trend 3			
		Years	APC	95% CI	p-value	Years	APC	95% CI	p-value	Years	APC	95% CI	p-value
Age (years) by drug type													
<i>Heroin no opioid analgesics</i>													
15-34	2000-2010	-7.52	-10.13, -4.83	< 0.001	2010-2015	23.65	14.75, 33.25	< 0.001					
35-54	2000-2006	-2.99	-7.66, 1.92	0.194	2006-2010	-16.32	-30.31, 0.46	0.055	2010-2015	15.59	6.98, 24.89	0.003	
55-84	2000-2015	5.80	3.08, 8.58	< 0.001									
<i>Opioid analgesics no heroin</i>													
15-34	2000-2015	10.06	5.41, 14.91	< 0.001									
35-54	2000-2010	9.84	5.33, 14.54	< 0.001	2010-2015	-2.15	-10.64, 7.14	0.608					
55-84	2000-2015	12.50	8.98, 16.13	< 0.001									
<i>Heroin and opioid analgesics</i>													
15-34	2000-2015	14.26	10.64, 18.01	< 0.001									
35-54	2000-2015	6.39	4.04, 8.80	< 0.001									
55-84	2000-2015	14.22	10.60, 17.96	< 0.001									

APC: Annual percent change; CI: confidence interval.

that this older age group had established drug use practices that went unchanged despite the addition of opioid analgesics to the drug market. The overall rate of overdose death in New York City decreased from 2006 to 2010; it is possible that this decrease is associated with the decline in the proportion of overdose deaths involving opioid analgesics without heroin. However, our findings indicate that opioid analgesic-involved overdose rates increased at an average annual rate of 19% per year from 2000 to 2006, before slowing to an average annual rate increase of 3.9% from 2006 through 2015. This slowing predates the changes in New York City and State opioid analgesic prescribing policy that began in 2013, such as public health detailing (Kattan et al., 2016), prescribing guidelines (Nagel et al., 2018), and implementation of the New York State prescription drug monitoring program (PDMP; New York State Internet System for Tracking Over-Prescribing, 2013).

In 2010, however, rates of heroin-involved death began to increase. National research has suggested that increases in heroin-involved overdose deaths and flattening of opioid analgesic-involved overdose deaths after 2010 might be associated with the reformulation of long-acting oxycodone (brand name Oxycontin®) to an abuse-deterrent formulation in August 2010 (Dart et al., 2015; Evans et al., 2018). The reformulation reduced the availability of opioid analgesics (Dart et al., 2015), and may have increased transitions to heroin use among populations of people who used primarily opioid analgesics (Evans et al., 2018).

In our study, rates of overdose death involving opioid analgesics without heroin increased steadily among White New Yorkers until 2010, at which point there was a significant increase in deaths involving heroin without opioid analgesics among White New Yorkers. This may suggest that some White New Yorkers transitioned from opioid analgesics to heroin following the 2010 reformulation. However, the

flattening of opioid analgesic related overdose deaths did not repeat for Black or Latino New Yorkers, who had annual increases in deaths involving opioid analgesic without heroin through 2015. Further research is necessary to understand the full effects of the reformulation on overdose deaths among different racial and ethnic groups in New York City.

Prior studies have shown that Black and Latino individuals are less likely to receive opioid analgesic prescriptions in the context of primary care and pain treatment, and are subject to more stringent oversight when they do receive opioid analgesics (Bauer et al., 2016; Hausmann et al., 2013; Ringwalt et al., 2015). While PDMP data for New York City is not available by race, the highest rates of opioid analgesic prescriptions—including high-dose prescriptions and prescription with a longer median day supply—have historically been in Staten Island, a borough that demographically is over 75% non-Hispanic White (Tuazon et al., 2013; United States Census Bureau, 2018). It is possible that greater access to opioid analgesic medications in demographically distinct geographic communities contributed to the shifts in drug overdose trends identified in this paper.

Similarly to White New Yorkers, Black New Yorkers experienced increases in heroin-related overdose deaths beginning in 2010, albeit at a lower average annual percent increase. While not statistically significant, the increase in heroin-involved overdose death among Latino New Yorkers from 2011 to 2015 may allude to changing drug use patterns among Latino and the potential for a new population of heroin users who transitioned from opioid analgesics.

While the present study cannot confirm distinct pathways to heroin initiation, qualitative data suggests that de novo users of heroin exist in multiple communities (Guarino et al., 2018; Harocopos and Allen, 2015) and national survey data indicate a rising prevalence of heroin

Table 3
Joinpoint regression results by gender and drug type, New York City 2000-2015.

		Trend 1				Trend 2				Trend 3			
		Years	APC	95% CI	p-value	Years	APC	95% CI	p-value	Years	APC	95% CI	p-value
Gender by drug type													
<i>Heroin no opioid analgesics</i>													
Male	2000-2006	-3.00	-7.56, 1.77	0.182	2006-2010	-14.97	-28.52, 1.15	0.063	2010-2015	18.70	10.82, 27.14	< 0.001	
Female	2000-2011	-4.20	-8.61, 0.43	0.071	2011-2015	16.91	-2.93, 40.81	0.092					
<i>Opioid analgesics no heroin</i>													
Male	2000-2006	18.18	8.52, 28.71	0.001	2006-2015	4.06	0.89, 7.32	0.016					
Female	2000-2015	7.54	4.34, 10.84	< 0.001									
<i>Heroin and opioid analgesics</i>													
Male	2000-2015	8.5	6.39, 10.65	< 0.001									
Female	2000-2015	11.43	8.03, 14.93	< 0.001									

APC: Annual percent change; CI: confidence interval.

Table 4
Joinpoint regression results by race-ethnicity¹ and drug type, New York City 2000-2015.

	Trend 1				Trend 2				Trend 3			
	Years	APC	95% CI	p-value	Years	APC	95% CI	p-value	Years	APC	95% CI	p-value
Race-ethnicity¹ by drug type												
<i>Heroin no opioid analgesics</i>												
Black (non-Latino)	2000-2006	-1.05	-5.59, 3.71	0.619	2006-2010	-17.51	-30.39, 2.24	0.031	2010-2015	15.33	7.62, 23.58	0.001
Latino	2000-2011	-5.31	-9.24, -1.21	0.016	2011-2015	17.78	-0.50, 39.41	0.056				
White (non-Latino)	2000-2006	-3.31	-7.96, 1.57	0.105	2006-2010	-12.77	-26.60, 3.66	0.105	2010-2015	21.52	13.44, 30.17	< 0.001
<i>Opioid analgesics no heroin</i>												
Black (non-Latino)	2000-2015	4.24	1.58, 6.98	0.004								
Latino	2000-2015	10.75	7.17, 14.45	< 0.001								
White (non-Latino)	2000-2010	15.20	9.53, 21.16	< 0.001	2010-2015	-3.89	-12.60, 5.69	0.378				
<i>Heroin and opioid analgesics</i>												
Black (non-Latino)	2000-2015	9.91	5.53, 14.48	< 0.001								
Latino	2000-2015	11.64	8.09, 15.31	< 0.001								
White (non-Latino)	2000-2015	8.88	6.87, 10.92	< 0.001								

APC: Annual percent change; CI: confidence interval.

¹ For the purpose of this publication, Latino includes persons of Hispanic origin based on ancestry reported on the death certificate, regardless of reported race; Latino excludes reported ancestry from non-Spanish speaking Central/South American countries, and non-Spanish speaking Caribbean islands. Black and White race categories do not include persons of Latino origin. Rates for Asian, Other, or missing race/ethnicity were not calculated due to multiple years of unstable estimates by drug type.

use even among people who have not previously misused opioid analgesics (Martins et al., 2017). Increases in the prevalence of heroin use nationally, including among new populations, may translate to increased heroin-involved overdose deaths (Cicero et al., 2017; Martins et al., 2015), although further research is required to better understand this relationship among populations of people who use opioids in New York City.

4.2. Limitations

This study had four limitations. First, although this study used 16 years of data, joinpoint regression requires at least seven data points to determine a joinpoint. Therefore this analysis was limited to trends described by two joinpoints. The best fitting trends for deaths involving opioid analgesics with and without heroin had zero to one joinpoint, with the exception of deaths involving both heroin and opioid analgesics by race/ethnicity, which had two joinpoints. While additional data may not have changed the trends for deaths involving opioid analgesics, different trends could have emerged for heroin-involved overdose deaths without opioid analgesics, as these trends already had two joinpoints.

Second, statistical significance is determined by both the length of the segment and the absolute change on the log scale. Using this approach, small changes over a long period of time will be statistically significant. Large changes over a short period of time, while important to recognize, may not achieve statistical significance. We allowed the model to assign up to two different join points. Although this approach results in the best description of the model, it complicates comparing annual percent change between models with joinpoints at different time points and different segment lengths.

Third, this analysis did not address other substances involved in overdose deaths. In fact, benzodiazepines were involved in one-third of opioid-involved overdose deaths from 2000 to 2015. In addition, cocaine was commonly involved in opioid overdose deaths, which is not described here. It is also possible that fentanyl was involved in some number of overdose deaths during the period of inconsistent testing in NYC (Colon-Berezin et al., 2019). However, the prevalence of fentanyl was low (6% of opioid analgesic and heroin overdose deaths; 15% of opioid analgesic no heroin overdose deaths; 3% of heroin no opioid analgesic deaths); therefore, we have confidence that fentanyl played a small role in the trends in this analysis. By not including other drugs in our analysis, we are potentially underestimating the risk of overdose of other substances. Nonetheless, because most overdose deaths in NYC

involved opioids, these data were representative of the current drug use landscape.

Lastly, this study used a cross-sectional design assuming that the drugs involved in an overdose death directly correlate with an individual's drug use behavior. Despite these limitations, our data source, which used matched toxicology and death certificate data, resulted in the robust examination of the distinct overdose trends of heroin and opioid analgesics in a large, urban city.

5. Conclusions

The trends in opioid-related overdose deaths prior to the introduction of fentanyl described in this study show that, from 2010 to 2015, New York City experienced significant increases in overdose deaths involving heroin without opioid analgesics, while overdose deaths involving opioid analgesics without heroin plateaued. During 2010 to 2015, rates of heroin-involved overdose deaths without opioid analgesics increased by higher annual percent change among men, decedents age 15 to 54, and both Black and White New Yorkers. Rates of overdose death involving opioid analgesics with and without heroin increased across all demographic subgroups, from 2000 to 2015. Although rates of opioid analgesic-involved overdose deaths slowed prior to implementation of local and state prescribing policies, the reformulation of oxycodone in 2010 occurred alongside these prescribing policies, and may have resulted in unintended consequences. That is, patients may have discontinued prescriptions and transitioned to heroin. These trends are suggestive of demographic shifts in drug use, which are important to consider as part of the development of public health interventions to mitigate the harms of fentanyl.

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Contributors

ET: Study conception and design, acquisition of data; analysis and

interpretation of data, drafting of manuscript; critical revision. HVK: Interpretation of data; drafting of manuscript; critical revision. BA: Interpretation of data; drafting of manuscript; critical revision. DP: Study conception and design; interpretation of data; drafting of manuscript; critical revision. All authors are employees of the New York City Department of Health and Mental Hygiene, and authorization to submit and publish the enclosed manuscript was received from that institution. All authors have approved the final manuscript.

Declaration of Competing Interest

No conflict declared.

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