

Intoxication Deaths Associated with Drugs of Abuse Or Alcohol

Baltimore, Maryland

January 1995 through September 2007



A Report from the Office of Epidemiology and Planning
Baltimore City Health Department

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About the Office of Epidemiology and Planning

This is a new office at the Baltimore City Health Department responsible for overseeing collection and analysis of data to assist with program planning and evaluation and policy development. It is led by Dr. Fichtenberg, a Ph.D. epidemiologist with a joint appointment at the Johns Hopkins Bloomberg School of Public Health. The office reports to the Commissioner of Health.

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Electronic Access

This publication can be accessed electronically at www.baltimorehealth.org/dataresearch.html

Executive Summary

Drug and alcohol abuse remains a serious problem in Baltimore, contributing to HIV and other medical illnesses, crime and victimization, family breakdown and foster care, and other harm to individuals, families, and communities. Over the last decade, the availability of drug treatment has increased substantially. However, with essentially level funding over the past several years, many city residents remain unable to obtain timely access to effective treatment.

One perspective on the scope of the substance abuse problem in Baltimore is the number of deaths due to intoxication. We used records from the Maryland Office of the Chief Medical Examiner (OCME) to examine trends in intoxication deaths in Baltimore City from 1995 to 2007. We analyzed intoxication deaths of undetermined or accidental manner that involved drugs of abuse or alcohol.

Key findings include:

- **Intoxication is an urgent public health challenge.** Drug of abuse- and alcohol-associated death rates are three to four times higher in Baltimore than in Maryland or the United States as a whole. The number of people who die in the city from intoxication associated with drugs of abuse or alcohol is comparable to the number of people murdered. In six of the last 12 years, the number of intoxication deaths exceeded the number of homicides.
- **Heroin is the most common drug associated with intoxication deaths.** More than three-quarters (77%) of drug and alcohol intoxication deaths among city residents over the study period were associated with heroin. Cocaine was implicated in 29% of the deaths, and alcohol in 26%.
- **Intoxication deaths have declined by a quarter since 1999.** Intoxication deaths associated with drugs of abuse or alcohol among Baltimore City residents peaked in 1999 at 321 deaths, or 48.8 deaths per 100,000 residents, and have decreased relatively consistently since then, to 244 deaths in 2006, or 37.9 deaths per 100,000 residents.
- **Heroin-associated intoxication deaths in particular have decreased dramatically since the late 1990s.** Nearly half as many heroin-associated fatal intoxications occurred in 2006 than in 1999 (150 vs. 283.) In the late 90s, heroin was implicated in almost 90% of intoxication deaths; while in 2006, only 61% of deaths were associated with heroin. Nonetheless, heroin remains the substance most commonly implicated in fatal intoxication deaths, and it is the most common cause of single-drug intoxication deaths.
- **Intoxication deaths increased in 2006, but appear to be decreasing again in 2007.** Despite an overall trend of declining deaths, 2006 saw a 14% increase in drug of abuse or alcohol intoxication deaths compared to 2005, from 214 to 244. Data for the first three quarters of 2007 suggest intoxication deaths may be lower in 2007 than in 2006.
- **Cocaine-associated intoxication deaths doubled between 2005 and 2006.** After a decade of relatively stable counts, cocaine-associated intoxications more than doubled from 52

deaths in 2005 to 116 in 2006. Almost all the additional cocaine associated deaths also involved opioids, in particular heroin or methadone. One third of the increase in cocaine-associated deaths could be due improvements in detection of recent cocaine use in toxicological samples. Data for the first three quarters of 2007 suggest cocaine deaths declined in 2007 compared to 2006.

- **Methadone-associated deaths increased gradually over the study period.** Methadone-associated deaths increased from 7 in 1995 to 61 in 2006, with a major jump occurring from 2002 to 2003. Since 2003, the increase has been more gradual, with deaths increasing from 52 in 2003 to 61 in 2006. In 2006, methadone was associated with a quarter of the city's drug of abuse- and alcohol- associated intoxication deaths. Data for the first three quarters of 2007 suggest this trend will continue in 2007.
- **Alcohol is involved in a quarter of intoxication deaths.** Alcohol-associated deaths peaked between 1997 and 2000, and decreased by more than 50% between 2000 and 2005. As with drug of abuse-associated deaths, alcohol-associated deaths increased in 2006. Data for the first three quarters of 2007 suggest alcohol deaths in 2007 have returned to 2005 levels.
- **Victims were predominantly male, African American and middle-aged.** From January 2003 to September 2007, 69% of intoxication deaths among Baltimore City residents occurred among men and 65% among African Americans. This mirrors the racial composition of the city. Age at death ranged from 14 to 77 years, with a mean of 44 years.
- **Non-city residents accounted for between one in ten and one in six fatal intoxication incidents occurring in Baltimore.** Non-residents who suffered fatal intoxications in Baltimore were more likely than residents to be Caucasian (73% vs. 33%) and more likely to be male (79% vs. 69%).

Progress has been made over the last decade in reducing the number of Baltimore City residents who die from intoxication associated with a drug of abuse or alcohol. However, significant challenges remain, and increased efforts are needed to limit drug and alcohol abuse and its fatal consequences.

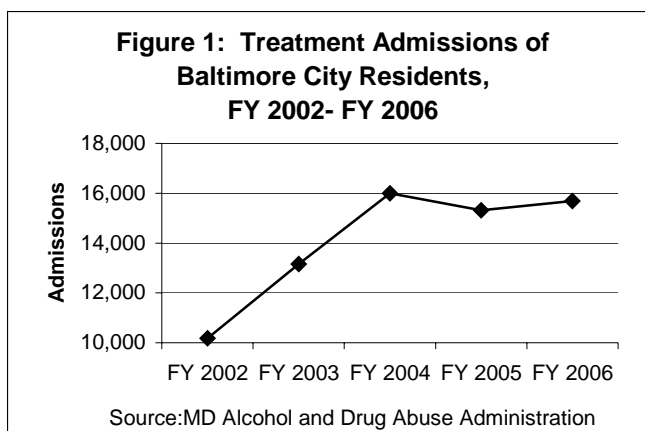
Introduction

Drug and alcohol abuse remains a serious problem in Baltimore, contributing to HIV and other medical illnesses,¹ crime and victimization,² family breakdown and foster care,³ and other harm to individuals, families, and communities.⁴

Over the past decade, significant investments have been made in drug treatment in Baltimore. State, federal and local funds for the uninsured through Baltimore Substance Abuse Systems, Inc. tripled over the decade from 1994 to 2003.⁵

The expansion in access to treatment, however, has plateaued over the last several years. Funding for treatment for the uninsured remained essentially flat from fiscal year 2003 to fiscal year 2007.

In fiscal year 2006, there were 15,687 admissions of Baltimore City residents to inpatient and outpatient drug treatment programs in the state of Maryland (Figure 1).⁶ This is a decline of more than 300 admissions from a peak of 15,992 admissions in FY 2004. Because treatment slots are limited, many of those seeking treatment are not able to access it.



One important perspective on the scope of the substance abuse problem in Baltimore – and the need for additional action – is the number of deaths due to drug or alcohol intoxication. This measure does not mirror drug use in the city, because impurities in drugs and use of more lethal drugs or combinations of drugs can cause more deaths without changes in overall use. But intoxication deaths are an important sign of the impact of drug and alcohol abuse in the city. The goal of this report is to quantify as accurately

¹ See, e.g., Maryland AIDS Administration, Baltimore City HIV/AIDS Fact Sheet. October 4, 2007. Accessed January 19, 2008 at <http://dhmh.state.md.us/AIDS/Data&Statistics/Statistics/Baltimore%20City%20HIV%20Fact%20Sheet%20100407.pdf>; ficCenter for Health Program Development and Management, Opioid Exposure in Maryland Hospitals. July 2007. Accessed January 19, 2008 at http://baltimorehealth.org/info/2007_10_16.HSCRC_bupre_final_r.pdf.

² Department of Justice. Drug Use and Crime. Accessed January 19, 2008 at <http://www.ojp.usdoj.gov/bjs/dcf/duc.htm>.

³ United States General Accounting Office. Foster Care: Parental Drug Abuse Has Alarming Impact on Young Children. April 1994. Accessed January 19, 2008 at <http://archive.gao.gov/t2pbat3/151435.pdf>.

⁴ Cartwright, WS. Costs of drug abuse to society. *J Ment Health Policy Econ.* 1999 Sep 1;2(3):133-134.

⁵ Baltimore City Health Department. Drug Treatment in Baltimore: 2005. 6 June 2006. Accessed January 17, 2008 at http://baltimorehealth.org/snapshots/DRUG_FINAL_6_6_06.pdf.

⁶ State of Maryland, Department of Health and Mental Hygiene, Alcohol and Drug Abuse Administration. Outlook and Outcomes For Maryland Substance Abuse Prevention, Intervention and Treatment. 2006. Accessed January 17, 2008 at http://www.maryland-adaa.org/content_documents/OandO2006.pdf.

as possible trends over the past decade in the number of deaths resulting from intoxication associated with drugs of abuse and alcohol in Baltimore.

Methods

The methods used in this report to identify fatal intoxications associated with drugs of abuse and alcohol were developed in coordination with the Maryland Office of the Chief Medical Examiner (OCME).

Data source

Office of the Chief Medical Examiner

Drug of abuse and alcohol intoxication deaths were identified based on electronic records from the Maryland Office of the Chief Medical Examiner (OCME). The OCME is responsible for investigating all deaths in Maryland caused by violence, suicide, or injury; sudden deaths in apparently healthy individuals; and deaths that are suspicious or unusual.

OCME investigation involves investigation of the death scene, review of medical records, review of police records, autopsy and, if there is evidence of an intoxication, toxicological analysis of autopsy specimens. The following substances are routinely tested for as part of the toxicological analysis: ethanol, heroin, morphine, methadone, fentanyl, codeine, oxycodone, cocaine, commonly used benzodiazepines, and amphetamines, among others. For a complete list of the drugs of abuse that are included in the OCME's routing toxicological analysis see Appendix 1. Testing for other substances, including buprenorphine, is carried out when indicated by the investigation.

The OCME uses scene evidence, witness reports and medical records in conjunction with autopsy and toxicological findings to reach a determination of intoxication as the cause of death and to identify the substances involved in the intoxication. Death records maintained by the OCME may change as additional deaths warrant review by the OCME or new information about a death comes to light. In general, review by the OCME is completed within a few weeks; however, cases can remain pending for several months.

The OCME provided the following electronic records: records for all deaths from January 1, 1995 to September 30, 2007 that included the terms "drug" or "intox" in the cause of death and where the victim was a Baltimore City resident or the incident or death occurred in Baltimore City. Electronic records included the cause of death, the manner of death, the date of death, the county of residence, incident and death, and the toxicological results. In addition, we obtained demographic (age, race, sex) and zip code data for deaths from January 1, 2003 to September 30, 2007, the period for which these data were readily available.

Definitions

Intoxication deaths

We considered intoxication deaths to be deaths where the OCME-determined cause of death included the words "intoxication" and the manner of death was categorized by the OCME as an accident or undetermined. Deaths determined to be suicides, homicides or of natural manner were therefore excluded from this analysis.

We use the term intoxication death in this report, as opposed to overdose death, in concordance with the way these deaths are labeled by the OCME.

Identification of drugs involved in intoxication deaths

In many cases, the OCME-determined cause of death specified the drugs determined by the medical examiner to be involved in the death. In those instances, we attributed the deaths to the drug(s) specified in the OCME-determined cause of death.

In some cases however, the OCME used non-specific terms such as “drug” or “narcotic” to describe the drugs involved in the death. This was particularly common for deaths involving opioids. In these instances, based on the OCME’s recommendation, we considered as associated with the intoxication any drug that was identified by the toxicological analysis, which we defined as any toxicological result for that drug that was labeled as “positive” by the OCME or where the amount of the drug found in any tested specimen was non-zero.

When using the toxicological results in this manner, we chose not to attempt to distinguish between substances that were present at non-lethal as opposed to lethal levels, because the distinction is difficult to make due to overlap between therapeutic and lethal drug levels, synergistic effects between substances, and changes in drug concentrations as a function of time elapsed since death.⁷

In so doing, we may have overestimated the number of deaths associated with particular substances. However, we preferred to err on the side of overestimating deaths associated with particular substances rather than risk underestimating them.

In summary, an intoxication death was considered to be associated with a given drug if either of two criteria were met:

- (1) the drug was specifically mentioned in the OCME-determined cause of death,
- OR
- (2) the OCME-determined cause of death used non-specific terms such as “drug intoxication” or “narcotic intoxication” and the toxicological analysis indicated the presence of the drug.

Table 1 summarizes these criteria for the different drugs considered in this report.

Which of the above two criteria we used to identify a drug depended on how likely it was for the medical examiner to use a non-specific term to describe the drug involved in the death. The quasi-totality (92%) of deaths we identified as heroin-associated were labeled by the OCME as “narcotic intoxication” and therefore required us to use the toxicological results to identify the presence of heroin (Table 2). In contrast, for cocaine, only 3% of deaths we identified as cocaine-associated did not list cocaine in the OCME-determined cause of death.

⁷ Center for Substance Abuse Treatment, Methadone-Associated Mortality: Background Briefing Report. Rockville MD: Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration, 2004.

Table 1: Definitions of criteria used to identify substances associated with intoxication deaths in OCME records, by substance

Death associated with	Criterion	OCME-determined cause of death includes “intox” and		Toxicological results are positive for
Any class of drugs (eg. drugs of abuse, opioids, benzodiazepines)	(1)	specific reference to the class or to any substance in the class		
	OR (2)	nonspecific reference to “drug(s)”	AND	any substance in the class or metabolites
Specific opioid (ie. methadone, oxycodone, or fentanyl) except heroin	(1)	specific reference to the opioid in question		
	OR (2)	nonspecific reference to “drug(s)” or “narcotic(s)” or “opiate(s)”	AND	opiod in question or metabolites
Heroin	(1)	specific reference to heroin or morphine		
	OR (2)	nonspecific reference to “drug(s)” or “narcotic(s)” or “opiate(s)”	AND	morphine or 6-monoacetylmorphine
Specific non-opioid drug of abuse (eg. cocaine)	(1)	specific reference to non-opioid		
	OR (2)	nonspecific reference to “drug(s)”	AND	non-opioid in question or metabolites
Alcohol	(1)	specific reference to ethanol or alcohol		

Table 2: Distribution of substance-associated deaths based on the criterion used to identify the specific substances involved, by substance identified

Identified substance(s)	% of deaths where substance was identified based on:	
	Criterion (1): OCME cause of death only*	Criterion (2): OCME cause of death and toxicological results*
Heroin	8%	92%
Methadone	58%	42%
Fentanyl	83%	17%
Codeine/Oxycodone/Hydrocodone	62%	38%
Cocaine	97%	3%
Benzodiazepines	48%	52%
Alcohol	100%	0%

*See Table 1 for details about the criteria

Deaths associated with alcohol

Alcohol associated deaths were defined as deaths where the term “alcohol” or “ethanol” was mentioned in the OCME-determined cause of death (Tables 1 and 2). Because the OCME never used a non-specific term to refer to alcohol, it was not necessary to use the toxicological results to identify alcohol-associated deaths.

Drugs of abuse

We defined a ‘drug of abuse’ as any drug classified as a controlled substance by the federal Controlled Substance Act or any drug classified as a commonly abused drug by the National Institute on Drug Abuse. See Appendix 1 for a list of drugs we considered to be drugs of abuse. Although it is not included in the Controlled Substance Act, we considered dextromethorphan a drug of abuse because of the problem of dextromethorphan abuse.

Opioids

Opioids, also known as narcotics, are natural, semi-synthetic and synthetic substances that behave pharmacologically like morphine, the primary active constituent of opium poppy. Opioids include heroin, morphine, methadone, buprenorphine, fentanyl, codeine, oxycontin and hydrocodone, among others. For a complete listing of the opioids considered in this analysis see Appendix 1.

Heroin

Because heroin is quickly metabolized to 6-monacetylmorphine and morphine in the body, and because morphine intoxications are rare, we defined a heroin-associated death as a death associated with heroin, 6-monacetylmorphine or morphine, in concordance with accepted standards in the field.⁸

Non-opioids

Non-opioids are all other drugs of abuse that are not opioids. Included in this category are cocaine, benzodiazepines, and barbiturates, among others. For a complete listing of the non-opioid drugs of abuse considered in this analysis, see Appendix 1.

Analysis

We quantified deaths associated with any drug of abuse or alcohol, and with the following specific substances or substance classes: opioids, heroin, methadone, fentanyl, codeine, oxycodone, hydrocodone, cocaine, and benzodiazepines. In addition, we identified deaths associated with combinations of the above substances.

We examined drug of abuse deaths from 1995 to 2006, the final year for which a complete year's worth of data is available. In order to examine trends for 2007, we examined deaths for the first three quarters of each year from 1995 to 2007, since data for the last quarter of 2007 were not yet available from the OCME and since trends for the first three quarters of each year from 1995 to 2006 mirrored whole year trends.

The primary analysis focused on deaths among Baltimore City residents, as this is the standard approach for mortality statistics. We excluded from this primary analysis 107 deaths because of unknown county of residence and 86 deaths among homeless individuals as it was not clear in which county they had lived.

Secondary analyses examined the number of deaths where the fatal intoxication occurred in Baltimore, regardless of county of residence. Deaths occurring among those with unknown county of residence and among the homeless were included in this analysis when the intoxications occurred in Baltimore. Only 15 deaths were excluded from the secondary analysis due to missing county of incident information.

⁸ Goldberger BA, Cone EJ, Grant, Caplan BS et al. Disposition of heroin and its metabolites in heroin-related deaths. *J Anal Toxicol.* 1994;18:22-28.

We described age, gender, and race of victims as well as the geographic distribution of deaths since 2003. We compared demographics of resident and non-resident deaths since 2003 using chi-squared statistics.

Results

Trends among Baltimore City residents

Overall trends

Overall from 1995 to 2006, intoxication deaths associated with drugs of abuse or alcohol among Baltimore City residents declined substantially (Table 3, Figure 2). Deaths peaked in 1999 at 321 deaths and have decreased relatively consistently since then, to 244 deaths in 2006, resulting in a 25% decrease since 1999.

Despite an overall trend of declining deaths, 2006 saw a 14% increase in drug of abuse- and alcohol-associated intoxication deaths compared to 2005, from 214 to 243 deaths. Most of the increase was due to a jump in polydrug-associated deaths involving cocaine, opioids (heroin and fentanyl) and alcohol (Table 3).

Data for the first three quarters of 2007 suggest a possible decline compared to 2006 (Table 4, Figure 3). There were 171 deaths from intoxication associated with drugs of abuse or alcohol in the first three quarters of 2007, compared to 178 in 2006 and 162 in 2005.

Heroin remains the major substance associated with intoxication deaths in Baltimore. The majority (77%) of drug and alcohol intoxication deaths over the study period were associated with heroin. Cocaine was implicated in 29% of deaths, and alcohol in 26%.

Heroin

Heroin-associated intoxication deaths in particular decreased dramatically since the late 1990s (Figures 2 and 4). There were 47% fewer resident deaths in 2006 than in 1999 (150 vs. 283 deaths.) Similarly, the rate of heroin-associated intoxication mortality in Baltimore decreased by 46% from a peak of 43.0 deaths per 100,000 residents in 1999 to 23.2 deaths per 100,000 residents in 2006 (Table 5). In the late 1990s, heroin was implicated in roughly 90% of resident intoxication deaths; by 2006, only 61% of intoxication deaths were associated with heroin.

On average, between 1995 and 2005, half of heroin-associated deaths involved neither alcohol nor other drugs of abuse. This proportion decreased to 32% in 2006 and 33% for the first three quarters of 2007. Over the past decade, a quarter of heroin-associated deaths also involved cocaine, and a quarter also involved alcohol.

Cocaine

After a decade of relatively stable numbers, cocaine-associated intoxications more than doubled from 2005 to 2006, from 52 to 116 deaths. Data through the third quarter of 2007 suggest that cocaine-associated deaths in 2007 will be lower than in 2006 but will still exceed counts for 2005.

Table 3: Intoxication deaths associated with drugs of abuse or alcohol among residents of Baltimore City, according to medical examiner records, 1995-2006

Intoxication death involves ¹	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Alcohol or at least one drug of abuse	248	229	262	267	321	281	254	287	252	241	214	244
At least one drug of abuse	238	222	256	258	310	272	237	279	249	228	207	237
Opioids	223	203	237	249	296	263	223	254	228	198	187	206
W/ cocaine	57	62	64	68	65	56	46	67	56	38	32	86
W/ alcohol	59	50	81	66	75	83	57	49	44	32	33	39
Alone ²	120	104	114	131	165	138	130	148	139	133	121	93
Heroin	217	187	224	234	283	243	202	227	190	156	131	150
W/ cocaine	56	59	63	64	60	50	43	63	50	31	21	58
W/ alcohol	55	47	79	64	75	80	54	47	37	24	25	27
Alone ²	111	87	99	120	150	120	104	111	97	80	61	49
Methadone	7	20	17	17	16	22	29	39	52	56	59	61
W/ heroin	5	9	8	11	10	10	15	18	22	15	12	13
W/ cocaine	0	1	3	7	3	6	3	6	9	10	6	27
W/ alcohol	2	3	2	2	0	4	4	1	5	8	4	3
Alone ²	0	8	7	4	4	6	12	18	23	27	31	22
Fentanyl	0	0	0	0	1	1	0	1	3	2	3	10
Cod/Oxy/Hyd	1	1	3	4	2	5	5	2	5	2	11	8
Cocaine	69	81	80	76	79	65	59	92	74	66	52	116
W/ alcohol	18	18	25	21	11	16	13	11	14	8	3	22
Alone ²	8	16	13	5	14	7	12	24	16	25	20	22
Benzodiazepines	2	3	2	4	1	2	3	0	2	1	2	2
Alcohol	75	60	91	78	86	94	75	58	51	49	40	55
Alone ²	10	7	6	9	11	9	17	8	3	13	7	7

Cod/Oxy/Hyd: Codeine, Oxycodone, or Hydrocodone. ¹ Due to poly-drug use, substance-specific categories are not mutually exclusive. ² Alone means that neither alcohol nor any other drug of abuse was involved in the death.

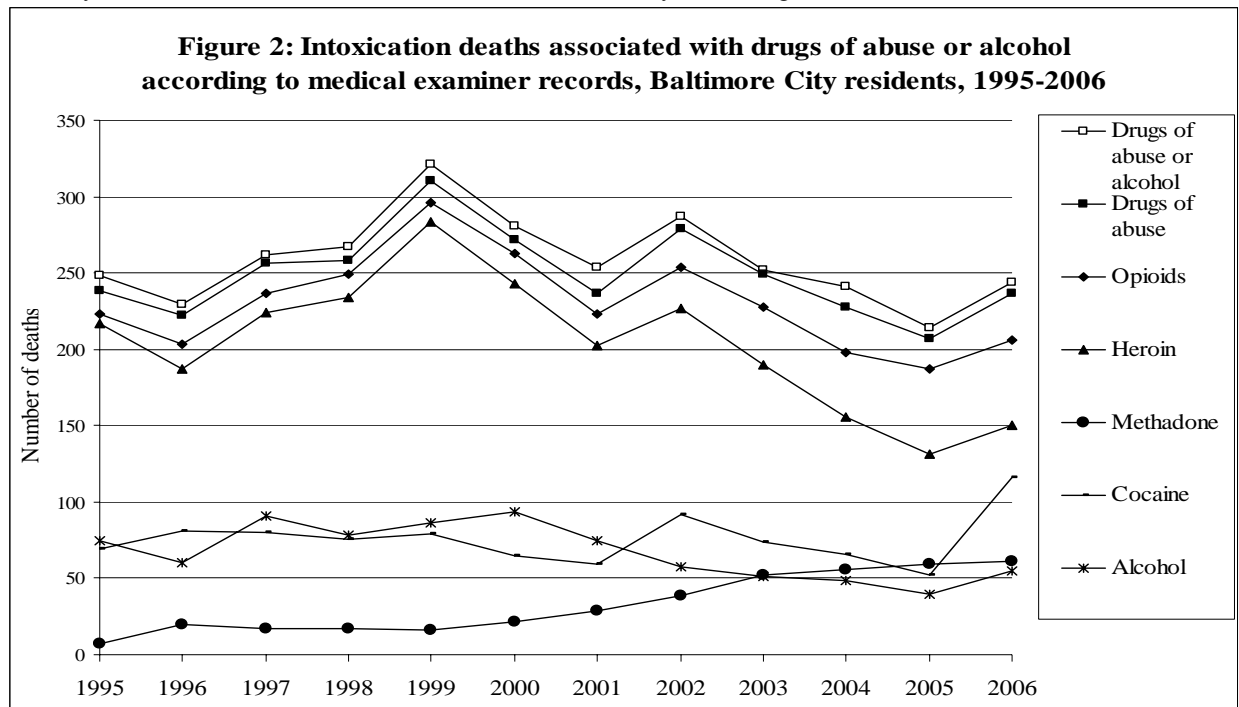
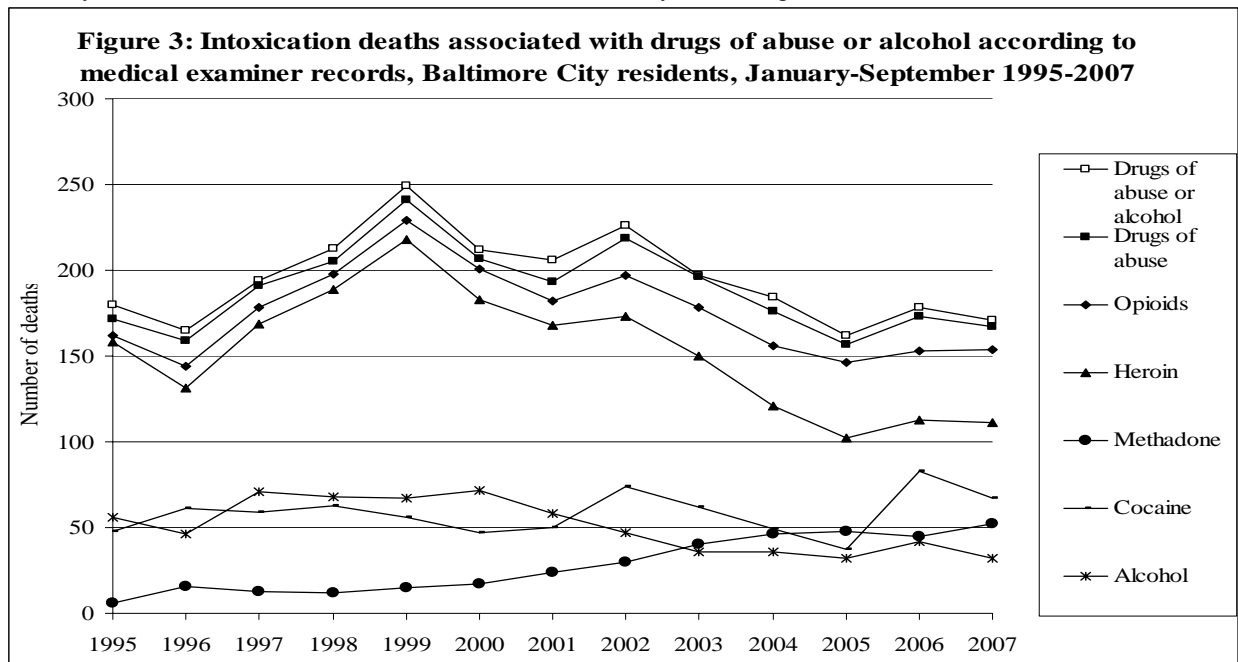


Table 4: Intoxication deaths associated with drugs of abuse or alcohol among residents of Baltimore City, according to medical examiner records, January-September 1995-2007

Intoxication death involves ¹	Jan-Sep 1995	Jan-Sep 1996	Jan-Sep 1997	Jan-Sep 1998	Jan-Sep 1999	Jan-Sep 2000	Jan-Sep 2001	Jan-Sep 2002	Jan-Sep 2003	Jan-Sep 2004	Jan-Sep 2005	Jan-Sep 2006	Jan-Sep 2007
Alcohol or at least one drug of abuse	180	165	194	213	249	212	206	226	197	184	162	178	171
At least one drug of abuse	172	159	191	205	241	207	193	219	196	176	157	173	167
Opioids	162	144	178	198	229	201	182	197	178	156	146	153	154
W/ cocaine	40	46	48	56	44	41	40	52	46	30	26	64	54
W/ alcohol	44	37	66	57	59	66	44	39	33	28	27	32	27
Alone ²	89	71	83	101	131	105	106	114	105	102	91	68	79
Heroin	158	131	169	189	218	183	168	173	150	121	102	113	111
W/ cocaine	39	44	47	54	40	36	37	49	42	24	18	45	34
W/ alcohol	41	35	64	56	59	63	41	38	28	20	21	24	19
Alone ²	81	58	72	94	117	90	87	83	73	60	45	36	36
Methadone	6	16	13	12	15	17	24	30	40	46	48	45	52
W/ heroin	5	6	7	7	10	7	15	12	18	11	9	11	8
W/ cocaine	0	1	2	4	3	4	3	4	6	7	4	20	15
W/ alcohol	1	3	2	2	0	4	4	0	4	8	4	2	5
Alone ²	0	7	4	4	3	5	7	17	16	22	25	16	24
Fentanyl	0	0	0	0	1	1	0	1	3	2	1	10	3
Cod/Oxy/Hyd	1	1	2	1	2	4	4	2	3	1	8	1	6
Cocaine	48	61	59	63	56	47	50	74	62	49	37	83	67
W/ alcohol	14	15	21	20	7	12	11	9	8	4	2	15	8
Alone ²	6	12	9	4	12	5	9	21	15	19	11	15	12
Benzodiazepines	1	3	2	3	1	1	3	0	1	0	2	1	4
Alcohol	56	46	71	68	67	72	58	47	36	36	32	42	32
Alone ²	8	6	3	8	8	5	13	7	1	8	5	5	4

Cod/Oxy/Hyd: Codeine, Oxycodone, or Hydrocodone. ¹ Due to poly-drug use, substance-specific categories are not mutually exclusive. ² Alone means that neither alcohol nor any other drug of abuse was involved in the death.



Part of the increase may be due to improvements in the OCME's toxicological detection of cocaine metabolites. Starting in 2004, such improvements allowed the medical examiners to better differentiate between recent as opposed to distant cocaine use, enabling medical examiners to more confidently identify the role of cocaine in a death. This led to a gradual increase in the proportion of cocaine positive intoxication deaths for which the OCME implicated cocaine in the cause of death, from 57% in 2003 to 81% in 2006, with a particularly large jump from 64% in 2005 to 81% in 2006. However, since there were 138 deaths that were toxicologically positive for cocaine in 2006, this change could have accounted only for an additional 23 deaths (17% of 138), or a little more than a third of the 64 additional deaths seen in 2006. Further, the timing of the methodological change does not coincide perfectly with the observed increase.

Throughout the study period, cocaine-associated intoxication fatalities were usually in combination with other substances; from 1995 to 2006 only 20% of cocaine-associated deaths involved neither alcohol nor other drugs of abuse. Heroin was the major other substance involved; however, the proportion of cocaine-associated deaths involving heroin dropped from 81% in 1995 to 50% in 2006. Concomitantly, the proportion of cocaine-associated deaths involving methadone rose from 0% in 1995 to 23% in 2006. Almost all the additional cocaine-associated deaths in 2006 also involved opioids, in particular heroin and methadone.

Methadone

Methadone-associated deaths increased gradually over the study period, from 7 deaths in 1995 to 61 in 2006, with most of the increase between 1999 and 2003. Since 2003, the increase has been much more gradual, with deaths rising from 52 in 2003 to 61 in 2006. By 2006, the rate of methadone-associated intoxication fatalities was 9.5 per 100,000 Baltimore City residents, and methadone was associated with a quarter of the city's drug of abuse- and alcohol-associated deaths. Data for the first three quarters of 2007 suggest methadone-associated deaths may continue to increase in 2007.

The proportion of methadone-associated deaths that involved neither alcohol nor other drugs of abuse increased from 0% in 1995 to 36% in 2006, while the proportion of methadone-associated deaths that involved heroin declined from 71% to 21%.

Fentanyl

Fentanyl-associated deaths were rare over the study period. Relative to other years, however, 2006 saw a particularly high number: 10 compared to a maximum of 3 in other years. Fentanyl-associated deaths were back to pre-2006 levels in the first three quarters of 2007.

Buprenorphine

Since 1995, the OCME identified only one intoxication death associated with buprenorphine, in 2007. Also included in the cause of death for this case were methadone intoxication and cocaine use.

Codeine, Oxycontin and Hydrocodone

Deaths associated with codeine, oxycontin and hydrocodone have increased over the past few years. Between 1995 and 2004 there were five or fewer of these deaths per year. In contrast, there were 11 deaths in 2005, 8 in 2006, and 6 in the first three quarters of 2007.

Benzodiazepines

Intoxication deaths associated with benzodiazepines have remained stably low over the past decade, ranging from 0 to 4 deaths per year.

Alcohol

Over the study period, alcohol was involved in a quarter of the drug of abuse- and alcohol-associated intoxication deaths. Alcohol-associated deaths peaked between 1997 and 2000, at a little over 90 deaths per year. Between 2001 and 2005, alcohol-associated deaths decreased by more than 50%, from 94 to 40. In 2006, deaths rose by 38%, to 55 deaths. Data for the first three quarters of 2007 suggest alcohol deaths in 2007 returned to 2005 levels. Alcohol-associated deaths usually involved other substances: three out of four alcohol-associated deaths over the study period involved heroin.

Rates of death among residents

Despite slight changes in population over time, trends in the rates of drug of abuse or alcohol associated intoxication deaths among Baltimore residents were nearly identical to trends for the absolute counts of intoxication deaths (Table 5, Figure 4). The rate of fatal intoxication associated with drugs of abuse or alcohol decreased by 22% from a peak of 48.8 deaths per 100,000 residents in 1999 to 37.9 deaths per 100,000 residents in 2006. Compared to 2005, the mortality rate increased by 13% in 2006, from 33.4 to 37.9 deaths per 100,000 residents.

Table 5: Crude rates* of drug of abuse- or alcohol-associated intoxication death among Baltimore City residents (per 100,000), by substance involved, according to medical examiner records, 1995-2006

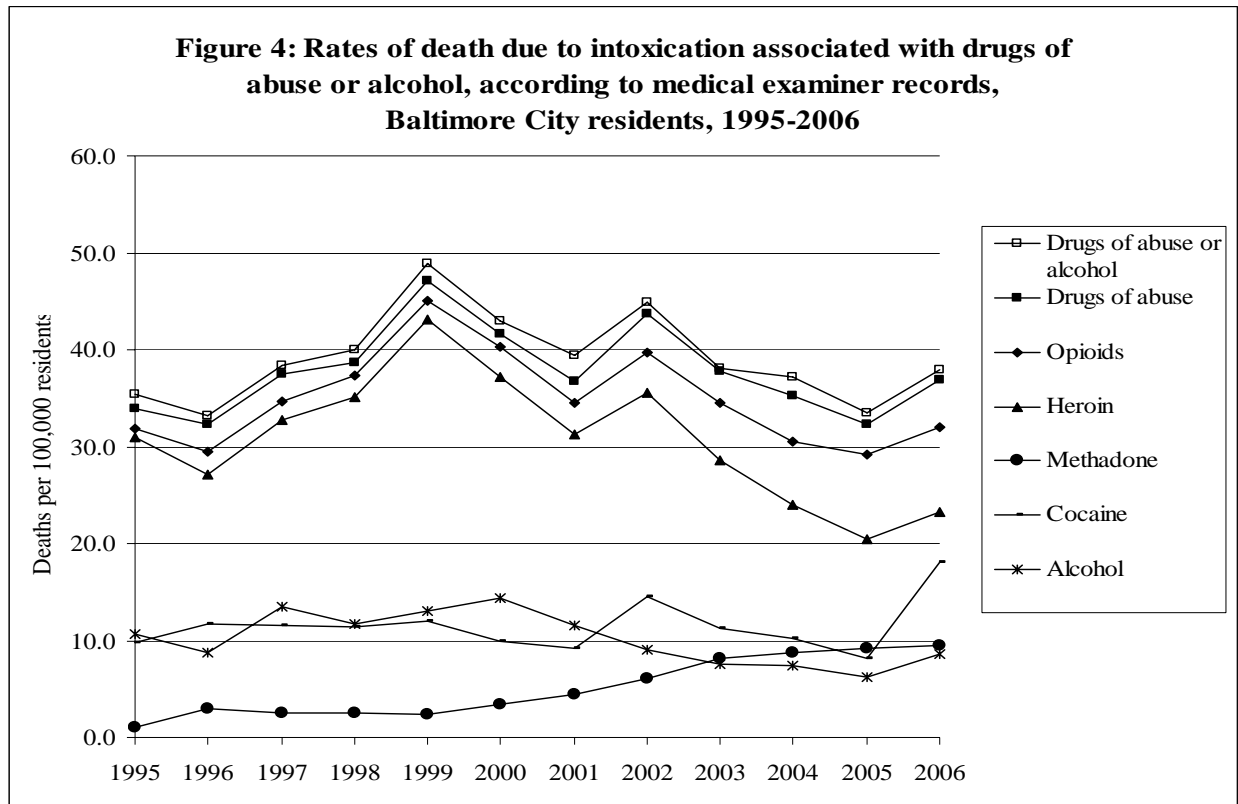
Substance involved	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	1995 - 2006 Average
Drug of abuse or alcohol	35.3	33.3	38.4	40.0	48.8	43.0	39.4	44.9	38.1	37.2	33.4	37.9	39.1
Drug of abuse	33.9	32.2	37.5	38.7	47.2	41.6	36.7	43.7	37.8	35.2	32.3	36.8	37.8
Opioid	31.8	29.5	34.7	37.3	45.0	40.2	34.6	39.7	34.5	30.5	29.2	32.0	34.9
Heroin	30.9	27.2	32.8	35.1	43.0	37.2	31.3	35.5	28.6	24.0	20.5	23.2	30.8
Methadone	1.0	2.9	2.5	2.5	2.4	3.4	4.5	6.1	8.1	8.7	9.2	9.5	5.1
Cocaine	9.8	11.8	11.5	11.4	12.0	10.0	9.1	14.4	11.2	10.3	8.1	18.1	11.5
Alcohol	10.7	8.7	13.4	11.7	13.1	14.4	11.6	9.1	7.6	7.5	6.2	8.6	10.2

* Population denominators are intercensal population estimates for 1995-1999, Census 2000 for 2000 and postcensal estimates for 2001-2006. Rates are not age adjusted.

Demographics among residents

Men comprised 69% of resident deaths that occurred between January 2003 and September 2007. Age at death varied from 14 to 77 years of age, with a mean of 44 years (Std Dev.=9.) The majority of deaths were among African Americans (65%); 34% were among Caucasians and 1% among other race/ethnic groups. This mirrors the racial composition of Baltimore, where

African Americans comprise 64% of the population.⁹ Demographic characteristics did not change substantially over time between 2003 and 2007.



Fatal intoxications occurring in Baltimore City

From January 1995 to September 2007, a total of 3781 fatal intoxications associated with drugs of abuse or alcohol occurred in Baltimore City. Among those, 84% were among Baltimore City residents, 11% were among non-residents, 2% were among homeless individuals and 3% had no recorded address. The non-residents came primarily from Baltimore County (5% of all intoxication deaths), out of state (2%), from Anne Arundel (1%), and Harford, Howard, and Carroll counties (<1% each).

Non-residents who suffered fatal intoxications in Baltimore differed demographically from Baltimore residents who suffered fatalities. Non-residents were more than twice as likely to be Caucasian (73% vs. 33%, $p < 0.0005$) and slightly more likely to be male (79% vs. 69%, $p = 0.03$).

On average, there were 34 more drug of abuse- or alcohol-associated deaths from intoxications occurring in Baltimore City than among Baltimore residents every year over the study period. However, trends over time and in terms of substances involved were similar for deaths from intoxications occurring in Baltimore and those seen among residents (Tables 6 and 7, Figures 5 and 6).

⁹ US Census Bureau, Population Estimates Division.

Table 6: Fatal intoxications associated with drugs of abuse or alcohol occurring in Baltimore City, according to medical examiner records, 1995-2006

Intoxication death involves ¹	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Alcohol or at least one drug of abuse	280	263	295	310	354	327	298	343	296	273	249	290
At least one drug of abuse	269	256	287	299	341	316	280	334	290	257	239	283
Opioids	252	232	266	286	327	305	265	307	268	224	217	248
W/ cocaine	66	75	71	81	73	60	59	81	69	49	42	102
W/ alcohol	63	61	93	79	86	99	68	58	52	43	37	52
Alone ²	136	112	126	149	183	159	152	179	161	140	138	110
Heroin	245	214	251	270	312	285	245	276	223	179	161	184
W/ cocaine	65	71	70	76	68	54	57	77	62	39	31	69
W/ alcohol	59	57	90	77	86	95	65	56	46	32	28	36
Alone ²	125	95	110	137	165	141	125	136	111	88	76	56
Methadone	9	22	19	20	15	23	30	43	58	57	61	69
W/ heroin	6	9	9	12	10	11	16	20	23	17	12	14
W/ cocaine	0	2	4	8	3	6	3	5	9	13	6	29
W/ alcohol	2	4	3	2	0	4	4	2	5	8	4	3
Alone ²	1	8	7	5	4	6	11	20	28	25	32	26
Fentanyl	0	0	0	0	1	1	0	1	3	2	3	12
Cod/Oxy/Hyd	1	2	3	4	2	5	6	3	6	4	12	12
Cocaine	80	97	89	93	87	71	72	107	89	80	64	136
W/ alcohol	19	23	28	28	16	17	18	12	17	12	5	27
Alone ²	9	19	14	9	14	9	12	25	18	28	21	25
Benzodiazepines	2	7	2	5	0	4	3	1	1	2	2	2
Alcohol	80	72	106	93	99	112	87	68	61	63	48	69
Alone ²	11	7	8	11	13	11	18	9	6	16	10	7

Cod/Oxy/Hyd: Codeine, Oxycodone, or Hydrocodone. ¹ Due to poly-drug use, substance-specific categories are not mutually exclusive. ² Alone means that neither alcohol nor any other drug of abuse was involved in the death.

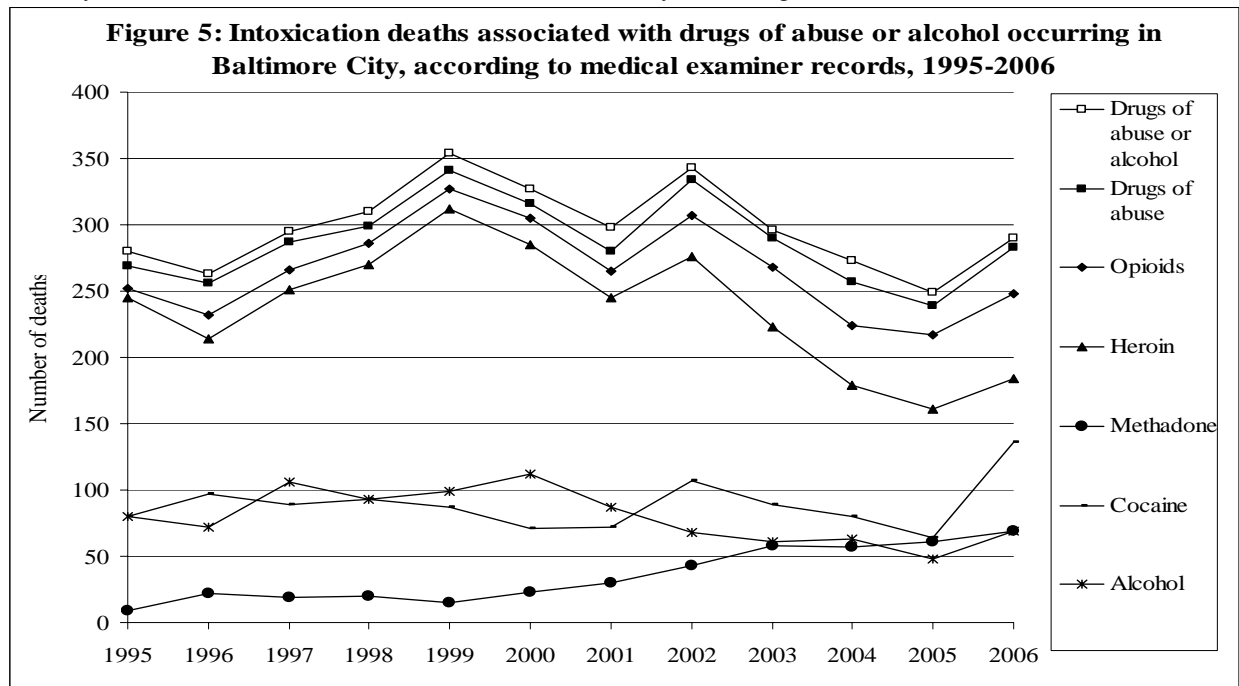
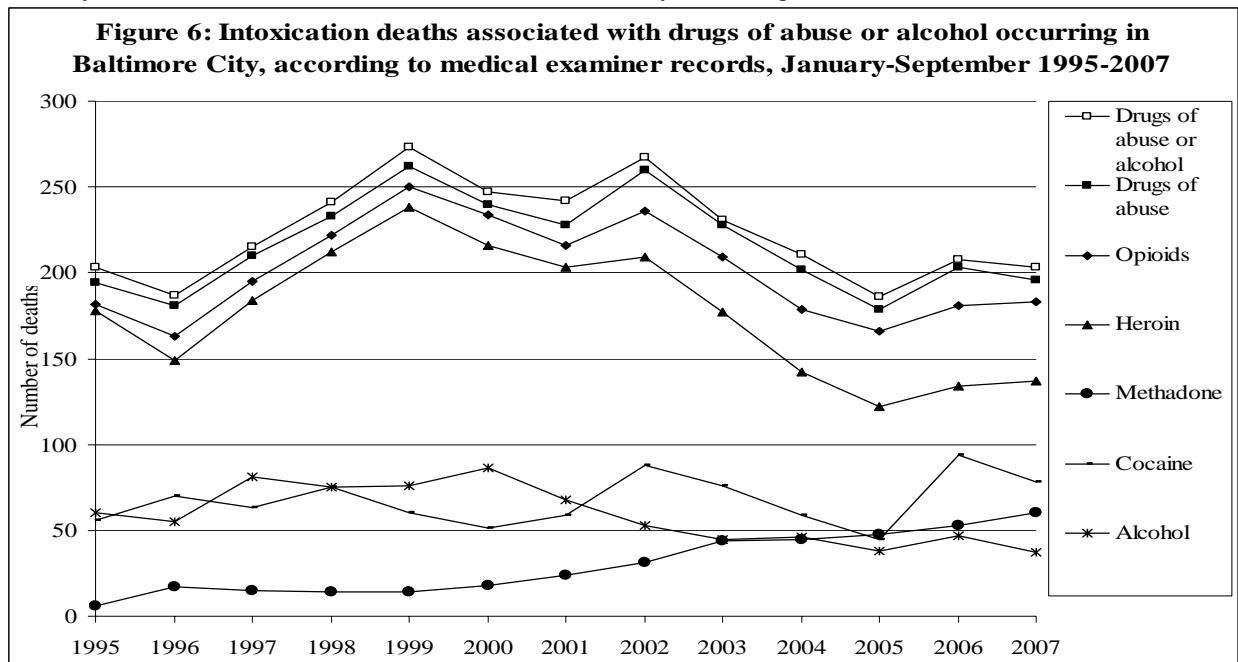


Table 7: Fatal intoxication associated with drugs of abuse or alcohol occurring in Baltimore City, according to medical examiner records, January-September 1995-2007

Intoxication death involves ¹	Jan-Sep 1995	Jan-Sep 1996	Jan-Sep 1997	Jan-Sep 1998	Jan-Sep 1999	Jan-Sep 2000	Jan-Sep 2001	Jan-Sep 2002	Jan-Sep 2003	Jan-Sep 2004	Jan-Sep 2005	Jan-Sep 2006	Jan-Sep 2007
Alcohol or at least one drug of abuse	203	187	215	241	273	247	242	267	231	211	186	208	203
At least one drug of abuse	194	181	210	233	262	240	228	260	228	202	179	203	196
Opioids	182	163	195	222	250	234	216	236	209	179	166	181	183
W/ cocaine	46	53	50	64	48	45	49	65	58	37	32	73	65
W/ alcohol	47	45	73	64	65	78	53	45	41	37	30	37	29
Alone ²	100	77	91	113	147	121	125	134	119	111	102	84	93
Heroin	178	149	184	212	238	216	203	209	177	142	122	134	137
W/ cocaine	45	50	49	61	44	40	47	62	53	29	24	50	43
W/ alcohol	44	43	70	63	65	75	50	44	37	26	23	28	21
Alone ²	92	64	79	106	131	106	106	100	82	70	56	43	45
Methadone	6	17	15	14	14	18	24	31	44	45	48	53	60
W/ heroin	5	6	8	7	10	8	15	12	19	12	8	12	11
W/ cocaine	0	2	3	5	3	4	3	4	6	8	4	22	18
W/ alcohol	1	3	3	2	0	4	4	0	4	8	4	2	5
Alone ²	0	7	4	5	3	5	6	18	19	20	25	20	27
Fentanyl	0	0	0	0	1	1	0	1	3	2	1	11	3
Cod/Oxy/Hyd	1	1	2	1	2	4	4	3	3	3	9	3	6
Cocaine	56	70	63	75	60	51	59	88	76	59	45	94	78
W/ alcohol	15	18	22	23	11	13	15	9	11	7	3	17	8
Alone ²	7	14	10	8	12	5	9	22	17	22	12	17	12
Benzodiazepines	1	5	2	3	0	2	3	1	0	1	2	1	6
Alcohol	60	55	81	75	76	86	68	53	45	46	38	47	37
Alone ²	9	6	5	8	11	7	14	7	3	9	7	5	7

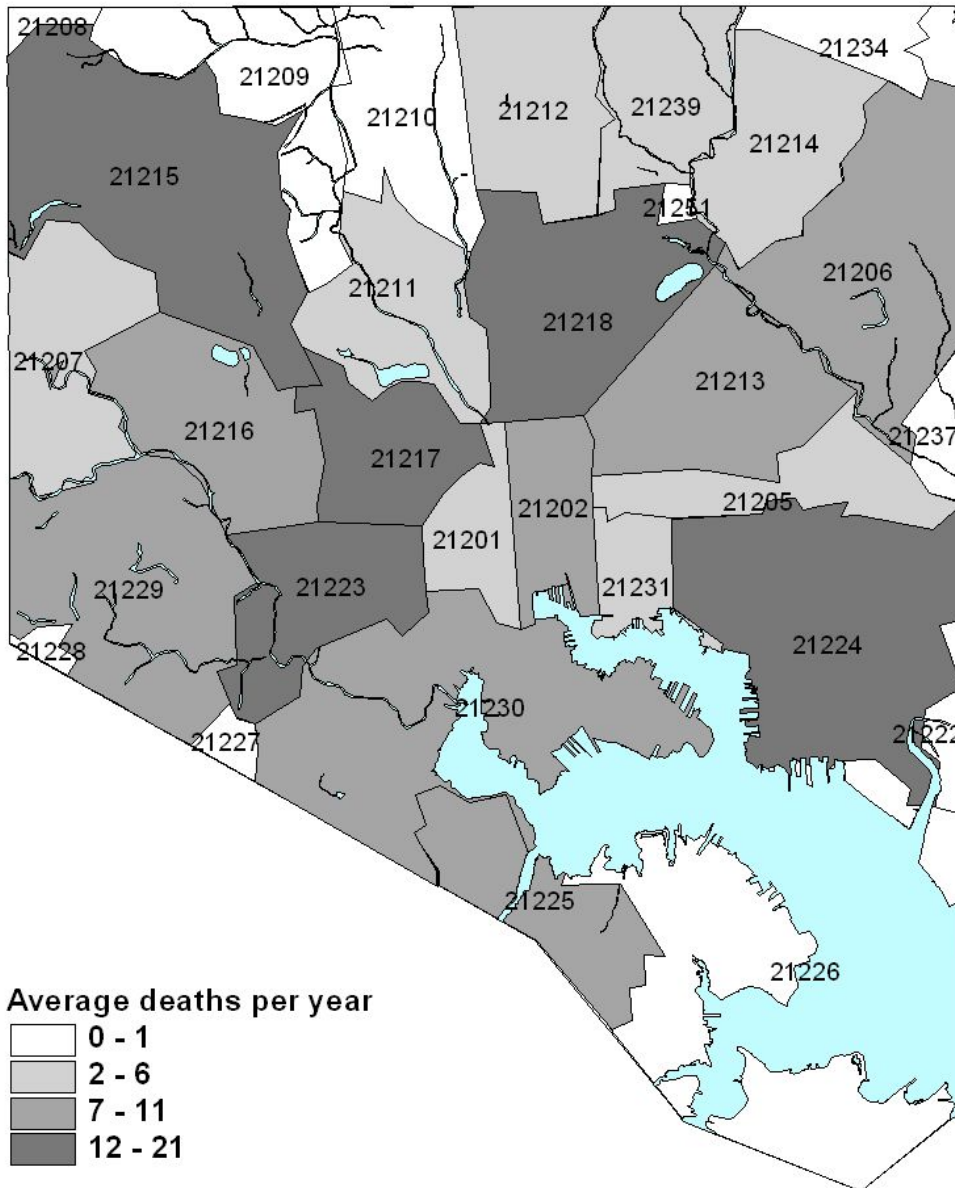
Cod/Oxy/Hyd: Codeine, Oxycodone, or Hydrocodone. ¹ Due to poly-drug use, substance-specific categories are not mutually exclusive. ² Alone means that neither alcohol nor any other drug of abuse was involved in the death.



Geographic distribution of resident deaths

Intoxication deaths associated with drugs of abuse or alcohol among residents from 2003 to September 2007 were concentrated in zip codes 21217, 21223, 21218, 21224, and 21215 (Figure 7). These five zip codes accounted for 44% of the City's deaths in that period.

Figure 7: Average annual count of intoxication deaths associated with drugs of abuse or alcohol among Baltimore City residents, according to medical examiner records, by zip code of residence, January 2003-September 2007



Discussion

Medical examiner records indicate that intoxication deaths associated with drugs of abuse are a major cause of mortality in Baltimore. In six of the last 12 years, the number of fatal intoxication occurring in Baltimore exceeded the number of homicides.¹⁰

Although comparable rates are hard to find due to differences in definitions and data sources, on average, death rates among Baltimore residents are more than three times higher than in the US, and Maryland as a whole. From 1999 to 2004, the rate of death from “drug-induced causes,” (which include deaths associated with all drugs, not just drugs of abuse) in the US as a whole peaked at 10.5 per 100,000 in 2004,¹¹ compared to 35.2 per 100,000 for just drugs of abuse in that same year in Baltimore. In Maryland, the death rate for opioid-related drug misuse (which includes all deaths related to drug misuse where an opioid was involved) was 10.8 per 100,000 in 2003,¹² compared to 34.5 per 100,000 in Baltimore.

Rates in Baltimore also exceed those in other cities. In New York City, rates of death from opioid-associated overdoses ranged from 9.3 in 1995 to 7.3 per 100,000 in 1998,¹³ compared to 31.8 to 37.3 in Baltimore in the same period. These results confirm the findings of the 2003 report from the Drug Abuse Warning Network that found that the Baltimore-Towson metropolitan area had the highest rates of drug-related deaths in 2003 out of 35 metropolitan areas including New York City, Philadelphia, Atlanta, Chicago, Washington DC, Detroit and Albuquerque.¹⁴

Trends. Intoxication deaths associated with drugs of abuse or alcohol among Baltimore City residents have decreased by a quarter since their peak in the late 1990s. This trend has been particularly pronounced for heroin-associated deaths, which constitute the majority of drug of abuse- and alcohol-associated intoxication deaths in Baltimore and which decreased by 47% since 1999. Over this period, there have been substantial increases in access to effective drug treatment.

Despite an overall declining trend, deaths due to drug of abuse or alcohol intoxication increased 14% in 2006 compared to 2005. Most of the increase was due to increases in polydrug-associated deaths involving cocaine, opioids (including heroin, methadone and fentanyl) and alcohol. The increase was particularly noticeable for cocaine-associated deaths (in combination

¹⁰ Homicide rates in Baltimore from 1995-2006 were 325, 328, 312, 312, 305, 261, 256, 253, 270, 276, 269, 276 according to the FBI Uniform Crime Reports (<http://www.fbi.gov/ucr/ucr.htm>, accessed 1-19-2008.)

¹¹ Miniño AM, Heron MP, Murphy SL, Kochanek, KD. Deaths: Final Data for 2004. National vital statistics reports; vol 55 no 19. Hyattsville, MD: National Center for Health Statistics. 2007

¹² Office of Applied Studies. The New Dawn Report. Opiate-Related Drug Misuse Deaths in Six States: 2003. 2006;issue 19. Rockville, MD: Substance Abuse and Mental Health Services Administration.

¹³ Coffin PO, Galea S, Ahern J, et al. Opiates, cocaine and alcohol combinations in accidental drug overdose deaths in New York City, 1990-98. *Addiction*. 2003;98(6):739-47.

¹⁴ Substance Abuse and Mental Health Services Administration, Office of Applied Studies. Drug Abuse Warning Network, 2003: Area Profiles of Drug-Related Mortality. DAWN Series D-27, DHHS Publication No. (SMA) 05-4023. Rockville, MD, 2005.

with opioids), which increased by more than 100% between 2005 and 2006, and for fentanyl-associated deaths, which increased by 200%.

Trends in drug- and alcohol-associated intoxication deaths reflect a variety of factors, including the prevalence of drug abuse, the types of drugs and drug combinations used, and drug purity. Possible explanations for the recent increase in intoxication deaths include the nationwide problem of fentanyl-tainted heroin in 2006; the declining availability of drug treatment associated with level funding; a possible increase in abuse of multiple drugs at the same time; and a possible decrease in purity of abused substances. Based on data for the first three quarters of 2007, the increase seems to be abating in 2007.

Heroin. Despite decreases in fatal intoxication deaths associated with heroin over the last decade, heroin remains the substance most commonly implicated in these deaths. It is also the most common cause of single-drug intoxication deaths. This illustrates both the potential for drug treatment to save lives, and the urgent need for further expansion of access to treatment.

Cocaine. The twofold increase in cocaine-associated deaths between 2005 and 2006 was particularly striking and remains largely unexplained. Part of the increase may be due to improvements in the toxicological detection of recent cocaine use. However, this would only explain a third of the increase. Further, the timing of the methodological change does not coincide perfectly with the observed increase. While cocaine overdose deaths have been found to increase with increasing temperatures,¹⁵ we found no evidence of higher counts during the summer months in our data.

Methadone. As has been observed in other parts of the country, methadone-associated deaths have gradually increased in Baltimore City over the past decade.

This report did not assess whether the methadone involved in these deaths has been diverted from addiction treatment (where it is tightly regulated), pain management (where any physician with a DEA license is eligible to prescribe), or elsewhere (such as through theft, prescription forgery or internet sales).

Even when special attention is paid to it, source information is difficult to collect. A pilot study by the Maryland Drug Early Warning System and the OCME in 2004 and 2005 attempted to increase the information collected about decedents' source of methadone. The study found that even with a new form designed to facilitate collection of the information, the source of methadone remained unknown for 58% of the reviewed cases.¹⁶

Nor could this report assess in how many deaths methadone played a critical causative role.

¹⁵ Marzuk PM, Tardiff K, Leon AC et al. Ambient temperature and mortality from unintentional cocaine overdose. *JAMA*. 1998;279(22):1795-1800.

¹⁶ Drug Early Warning System. DEWS Investigates: A pilot study to enhance the understanding of methadone intoxication deaths in Maryland. College Park, MD: Center for Substance Abuse Research. July 2005

We identified all intoxication deaths where methadone was either listed on the cause of death, or present in the toxicological analysis when the cause of death listed narcotics or drugs without naming the substances involved. In the latter case, methadone may have been present because of therapeutic use and may not have played a role in the death. However, due to the high degree of overlap between therapeutic and lethal serum methadone levels,¹⁷ it was not possible to identify deaths where methadone was known to contribute to the death.

Intoxication deaths where methadone was the only substance identified can serve as a minimum estimate of deaths where methadone is highly likely to be the causative agent. Such deaths increased from 0 in 1995 to 22-30 deaths per year since 2003, or from 0% to 9-14% of all drug of abuse or alcohol intoxication deaths among residents. This suggests that intoxication deaths due to methadone have increased substantially in Baltimore since 1995.

Buprenorphine. Because of unique pharmacological properties that limit the extent of respiratory depression, the risk for fatal overdose with buprenorphine is much lower than with other opiates such as heroin, methadone, or oxycodone. While the medication can be abused and can cause a fatal overdose in combination with other substances, particularly benzodiazepines, the overall risk is still much lower than for other opiate drugs. In France, tens of thousands more patients receive buprenorphine than in Baltimore, and the drug is not formulated (as it is in the United States) with naloxone to reduce the potential for intravenous abuse. Yet even under these conditions, among 1600 toxicological assessments of fatalities conducted over a five-year period in Paris, only 34, or 2%, were positive for buprenorphine.¹⁸ In only 4 of these cases was buprenorphine determined to have contributed to the cause of death. Furthermore, buprenorphine is rarely the only drug associated with deaths, making it difficult to definitively implicate buprenorphine in the cause of death.¹⁹ At the same time, the use of buprenorphine as treatment for heroin addiction is credited with contributing to a 79% decline in heroin overdose deaths in France during the decade after buprenorphine was introduced.¹⁹

In Maryland, an OCME death investigation does not routinely include a buprenorphine test. However, the medical examiner can order specific tests if investigation indicates that buprenorphine may be involved. In the period covered by this study, the OCME only identified as associated with buprenorphine, in combination with cocaine and methadone. More routine testing would improve surveillance, but is not likely to identify a significant problem of deaths caused by buprenorphine.

Alcohol. Despite the lower visibility of alcohol compared to drugs of abuse, alcohol was involved in a quarter of the drug of abuse- and alcohol-associated intoxication deaths over the

¹⁷ Center for Substance Abuse Treatment, Methadone-Associated Mortality: Background Briefing Report. Rockville MD: Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration, 2004.

¹⁸ Pirnay S, Borron SW, Giudicelli CP et al. A critical review of the causes of death among post-mortem toxicological investigations: analysis of 34 buprenorphine-associated and 35 methadone-associated deaths. *Addiction*. 2004;99:978-988.

¹⁹ Auriacombe M, Fatseas M, Dubernet J et al. French field experience with buprenorphine. *The American Journal on Addiction*. 2004;13:S17-S28.

study period. This highlights the importance of increasing access to alcohol addiction treatment in addition to drug addiction treatment.

Comparisons to previous studies. Our results are similar to those found in a 2002 report from the University of Maryland's Center for Substance Abuse Research that examined alcohol and drug-related overdoses in Maryland from 1997 to 2001 based also on OCME records.²⁰ Differences between our counts and theirs are likely due to differences in the substances included in the analyses and the way in which toxicological tests were used to identify contributing substances. Our results also confirm trends observed in earlier analyses of OCME data released by the Baltimore City Health Department.²¹

Non-residents. At least 11%, and as much as 16%, of the fatal intoxications that occurred in Baltimore from 1995 to September 2007 occurred among non-city residents. This fact highlights that drug addiction and drug overdose in Baltimore are not solely urban phenomena. It also emphasizes the need for improved access to treatment in surrounding jurisdictions in addition to Baltimore City.

Limitations. The numbers presented in this report are the best estimates that we could develop but are subject to some limitations. The following factors could have affected the data that we analyzed: variability between medical examiners and changes over time in death investigation procedures (including toxicological analyses), errors in data entry, and incomplete or incorrect address information. Furthermore, these numbers could change slightly in the future due to delays in reporting of deaths to the OCME and changes in information about the death. The numbers we present should be interpreted in the light of these possible limitations.

Future studies. The Office of Epidemiology and Planning Baltimore City Health Department will work with the OCME to publish quarterly updates to this report in order to closely monitor this important public health problem. The Office will also consider additional analyses in order to better understand intoxication deaths.

Conclusion

Progress has been made over the last decade in reducing the number of Baltimore City residents who die from intoxication associated with a drug of abuse or alcohol. However, significant challenges remain, and increased efforts are needed to limit drug and alcohol abuse and its fatal consequences.

²⁰ Lehder DM, Arria A, Artigiani EE, Wish ED. Alcohol and Drug-related overdose deaths in Maryland: 1997-2001. College Park, MD: Center for Substance Abuse Research, November 2002. Available at <http://www.cesar.umd.edu/cesar/pubs/20021101.pdf>.

²¹ Baltimore City Health Department. Drug Treatment in Baltimore: 2005. Baltimore City, MD, June 2006. Available at http://www.baltimorehealth.org/snapshots/DRUG_FINAL_6_6_06.pdf.

Appendix 1: List of drugs identified in medical examiner records of Baltimore City intoxication deaths, January 1995-September 2007.

* indicates substance is a drug of abuse in the medical examiner's routine toxicological analysis

Drugs of Abuse	Not Drugs of Abuse	
Ethanol*	Acetaminophen	Salicylic acid
<u>Opioids</u>	Amitriptyline	Salicylate
Buprenorphine	Amoxapine	Sertraline
Codeine*	Atenolol	Sodium Penthanol
Fentanyl*	Bupropion	Theophylline
Heroin (and metabolite 6-monoacetylmorphine*)	Carbamazepine	Thioridazine
Hydrocodone*	Carbon monoxide (CO)	Toluene
Hydromorphone	Cardizem	Trazodone
Meperidine*	Carisoprodol	Tricyclate
Methadone*	Chlorodifluoromethane	Tricycline
Morphine*	Citalopram	Venlafaxine
Oxycodone*	Cyclobenzaprine	Verapamil
Pentazocine*	Cyproheptadine	
Propoxyphene*	Desipramine	
Tramadol*	Diltiazem	
<u>Non-opioids</u>	Diphenhydramine	
Cocaine* (and metabolite benzoylecgonine*)	Doxepin	
<i>Benzodiazepines</i>	Doxylamine	
Alprazolam*	Ethylene Glycol	
Chlordiazepoxide*	Fluoxetine	
Clonazepam	Gasoline	
Diazepam*	Hydrochlorothiazide	
Flurazepam*	Hydroxyzine	
Lorazepam	Imipramine	
Midazolam	Isopropanol	
Nordiazepam*	Isopropyl alcohol	
Triazolam	Lidocaine	
Amobarbital*	Lithium	
Butalbital*	Methane	
Pentobarbital*	Methanol	
Phenobarbital*	Nifedipine	
Secobarbital*	Nortriptyline	
Sodium Thiopental/Sodium Pentothal	Olanzapine	
Amphetamine*	Pancuronium Bromide (Pavulon)	
Dextromethorphan*	Paroxetine	
Methamphetamine*	Perphenazine	
Methylenedioxyamphetamine (MDA)*	Phenytoin	
Methylenedioxymethamphetamine (MDMA)*	Potassium chloride	
Phentermine*	Promethazine	
Chloral hydrate (metabolized to trichloroethanol)	Propanol	
Ketamine*	Propofol	
Meprobamate*	Propranolol	
Phencyclidine (PCP)*	Pseudoephedrine	
Zopiclone	Quetiapine	
Zolpidem*	Rocuronium Bromide	