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Fatal Heroin-Related Overdose in San Francisco, 1997–2000: a Case for Targeted Intervention

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ABSTRACT *Heroin-related overdose is the single largest cause of accidental death in San Francisco. We examined demographic, location, nontoxicological, and toxicological characteristics of opiate overdose deaths in San Francisco, California. Medical examiner's case files for every opioid-positive death from July 1, 1997, to June 30, 2000, were reviewed and classified as overdose deaths or other. Demographic variables were compared to two street-based studies of heroin users and to census data. From 1997 to 2000, of all heroin-related overdoses in San Francisco, 47% occurred in low-income residential hotels; 36% occurred in one small central area of the city. In 68% of deaths, the victim was reportedly alone. When others were present between last ingestion of heroin and death, appropriate responses were rare. In three cases, police arrested the person who called emergency services or others present on the scene. We recommend the development of overdose response training targeted at heroin users and those close to them, including the staff of residential hotels.*

KEYWORDS *Epidemiology, Heroin overdose, Injection drug users, San Francisco.*

INTRODUCTION

Fatal heroin-related overdose is the single largest cause of accidental death in San Francisco, California, exceeding motor vehicle accidents, suicide, and homicide.[1] San Francisco is among the leading cities included in the Drug Abuse Warning Network in the United States for heroin-related deaths.[2]

The biomedical antecedents of heroin-related overdose are well understood. Heroin at a sufficient dose, or in conjunction with other central nervous system depressants, acts to slow and eventually stop breathing.[3] Immediate death is unusual, with most deaths occurring 1 to 3 hours after last ingestion.[4] Effective intervention requires recognizing that the victim is having difficulty breathing, calling emergency services, and when breathing has stopped, performing "mouth-to-mouth" resuscitation until assistance arrives.[5] Bystander attempts at intervention have been shown to improve outcomes,[6] and the distribution of naloxone (a short-acting opioid antagonist) to injecting drug users and their peers has been suggested[7–9] and

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legally conducted with as-yet undocumented results in several countries, including Italy[10] and the United States.[11] Survival rates approach 100% when emergency services attend before the victim loses pulse and blood pressure.[12]

When bystanders are present, willing, and able to act effectively, overdose fatalities should therefore be extremely rare. That overdose deaths are frequent suggests that one or more of these three factors is commonly missing, and that the social context of overdoses may be as important as the biomedical context in understanding and preventing fatalities.

Medical examiner's or coroner's files have been used in a number of studies to investigate the biomedical antecedents of heroin-related overdose death.[4,13–15] The detailed case notes often present in such files have been suggested as a source of data to investigate the nontoxicological factors surrounding fatal overdose.[16] Some use of such data has been made,[4,16] but only recently has there been any attempt to use these data to look at the specific social context of overdose in the United States.[17]

We reviewed every opioid-positive death reported to the City and County of San Francisco Medical Examiner's Office between July 1, 1997, and June 30, 2000, to describe the characteristics of those deaths caused by respiratory depression following the administration of heroin or other illicitly obtained opioids when suicidal intent was not a clear factor.

METHODS

Medical Examiner Files

The Medical Examiner's Office of the City and County of San Francisco is legally responsible for investigating any death meeting criteria set out in California State law. These criteria include all "violent, sudden, or unusual deaths; . . . deaths known or suspected as resulting in whole or in part from or related to or following . . . drug addiction."[18] When a case meets these criteria, an investigator from the medical examiner's office attends the scene of death, usually within an hour after emergency responders declare life extinct. A written report is produced that describes the scene and chronology of events leading up to the death or the discovery of the body as described by witnesses. An autopsy is performed for every investigated death. Toxicological specimens are taken during the autopsy and analyzed using in-house facilities. The scene investigator's report, results of toxicology, and a summary of the pathology possibly contributing to death are entered into a computerized database. Police routinely attend all fatalities occurring in San Francisco, and details of attending officers and the San Francisco Police Department case number are also recorded.

Case Selection

We defined *heroin-related overdose* as accidental death caused by respiratory depression following the administration of illicit opioids. We reviewed all 4,863 deaths investigated by the City and County of San Francisco Medical Examiner's Office between July 1, 1997, and June 30, 2000. All morphine-negative cases or cases with morphine data absent were removed, leaving 661 morphine-positive cases. Diacetylmorphine (heroin) metabolizes into morphine within minutes of injection.[19] The presence of morphine in toxicology is therefore indicative, but not diagnostic, of the presence of diacetylmorphine. Tests for diacetylmorphine exist, but are rarely

used in forensic settings.[20] Scene evidence (such as injecting paraphernalia) and witness reports are typically used in conjunction with the presence of morphine in toxicology to reach a determination of heroin or heroin-related overdose.[20]

We discarded 19 cases for which the medical examiner returned a finding of homicide and 46 cases for which the medical examiner returned a finding of suicide. Two cases that were still active at the time of access (October 2000) were removed from analysis at the request of the medical examiner's office. The remaining 594 cases were considered not to be an overdose if (1) opioids were administered by or at the prescription of medical personnel prior to death (e.g., fire victims administered morphine between the accident and death); (2) autopsy pathology indicated another cause of death that could have been sufficient to cause death in the absence of opioids (e.g., heart attacks); or (3) autopsy or circumstances of death indicated a nonoverdose cause of death, even when opioid intoxication may have played a significant role (e.g., falls, motor vehicle accidents). The remaining 333 cases were considered overdoses.

Toxicology

Blood and other specimens are taken at autopsy for toxicological analysis. Medical examiner toxicology reports describe only those substances that can be quantified when present and that, in the judgment of the medical examiner, may have contributed to the death. The absence of a substance in reported toxicology does not therefore mean the substance was not detected or was not present (B. Stephens, chief medical examiner, e-mail communication, August 26, 2002). Toxicological characteristics of all deaths are described with an emphasis on the presence of central nervous system depressants. Blood morphine and blood alcohol medians and ranges are reported when blood samples were available, with the least peripheral sample reported for cases for which multiple blood samples were taken.[21]

Demographics and Population Matching

To determine if demographic characteristics of those who died of overdoses differed from either the general population or other heroin users, we compared data from medical examiner case files to data from the US Census (year 2000) for the city and county of San Francisco, and data from two street-based studies of heroin-using injection drug users (IDUs) conducted in San Francisco. Race, as described in medical examiner files, refers to the apparent race of the decedent as observed by a scene investigator, whereas race or ethnicity in comparison groups was obtained by self-report.

Cases that involved individuals younger than 30 years old were compared to 1,108 IDUs under age 30 years who had used heroin in the last 30 days and who had participated in the UFO Study, a longitudinal study of young IDUs[22] between January 2000 and December 2001. Cases of individuals aged 30 years and older were compared with 1,976 street-recruited IDUs aged 30 years and older who had used heroin or speedballs (heroin mixed with cocaine) in the last 30 days and who had participated in the Urban Health Study[25] between July 1, 1997, and June 30, 2000. Both studies were seroepidemiological surveys, and both studies were conducted at the University of California, San Francisco.

UFO Study participants were recruited in three San Francisco neighborhoods selected for their high concentrations of young injecting drug users. Participants were recruited by experienced outreach workers and word of mouth and were paid \$10–\$20 at each visit. All participants provided written consent at enrollment. All

study procedures were approved by the Committee on Human Research at the University of California, San Francisco.[22]

Urban Health Study participants were recruited in four San Francisco neighborhoods selected for their high concentrations of injecting drug use. To obtain a more diverse sample, IDUs were recruited from the four neighborhoods in roughly equal numbers, although the large preponderance of IDUs in San Francisco is in the Tenderloin. This resulted in an overrepresentation of women and IDUs of minority ethnicity. Participants were recruited every 6 months using targeted sampling methods.[23,24] Recruitment was carried out by experienced street outreach workers and word of mouth. Respondents were paid $15–$20 at each visit. All subjects provided written informed consent each time they participated. All study procedures were approved by the Committee on Human Research at the University of California, San Francisco.[24,25] Sampling and study methods for both studies have been described in more detail elsewhere.[22,25]

As in all street-based sampling, socially hidden IDUs and economically advantaged IDUs were undersampled in both studies.

Location of Death

We coded all medical examiner location of incident data as hotel, outdoors, public bathroom (included both outdoor facilities and those located in medical facilities, restaurants, and other locations where the public have access), shelter, or private residence. Hotels were identified by matching addresses to a list of hotel addresses created by merging the May 1997 and September 2000 lists of hotels maintained by the San Francisco Housing Inspection Services. Outdoors, bathroom, and shelter coding was based on descriptive evidence in case file notes. Deaths were also mapped by street address of death or incident. For mapping purposes, deaths were reclassified as hotel, outdoors (including public bathroom), and housed (all nonhotel, nonoutdoors).

Case History Coding

All 594 morphine-positive cases were assigned a computer-generated random number and sorted in numerical order. The case notes produced by the attending field investigator from the medical examiner's office for the first 100 files meeting the overdose criteria described above were analyzed thematically to identify relevant variables.

The following variables were then coded for all overdose cases: presence of others at last ingestion of heroin; presence of others during unconsciousness; deceased behind closed doors (i.e., a closed door was between the deceased and all other persons); deceased behind locked doors; presence or involvement of hotel or residence staff at discovery; first aid interventions attempted by those present at discovery; whether paramedics attempted interventions; police presence at the scene; and police actions at the scene.

Human Subjects

The study was granted exempt from review status by the Committee on Human Research, University of California, San Francisco.

RESULTS

From the period July 1, 1997, to June 30, 2000, we used the criteria described to code 333 deaths as overdose. Over the same period, the medical examiner's office

reported 384 deaths "due to heroin," a classification that includes, but is not limited to, overdose.[1]

Demographics

Median age of death was 40 years (range 16–80). There were 290 (87%) described as male, including one described as a transvestite, and 43 (13%) were described as female. Younger deaths were predominantly of those who were white (84% of those aged 16–30 years); with increased age, the proportion of white decedents decreased (48% of those aged 51–60 years), and the proportion of black decedents increased (45% of those aged 51–60 years) (Table 1).

When compared with year 2000 census data for San Francisco,[26] decedents were more likely to be male (87% vs. 51% in the population), more likely to be white (68% vs. 47%), and more likely to be black (21% vs. 7%). Asians were substantially underrepresented (1% vs. 30% in the population) ($P \leq .001$ for all comparisons).

Based on the total population of San Francisco reported in the year 2000 census data, the death rate due to heroin-related overdose for San Francisco was 14.29 per 100,000 per year. The death rate was 24.48 for males and 3.75 for females per 100,000. By race, rates per 100,000 were 42.91 for blacks, 20.82 for whites, 8.91 for Hispanics, 5.72 for other races, and 0.57 for Asians. Using the estimate of 17,000 IDUs in San Francisco,[27] we estimated that there were approximately 653 heroin-related deaths per 100,000 IDUs per year.

Sex, race, and housing status variables were compared with the two heroin-using populations described in the Methods section. Compared with Urban Health Study participants who reported using heroin, decedents older than 30 years were more likely to be male (90% vs. 71%), more likely to be white (65% vs. 42%), and nearly five times as likely to be in a hotel (49% vs. 10%) ($P \leq .001$ for all three comparisons). Decedents younger than 30 years, compared to UFO Study participants who reported using heroin, were more likely to be black (7% vs. 1%) and twice as likely to be in a hotel at time of death (37% vs. 15%) ($P \leq .001$ for both comparisons). No statistically significant difference was found by sex among decedents younger than 30 years old.

Housing Status and Incident Location

There were 157 of 333 deaths (47%) that occurred in hotels. In all but 3 cases, these deaths occurred in low-income, single room occupancy (SRO) residential hotels. Of the deaths, 80 (24%) occurred outdoors or in public places; 16 of these occurred in bathrooms accessible to the public, and 6 occurred in vehicles. There were 92 (28%) deaths that occurred in private residences. Four (1%) deaths occurred at a hospital after the deceased was transported from unknown locations by nonparamedics. Two deaths (0.6%) occurred in shelters or other temporary emergency housing.

All cases were mapped by street address of death or incident onto a map of San Francisco (Figure). Deaths were heavily clustered in the Tenderloin and South of Market neighborhoods (the gray shaded area on the map), with a second, more limited cluster occurring in the Mission district (to the southwest of the shaded area). All three areas are notable for their high concentration of low-rent hotels and other low-income housing. Of all deaths, 36% occurred within a 500-meter radius of the intersection of Golden Gate and Jones streets (shaded area) in the

TABLE 1. Sex, race, and housing status by age for 333 heroin-related overdose deaths

Age, years	Sex (%)		Race (%)					Housing (%)			
	Male	Female	White	Black	Hispanic	Asian	Other/ uncoded	Outdoors	Hotel	Other	Total
16–30	49 (76)	15 (24)	54 (84)	4 (6)	4 (6)	1 (2)	1 (2)	12 (19)	24 (38)	28 (43)	64
31–40	101 (90)	11 (10)	82 (73)	18 (16)	10 (9)	0 (0)	2 (2)	29 (26)	50 (45)	34 (30)	112
41–50	108 (89)	13 (11)	74 (61)	32 (26)	12 (10)	2 (2)	1 (1)	30 (25)	56 (46)	35 (29)	121
51–60	27 (87)	4 (13)	15 (48)	14 (45)	1 (3)	1 (3)	0 (0)	1 (3)	24 (77)	6 (19)	31
61–80	5 (100)	0 (0)	3 (60)	2 (40)	0 (0)	0 (0)	0 (0)	0 (0)	3 (60)	2 (40)	5
Total	290 (87)	43 (13)	228 (68)	70 (21)	27 (8)	4 (1)	4 (1)	71 (21)	157 (47)	105 (32)	333

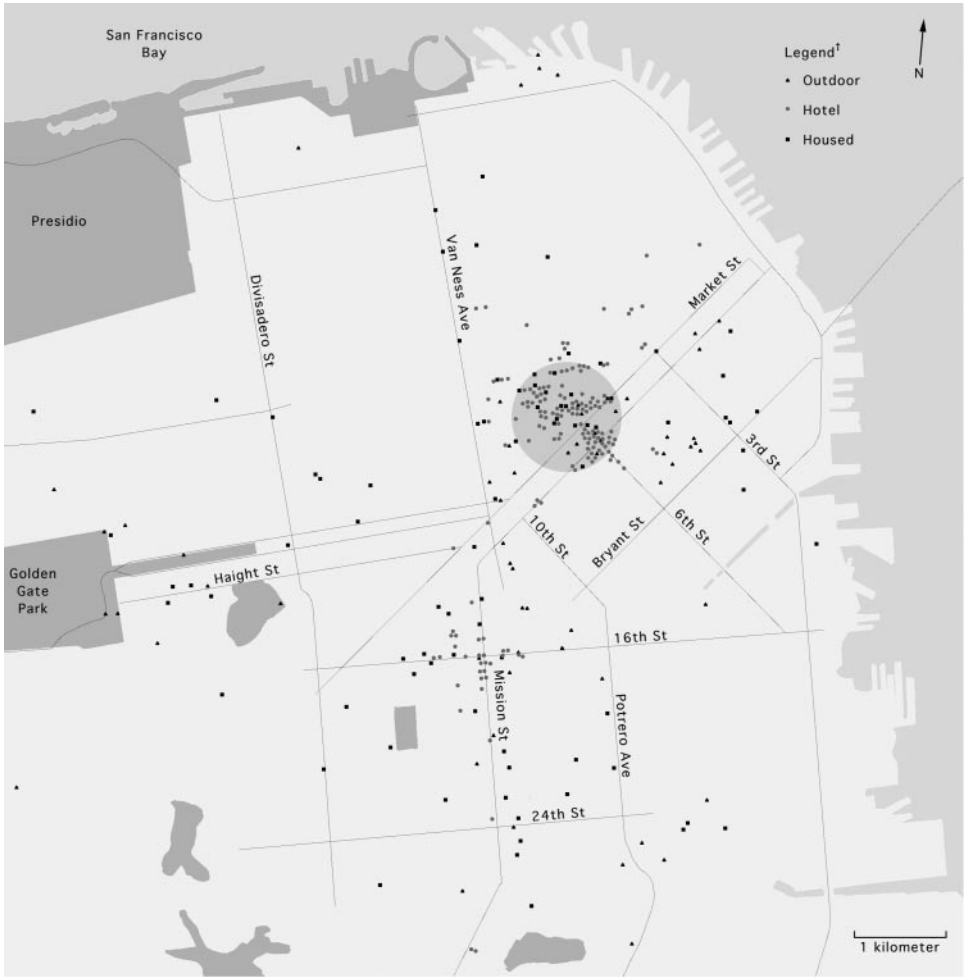

FIGURE Heroin-related overdose deaths (300) in the city and county of San Francisco, July 1, 1997 to June 30, 2000. Of the total 333 deaths, 33 are not shown in this map; 29 deaths occurred within the boundaries of the county but outside the area shown, and 4 deaths occurred after the deceased was transported from an unknown location to a hospital by third parties.

Tenderloin neighborhood, an area comprising less than 0.7% of the area of the city and county of San Francisco.

Toxicology

Blood morphine levels were available for 308 of 333 cases (92%). Median blood morphine level was 0.24 μg/mL (range 0.01–6.50 μg/mL). The ranges of blood morphine levels in therapeutic use, recreational use, and use resulting in fatalities can, and often do, overlap. Therapeutic blood morphine ranges for palliative care patients, for example, can be up to 50 times higher than those found in fatal overdose cases.[28] Other factors, such as illness or recent abstinence, can also significantly alter the lethality of a given dose for a given individual.[3]

Methadone was present in 15 of 333 cases (5%). Benzodiazepines were detected and quantified in 41 of 333 of cases (12%); however, the screening test used

for benzodiazepines does not detect clonazepam in urine, and hence benzodiazepines may be underreported. Clonazepam (Klonopin), the most commonly street-available benzodiazepine in San Francisco (B. Prince, ethnographer, letter communication, August 18, 2002) was reported in two cases. Psychiatric medications (nearly all antianxiety agents) with central nervous system depressant properties[29] appeared in 11 cases. Alcohol was detected in 154 of 333 cases (46%). A blood alcohol level was available for 145 of these 154 cases; these provided a median blood alcohol of 0.14% (range 0.02%–0.43%). In total, in 190 of 333 deaths (57%), at least one reported central nervous system depressant was present in addition to morphine.

Stimulants were also highly prevalent. Cocaine was present in 183 of 333 (55%) cases. Amphetamine or methamphetamine was present in 39 cases (12%). Combinations of multiple substances were common. Table 2 describes frequencies for all reported combinations of morphine, alcohol, benzodiazepines, cocaine, and amphetamines.

Case Notes

In 106 of 333 cases (32%), another person was known to have been present after the deceased lost consciousness and before the discovery or realization that the deceased was not breathing.

In 178 of 333 cases (53%), the deceased was separated from other people by a closed door. In 106 cases (32%), the door was also locked, necessitating the use of a key or forced entry for others to establish the status of the deceased.

In 19 of 333 cases (6%), medical examiner case notes recorded efforts by those present to perform first aid prior to the arrival of paramedics. The most commonly described intervention was cardiopulmonary resuscitation.

In the 157 cases for which the death occurred in a hotel, hotel staff either

TABLE 2. Selected* toxicology combinations for 333 heroin-related overdose deaths

Substances reported in addition to morphine	Cases	(%)
Cocaine	83	(25)
Alcohol	67	(20)
Alcohol and cocaine	56	(17)
None	52	(16)
Benzodiazepines and cocaine	12	(4)
Cocaine and amphetamines	15	(4)
Alcohol and benzodiazepines	10	(3)
Alcohol, benzodiazepines, and cocaine	9	(3)
Benzodiazepines	7	(2)
Amphetamines	7	(2)
Alcohol, benzodiazepines, and cocaine	7	(2)
Benzodiazepines and amphetamines	2	(<1)
Alcohol and amphetamines	3	(<1)
Alcohol, benzodiazepines, and amphetamines	2	(<1)
Benzodiazepines, cocaine, and amphetamines	1	(<1)
Alcohol, benzodiazepines, cocaine, and amphetamines	0	(0)
Total	333	(100)

*Morphine, alcohol, benzodiazepines, cocaine, and amphetamines.

discovered the person who overdosed or were present at the time of discovery in 74 cases (47%). In most of the remaining cases, hotel staff were among the first on the scene. In no case is there a record of any hotel staff member attempting any form of intervention.

Paramedic intervention was described in a total 87 of 333 cases (26%). In 7 of these cases, the deceased was not declared dead until after arrival at a hospital emergency department.

Police were present at the scene in 317 of the 333 cases (95%). Four people were arrested in three separate cases. In one instance, the main witness was arrested for outstanding warrants after calling emergency services and waiting for assistance. In another instance, police made two apparent drug-related arrests of other individuals living in an attached basement apartment with no documented connection to the overdose. In the final case, the main witness was charged with possession of drugs at the scene after calling emergency services and, on the arrival of paramedics, found attempting resuscitative measures.

DISCUSSION

In this analysis of fatal heroin-related overdoses in San Francisco, almost half of all deaths occurred in low-income single room occupancy hotels. One other study of fatal heroin overdose in the United States has identified SRO hotels as a specific location of deaths.[17] Deaths were also highly concentrated geographically, with over a third of all deaths occurring within 500 meters of one street intersection. It may be that one consequence of high housing costs in San Francisco is a concentration of low-cost, short-term housing in one small geographical area. Heroin users in search of indoor accommodation may therefore find themselves unusually concentrated both geographically and by housing type.

SRO hotels, however, may also be a risk factor for heroin-related overdose death. Almost by definition, single room occupancy accommodation is limited to individuals or couples, increasing the likelihood that an SRO hotel resident who uses heroin while "at home" will be alone, which in turn greatly reduces the likelihood of outside intervention in the event of an overdose. During the period under study, the charging of "visitors' fees" to nonresidents by SRO hotel owners and managers was also commonplace, further increasing the likelihood that an SRO hotel resident using heroin in an SRO hotel room will be alone. This practice has since been restricted by city ordinance.[30] Our results show that over half of those who died had a closed door between them and any possible source of help; one third of those who died had a locked door.

Studies of nonfatal overdose frequently report relatively high levels of bystander intervention.[6,31] Our data show that, in cases for which death was the outcome, efforts to assist the deceased were rare even when bystanders were present.

Those who died were not demographically representative of either the heroin-using population or the total population of San Francisco. Ethnographic research with IDUs in the United States suggests that women are more likely to use injection drugs in the company of another person.[32] By using heroin alone less often, it is plausible that women may be substantially reducing their risk of death in the event of an overdose. Further research on the role of gender and ethnicity in overdose and overdose outcomes is suggested.

Finally, more than half of all deaths involved at least one central nervous system depressant other than morphine. This finding is similar to that of other studies

of the toxicology of fatal heroin-related overdose[4,13–15] and emphasizes the need for further education among heroin users regarding the risks associated with polydrug use.

Medical examiner data have a number of limitations when used for the purpose of investigating the social contexts of overdose deaths. Such data are collected to address the biological cause of death rather than the social context in which the death occurs. The data are collected within a legal context, and the illicit and stigmatized nature of opioid use in North America may induce witnesses to modify their accounts or depart before being interviewed. Our data describing the frequency of bystander action may therefore underreport the presence of others and attempts to intervene. Sampling methods used in the two heroin user studies may also have limitations. Because heroin use is illegal, it is not possible to recruit a random sample. As such, there is no guarantee of the generalizability of findings. Nonetheless, the street-based recruiting sampled directly from the community avoids the biases of institutional samples drawn from substance abuse treatment programs, health facilities, or the criminal justice system.

Within these limitations, our data suggest at least three intervention strategies that could be effective in reducing fatal heroin-related overdose in San Francisco and similar urban areas. First, we suggest that the specific social and practical barriers that prevent heroin users from using drugs within the reach of help be explored further. Interventions designed to offer alternatives to using alone behind closed doors should be explored. Trials elsewhere of safe injection rooms, where users can inject under medical supervision, have suggested that such facilities provide viable alternatives to injecting alone and may substantially reduce heroin-related death rates.[33–36] The tight geographical clustering of deaths in San Francisco suggests that even a single such facility could, if appropriately located, serve a considerable proportion of those at highest risk of death.

Second, we suggest that heroin users and those close to them need targeted, culturally appropriate training on recognizing and responding to overdose. The high prevalence of deaths in low-income residential hotels suggests that hotel residents should be a particular focus of such interventions, and the geographical clustering of deaths suggests that such interventions could be done with relatively limited resources. Data from this study suggest that hotel staff, a group of people close to the lives of heroin users, are in particular need of information and training. In some locations, it may be possible to mandate that hotel staff be offered first aid training. Programs in the United States and elsewhere have studied the distribution of the opioid antagonist naloxone to drug users for use in the event of an overdose.[37–41] We also suggest that those investigating community distribution of the opioid antagonist naloxone consider hotel staff as one possible target for training and distribution.

Finally, barriers to accessing emergency services need to be addressed. In previous work with witnessed overdose among young injectors in San Francisco, we found emergency services were accessed for only 52% of reported overdoses, with 56% of those who did not call emergency services reporting fear of police as the main reason. Those who had previously been arrested at the scene of an overdose were almost twice as likely to report fear of police.[31] While arrest at fatal overdose events was rare, other research has shown that fear of arrest in connection with overdose is common,[42,43] and events such as those described in our data are likely to be discussed widely among heroin users. We recommend that, when police attend overdoses, they limit their role to protection of paramedics and scene control if no

evidence of homicide or other serious felony exists. Treating overdose as a crime scene rather than a health event severely curtails the ability of the emergency response system to prevent deaths. Reducing fatal overdose deaths requires collaboration between public health and public safety agencies. Such collaborations have resulted in negotiated reductions in police presence and activity at overdose in both the United States and elsewhere,[44,45] and we recommend that these approaches be further developed and widely implemented.

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