

## Fatal Descent from Height in New York City

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**ABSTRACT:** All deaths due to descent from height that underwent autopsy at the Manhattan Office of Chief Medical Examiner of New York City over a two year period (1997–1999) were reviewed. The scene and autopsy findings, psychiatric history, and toxicology results were examined. There were 120 deaths: 77 suicides, 36 accidents, 5 undetermined, and 2 homicides. Psychiatric illness was reported in 86% of suicides. The toxicological detection of psychiatric medications supports the high percentage of psychiatric disease in the suicide group. In the accidental group, the detection of ethanol and illicit drugs was higher (36%) than expected from the case investigation and similar to the suicide group (29%). Accidental falls by women made up fewer than 3% of all manners. Due to the variation in the extent of injuries, it is unwise to attempt to conclude how high a person descended based on the autopsy findings. Descents into water commonly have minimal findings on external examination with marked internal injuries. The methods of investigation and criteria for death certification using the study results are discussed.

**KEYWORDS:** forensic science, forensic pathology, falls and descents from height, blunt injury, manner of death, toxicology, New York City

Deaths from blunt injuries resulting from falls from height are common in New York City. These deaths exemplify the contributions of forensic pathology to a wide range of medicolegal issues including: criminal investigations, insurance claims, work and public safety concerns, and family bereavement matters. Such deaths have few autopsy findings that can differentiate accidental, homicidal, and suicidal manners. In addition to a complete autopsy with toxicologic studies, the circumstances, medical history, and a thorough scene investigation are necessary to properly certify the death.

The scene and autopsy findings, psychiatric history, and toxicology results were reviewed to determine if certain findings can aid in the investigation and the determination of the cause and manner of these deaths. The methods of investigation and criteria for death certification using the study results are discussed.

### Materials and Methods

The Office of Chief Medical Examiner investigates all unexpected, violent, and suspicious deaths in the five boroughs that comprise New York City. This study was conducted only on fatalities in Manhattan, the borough with the greatest number of tall

buildings and the largest number of fatalities due to falls from height. Autopsies with toxicologic testing are routinely performed on violent deaths.

All deaths in Manhattan due to falls from height autopsied from January 1997 to January 1999 were identified through the New York City Office of Chief Medical Examiner (OCME) data base using a textword search for “fall,” “fell,” “jump,” “descent,” and “height.” Falls down stairs and from standing height were excluded. All case files were reviewed including: the autopsy, toxicology, and investigator’s report. In select instances, police reports, suicide notes, medical records, and scene photographs/diagrams were reviewed. The age, race, sex, height of descent, injuries, circumstances, medical history, location, toxicology results, and cause and manner of death were extracted. Injuries were classified according to type, body region, and the absolute level (by floor) of descent. For example, the extent of injuries of a jump from the roof of an 11 story building to the roof of an adjacent two story building, would be grouped by the height of nine floors. The number of stories was used to estimate the height and averages approximately 10 to 15 ft per story (1–3).

Toxicological testing was performed on all deaths at the toxicology laboratory of the Office of Chief Medical Examiner. Specimens routinely collected for toxicological analysis include: blood (peripheral preferred), urine, bile, vitreous humor, brain, liver, and gastric contents. Autopsy blood specimens were collected with addition of sodium fluoride and stored at 4°C. If one or more antidepressants were detected in a decedent, it was counted as one positive antidepressant death.

### Results

In Manhattan, between January 1997 and January 1999, there were 77 suicides, 36 accidents, 2 homicides, and 5 undetermined deaths due to blunt injury resulting from a descent from height. The 120 fatalities due to descent from height comprised 4.2% of the 2860 autopsies performed during the study interval.

### The Scene

For buildings, the height ranged from 3 to 47 stories for suicides and from 1 to 11 for accidents. The range of 3 to 11 stories was the most frequent height for accidents (82%) and included 50% of the suicides (see Table 1). No accidents and the remaining 50% of suicides were above 11 stories. No suicides and 18% of accidents occurred below three stories.

Six people intentionally jumped from bridges while three accidentally fell from bridges. In three suicides, the height could not be determined due to lack of witnesses or of a clear departure site (e.g., fire escape stairs). One accident was from a single-story-height wall. The range of building heights in Manhattan is 1 to 110

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TABLE 1—Summary of suicide versus accident data.

	Suicide	Accident
Total	77	36
Age range, years (mean)	16–92 (43)	19–62 (39)
Men: Women	49 (64%): 28 (36%)	33 (92%): 3 (8%)
White: Black: Asian	59 (77%): 10 (13%): 8 (10%)	25 (69%): 10 (28%): 1 (3%)
Suicide note found	20 (26%)	0 (0%)
Location:		
Home	53 (69%)	7 (19%)
Work	2 (3%)	15 (42%)
Bridge	7 (9%)	3 (8%)
Other	15 (19%)	11 (31%)
Site		
Window/Balcony	47 (61%)	11 (31%)
Roof	21 (27%)	9 (25%)
Construction Site	0 (0%)	12 (33%)
Other	9 (12%)	4 (11%)
Height (Stories)		
Range	3–47	1–11
<3	0 (0%)	6 (17%)
3–11	34 (44%)	27 (75%)
>11	34 (44%)	0 (0%)
Unknown/Bridge	9 (12%)	3 (8%)
Psychiatric illness*	66 (86%)	6 (17%)
Positive toxicology†	50 (69%)	14 (39%)
Psychiatric medications	20 (28%)‡	0/31 (0%)
Ethanol/illicit drugs	21 (29%)	11/31 (36%)

\* Including substance abuse.

† Five not tested due to prolonged hospitalization.

‡ Four had unfilled prescriptions for psychiatric medications.

stories. The average and distribution of the number of floors for all buildings in Manhattan is unknown.

The location of the descent was the decedent's residence in 69% of suicides and 19% of accidents and at his/her workplace in 3% of suicides and 42% of accidents. Fewer than 10% of both accidents and suicides were from bridges. Windows/balconies were the point of exit in 61% of suicides and 31% of accidents. The roof was the location in 27% of suicides and 25% of accidents. No suicides but 33% of accidents occurred from scaffolding/construction sites. All suicides and 66% of accidental deaths were pronounced dead at the scene or on admission to the emergency room. Suicide notes were found in 26% of suicides and in no accidents.

### The Autopsy

Major injuries include aortic lacerations and fractures of the skull, pelvis, ribs, and extremities. Below six stories, 89% had rib fractures and this increased to 95% from six to ten stories and 100% above ten stories. Below six stories, 53% had extremity fractures and this increased to 90% from 11 to 20 stories and 100% above 20 stories. Skull fractures increased from 59% below 20 stories to 86% above 20 stories. Skull fractures were noted in 53% of deaths under six stories. Aortic lacerations and pelvic fractures were seen in approximately 40% of falls below six stories and increased to nearly 80% in falls of greater than 20 stories. There were two witnessed jumps from a 212 ft high bridge into the water. Both had typical deceleration injuries (e.g., aortic laceration), other internal blunt head/trunk injuries (without extremity fractures), and minimal external injuries.

The age, sex, and racial breakdowns are reported in Table 1. Above the age of 62, there were suicides (14%) but no accidental

deaths. There were no deaths under the age of 16. Men accounted for 92% of accidents and 64% of suicides. Of all deaths by descent among men, the manners were: 57% suicide, 38% accident, 4% undetermined, and 1% homicide. Among women, the manners were: 82% suicide, 9% accident, 6% undetermined, and 3% homicide.

### Psychiatric History

Psychiatric illness (including substance abuse) was reported in 86% of the suicide deaths and 17% of accidents. For suicide, these include: major depression (51%), substance abuse with depression (12%), depression with a major/terminal illness (8%), schizophrenia (7%), psychiatric illness NOS (7%), and substance abuse (3%). For the accidents, these include: one psychotic illness NOS, one bipolar illness, and four with substance abuse.

### Toxicology

Toxicological testing was performed on all deaths. Psychiatric medications were detected in 28% of the suicides and in none of the accidental deaths. Ethanol and/or illicit drugs were detected in 29% of suicides and 36% of accidents. Blood alcohol concentrations ranged from 0.06 to 0.49 g% among suicides and 0.06 to 0.3 g% among accidental deaths.

The types of medications detected in the suicides and accidents are listed in Table 2. Toxicology results at the time of the fall of five of the accidental deaths could not be determined because of prolonged survival and/or absence of hospital testing or hospital samples. Only medications detected by toxicologic testing are included. Four of the suicides had unfilled prescriptions for antidepressant medications.

### Special Circumstances

Four of the accidental deaths were men who fell during attempted burglaries. Four of the suicides were "homeless" persons who jumped from publicly accessible buildings. Three deaths involved breaking through a closed window, including: a man witnessed to jump through a closed window at an immigration office (suicide); a hospitalized psychotic man, expressing suicidal ideation, who smashed a window with his I.V. pole and then jumped through it (suicide); and a person who was heard in an agitated psychosis by neighbors, expressing paranoid ideation ("people are after me"), and then jumped through a closed window from his secure apartment (undetermined manner). In a small number of cases, the medical investigator noted that the decedent had removed his/her shoes before jumping.

TABLE 2—Summary of toxicologic findings in suicides and accidents.

	Suicide*	Accident
Sedative-Hypnotics	13/77 (18%)	2/31 (7%)
Antidepressants	13/77 (18%)	0
Antipsychotics	5/77 (7%)	0
Ethanol	14/77 (19%)	5/31 (16%)
Blood alcohol concentration, g% (mean)	0.06–0.49 (0.17)	0.06–0.30 (0.14)
Cocaine/benzoyllecgonine	9/77 (13%)	8/31 (26%)
Methadone	6/77 (8%)	1/31 (3%)
Antihistamines	14/77 (19%)	0
Salicylates/acetaminophen	3/77 (4%)	0

\* Five not tested due to prolonged hospitalization.

Several of the accidental deaths involved men attempting to climb into or out of an apartment for a variety of reasons: locked out, to avoid conflicts with a returning lover's spouse, and burglary. The various risky means used included stepping onto air conditioners or window ledges and climbing down cable TV coaxial wires. Two deaths involved men who may have had grandiose notions about their physical abilities (one with bipolar disease and one with an acute cocaine intoxication). Of the accidental deaths in women, two jumped to escape from the same house fire and one fell from her apartment while attempting to fix a window fan that subsequently dislodged.

For the homicides, one victim was pushed by her assailant and the other was attacked by armed intruders and jumped from a window in an attempt to escape. Five deaths had unclear circumstances or confounding variables such as schizophrenia or substance abuse and were certified as undetermined manner.

## Discussion

The investigations of 120 deaths due to falls from height were examined to determine what findings can aid in the determination of the cause and manner of death. As with most violent injuries, the proximate cause of death usually is not difficult to determine. The manner, however, may not be as clear. From this study, we will discuss certain scene, autopsy, psychiatric, and toxicology findings that may assist in the certification of death.

### The Scene

The scene investigation by a medicolegal death investigator is crucial to properly certify a death from a descent from height. The important "scene" to examine is not where the body is but where the body *was* before the descent since this may help demonstrate intent. In order to certify a death as a suicide, the violent death must be caused by an intentionally self-destructive act. Suicide notes establish intent but were found in only ¼ of these deaths that were classified as suicides. This percentage is slightly lower than reported in suicides by other causes (4,5) but similar to one study of suicide by descent from height (3).

The barrier that prevents an accidental fall may help in demonstrating intent and is important to document. The window (height from floor and size of opening), railing, ledge, wall, and/or fence should be measured and photographed. The intent needed for a suicidal certification may be satisfied if it can be demonstrated that a person needs to commit an intentional act in order to get out of a window or over a railing. If the balcony railing is above the decedent's center of gravity, that person could not have accidentally fallen over the railing. The majority of people committed suicide at their home from a window or balcony. It is rare for a person attempting suicide to jump through a closed window and those who do typically have a psychotic illness.

It is difficult to deduce the intent of psychotic patients who may believe people are out to get them and jump to escape or who may believe that they can "fly." We commonly classify such deaths as undetermined or accidental, even if it is clear that they intentionally jumped. In this study, we certified five deaths (4%) as undetermined manner. A previous study on falls from height in London from 1958 to 1978 included 146 deaths with 26 (18%) certified as open verdict. These cases included people with substance abuse, mental illness, and epilepsy (6).

Overall, suicides occurred from higher floors than accidents. Half of the suicides and none of the accidents were from above 11 floors. This is further demonstrated by the fact that all suicides

were dead at the scene or on arrival to the hospital while several of the accidental deaths survived for hours to years. Overall, a person intent on taking his/her own life is more likely to descend from a higher height than those who fall accidentally. There is, however, substantial overlap and the height should not be used as the sole indicator of the manner. Clinical studies demonstrate that falls below four stories are usually survivable and above seven are usually fatal (2,7–9).

The distance of the impact site from the base of the building has been proposed to determine if a person leaped from a building or fell straight down (10). These data were not routinely collected in the Manhattan deaths. From the few reports that did record this measurement and from scene photographs, the distance from the building does not appear to be a reliable indicator of intent.

The intentional act of "jumping" is not always enough to classify a death as a suicide. In this review, two women jumped from a fifth floor balcony due to heat from an electrical fire in their home. The deaths, due to blunt injury, were certified as accidents because the women did not intend to kill themselves.

Most suicides occurred at the decedent's residence while most accidents occurred at a workplace. All descents at construction sites were determined to be accidental work-related mishaps. In a study by Kisner and Fosbroke (11), the three leading causes of death for construction workers in the United States in the 1980s were falls (25%), electrocutions (15%), and motor vehicle-related incidents (14%). Of fatalities in the construction industry, 99% involve men (11,12). In these deaths the autopsy has a second major role: the evaluation of natural disease. A person who has a fatal arrhythmia while on scaffolding has numerous implications for insurance benefits and work-related lawsuits. Marked natural disease with an inefficient blunt injury mechanism and/or injuries with little vital reaction would favor the natural disease. Unfortunately, the autopsy seldom discloses natural disease inconsistent with continued life.

### The Autopsy

The pattern of internal and external injuries can help in the determination of how the injuries occurred and the manner of death. Typically in a fall, one sees *planar impacts*. Planar impacts are blunt injuries to one body surface plane and are due to a single impact on a flat surface. Distinct lacerations and contusions on various surfaces of the body (i.e., nonplanar) or on the back of the hands are unusual in simple falls unless the person struck protruding objects on the way down (air conditioner, balcony). Blunt injuries of different body surfaces without major trunk and extremity fractures are typical in bludgeonings. Fractures of the pelvis, long bones, and spine were common in falls from height and are unusual in pure bludgeoning deaths.

Certain injuries, although not common, are nearly pathognomonic for a descent from height. Ring fractures of the base of the skull, open fractures of the soles of the feet, compression vertebral fractures, and inverted V-shaped symmetrical inguinal lacerations of skin (and even clothing) are seen with falls from height with feet-first impacts (Fig. 1). Certain injuries may help in the determination of the manner of death. Palmar injuries of the hands may be useful to reconstruct the events surrounding a fall (Fig. 2). These abrasions (commonly referred to as "rope burns") are consistent with tightly holding an object while that object moves through one's grasp. Parallel wrist incisions (hesitation marks) or scars may be a sign of a recent or remote suicide attempt.

The types of injuries are similar to those described in other studies of falls from height (1,3,7,8,13–16). The extent of injuries

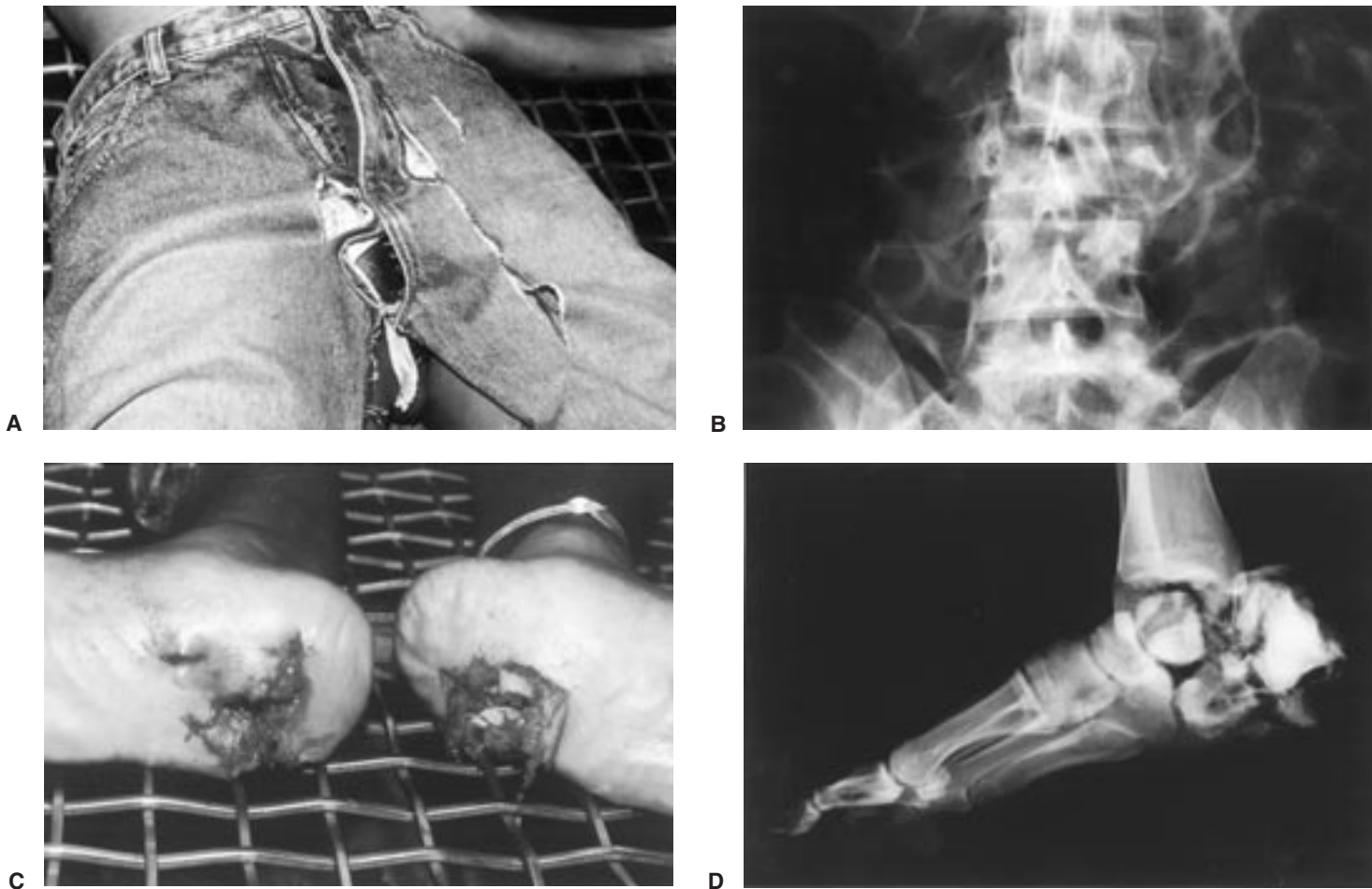


FIG. 1—Feet first impacts: (a) inguinal clothing tears, (b) radiograph of vertebral compression fracture in a 25 year old man, (c) open fractures of the soles of the feet, (d) radiograph of open fractures of the ankle.

documented in all manners was quite variable but there were overall trends. Rib fractures were nearly universal in descents above three floors. Pelvic, skull, and aortic injuries showed a steady increase with increasing height. The skull and pelvic fracture findings confirm their greater resilience compared with ribs and some long bones. Height of descent, body landing position, impact surface, and clothing can affect the extent and distribution of external and internal injuries. Failure to examine the posterior neck and to strip the dura mater, parietal pleura, and psoas muscles also may underestimate the degree of injury. Due to these factors and the resultant variation in injuries, it is unwise to attempt to conclude, based upon the extent of injuries, from how high a person descended. Mathematical models have attempted with some success to relate the height of the fall to the extent of injuries (17). External findings can be particularly misleading since there can be a dichotomy between the extent of the external and internal injuries. Falls into water are notorious for this external-internal injury disharmony.

Falls into water may complicate the proximate cause as well as the manner of death. Is the cause of death drowning or blunt injury? Drowning is favored when there are no or minimal injuries (or injury consistent with superimposed water-related artifacts). Two descents into water were witnessed and each had minimal external but marked internal injuries. In unwitnessed deaths into water, the



FIG. 2—Hand abrasions in accidental fall from height.

autopsy can reveal internal injuries that may aid the police in the investigation and/or reconstruction of the death.

Studies by Lukas and Snyder examined deaths and survivors from descents from the Golden Gate Bridge in San Francisco which has a height of 250 ft (17 to 25 stories) at midspan (14,18). Among the deaths, 71% had rib fractures, 42% had other skeletal injuries, and 27% had lacerations of the great vessels. In the present

study, among nonwater impacts from heights over 11 stories but lower than the height of the Golden Gate, all had rib fractures, 90% had extremity fractures, and 77% had aortic lacerations. These findings highlight the importance of the impact surface's relationship to the extent of injury (3,13).

The epidemiologic profile of these deaths may aid in the determination of the manner of death. The vast majority of accidental deaths (92%) were men. This finding is similar to the 94% found by Li and Smialek (3). Accidental falls by women made up fewer than 3% of all manners of descent deaths. This relatively small number may be due to the fact that fewer women are employed in construction/manual labor occupations (11) and women may take fewer unnecessary physical risks than men. The age range of accidental and suicidal deaths were similar and therefore not helpful in distinguishing manners among adults. There were no deaths due to falls from height in children under the age of 16. In 1971, Bergner reported that falls from height represented 12% of all accidental deaths in children under age 15 in New York City (19). In 1972, the New York City Department of Health developed a "Children Can't Fly" educational program. In 1976, the New York City Health Code was amended to require owners of multiple dwellings to provide window guards in all apartments where children ten years of age or younger resided (20). Other studies have demonstrated the effectiveness of these interventions in reducing childhood falls from height (16,21).

#### *Psychiatric History*

As expected, psychiatric illness was reported in a high percentage of suicides in this study and in others (5,22). The nearly universal denial of suicidal ideation by the deceased's medical care giver should not be taken as absolute. The treating physician is placed in a potential conflict of interest situation when queried about the suicidal propensity of a person under his/her care when that person was not placed in a hospital or other protective environment.

Only two psychiatric illnesses (other than substance abuse) were reported in the accident group. This may be related to the investigation and documentation since an investigator may not inquire about or document a history of psychiatric illness in a death that appears clearly accidental. The complete toxicologic absence of psychiatric medication in the accidental deaths, however, supports the paucity of psychiatric disease reported in this group.

#### *Toxicology*

The toxicology findings may aid in the certification of manner of death and can be grouped into three categories: drugs of abuse, psychiatric medications, and other medications. The similar percentages of detection of ethanol and/or illicit drugs in the suicide and accident groups make it an unreliable factor to distinguish the two manners. The toxicologic detection of psychiatric medications is helpful in verifying or establishing a history of major depression. These results may even underestimate the number of deaths treated with psychiatric medications. Several suicides had unfilled prescriptions for antidepressant medications or a history of current treatment with long acting intramuscular antipsychotic medications that may not be detected by routine toxicologic testing. In addition, some of the new selective serotonin reuptake inhibitors (e.g., paroxetine) may not be detected on routine screening. The detection of antidepressant medication is not always synonymous with depression. Several "antidepressant" medications are used for nondepressive illnesses: migraines, premenstrual syndrome, and epilepsy, etc.

Detection of certain nonpsychiatric medications also may support a manner of suicide. For example, antihistamines (over-the-counter, readily available sleep and "cold" medications) were detected in 19% of suicides and no accidents. Their prevalence may be related to sleep disturbances among the depressed (23,24) or may be a failed attempt at suicide by ingestion. Furthermore, three suicides had markedly elevated concentrations of salicylates or acetaminophen. These acute intoxications did not contribute to the cause of death but clearly support a manner of suicide. Toxicology testing should be performed even if there is a clear proximate cause of death at autopsy. The results may not change the cause of death but may affect the manner of death.

Toxicology results appear on the death certificate in two circumstances. The first is when the acute intoxication makes a physiologic contribution to the death. The second circumstance is when the cause of death does not make sense without an acute intoxication (such as an otherwise neurologically healthy adult who chokes on a bolus of food). People accidentally fall from heights for many reasons. From this study, the majority (64%) of accidental falls were not under the influence of ethanol or illicit drugs. The cause of death statement should not be an attempt to explain *why* the injury occurred. It is too judgmental to solely blame an acute intoxication for the fall and list that as the proximate (or contributory) cause of death. The person died from blunt injuries and not from the intoxication.

There is no single scene, autopsy, psychiatric, or toxicologic finding that can consistently and reliably be used to determine the manner of these deaths. This study describes certain findings, that when used in the context of a complete death investigation, may help to further support or refute a particular manner of death.

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