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Adolescent Death: A 15-Year Retrospective Review*

ABSTRACT: Adolescents comprise an eclectic mix of people vitally important to society yet long-term comprehensive studies on the circumstances of their deaths are lacking in the pediatric forensic literature. The authors reviewed all forensic cases referred to the Medical University of South Carolina Forensic Pathology section over the fifteen years between January 1989 and December 2003. In accordance with the World Health Organization (WHO) definition of adolescents, only decedents 10–19 years of age were included. The authors examined the cause and manner of death, age, gender, and race of the victims in all cases. The toxicology results, perpetrator, death scenario and location, and victim traits were analyzed when available. For all adolescents, the most common manner of death was accident followed by homicide, suicide, natural, and undetermined. Within the adolescent population two distinct groups, 10–14 years old and 15–19 years old, were identified. Though both groups were similar in that they experienced a high number of accidental deaths, decedents of older age group suffered a higher percentage of violent deaths while decedents of the younger group were more likely to die of natural causes. Many of the accidental deaths in this review were preventable, including deaths due to motor vehicle collisions and drowning. In deaths due to homicide, the perpetrator was often known to the victim, whether as an acquaintance or family member. Toxicology testing was often positive in decedents of the older age group, while only rarely positive in decedents of the younger age group. With a solid understanding of the circumstances, it may be possible to predict, and hopefully prevent, future cases of adolescent death. The authors present their findings in this 15-year retrospective study to better aid forensic pathologists, death investigators, law enforcement, and epidemiologists.

KEYWORDS: forensic science, forensic pathology, death, adolescents, autopsy, cause of death, manner of death, toxicology

Deaths in childhood and adolescence are tragedies not only for the decedent's friends and family but also for death investigators, medical examiners, forensic pathologists and others whose work is to certify and make sense of these unfortunate events. Adolescents are an interesting group, as they enter the period as children dependent on their families and leave as self-sufficient young adults. The health issues confronting adolescents also change over this period as congenital illnesses, natural disease, and neoplasms are reduced from leading causes of morbidity and mortality to much less common causes (1). At the same time, violent causes of death such as homicide and suicide become larger threats to adolescent lives (1). Still, many reports in the literature have focused on infant and early childhood deaths or concentrated on only specific aspects of adolescent death.

A better understanding of adolescent deaths as a whole might provide information to aid those whose work is to investigate and certify these deaths. Identifying common relationships of perpetrators to victims in violent deaths could help to find and convict the perpetrators. A review of the toxicology in these cases could help delineate any trends in drugs of use and abuse in the adolescent age group, making it possible to prevent some accidental deaths through public health and safety measures. A review of natural deaths will demonstrate the most common natural disease processes presenting in a forensic setting, which could help in determining the causes of sudden, unexpected deaths in this population. Finally, and most importantly, understanding the typical victim and circumstances

surrounding his or her death could help prevent future violent and accidental adolescent deaths.

Methods

A retrospective review was performed on all forensic cases referred to the Medical University of South Carolina Forensic Pathology section over a 15-year period from January 1989 to December 2003. Of this total, we looked at only adolescent deaths, ages 10 to 19 as defined by the World Health Organization (WHO). A total of 537 autopsies and investigations were identified in this group over the defined time period. The age, gender, and race of the decedent along with the cause and manner of death were determined in all cases by review of the autopsy log. Full case reviews were then performed in order to determine details of the deaths including circumstances leading to death, location of death, toxicology findings, and perpetrator in cases of homicide. Full case reviews were performed on 497 cases, as toxicology results and case details from 40 cases were not available for review. The cases were then further categorized according to cause of death. Data was separated into two age groups, 10–14 (113 cases) and 15–19 (424 cases) years, in order to detect differences in death trends within the adolescent population. Finally, decedents were classified by demographic groups (black male, black female, white male, white female, other male, and other female).

The Medical University of South Carolina Forensic Pathology section is located in Charleston, South Carolina. The majority of forensic cases are referred from the Charleston County coroner's office, however cases are also referred from other counties across the state. Charleston county is located on the southeast coast of the United States along the Atlantic ocean and has a diverse population of almost 310,000 people (2). The population, which is an admixture of urban and rural residents and is representative for the state

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TABLE 1—Classification of gender, race, and manner in all adolescent deaths.

	10–14	15–19
Total cases (%)	113 (100%)	424 (100%)
Sex		
Male	78 (69)	330 (77.8)
Female	35 (31)	94 (22.2)
Race		
Black	68 (60.2)	235 (55.4)
White	44 (38.9)	181 (42.7)
Other	1 (0.9)	8 (1.9)
Manner		
Accident	54 (47.4)	141 (33.3)
Homicide	20 (17.7)	163 (38.4)
Suicide	13 (11.5)	72 (17)
Natural	24 (21.2)	39 (9.2)
Undermined	2 (1.8)	9 (2.1)

as a whole, is mostly white (62% vs. 35% black) and has a male to female ratio of approximately 1:1.² Adolescents comprise approximately 15% of South Carolina’s population, yielding an estimate of almost 600,000 adolescents in the state (2).

Results

Overview

Of all adolescent cases, the most common manners of death were accident (36%), homicide (34%), suicide (16%), and natural (12%). Manner of death was left undetermined in 2% of the cases. Examination of the two age groups showed significant differences in the order of manners of death between the groups. In the 10–14 year age group the order, from most common to least common, was accident, natural, homicide, and suicide. This differs from the order of the 15–19 year age group that was homicide, accident, suicide, and natural (Table 1). A look at decedent demographics shows the

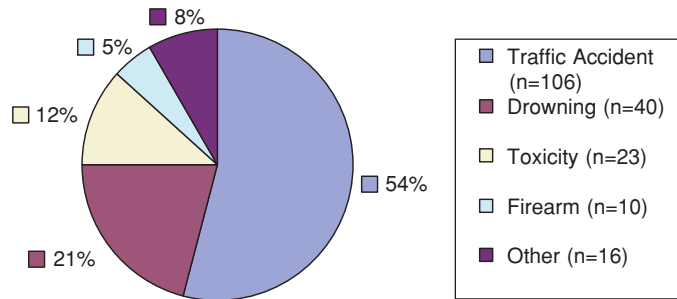


FIG. 3—Distribution of causes of death in accidental adolescent deaths.

most common gender was male (76%) and the most common race was black (56%), with no significant differences between the two age groups. The remainder of decedents were white (42%) and other (2%), a group mostly composed of Hispanics. No significant trends in the demographic groups or the cause and manner of death were seen over the period of study (Figs. 1 and 2). The data regarding the causes and manners of death in this review were determined from the original case files; however, upon review there were rare cases which would be classified differently at this point in time (3). As these cases would not affect the statistics significantly, the figures and tables were not adjusted.

Accident

As previously mentioned, accident was the most common manner of death overall and of the 10–14 year age group, while it was second most common manner of death of the 15–19 year age group. Accidental causes of death included motor vehicle collisions (MVC), drowning, drug toxicity, gunshot wounds (GSW), and other (Fig. 3). Male decedents outnumbered female decedents nearly 3:1, while there was no significant difference between races (Table 2).

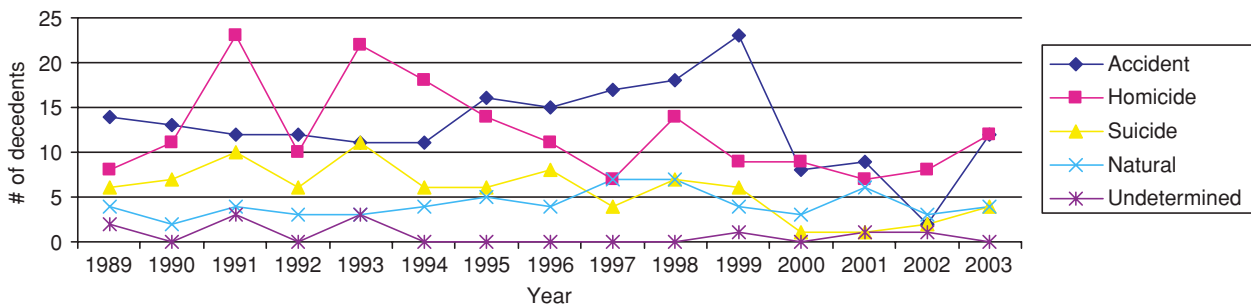


FIG. 1—Manners of death in adolescents over a 15-year period.

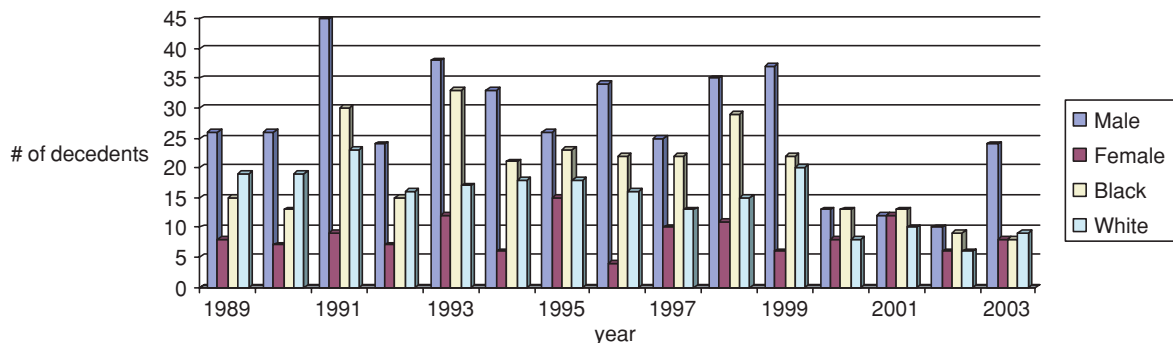


FIG. 2—Gender and race of adolescent decedents over a 15-year period.

TABLE 2—Manners of death and percentage accounted for by each demographic group. BM = black male, BF = black female, WM = white male, WF = white female, OM = other male, OF = other female.

	BM	BF	WM	WF	OM	OF
Accident (n = 195)	33.8	12.8	36.9	13.4	2.6	0.5
Homicide (n = 183)	60.1	13.6	18.0	7.1	0.6	0.6
Suicide (n = 85)	30.6	2.3	55.3	10.6	1.2	0.0
Natural (n = 63)	41.3	27.0	22.1	9.6	0.0	0.0
Undetermined (n = 11)	36.3	18.2	18.2	27.3	0.0	0.0

The MVC group included drivers and passengers of automobiles, motorcycles, go-karts, and all terrain vehicles along with bicycles and pedestrians. Of the 18 reports that mentioned restraint, 78% were not restrained (7 drivers, 7 passengers). Of the 83 reports in which toxicology was performed and available, 36% of decedents (18 drivers, 9 passengers, 3 pedestrians) had documented alcohol use. Blood ethanol levels of drivers ranged from 2 mg/dL to 255 mg/dL. Additionally, 13% of decedents (6 drivers, 3 passengers, 1 bicyclist, and 1 pedestrian) tested positive for other drugs at autopsy. Marijuana (7%) was the most common drug detected followed by ephedrine/pseudoephedrine (5%), and cocaine/benzoylcegonine (3%). Use of a combination of drugs and ethanol was seen in 7% of cases. Of note, MVC deaths accounted for 1/3 of all white female deaths, regardless of manner.

Drowning was the leading cause of accidental death in the 10–14 year age group and incidents occurred in the ocean, rivers, tidal creeks, pools, and a bathtub. Ethanol was identified on toxicology screens in 3 cases, with levels only up to 3 mg/dl. Additionally, one decedent had toxicology testing positive for marijuana, while two other decedents tested positive for therapeutic substances which may have contributed to death (diphenhydramine and sertraline); however, levels of these medications were within therapeutic ranges.

The drug toxicity group included accidental drug deaths (9 cases) and deaths due to carbon monoxide (CO) inhalation (14 cases). All 9 cases of drug toxicity were in the 15–19 year age group. Implicated drugs included butane (3 cases), freon, opiates, dimenhydrinate, acetaminophen, desipramine, and cocaine (all 1 case each).

Deaths due to GSW occurred in males of both age groups (4 cases 10–14, 6 cases 15–19) and races, but not in females. The underlying circumstances in the GSW deaths included human mishaps, hunting incidents, mechanical misfires, and two cases of Russian roulette. These two cases now would both be classified as suicides. Fifteen cases classified as “other” included blunt force trauma (boxing and crush injuries), electrocution, dehydration, explosions, and asphyxia (cases of both positional asphyxia and foreign body obstruction).

Homicide

Homicide was the second leading manner of adolescent death overall and the leading manner of death in the 15–19 year age group (Table 1). Homicides were due to GSW, sharp force injury, blunt force injury, and asphyxia. GSW accounted for the majority of homicides in both age groups (Fig. 4). Black males were the victims in over 60% of cases, accounting for the highest percentage of deaths in any demographic group regardless of manner (Table 2). Victims in homicides due to blunt force trauma and sharp force injury were evenly spread over the various demographic groups, while all 6 victims in strangulation deaths were females (2 black, 3 white, 1 other).

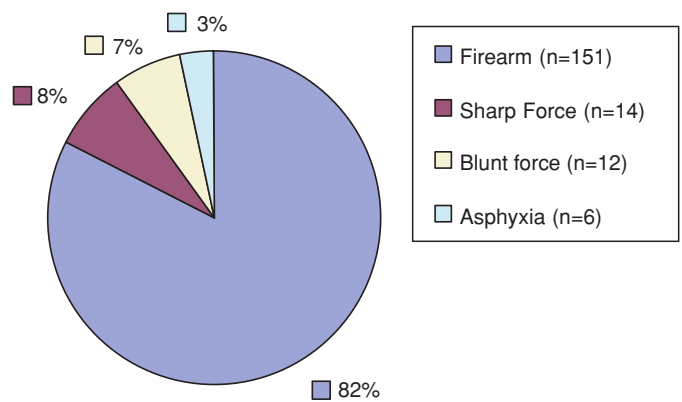


FIG. 4—Distribution of causes of death in adolescent homicides.

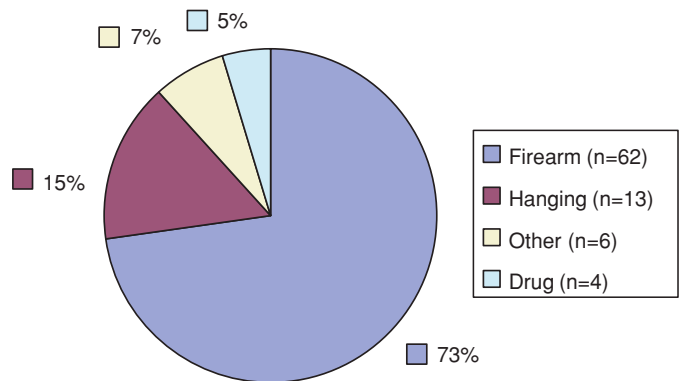


FIG. 5—Distribution of causes of death in adolescent suicides.

Examination of homicides by age group revealed some pertinent findings. Of the 19 cases of homicide in the 10–14 year age group available for review, 68% (13 victims) were killed by a close acquaintance or family member (4 parents/step-parents, 4 siblings, 5 close acquaintances). Of the 147 cases in the 15–19 year age group, the perpetrator was a family member (2 cases) or known to the victim (59 cases) in 42%. Most strikingly, of the 33 females in the 15–19 year age group, 10 victims (30%) were killed by a boyfriend or ex-boyfriend. Finally, the location of the homicide was known to the victim in at least 60% of cases. Familiar locations included decedent’s own homes or cars (23%), outside nightclubs (15%), at an acquaintance’s house (11%), in or near their neighborhood (7%), and at school or a school related function (5%).

Suicide

Suicide was the third most common manner of death overall and accounted for a higher percentage of deaths in the older age group (Table 1). Amongst all victims, males accounted for 86% of suicides, while whites accounted for 66% of deaths (Table 2). Amongst 10–14 year olds, whites (7 male, 4 female) were even more predominant, comprising 85% of the suicides. In contrast, only two black females committed suicide over the study period, regardless of age. Suicide deaths were due to GSW (including 5 cases of Russian roulette), hangings, “other,” and drug toxicity (Fig. 5). As previously mentioned, two additional cases of Russian roulette were originally classified as accidents and would now be classified as suicides. Causes of death in the “other” group included self immolation (2 cases), blunt force trauma secondary to bridge jump

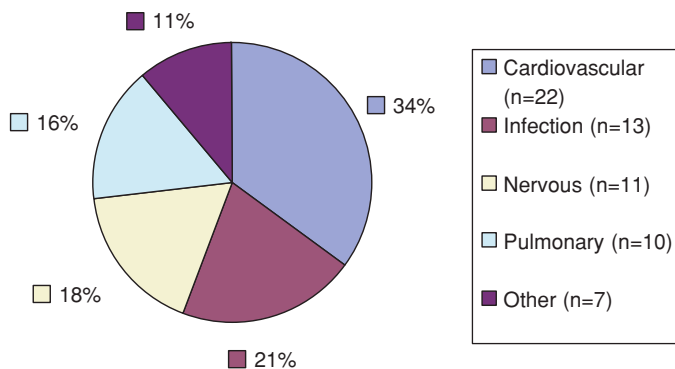


FIG. 6—Distribution of causes of death in adolescent natural deaths.

(2 cases), CO poisoning, and blunt force trauma secondary to MVC (1 case each).

Decedents committed suicide in their home or car in at least 57% of cases. The majority of adolescents in this review did little to give notice of their act. A note or verbalized warning was present in 24% of cases, 19% of decedents had a clinical diagnosis of depression or other psychiatric illness, and 8% of decedents had previously attempted suicide. In 35% of cases, the decedent recently experienced a severe stressful event including fights with significant others, police altercations, school problems, an accidental shooting of a friend, and collision in/of a family car.

White males accounted for all cases of suicide due to drug toxicity. Antidepressant agents (fluoxetine and sertraline, amitriptyline, and desipramine) were used in three cases, while caffeine tablets were used once. All three decedents who overdosed on antidepressant medications had either a history of suicide attempts or a history of clinical depression. In the caffeine overdose case, the decedent was witnessed ingesting forty 200 mg caffeine tablets after an argument with his grandmother.

Natural

Natural deaths, while accounting for the second most deaths death in the younger age group, accounted for the least number of deaths in adolescents overall (Table 1). Decedents of this group were diverse, with black males accounting for the most cases and white females accounting for the least (Table 2). Cardiovascular disease was the leading cause of death followed by infections, central nervous system disease, pulmonary disease, and “other” (Fig. 6). One decedent died due to pulmonary edema secondary to sickle cell disease. Causes of natural death in the “other” category include anaphylaxis, diabetes mellitus, heat exhaustion, muscular dystrophy, rhabdomyolysis, and sickle cell disease. The single case of heat exhaustion now would be classified as an accidental death.

Cardiovascular disease included arrhythmia of unknown etiology, cardiomyopathies, congenital anomalies, myocardial infarction, and Wegener’s granulomatosis. Infectious deaths consisted of myocarditis, pneumonia, and sepsis. Pulmonary disease included pulmonary emboli and status asthmaticus. Central nervous sys-

tem disease included arteriovenous malformation, complications of cerebral palsy, arrhinencephaly, and epilepsy.

Undetermined

The manner of death was left as undetermined in eleven cases, including decedents of all demographic groups (Tables 1 and 2). Five of these cases involved a question of suicide versus homicide (4 GSW, 1 hanging), three cases were badly decomposed, and three cases involved drug toxicity.

Toxicology

Toxicology results were reviewed in 447 cases (not available in 40 cases, not performed in 50 cases). Excluding resuscitative drugs, drug screens were positive in 42% of cases. Only 13% of toxicology screens in the 10–14 year age group were positive (8 caffeine/nicotine, 2 ethanol, 1 clonidine, and 1 sertraline). No drug screens were positive for multiple drugs in this age group.

Results were much different for the 15–19 year age group in which almost 50% of available cases yielded a positive drug screen (Table 3). Of this group, 17% of drug screens were positive for multiple drugs. The most commonly detected drugs were ethanol, caffeine/nicotine, marijuana (THC), cocaine (or benzoylecgonine), depressants (barbiturates and benzodiazepines), and stimulants (ephedrine, pseudoephedrine). Other drugs detected less commonly in this group include anti-depressants, opiates, inhalants (freon, butane), and lysergic acid diethylamide (LSD).

Discussion

The goal of this 15-year review is to analyze all adolescent deaths presenting in a forensic setting and to better characterize the decedents in these cases. This information could be used by others when investigating adolescent deaths and, hopefully, to prevent future deaths. This review has its limits due to its size; however, many of the trends seen in these deaths likely are true for other parts of the United States as well.

The demographics of all deaths in this review are worrying due to their discrepancy with the general population of the study area. While race of the population in Charleston County was 62% white and 35% black (2), the race of the decedents was nearly reversed as 56% were black and 42% were white. When removing fatalities due to homicide, blacks accounted for only 44% of the remaining deaths, a percentage much closer to that of the general population. Also, male decedents outnumbered female decedents by 3:1, a much greater ratio than seen in Charleston county and South Carolina, and also that of a previous study of adolescent deaths (4). Race and gender demographics were nearly equal in both age groups; however, deaths in the 15–19 year age group were 3–4 times as common as deaths in the 10–14 year age group, mirroring what is reported nationally (1).

Accident was the most common manner of death in this review, which is consistent with nationwide and other previously published statistics on adolescent death (1,4,5). Accidental deaths are not only

TABLE 3—Most common drugs detected on toxicology screens of autopsy specimens of 15–19-year olds over a 15-year period.
Caff/Nic = Caffeine/Nicotine.

	Total	Ethanol	Caff/Nic	THC	Cocaine	Depressants	Stimulants
Cases (%)	355 (100)	72 (20.3)	69 (19.4)	54 (15.2)	27 (7.6)	11 (3.1)	7 (2.0)

important because of their prevalence, but also because these deaths are often preventable. Similar to other studies, MVC was the most common cause of accidental death (1,4,5). Of all accidental deaths, these may be the most avoidable. Of the available data in this study, 78% of decedents were not restrained, and 36% of decedents had positive testing for alcohol at autopsy. Many dollars are spent each year at the local and national levels to encourage seat belt use and to curtail teen drinking and driving, and these statistics demonstrate that this effort must continue. These cases also illustrate the need for thorough death investigations to document restraint use along with drug and alcohol use. If nothing else, a toxicology screen and scene investigation (performed by a pathologist, coroner, or other qualified death investigator) should be completed in all cases.

Drowning deaths were most common in males, and were found in all ages and demographic groups. Interestingly, there was little evidence of drug or alcohol use in the drownings of this review, which does not correspond with previous reports (5). All drowning cases require a detailed history, scene investigation, and autopsy to rule out drug and alcohol use, evidence of foul play, and natural causes of death. To illustrate this point, one decedent in this review was a near-drowning victim in a hotel pool who died hours later. Unexpectedly, autopsy revealed lymphocytic myocarditis as the cause of death. A recent series detailed five similar cases (6). Drownings represent yet another group of preventable deaths. Current efforts to encourage proper parental supervision, safety vest use on boats, and properly secured pools could certainly prevent future drowning deaths.

Of note, seven mentally handicapped individuals died as a result of accidents. Causes of death in these cases were included in all previously mentioned data and include asphyxia or aspiration (3 cases), drowning (3 cases), and acetaminophen toxicity (1 case). Additionally, one 18-year-old physically handicapped decedent died of dehydration after his mother, his primary caretaker, died at home and the decedent was unable to call for help or consume food or drink. These cases require special attention as this group is not only more susceptible to accidents and certain natural diseases (aspiration pneumonia) than the general population, but they also are targets for neglect and abuse by their caretakers (5). For this reason, full post-mortem examinations should be performed in any unsuspected death involving these individuals.

Homicide was the second most common manner of death in this review. As with the national data, homicides were much more common in the 15–19 year age group than the 10–14 year age group (1). Also in accordance with national data, GSW was the most common cause of death in homicides (7). In this review, the typical victim was a black male in his late teenage years who was killed by an acquaintance in a place familiar to the victim; however, two other typical circumstances are of importance. Adolescents in the 10–14 year age group were killed by a family member (42%) or close acquaintance (26%) in 68% of cases. Also, females in the 15–19 year age group were killed by boyfriends or ex-boyfriends in at least 30% of cases. The demographic information of the victim and the typical perpetrator from this review are similar to that of a past review from this institution which only looked at homicides in children less than 5 years old, suggesting these trends hold true in all childhood homicides and not just those of adolescents.⁸ This information may be of paramount importance in determining the perpetrator in an adolescent homicide.

Suicides represent a tragic manner of death as adolescents take their life often in a hasty act. Cultural differences clearly played a role in this review as whites committed suicide twice as often as their black counterparts. Suicides in black females occurred only rarely. Firearms were used in over 70% of cases. The typical dece-

dent in this study was a white male in his late teenage years that shot himself at home or in a familiar place. The predominance of older, male decedents has been seen in other studies (9–11). One third of decedents in this study had recently experienced a significant stressful event including problems at school, relationship troubles, and run-ins with law enforcement. This stressful event may have given already suicidal adolescents a final reason to commit suicide, and previously non-suicidal adolescents may view the situation inescapable and resort to suicide. Sometimes it may be necessary to interview friends, classmates, teachers, and co-workers in addition to the decedent's family in order to detect a recent stressor. This is of importance as only a minority of decedents left a note, issued a verbalized warning, previously attempted suicide, or had a clinical psychiatric disorder (including depression and substance abuse). The absence of these classical signs and symptoms can complicate death certification (9,10). In order to alleviate this problem, it is imperative to obtain a detailed history and also to conduct a thorough investigation of the scene and the decedent's home in order to find any information which may aid manner classification. The absence of warning signs in the majority of cases makes prevention difficult; however, improved security and regulation of firearms may offer a means to prevent future suicides (9–11).

Natural deaths were present in both age groups of adolescents, but comprised a much higher percentage of the younger group, as seen in the national statistics regarding common causes of death in similar age groups (1). As this study only reviewed forensic autopsies and investigations, likely there is a bias against some natural causes of death. For example, malignant neoplasms are responsible for almost 10% of adolescent deaths nationwide (1), yet this review did not include one fatality due to malignancy. Still, many natural diseases in children and adolescents present with sudden death (12). There was a wide distribution of causes of sudden natural deaths, with cardiovascular disease being the most common. Deaths were due to congenital and acquired disease. Previous medical records along with family medical history should be obtained in cases of suspected natural death in order to understand the circumstances leading to death. This may be especially important if one questions arrhythmia, seizure disorder, asthma, or anaphylaxis—all causes of death from this review.

Toxicology screens for ethanol and drugs of abuse should be performed in every case of adolescent death. While positive drug screens were rarely positive in the 10–14 year age group of this review, the negative results were still helpful in ruling out causes of sudden death. Among the older age group, screens were positive for ethanol, marijuana, or cocaine in over 40% of cases. Positive analyses are essential to confirm drug toxicity and can also be helpful in understanding other deaths such as drownings and MVC. Furthermore, the results identify the drugs of abuse among the adolescent community (13). Drugs detected at autopsy may be the first evidence of new drug usage amongst adolescents. This information can be of use to emergency room physicians, as well as law enforcement officers and government officials in directing anti-drug efforts. In this review, accidental deaths were most frequently due to toxicity of volatile inhalants, but a variety of drugs were used. Suicide deaths were due to toxicity of an antidepressant agent in 3 of 4 cases, all four decedents white males. This is important in light of the recent United States Food and Drug Administration (FDA) public health advisory regarding the use of anti-depressant drugs in children and adolescents (14). Briefly, a short-term study of children and adolescents, with a clinical diagnosis of depression or other psychiatric disorder, taking nine different anti-depressant medications showed this group had a higher incidence of suicidal thinking and behavior when compared to the control group. The

greatest risk of suicidal behavior was in the first few months of treatment. Fastidious prescription habits and close monitoring of these adolescents could be helpful in preventing future adolescent suicides.

Conclusions

Adolescent deaths pose a challenge to the investigators, medical examiners, and pathologists who must work not only to certify the death but also to prevent future deaths. In order to accomplish these tasks one must be familiar with the most common circumstances, causes and manners, victims, perpetrators, natural diseases, and drugs of abuse in adolescent deaths. Our study revealed two distinct age groups within the adolescent group, 10–14 years and 15–19 years. The former is composed of mostly males who die as a result of accidents and natural deaths. In cases of homicide, the perpetrator is likely a family member or close acquaintance. The older group is predominantly male and, most often, death results from homicides and accidents. In cases of homicide, the perpetrator is likely an acquaintance, but only rarely a family member.

Toxicology plays a key role in identifying drugs of abuse and ruling out causes of sudden death. A thorough scene investigation is required in all deaths in order to collect as much information as possible to aid death certification. Social history is especially helpful in cases of suspected suicide in order to gain better insight to the decedent's mind frame at the time of the act. A detailed medical history can provide valuable information in sudden, natural deaths. Complete autopsies must be performed in a majority of cases to determine cause and manner of death. An understanding of pertinent information along with a well-coordinated approach should make it easier for one to certify adolescent death, and hopefully prevent future fatalities.

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