Confronting an Upsurge in Opiate Deaths With Limited Resources

Thomas A. Andrew, Jennie V. Duval

ABSTRACT

The dramatic increase in drug-related deaths in the last decade has presented fiduciary and logistical difficulties to medicolegal jurisdictions of all types and sizes. New Hampshire, with a centralized state medical examiner system of death investigation, has been confronted with the task of investigating these drug-related deaths against the backdrop of statutory hurdles inhibiting a nimble response to the situation. This has led to a collaborative approach with law enforcement and the state Department of Justice in terms of triaging drug deaths to full autopsy versus external examination with toxicology testing. Preliminary data suggest that between 11 and 13% of suspected drug deaths have an alternative cause of death revealed by autopsy. Positive toxicological findings were documented in 97.5% of cases in which only an external examination was performed; however, some of these cases may have had undetected, significant internal findings that could have accounted for an alternative cause of death if an autopsy had been performed. While the case triage system described has temporarily addressed the acute problem, the issue of the medical examiner's appropriate role in the adequate evaluation of public health and safety remains extant. Furthermore, noncompliance with the National Association of Medical Examiners inspection and accreditation standards puts this agency, and others facing the same issues, at risk of losing full accreditation status until such resource issues are addressed by legislators and other stakeholders in the quality of medicolegal death investigation in the United States.
Acad Forensic Pathol. 2017 7(1): 7-18

AUTHORS

Thomas A. Andrew MD, Office of Chief Medical Examiner, State of New Hampshire

Roles: A – Project conception and/or design, data acquisition, analysis and/or interpretation, manuscript creation and/or revision, approved final version for publication, accountable for all aspects of the work, principal investigator of the current study.

Jennie V. Duval MD, Office of Chief Medical Examiner, State of New Hampshire

Roles: Data acquisition, analysis and/or interpretation, manuscript creation and/or revision, approved final version for publication, accountable for all aspects of the work, principal investigator of the current study.

CORRESPONDENCE

Thomas A. Andrew MD, 246 Pleasant Street Suite 218, Concord NH 03301, TAndrewME@comcast.net

ETHICAL APPROVAL

As per Journal Policies, ethical approval was not required for this manuscript

STATEMENT OF HUMAN AND ANIMAL RIGHTS

This article does not contain any studies conducted with animals or on living human subjects

STATEMENT OF INFORMED CONSENT

No identifiable personal data were presented in this manuscsript

DISCLOSURES & DECLARATION OF CONFLICTS OF INTEREST

The authors, reviewers, editors, and publication staff do not report any relevant conflicts of interest

FINANCIAL DISCLOSURE

The authors have indicated that they do not have financial relationships to disclose that are relevant to this manuscript

KEYWORDS

Forensic pathology, Opiates, Fentanyl, Autopsy, Scene investigation

INFORMATION

ACADEMIC FORENSIC PATHOLOGY: THE OFFICIAL PUBLICATION OF THE NATIONAL ASSOCIATION OF MEDICAL EXAMINERS
 • (ISSN: 1925-3621) • https://doi.org/10.23907/2017.002
Submitted for consideration on 14 Dec 2016. Accepted for publication on 3 Jan 2017

INTRODUCTION

The last two decades have seen drug-related deaths increase by an order of magnitude in the state of New Hampshire (**Figure 1**). The upswing has been particularly swift in the last four years. In the late 1990s, there were 30-40 drug deaths annually in the Granite State. The mid 2000s saw major increases in prescription opiate/opioid abuse, with deaths approaching 200 per year and methadone being the agent most commonly indicated (**Figure 2**). The reemergence of heroin as a leading cause of drug-related fatalities in 2011 and recent emergence of illicit fentanyl and its analogues have pushed drug deaths to unprecedented levels (**Figure 3**). To date, fentanyl analogs isolated in our case material include U-47700, furanylfentanyl, acetylfentanyl, and fluorofentanyl.

Current intelligence suggests that fentanyl analogs are illicitly produced by clandestine laboratories, likely in Mexico and/or China, which then utilize the preexisting heroin distribution infrastructure to disseminate the drug. Contraband may appear as a pure white, light tan, or light brown powder, and range from fine to coarse to cake-like and crumbly, resembling powdered milk. The brown color comes from lactose that has been heated and caramelized slightly. Some packets will have a medicinal or chemical odor, but this is not characteristic. The product is typically sold like heroin in small ziplock-type plastic bags and bindles. There have been recent seizures in this jurisdiction and elsewhere of synthetic fentanyl pressed into tablets masquerading as hydrocodone and oxycodone. **Image 1** shows a 40 mg oxycodone pill side-by-side with pills seized in this jurisdiction, which, on analysis, were found to contain pure fentanyl.

At the time of this writing, it is projected that drug fatalities will number 488 by the end of the calendar year. Deaths are seen in decedents of a wide age range (**Figure 4**) and, like most high risk behaviors, tend to involve males two to three times more often than females (**Figure 5**). The decided majority of drug intoxications are certified as accidents (**Figure 6**). In 2014, the last for which nationwide data is available, New Hampshire, with its population of 1.33 million, ranked

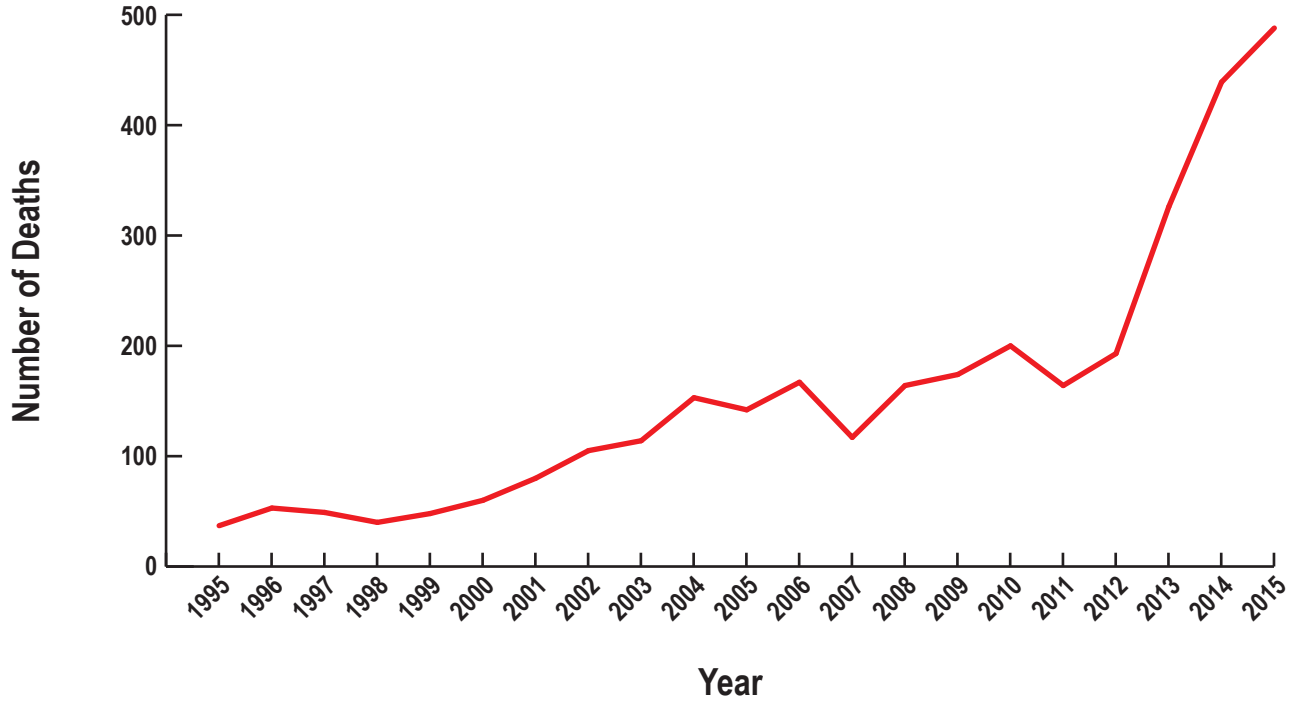

Figure 1: New Hampshire drug deaths, 1996-2015.

third in the United States, with 26.2 drug deaths per 100 000 population (1).

Ripple effects of these trends can be seen in other areas that directly impact the death investigation system in New Hampshire. After nearly a decade of slow but steady decline, traffic fatalities have increased from 95 in 2014, to 114 in 2015, and a projected 135 in 2016 (**Figure 7**). Suicides and homicides, which have remained flat for a decade, appear poised to increase as well. In addition, the potential for workplace exposure to hepatitis C has dramatically increased. All these developments are against a background of a medical examiner statute (2) that establishes two forensic pathologist positions and no provision for building any "surge capacity" to meet a public health and safety emergency such as the current drug death situation. As early as 2006, the State of New Hampshire Office of the Chief Medical Examiner (OCME) recognized the growing need for additional forensic pathology full-time equivalents, but in a climate of fiscal austerity, could not convince stakeholders this was a priority item compared to other needs deemed more pressing.

With drug deaths alone approaching 500, the remainder of OCME's caseload, crippled toxicology and body transport budgets, and the prospect of no additional forensic pathologists to perform the extra autopsies, the situation was deemed unsustainable. An infusion of federal dollars directed at the problem did not translate into assistance for OCME, but did lead to the addition of two new prosecutors and the formation of a statewide Drug Death Task Force (DDTF) based in the Department of Justice (DOJ). The mission of

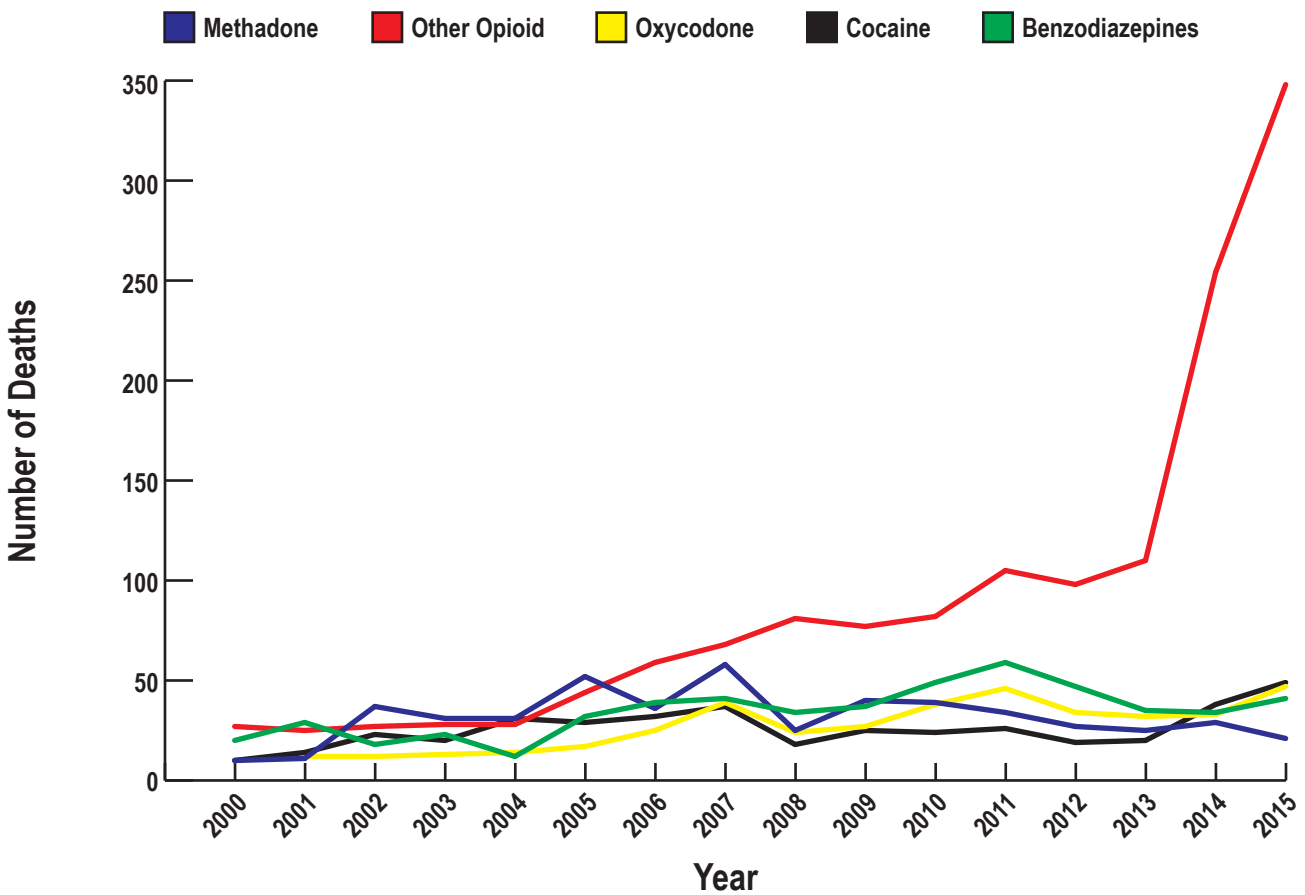

Figure 2: Drugs most commonly listed in death certificates, 2000-2015.

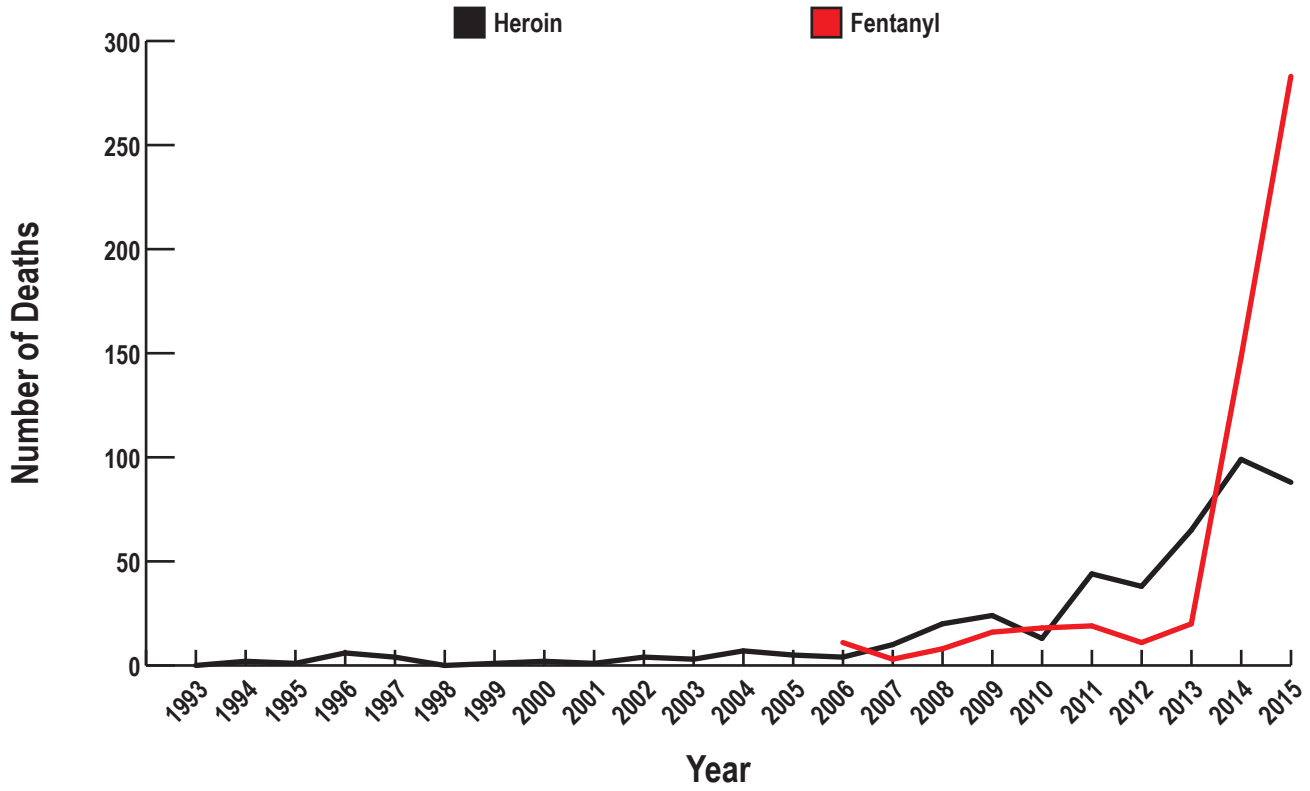

Figure 3: Emergence of heroin and fentanyl.

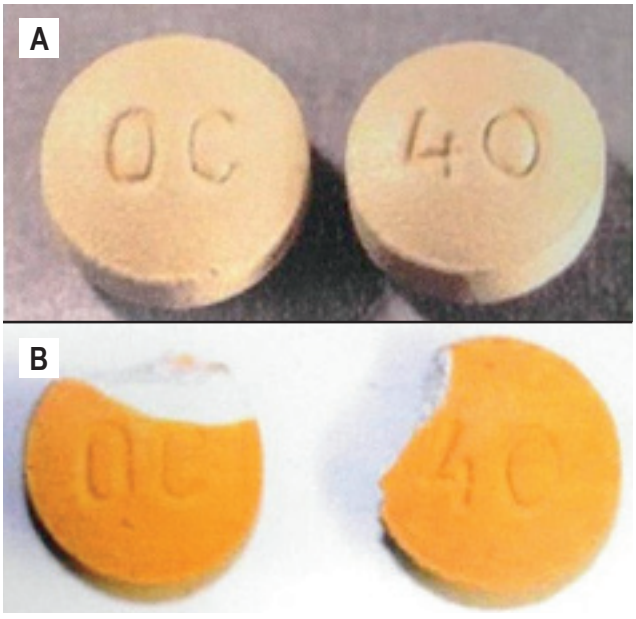

Image 1: Fentanyl marketed as oxycodone. **A)** Pharmaceutical oxycodone 40 mg. **B)** Seized by New Hampton, New Hampshire Police Department: pure fentanyl and no oxycodone.

the DDTF is ostensibly to more aggressively pursue prosecutions in drug deaths utilizing a "death resulting from" statute. This, of course, did not address the resource issue at OCME and negotiations commenced to find a middle ground.

The agreed upon protocol consists of a two-tiered approach to deaths that appear to be due to drug intoxication (**Figure 8**). For deaths occurring in hospitals, if there is a significant (days) survival interval and fatal intoxication has been proven or if the death is in the emergency department and no substantial case leads are developed within 24 hours, the case is released after external examination and procurement of appropriate toxicology specimens. If there is a survival interval but intoxication remains unproven or if the

death is in the emergency department and substantial case leads are developed within 24 hours, an autopsy is performed. Note that these decisions do not rely on emergency department or hospital drug screens. Routine toxicology testing in hospitals in our jurisdiction is typically performed on urine and will not detect fentanyl or fentanyl analogues. Positive results in urine may indicate recent use but not necessarily acute intoxication. Negative results will not rule out use of fentanyl and fentanyl analogues. In these cases, admission blood is obtained and submitted to a full service laboratory for comprehensive toxicology testing. With regard to scene deaths, the presence of drug paraphernalia, physical stigmata of recent drug use, known history of drug abuse, or witnessed event will result in external examination with toxicology unless there are substantial case leads developed within 24 hours. In the latter case, as well as cases in which scene and circumstances are unclear, an autopsy is performed. A representative of the DDTK is on call 24 hours a day to "start the clock" on the development of case leads. The Office of Chief Medical Examiner, in cooperation with local funeral homes, will hold decedents for the 24 hour period within which case disposition is ultimately made.

Conspicuously absent in the system is input from the Public Health department. This is due, in part, to OCME being part of the DOJ in this jurisdiction. The unfortunate reality is that the Public Health department is also operating beyond capacity, and has raised no substantive objections to this approach. Neverthe-

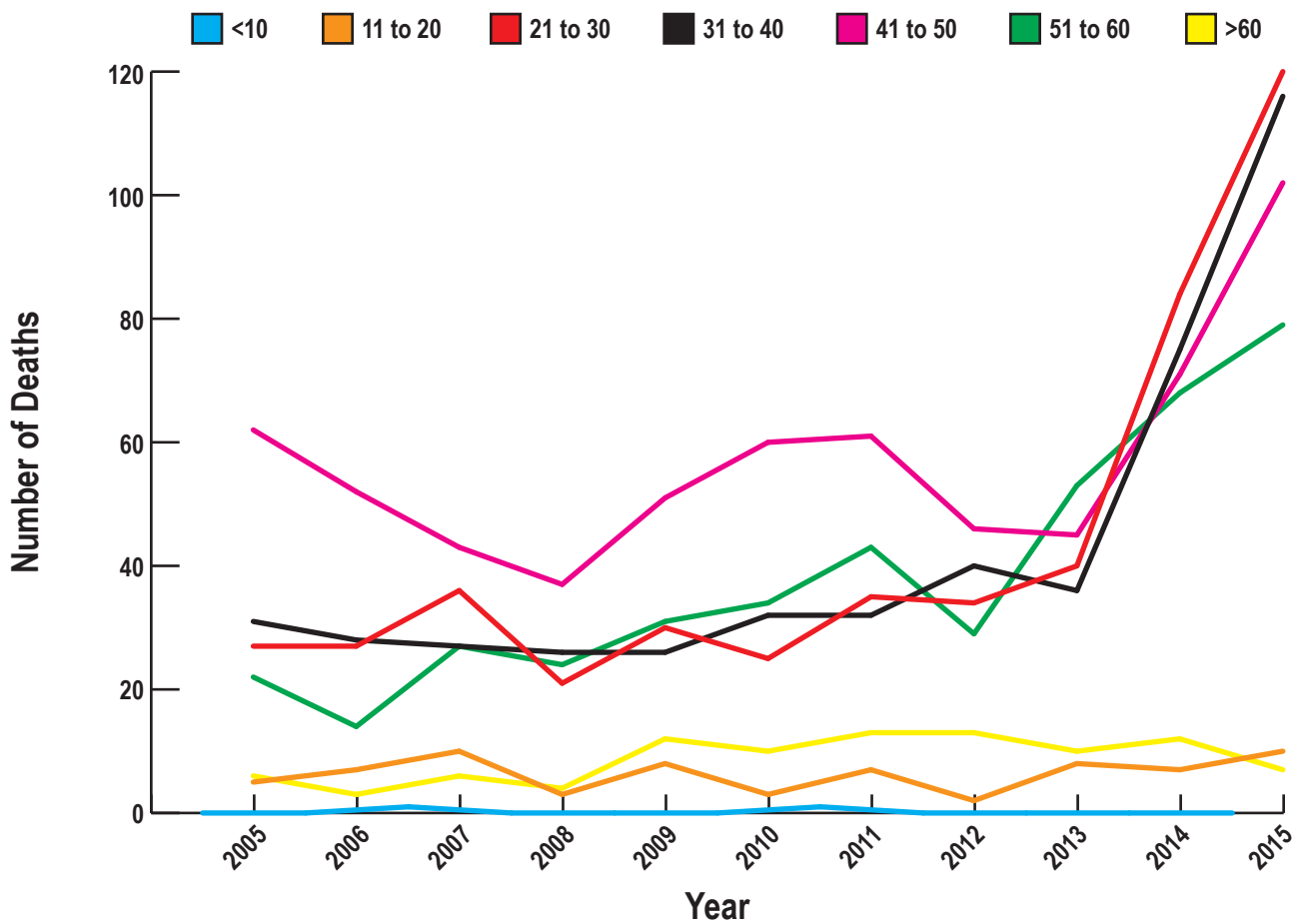

Figure 4: Drug deaths by age, 2005-2015.

less, there is public health impact addressed in our discussion. Undisputed is the existence of a National Association of Medical Examiners (NAME) autopsy performance standard to autopsy all suspected drug intoxication deaths (3). There are certainly medicolegal jurisdictions that have the capacity to absorb the extra caseload, but the reality in a jurisdiction with limited resources is that compliance with this standard will necessarily require noncompliance with other standards, including autopsies per pathologist, turnaround time parameters, and overall quality of work product.

Over many decades, there have been numerous studies documenting the inaccuracy of death certification without the benefit of autopsy (4-13). Discrepancy rates ranging from 9 to 40% have been identified in these studies, nearly all of which deal with inaccuracies of clinical diagnoses when compared to postmortem examination. Four studies, one by Asneas and Paaske in 1980 (14), a second by Vanatta and Petty in 1987 (15), a third by Nashelsky and Lawrence in 2003 (16), and the fourth by Gill and Scordi-Bello in 2010 (17) specifically compared autopsy to external examination. The most common cause of death in these studies was some variation of hypertensive and arteriosclerotic cardiovascular disease. In the Nashelsky study, there were four fatal drug intoxications comprising 1.5% of the study group (16). No study specifically addressed the reliability of predicting fatal drug intoxication based on scene investigation, external examination, and toxicological analysis. The small, in-house study outlined below represents an effort to determine the reliability of this approach in the accurate determination of cause of death.

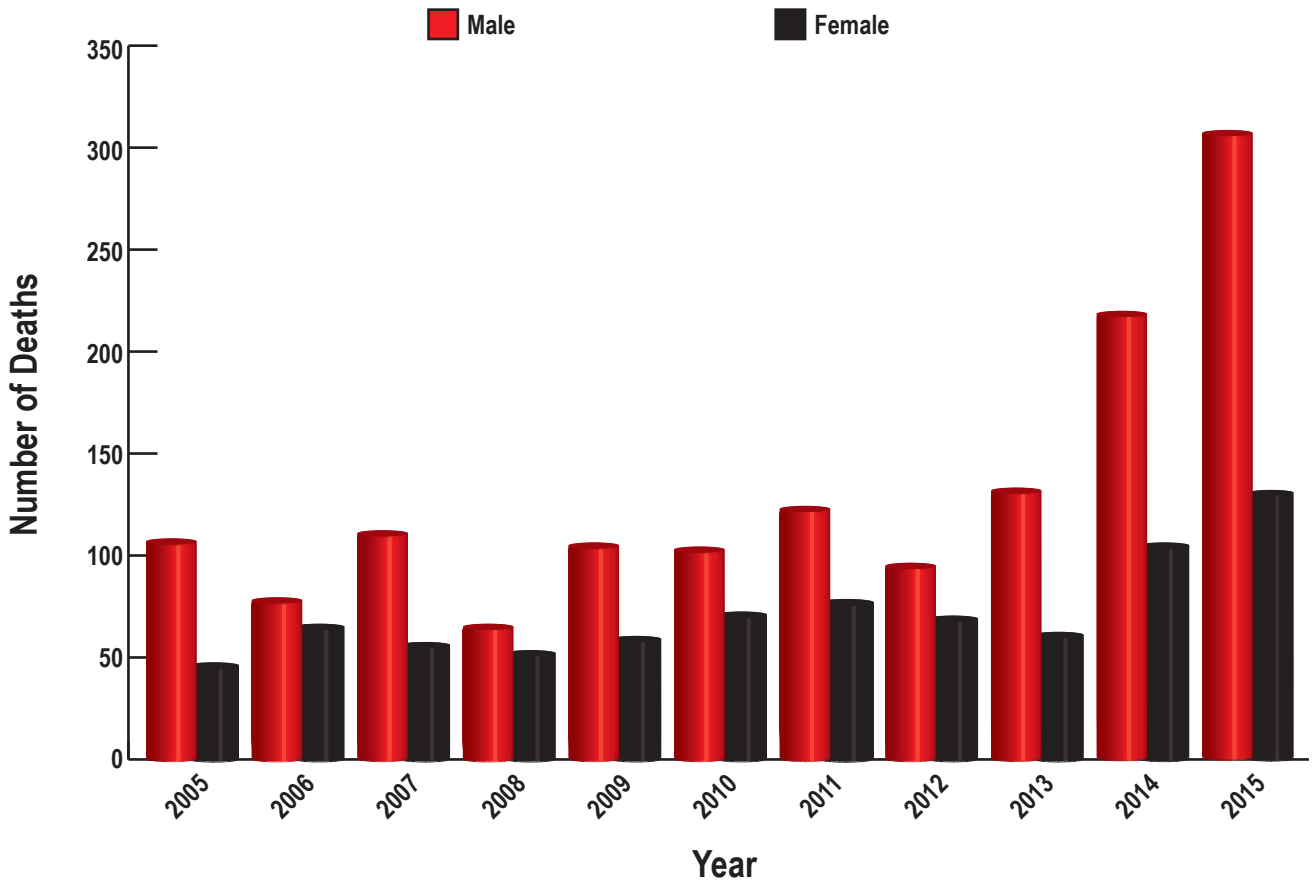

Figure 5: Drug deaths by sex, 2005-2015.

METHODS

Medical examiner cases flagged at initial investigation as likely drug-related were culled from OCME case management software. Ultimate cause of death for all such cases, both those autopsied and those released after external examination and procurement of toxicology specimens, were recorded. A comparison was then made between the two groups to determine what percentage of autopsy cases had causes of death other than drug intoxication versus what percentage of externally examined cases had nondiagnostic toxicology results. A retrospective review was then undertaken for calendar year 2010, at which time all suspected drug deaths were routinely autopsied.

RESULTS

To date in calendar year 2016, there have been 364 cases that have fallen into one or the other of the categories described above. Eleven cases remain pending as of this writing and are not included in the statistics. Data are summarized in **Table 1**.

In 16 of 152 (10.5%) autopsied cases, an alternative cause of death was revealed. Eight were due to hypertensive and/or arteriosclerotic cardiovascular disease, three were due to acute ethanol intoxication, two were due to complications of chronic alcoholism, and two deaths were due to infections, one with acute bronchopneumonia and subacute myocarditis and another with sepsis with multi-organ system involvement in a person with AIDS. The last case involved a 36-year-old male with a long-standing substance abuse history found submerged near the bank of a river. Toxicology revealed ethanol concentration of 389 mg/dL and no other substances. Death was certified as due to drowning.

In five of 200 (2.5%) external-exam-only cases, an alternative cause of death was revealed, four of which were attributed to arteriosclerotic cardiovascular disease based on clinical history. The fifth case was an

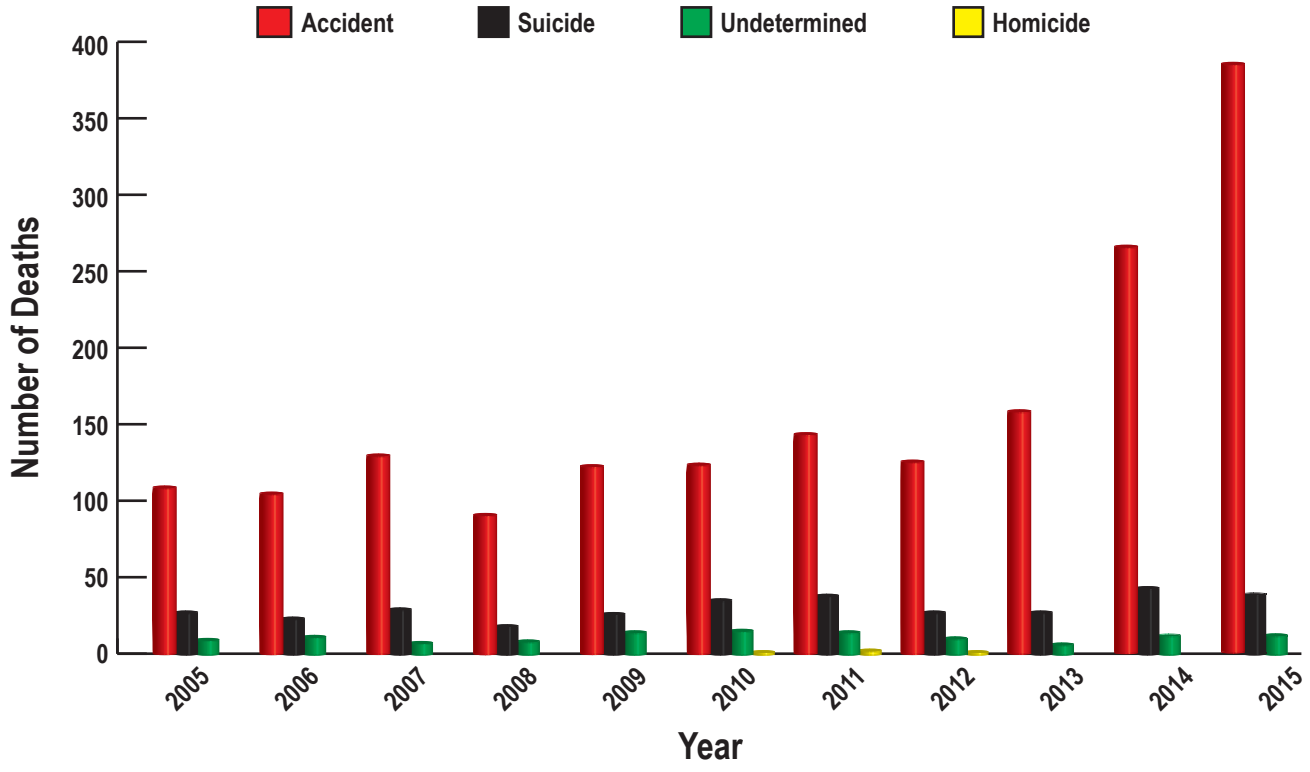

Figure 6: Drug deaths by manner.

individual with a documented intracerebral hemorrhage in which stimulant abuse was suspected, but not proven.

The 2010 data are summarized in **Table 2**. All 91 deaths suspected to be drug-related based on investigative information alone, were referred for autopsy. These represent cases wherein an external examination with toxicology would be performed in 2016. In 79 cases, the cause of death was indeed due to acute drug intoxication. Alternative causes of death revealed at autopsy in 12 (13.2%) cases included five deaths due to arteriosclerotic cardiovascular disease, and one each of meningitis, pulmonary thromboembolism, pulmonary vascular disease stemming from injection of oral pharmaceuticals, aspiration pneumonitis, acute ethanol intoxication, and diabetic ketoacidosis. One case was certified as manner undetermined. Of the 12 cases that had alternative causes of death, five (5.5%) had a positive toxicology screen. Results for this group are summarized in **Table 3**.

DISCUSSION

The aim of this brief review was to determine the reliability of the approach of not performing autopsies in all suspected drug-related deaths. The following are possible outcomes and explanations using such an approach:

1. No autopsy/Toxicology negative:
   a. True cause of death missed by not doing autopsy
   b. True drug death but agent undetected
      i. Fentanyl analogues or novel psychoactive substances beyond laboratory detection capacity
      ii. Drug metabolized to undetectable levels

2. No autopsy/Toxicology positive:
   a. True drug death
   b. Not a drug death, true cause of death missed by not doing autopsy

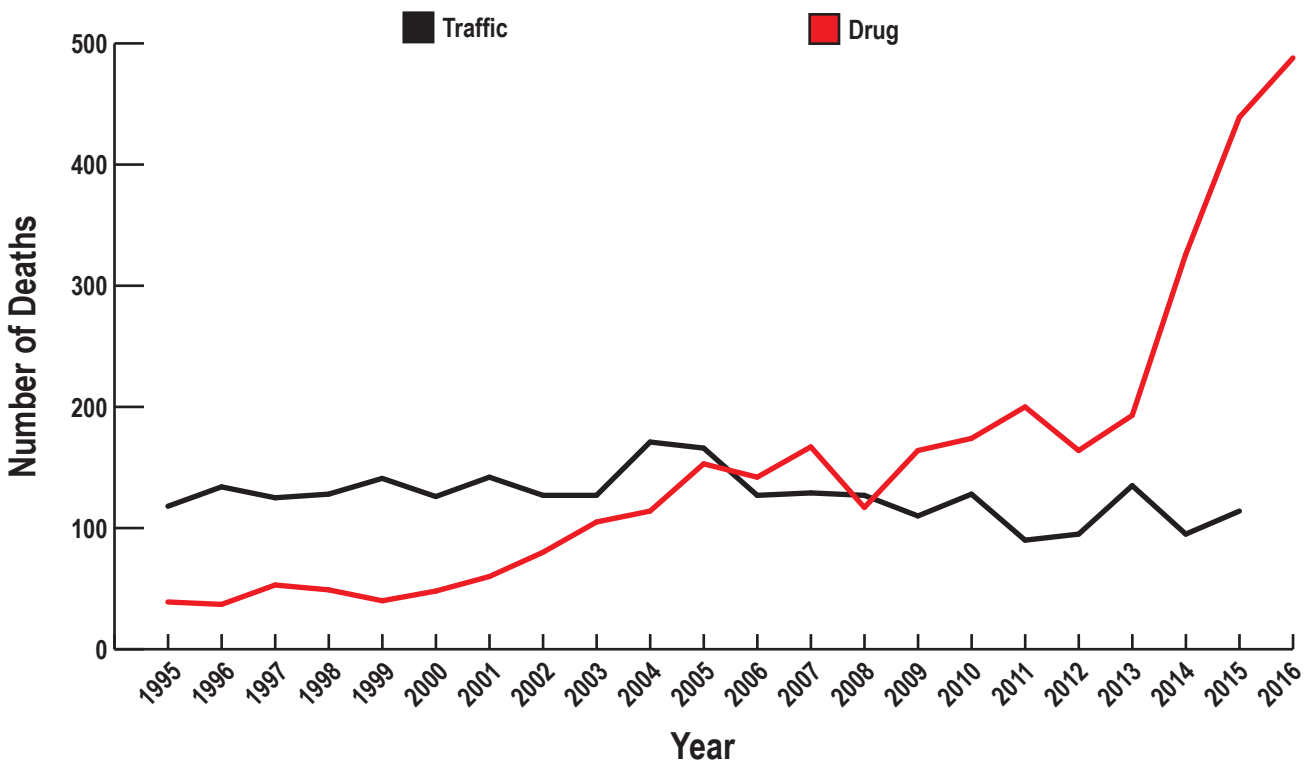

Figure 7: Drug deaths versus traffic deaths, 1995-2016.

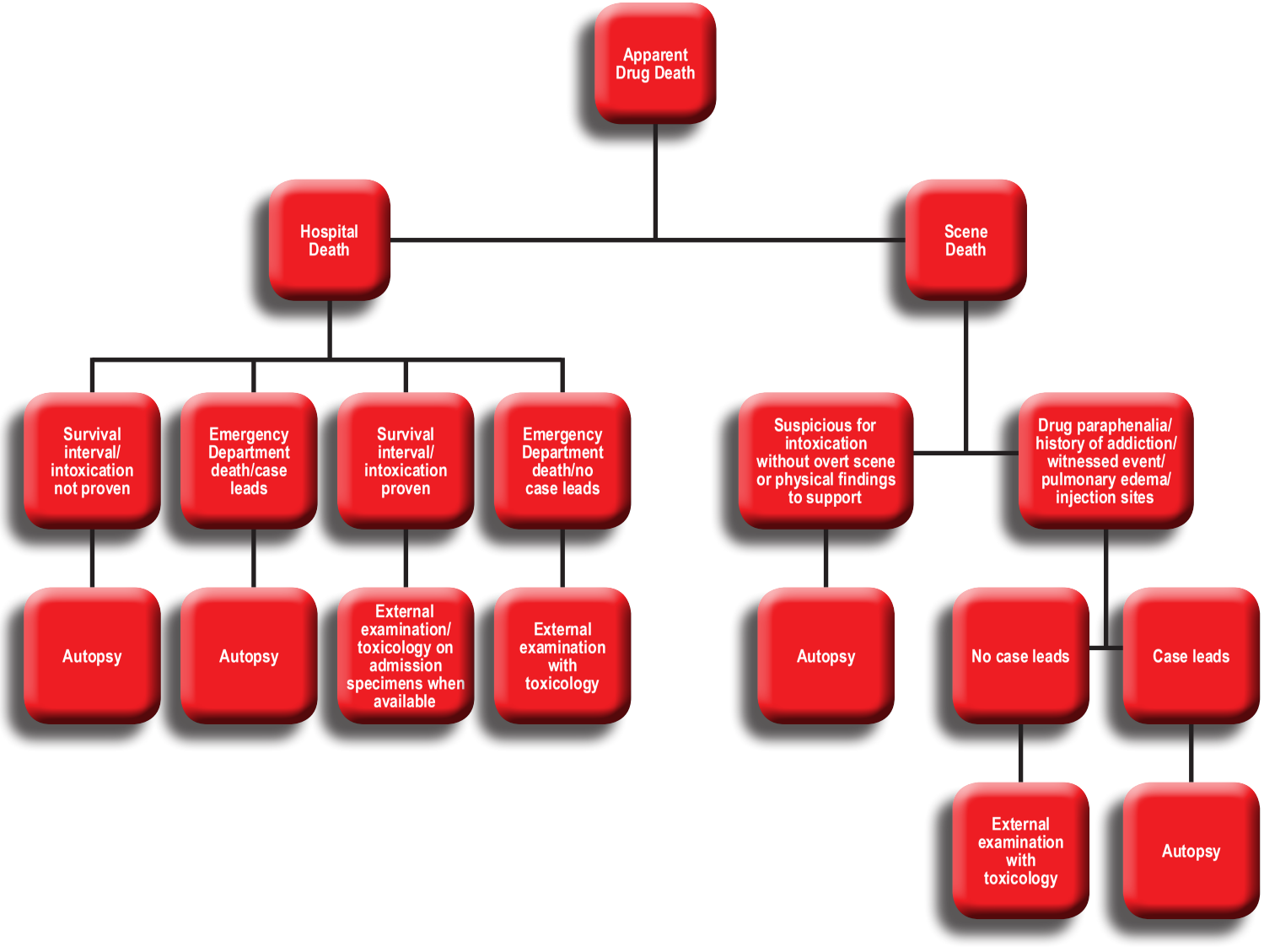

Figure 8: Case triage system for suspected drug deaths.

The 10.5% rate of alternative causes of death in the autopsy group appears to be an endorsement of autopsying cases wherein, despite a known history or scene suggestion of drug intoxication, the circumstances of death remain murky. This also compares favorably with the 13.2% rate of alternative causes of death when all such cases were autopsied in 2010. None of the autopsy cases requested by law enforcement for prosecutorial purposes under the current system have had an alternative cause of death. If one is willing to assume the toxicology results in the 97.5% of externally examined subjects were sufficient to explain the deaths, this concordance rate appears satisfactory. However, as the 2010 data show, up to 5.5% of such cases may have been misclassified as drug deaths in absence of an autopsy. This can be extrapolated to a total of 12 of the 195 cases certified as drug deaths to have been misclassified. Answering the question of whether or not autopsying these individuals would have actually pushed the alternative diagnoses closer to the 10% of the autopsy group will require a differently designed study.

Table 1: Autopsy Versus External Only Examination, 2016

N=352	Autopsy (n=152)	External Examination (n=200)
Toxicology sufficient to certify death due to intoxication	136 (89.5%)	195 (97.5%)
Toxicology not consistent with death due to acute intoxication	16 (10.5%)	5 (2.5%)

Table 2: Autopsies of Suspected Drug Deaths, 2010

N=91	Autopsy of Suspected Drug Death
Toxicological cause of death/Toxicology positive	79 (86.8%)
Toxicological cause of death/Toxicology negative	0
Alternative cause of death/Toxicology positive	5 (5.5%)
Alternative cause of death/Toxicology negative	7 (7.7%)

Table 3: Suspected Drug Deaths with Alternative Cause of Death and Positive Toxicology Screen, 2010

Cause of Death	Postmortem Toxicology
Arteriosclerotic cardiovascular disease	Methadone 62 ng/mL Oxycodone 420 ng/mL
Acute and chronic pulmonary vascular disease with pulmonary hypertension from injection of oral pharmaceuticals	Amlodipine 60 ng/mL Acetaminophen 20 µg/mL Oxycodone 210 ng/mL Bupropion 130 ng/mL Hydroxybupropion 370 ng/mL Citalopram/Escitalopram 190 ng/mL
Arteriosclerotic cardiovascular disease	Methadone 720 ng/mL 2-ethylidene-1,5-dimethyl-3.3-diphenylpyrrolidine160 ng/mL Benzoylecgonine 240 ng/mL Hydroxyzine 20 mg/mL
Arteriosclerotic cardiovascular disease	Clonazepam 15 ng/mL 7-Amino Clonazepam 180 ng/mL Morphine 10 ng/mL Hydromorphone 18 ng/mL Nortriptyline 130 ng/mL Fluoxetine 140 ng/mL Norfluoxetine 190 ng/mL 6-Monoacetylmorphine 110 ng/mL (Urine)
Pulmonary thromboembolism due to obesity (Body mass index 41.4 kg/m^2)	Quetiapine 21 ng/mL Sertraline 51 ng/mL Buprenorphine 1.7 ng/mL Norbuprenorphine 1.7 ng/mL

There are other alarming issues that spotlight the vulnerability of this case triage approach to error. For example, there were an additional 54 cases not suspected to be toxicologically mediated deaths at initial investigation that turned out to be drug intoxications, typically older individuals signed out as natural deaths with subsequent toxicology results that warranted an amendment of the original death certificate. Clearly, there is an unavoidable subjective component to the scene investigation that can influence the decision to bring in any given case for autopsy. The following examples were autopsied on the basis of a slightly atypical presentation for a drug-related death. Ideally, these individuals would have been autopsied under the guidelines in the flow chart above; however, some practitioners may have elected to only perform external examinations with toxicology, which may have led to erroneous death certification.

Case 1: 29-year-old female with a history of asthma, chronic pain and prescription drug abuse. Scene investigation revealed numerous unaccounted for oxycodone and alprazolam tablets. She became unresponsive while attempting nebulizer treatment. Autopsy findings were consistent with severe asthma. Postmortem toxicology showed free morphine, 6-monoacetylmorphine, and oxycodone.

Case 2: 41-year-old male with a history of intravenous drug abuse, found dead in the attic of a known "heroin house" with drug paraphernalia. There were recent complaints of fever and diarrhea. Autopsy revealed *Staphylococcus aureus* sepsis in the setting of acute influenza A infection. Fentanyl was detected in urine only.

Case 3: 24-year-old male with a history of insulin dependent diabetes mellitus and substance abuse found dead on bedroom floor with illicitly obtained buprenorphine nearby. There were recent complaints of vomiting. Autopsy revealed diffuse esophageal necrosis ("black esophagus") and diabetic ketoacidosis. Postmortem toxicology showed a fentanyl concentration of 0.83 ng/mL.

Case 4: 27-year-old female with a history of heroin use arrested in the emergency department after presenting with altered mental status. The decedent's sister offered a recent history of shortness of breath and lethargy. At autopsy there was necrotizing pneumonia and infective endocarditis. Postmortem toxicology showed a fentanyl concentration of 29 ng/mL.

Case 5: 30-year-old male with a history of substance abuse found gasping and moaning in bed following an apparent seizure. A spoon bearing powdery residue was in a pocket. Florid lyme carditis in a 704 g heart was the critical autopsy finding. Postmortem toxicology showed a fentanyl concentration of 7 ng/mL.

Case 6: 29-year-old male with a history of heroin use arrested for driving under the influence. He was driven home from jail by his wife and en route complained of sweating, nausea, vomiting. He was found dead in his bathroom hours later with a drug packet in his wallet. At autopsy, there was an occlusive thrombus in the left main coronary artery. Postmortem toxicology showed a fentanyl concentration of 5.4 ng/mL.

CONCLUSION

A case triage system developed to cope with a dramatically increased caseload stemming from this jurisdiction's current struggle with opiate- and opioid-related fatalities has been presented. The retrospective data from 2010 in 2016 show a relatively high degree of reliability of this case triage method. We cannot, however, endorse such an approach over the long term. This preliminary study suggests that up to 5.5% of nonautopsy cases would be misclassified as drug intoxications and, as the individual cases outlined in the discussion section show, toxicological evidence in cases undergoing external examination only may suggest a drug-related death when autopsy would reveal an alternative, nontoxicological cause of death.

This goes beyond mere academic interest, as the current wave of opioid fatalities is an important public health issue, and when these deaths involve the criminal justice system it is even more important to be correct. Both the public health and criminal justice

systems are not optimally served by this approach. Considering the latter, by convention, the death certificate standard is "more probable than not." Our data suggest that 5.5% of cases not autopsied may be incorrectly certified as drug-related deaths. Is a 94.5% chance of being correct beyond a reasonable doubt? Regarding public health, missed alternative causes of death would not be recorded in vital statistics. In addition, OCME typically tests for hepatitis B, C and HIV in autopsy drug deaths but not on external examinations, save for the instance of a needle stick or other exposure.

While we unreservedly endorse the existing NAME standard of autopsying such cases, we remain firmly entrenched in a system that demands doing more for less. To date, we have not experienced any pushback from families given the potential delay in release of remains, though funeral homes have balked at being reimbursed for transport to OCME but not for transport to the holding funeral home from the scene of death. Additionally, more detailed study may further refine and improve the reliability of such a case triage system in the event that an office should remain under resourced, even in the face of a markedly increased caseload. Inaccurately classified cases could be examined in detail to develop improved case triage criteria. Some jurisdictions use commercially available field tests to determine disposition of such cases. Ideally, a study of autopsy results in cases that meet criteria for external examination as outlined in this preliminary study could be carried out to more directly assess the accuracy of the hypothesis behind the case triage system. Analysis of the cost benefit ratio as well as reliability of such an approach is worth further study as well. Analysis of the true cost of doing autopsies on all suspected drug deaths would describe in detail the actual financial burden of this approach in small, rural, or other under-resourced jurisdictions.

REFERENCES

1) CDC WONDER [Internet]. Atlanta: Centers for Disease Control and Prevention; 2015. Multiple cause of death 1999-2014; [cited 2016 Dec 14]. Available from: https://wonder.cdc.gov/mcd.html.

2) New Hampshire revised statutes annotated [Internet]. Title LIX, Proceedings in criminal cases, Chapter 611-B:1-31, Office of chief medical examiner; [cited 2016 Dec 14]. Available from: http://www.gencourt.state.nh.us/rsa/html/lix/611-b/611-b-mrg.htm.

3) Forensic Autopsy Performance Standards [Internet]. Walnut Shade (MO): National Association of Medical Examiners; c2016. Standard B3.7, p. 9; [cited 2016 Dec 14]. Available from: https://netforum.avectra.com/public/temp/ClientImages/NAME/684b2442-ae68-4e64-9ecc-015f8d0f849e.pdf.

4) Kircher T, Nelson J, Burdo H. The autopsy as a measure of accuracy of the death certificate. *N Engl J Med*. 1985 Nov 14; 313(20):1263-9. PMID: 4058507. https://doi.org/10.1056/nejm198511143132005.

5) Maclaine GD, Macarthur EB, Heathcote CR. A comparison of death certificates and autopsies in the Australian Capital Territory. *Med J Aust*. 1992 Apr 6; 156(7):462-3, 466-8. PMID: 1556973.

6) McKelvie PA. Medical certification of causes of death in an Australian metropolitan hospital. Comparison with autopsy findings and a critical review. *Med J Aust*. 1993 Jun 21; 158(12):816-8, 820-1. PMID: 8326892.

7) Hill RB, Anderson RE. An autopsy-based quality assessment program for improvement of diagnostic accuracy. *Qual Assur Health Care*. 1993 Dec; 5(4):351-9. PMID: 8018895. https://doi.org/10.1093/intqhc/5.4.351.

8) Ermenc B. Discrepancies between clinical and post-mortem diagnoses of causes of death. *Med Sci Law*. 1999 Oct; 39(4):287-92. PMID: 10581907.

9) Sington JD, Cottrell BJ. Analysis of the sensitivity of death certificates in 440 hospital deaths: a comparison with necropsy findings. *J Clin Pathol*. 2002 Jul; 55(7):499-502. PMID: 12101193. https://doi.org/10.1136/jcp.55.7.499.

10) Pritt BS, Hardin NJ, Richmond JA, Shapiro SL. Death certification errors at an academic institution. *Arch Pathol Lab Med*. 2005 Nov; 129(11):1476-9. PMID: 16253030.

11) Ravakhah K. Death certificates are not reliable: revivification of the autopsy. *South Med J*. 2006 Jul; 99(7):728-33. https://doi.org/10.1097/01.smj.0000224337.77074.57.

12) Tavora F, Crowder C, Kutys R, Burke A. Discrepancies in initial death certificate diagnoses in sudden unexpected out-of-hospital deaths: the role of cardiovascular autopsy. *Cardiovasc Pathol*. 2008 May-Jun; 17(3):178-82. PMID: 18402800. https://doi.org/10.1016/j.carpath.2007.07.010.

13) Mieno MN, Tanaka N, Arai T, et al. Accuracy of death certificates and assessment of factors for misclassification of underlying cause of death. *J Epidemiol*. 2016; 26(4):191-8. PMID: 26639750. https://doi.org/10.2188/jea.je20150010.

14) Asneas, S, Paaske, F. Uncertainty of determining cause of death in medicolegal material without autopsy: an autopsy study. *Forensic Sci Int*. 1980; 15:103-114. PMID: 7358323. https://doi.org/10.1016/0379-0738(80)90149-8.

15) Vanatta PR, Petty CS. Limitations of the forensic external examination in determining the cause and manner of death. *Hum Pathol*. 1987 Feb; 18(2):170-4. PMID: 3804321. https://doi.org/10.1016/s0046-8177(87)80335-0.

16) Nashelsky MB, Lawrence CH. Accuracy of cause of death determination without forensic autopsy examination. *Am J Forensic Med Pathol*. 2003 Dec; 24(4):313-9. PMID: 14634467. https://doi.org/10.1097/01.paf.0000097857.50734.c3.

17) Gill JR, Scondi-Bello IA. Natural, unexpected deaths: reliability of a presumptive diagnosis. *J Forensic Sci*. 2010; 35(1):77-81. PMID: 20002277. https://doi.org/10.1111/j.1556-4029.2009.01227.x.