



Young Anthropology

Undergraduate Journal of Anthropology
at the University of Toronto Mississauga

Title: “The Benefit of Autopsies in Suspected Drug Overdose Cases, as seen in Nova Scotia, Canada.”

Authors: Sukarmina Singh Shankar, Matthew J. Bowes

Source: *Young Anthropology* – Undergraduate Student Journal of Anthropology
Vol. 1, No. 1, pp. 22-27 (Fall 2019).

Published by: The Department of Anthropology, University of Toronto Mississauga



This work is licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License](https://creativecommons.org/licenses/by-nc-sa/3.0/).
To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-sa/3.0/>

The Benefit of Autopsies in Suspected Drug Overdose Cases, as seen in Nova Scotia, CA.

Sukarmina Singh Shankar^{1*}, Matthew J. Bowes²

1. Forensic Science Program, Department of Anthropology, University of Toronto
Mississauga, Canada

2. Nova Scotia Medical Examiner Service, Nova Scotia, Canada

*Corresponding author e-mail: sukarmina.ss@gmail.com

Abstract

The current opioid crisis in Canada calls for accurate information on drug overdose deaths (DOD) to help formulate effective public health policy (Health Canada 2018). The effect of the lack of standardization on the comparability of mortality statistics in Canada has not been studied. One of the major issues regarding accuracy of DOD is whether suspected DOD should undergo an autopsy (Kelsall and Bowes 2016). This research analyzes the impact of performing an autopsy on the accuracy of determining the cause of death (COD) as drug overdose, by comparing putative COD with post-autopsy COD for each drug related death investigated by the Nova Scotia Medical Examiner Service (NSMES) in 2015 – 2016. The McNemar test results show a statistically significant difference between putative COD and post-autopsy conclusions ($\chi^2 = 16.17$, d.f.=1, $p < 0.0001$). The research concludes that determination of COD in suspected DOD without an autopsy could misrepresent DOD statistics. This study suggests that autopsies are necessary for the accurate classification of drug-related deaths and that a standardized nation-wide approach to this problem could be of significant benefit.

Keywords: forensic anthropology, opioid crisis, autopsy

1. Introduction

According to a National Report by the Government of Canada, the number of opioid-related deaths are growing in the country. There were 3,017 apparent opioid related deaths in 2016, 4,034 in 2017 and 3,286 in the first nine months of 2018 (Health Canada 2018). In the United States, from 1999 to 2017, 70,237 drug overdose deaths (DOD) have been reported by National Institute of Drug Abuse (NIH 2018). This growing crisis calls for accurate reporting of statistics to understand the magnitude and distribution of the issue to inform actions that reduce opioid related harm and deaths (Health Canada 2018). The availability and quality of relevant information is critical for public health policy to have a positive impact on illicit drug related mortality. Canadian Forensic Scientists have expressed concern about the integrity of mortality

data and highlighted a need for improving the quality of medico-legal death investigations in the country (Kelsall and Bowes 2016). The final outcome of a death investigation is an opinion on the cause and manner of death, for which international guidelines are available. However, these practices are not adopted uniformly across Canada (Pollanen et al 2014).

One of the areas of concern is the lack of standardization in the decision to perform an autopsy in deaths that are unnatural or unexplained, and specifically whether all suspected DOD should undergo autopsy. These investigations are a provincial or territorial responsibility and the decision to perform autopsy varies across Canada (Kelsall and Bowes 2016). Across jurisdictions, there is a variation in the rate of deaths investigated annually from 7% - 45% (Kelsall and Bowes 2016). As well, there is a wide variation in autopsy rates (Kelsall and Bowes 2016). Cases where autopsies

are not conducted, and deaths are classified as “undetermined” may misrepresent statistics of DOD (Kelsall and Bowes 2016). Such misrepresentation can negatively impact the development of effective strategies to prevent drug related deaths.

There are differing views on performing autopsy in apparent drug related deaths. Conducting an autopsy, however, is a resource-intensive process, requiring substantial finances and human effort. In the United States, a significant increase in DOD has put stress in jurisdictions where autopsies are mandated as the maximum workload levels of pathologists are prescribed to meet accreditation requirements (Fowler 2017). Advocates of conducting autopsy in DOD cases argue that one of the challenges in determining DOD is post-mortem drug redistribution or the movement of drugs within the body after death (Fowler 2017). Some drugs can be falsely elevated in post-mortem blood and others may be falsely depressed and analysis of this material can thus be misleading (Fowler 2017). The difficulty of interpreting post-mortem blood concentrations without an autopsy illustrates the importance of autopsy in DOD investigations (McIntyre and Escott 2012).

Considering the increase in drug-related deaths in Canada, and the considerable resources necessary to perform autopsies, this paper investigated whether conducting autopsies improved the accuracy of cause of death conclusions in apparent drug related deaths in Nova Scotia. This research analyzes the impact of performing an autopsy on the accuracy of determining the cause of death (COD) as drug overdose, using Nova Scotia Medical Examiner Service (NSMES) data.

At the NSMES by longstanding practice, all deaths that are suspected as DOD during initial investigation, undergo autopsy. The NSMES is guided by the Fatality Investigations Act (FIA). The procedure for every autopsy is the same: a full external examination is followed by a full examination of all organs, which are removed, weighed, and examined (FIA 2001). The extent of the exam may vary depending upon the specifics of the case, and the decision is made by the medical examiner (FIA 2001). Additionally, ancillary testing such as toxicology, supplements the case information (FIA 2001). Toxicology reports are considered when writing the final death report, once a complete autopsy has been performed (FIA 2001). Toxicology reports can provide information on whether a deceased individual had drugs present in

their system at the time of death, and in what amount (Watkins, Anderson and Rondinelli 2013).

The death investigation process at the NSMES begins with the case investigator attending the scene of death. Based on this initial investigation, putative COD is determined. All deaths with putative COD classified as “drug related”, undergo autopsy. Confirmation of death as DOD or not is made on the basis of autopsy with supplemental information from ancillary test reports.

2. Study sample

The sample selected for this study included all death investigations that underwent autopsy at the NSMES between January 1, 2015 and December 31, 2016, the two-year period with most recently closed cases. The number of cases in this sample was 1,498. These included cases that were suspected as DOD during initial investigations; confirmed as DOD post autopsy; as well as cases that were neither suspected nor confirmed as DOD post autopsy.

Data for this research was extracted from the Medical Examiner Application (MEA) database at the NSMES. The MEA maintains case information of all death investigations conducted by the NSMES. It contains reports and documentation from various agencies including the police and medical experts. Documents that are scanned and securely stored in the MEA include the decedent’s medical records, emergency hospital records, paramedic reports, and ancillary test reports. The MEA database is also used to record over 100 fields of data for each case. These fields of data summarize information from the scanned documents and records. The fields extracted from the MEA for this study were “year of death”, “death class”, “case status”, “autopsy performed indicator”, “final manner of death”, “immediate cause of death”, “antecedent cause of death”, toxicology report summaries (blood alcohol, blood drug, blood carbon monoxide, urine alcohol, urine drug, vitreous alcohol, liver drug screen, stomach drug screen) and “other significant conditions”.

In the MEA, putative COD is recorded under the category “death class”. Deaths that are suspected to be drug related are classified as “drug related” under this category. There are five sub categories under “drug related” deaths: drug related alcohol; drug related - illegal drugs; drug related-polymorphic; drug related - prescribed drugs; and drug related - unspecified.

Cases that were included in the sample were classified as drug related - illegal Drugs; drug related – Polymorphic; drug related – Prescribed Drugs and Drug related – Unspecified were included in the sample. All cases classified as drug related – alcohol was excluded from the analysis. These cases were excluded as many of these deaths are due to the chronic effects of alcohol like cirrhosis of the liver. Since this study aims to address only acute drug overdose deaths, this category of deaths is not relevant. The variables used for analysis were “death class”, “immediate cause of death”, “antecedent causes of death”, “other significant conditions” and “final manner of death”. All cases that did not undergo autopsy were excluded.

The selection of the sample was done by first extracting all the cases for which autopsy had been performed and were classified as “drug related” with the exclusion of “drug related – alcohol”. A list of immediate and antecedent causes of death, as well as other significant conditions was prepared to help identify cases considered DOD by NSMES. For each case, a comparison was made between the investigative findings “death class” and the post autopsy COD “immediate cause of death”. Statistical analysis was done to investigate if there was a variation in initial COD findings and post autopsy COD conclusions. Additionally, a qualitative analysis was done for all cases in which there was variation in putative COD and post-autopsy conclusions. For the qualitative analysis, causes and manners of death were identified for cases that were suspected to be DOD during initial investigation and not confirmed post autopsy. As well, putative COD was identified for cases that were not suspected to be DOD but confirmed post-autopsy to be DOD the putative COD.

A limitation of this study was that only closed cases were analyzed for 2015-2016. Some of the cases that were open could have been drug related. While the rationale for not considering drug related – alcohol cases from the MEA has been discussed, there could be some cases of drug overdose that may have been missing from the data. Absence of both open cases and alcohol related cases would introduce sample bias.

3. Ethics

The reference number of the completed Ethics Review form for the University of Toronto, Mississauga (UTM) is 2017-044 and was filed with the Research and Graduate Office on the UTM

campus. Approval for conducting this research electronically was given by the NSMES followed by signing a Confidentiality Agreement. The researcher and the NSMES Research Supervisor signed an agreement, which allowed the researcher to remove notes and documents from NSMES under the conditions stipulated. The study complies with the NSMES ethics approval protocols. The NSMES allowed the researcher ‘read only’ access to MEA through government computers at NSMES premises. The confidentiality of all case files was protected by saving all raw data on a password protected USB at the NSMES. The data was then encrypted into an Excel file using a non-identifying numbering system, preventing identification of individual cases by the researcher. Only summary data could be reported, and computers used for research as well as the specific files for analysis were password protected.

4. Methods

Since the COD decisions before and after autopsy for each case form a matched pair, the McNemar paired test was conducted to test the significance of differences in decisions. The McNemar test is used for categorical variables where each variable has only two possible outcomes (Koletsis and Pandis 2017). Categorical variables represent data like ancestry, hair colour, and gender. In this study, each of the two categorical variables, putative COD and post- autopsy COD, have two outcomes: DOD or not DOD.

The McNemar test is a non-parametric statistical test; a type of a chi-square test that uses paired data (Adedokun and Burgess 2012). The test assesses the extent of change in the dichotomous dependent variable from pre-intervention to post-intervention (Pett 2015). The null-hypothesis is rejected if the proportion of changed outcomes in one direction is sufficiently larger than what can be expected by chance (Pett 2015). It has been used for measuring the impact of interventions like the effectiveness of home monitoring in hip replacement surgery patients and to evaluate the impact of individualized lifestyle intervention on the obesity and metabolic syndrome of children (Pett 2015).

In this study, the objective was to examine the impact of autopsy on improving the accuracy of assessment of cause of death. It was important to understand the extent of difference in suspected cause of death as being drug overdose death before

undergoing autopsy and cause of death being drug overdose death post autopsy.

5. Results

Analysis of all cases in the two-year period shows that 136 cases were putative DOD (Table 1). Of these cases, 125 were confirmed as DOD, 11 confirmed as not DOD. Of the rest 1362 cases that were not initially suspected as DOD, 41 were confirmed as DOD at autopsy. The McNemar test results ($\chi^2= 16.17$, d.f.=1, $p=0.00006$) show that there is a statistically significant difference between the putative COD and post-autopsy conclusions. Of the 166 confirmed DOD, 41 cases or approximately 25% were not suspected as DOD initially but confirmed at autopsy. The observations also show that 9-10 % of the putative DOD had an anatomical cause of death and did not include intoxication.

Table 1. Number of cases that were identified as DOD or not DOD at initial investigation and autopsy

		Post Autopsy COD		
		DOD	Not DOD	Total
Putative COD	DOD	125	11	136
	Not DOD	41	1321	1362
Total number of cases		166	1332	1498

There were 41 cases that were not suspected as DOD during the initial investigation period but were found to be DOD after an autopsy was performed. These cases were classified under various Death Classes, with 42% of these cases under Medical and 37% were initially Undetermined (Table 2, Figure 1).

Table 2. Death Class of cases not initially thought to be DOD but confirmed after autopsy

Putative COD: Death Class	Number of cases
Asphyxia - Gas/Chemical	1
Asphyxia- Suffocation	1
Drug Related - Alcohol	4
Fall	2
Medical	17
Other	1
Undetermined	15
Total	41

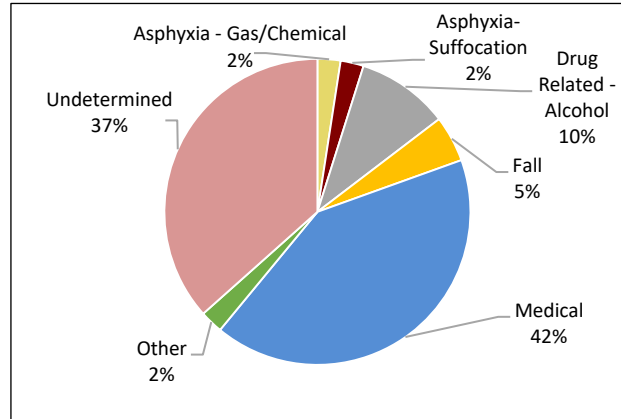


Figure 1. Death Class of cases not initially thought to be DOD but confirmed after autopsy

Of the 11 suspected DOD that were concluded as not DOD after autopsy, the COD was mostly related to natural diseases (Table 3, Figure 2). The manner of death for 73% of these 11 cases was Natural.

The final cause of death for cases that were putative DOD but confirmed as not DOD after autopsy were: acute lobar pneumonia, atherosclerotic coronary artery disease, complications of blunt leg trauma, hepatic failure, hypothermia, hypoxic-Ischemic encephalopathy, Intraparenchymal hemorrhage, ischemic heart disease, myocardial infarction, pneumonia, and sepsis.

Table 3. Final manners of death for putative DOD cases that were confirmed as not DOD after autopsy

Manner of death	Number of cases
Accident	2
Natural	8
Suicide	1
Total	11

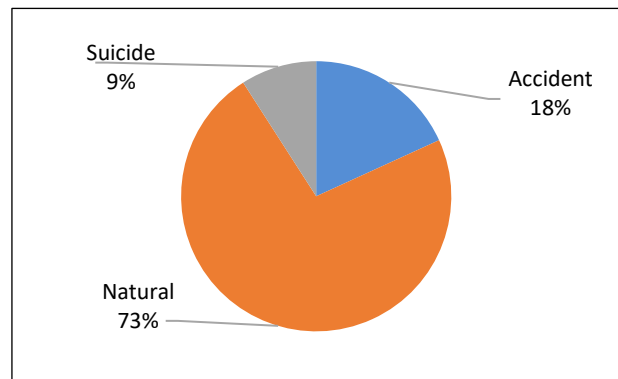


Figure 2. Final manners of death for putative DOD cases that were confirmed as not DOD after autopsy

6. Discussion

The statistical analysis of this study showed that approximately 25% of cases that were not suspected as DOD were confirmed as DOD after the performance of an autopsy. The results have a relevant implication on drug related investigations in Canada due to lack of standardization across jurisdictions (Kelsall and Bowes 2016). Drug related death investigations are complex and there is need for testing after the initial investigations, to improve the accuracy of DOD estimates. The initial investigation, if not supplemented by adequate testing can result in misreporting of DOD. The 41 cases would not have been correctly classified had the forensic pathologist not chosen to perform a complete autopsy and supplement it with ancillary testing. As well, 9-10 % of the putative DOD that did not include intoxication would have overestimated the number of DOD if autopsy had not been performed. Decision on autopsy and ancillary testing may vary across jurisdictions. Considering the variation in testing decisions after initial investigations, DOD statistics at the national level may not be accurate.

Another observation in this study is that the putative COD for a large proportion of deaths confirmed as DOD at autopsy was “undetermined”. Medical examiners are concerned that the classification of drug overdose cases as “undetermined” when an autopsy is not performed, impedes efforts to prevent DOD (Davis 2014).

The need for accurate statistics is critical in designing effective public health policies and making efforts to reduce drug related harm and deaths. Effective public health policies have been shown to make an impact on reducing drug overdose harm. Examples from supervised injection facilities in Vancouver and a pilot study where injection drug users were trained in San Francisco, show that drug overdose fatalities can be reduced (Kerr et al 2006; Seal et al 2014).

In this study, the McNemar test was uniquely used to compare before and after autopsy results and the analysis indicates the possibility of significant errors. This research is limited to the DOD investigations at the NSMES. A larger sample size, especially representation of more densely

populated provinces and territories would be required for developing standards across the country. Analysis of a larger sample of cases can also help identify how the initial death investigation process of drug related cases can be improved. By understanding the specific ambiguities faced while determining the putative COD, training of investigators can help improve accuracy during the initial investigation.

Acknowledgements

The authors wish to thank an anonymous reviewer for the valuable comments and suggestions. We also thank Dr. Tracy Rogers, Director of the Forensic Science Program, Dr. Lauren Schroeder, Assistant Professor of Anthropology, Emily Schleihauf, and the staff in the Department of Anthropology, at the University of Toronto Mississauga.

References

- Adedokun, Omolola A., and Burgess, Wilella D. 2012. “Analysis of Paired Dichotomous Data: A Gentle Introduction to the McNemar Test in SPSS.” *JMDE* 8(17): 125-131.
- Davis, Gregory G. 2014 “Complete Republication: National Association of Medical Examiners Position Paper: Recommendations for the Investigation, Diagnosis, and Certification of Deaths Related to Opioid Drugs.” *J Med Tox* 10(1): 100-106.
- Fatalities Investigation Act 2001. Accessed Jun 9 2018. <https://nslegislature.ca/sites/default/files/1gc/statutes/fatality%20investigations.pdf>
- Fowler, David R. 2017 “Drug intoxication and the need to autopsy: a diagnosis of exclusion?” *Acad Forensic Pathol* 7(1): 2-6.
- Health Canada “Opioid- related harms and deaths in Canada”. Accessed Jun 7 2018. <https://www.canada.ca/en/health-canada/services/substance-use/problematic-prescription-drug-use/opioids/data-surveillance-research/harms-deaths.html>
- Kelsall, Diane, and Bowes, Matthew J. 2016. “No standards: medicolegal investigation of deaths.” *CMAJ* 188 (3): 169.
- Kerr, Thomas, et al. 2006. “Drug- related overdoses within a medically supervised safer injection facility.” *Int J Drug Policy* 17: 436-441.

- Koletsis D, Pandis N. 2017. "Matched analysis for paired binary data (McNemar test)." *Am J Orthod Dentofacial Orthop* 151(1): 222-223.
- McIntyre, Iain M, and Escott, Christina Meyer. 2012 "Postmortem drug redistribution." *J Forensic Res* 3: e108.
- NIH: National Institute on Drug Abuse "Overdose death rates". Accessed [Jun 28 2018]. <https://www.drugabuse.gov/related-topics/trends-statistics/overdose-death-rates>
- Pollanen, Michael S. "Forensic Science in Canada: A Report of Multidisciplinary Discussion". Accessed [Jun 5 2018]. <http://www.crime-scene-investigator.net/forensic-science-in-canada.pdf>
- Pett, Marjorie A. 2015. *Nonparametric Statistics for Health Care Research*. Utah: SAGE Publications.
- Watkins, Kerry, Anderson, Gail, and Rondinelli, Vincenzo. 2013. *Evidence and investigation: from the crime scene to the courtroom*. Toronto: Edmond Montgomery Publications.
- Seal, Karen H, et al. 2014. "Naxolone distribution and cardiopulmonary resuscitation training for injection drug users to prevent heroin overdose death: A pilot intervention study." *J Urban Health* 82: 303-311.