



In 2016 — moved by the deaths of Tamir Rice, Philando Castile, Natasha McKenna, Eric Garner and many others — the Department of Health and Mental Hygiene began to examine various surveillance approaches for law enforcement intervention deaths in New York City. The goal of this project was to create a more robust public health surveillance system for law enforcement deaths and not just rely on information provided on death certificates as currently reported in the Annual Summary of Vital Statistics, which is a system used by every other vital registrar in this country.

Attached is a preliminary draft of an academic manuscript from 2017 that outlines the project; this is the document that is referenced in the New York Times article. Please note that this is a draft manuscript intended to go through additional review at the Department and standard peer-review journal processes and is not intended for publication in its current state. This remains an ongoing project.

The racial/ethnic disparities highlighted in the preliminary findings, combined with recent calls for increased transparency on police-related interactions requires complete, accurate, and timely surveillance of law enforcement related deaths moving forward. Over the last four years we have researched various methods to gather this data, drafted new case definitions to capture an expanded list of law enforcement-related deaths and spoken to stakeholders, both inside and outside of City government. The Department has developed and piloted a novel surveillance system, but for it to be useful in understanding, preventing, and reducing law enforcement deaths, it must be routinely updated with timely data that only NYPD collects. In early 2020, I met with Commissioner Shea for a discussion on how to move this pilot project forward and secure an ongoing commitment from NYPD to share this data.

Enumeration and classification of law enforcement-related deaths — New York City, 2010–2015

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DRAFT

ABSTRACT

Importance:

Deaths that occur during, or as a result of, law enforcement (LE) action might not be fully enumerated by local and national vital statistics.

Objectives:

To enhance vital statistics surveillance of LE-related deaths and improve cause of death coding in New York City (NYC).

Design:

We retrospectively identified suspected LE-related deaths during 2010–2015 by querying NYC death certificates (DC) with ICD-10 codes for legal intervention (Y35 or Y89), or “police” or “officer” in the description of injury, and media reports from an open-access database; we matched cases with DCs and medical examiner (ME) investigations.

Setting:

Population-based.

Participants:

LE-related deaths were confirmed if they occurred during, or as a result of, LE in the line of duty, with injury location in NYC.

Exposures:

Demographic data were abstracted from DCs and characteristics of the encounter, including whether the decedent was armed, were abstracted from ME or media reports.

Measures:

We classified LE-related deaths into three subtypes: legal intervention (homicide manner of death [manner]; LE delivers deadly force), arrest-related (any manner; occurred during the process of pursuit, apprehension, or in custody), and community/bystander (any manner; decedent not intended suspect). We calculated incidence rate ratios (IRR) and 95% confidence intervals (CI) using intercensal population estimates.

Results:

We identified 61 legal intervention deaths, 31 arrest-related deaths, and 13 community/bystander deaths; 91% of decedents were male and 54% were non-Hispanic black. One-third (33%) of legal intervention deaths were not assigned legal intervention ICD-10 codes, often because LE involvement was not indicated on the DC. Incidence of legal intervention death was significantly higher among non-Hispanic blacks than non-Hispanic whites (IRR 4.9; CI 2.4–10.0). There were no non-Hispanic white deaths categorized as legal intervention where the decedent was unarmed; whereas 6 (18%) non-Hispanic black decedents and 5 (38.5%) Hispanic decedents were unarmed.

Conclusions:

We identified cases of LE-related deaths and legal intervention deaths that might be missed by existing surveillance. For a death to be coded as legal intervention, an indication of police involvement on the DC must be included. There are significant racial disparities in legal intervention mortality, particularly among unarmed persons.

BACKGROUND

Deaths that occur during, or as a result of, interactions with law enforcement (LE) (i.e., LE-related deaths), have garnered substantial public attention in the United States as a result of several high profile deaths of unarmed black men.¹⁻⁴ Concerns about police use of force within minority communities have led to protests, civil unrest, and calls for government agencies to produce accurate counts of persons killed during interactions with LE.^{1,5,6}

The Death in Custody Reporting Act of 2000⁷ required the collection of data on deaths in the process of arrest, local jails, and state prisons, and was reauthorized in 2013.⁸ Until 2014, the Bureau of Justice Statistics enumerated arrest-related deaths (ARD): persons who died either during the process of arrest or while in the custody of state or local LE personnel.⁹ The Federal Bureau of Investigation (FBI) Uniform Crime Reporting Program collects data from more than 18,000 LE agencies. The number of “justifiable homicides,” defined as the killing of a felon by a LE officer in the line of duty, are enumerated by the FBI supplemental homicide reports (SHR).¹⁰ An evaluation of the ARD program using capture-recapture methods to estimate the total universe of persons killed by or during interactions with LE during 2003–2009 and 2011 found that of a total of 7,427 estimated deaths, 49% were reported to ARD, 46% were reported to SHR, and 28% were not reported to either ARD or SHR, at which time BJS suspended data collection efforts and began a program redesign.^{11,12} Media surveillance might increase public health reporting of certain conditions,¹³ including LE-related deaths.¹⁴ Projects by the newspapers *The Guardian*¹⁵ and the *Washington Post*¹⁶ to enumerate police killings have drawn significant attention to the underreporting of these deaths by federal sources. *The Guardian* identified 1,134 cases of persons killed by police in the United States during 2015, a figure more than double the 444 justifiable homicides reported by FBI SHR during 2014, the most recent

year of data available (2010–2014 range: 397–471).¹⁷ However, *The Guardian* has not published a clear case definition of police killings, and enumerated cases only during 2015 and 2016.

Public health surveillance using high quality cause of death data might provide a timely mechanism for enumerating LE-related deaths. In the United States, the Centers for Disease Control and Prevention (CDC) conducts mortality surveillance via the National Vital Statistics System (NVSS). Although an International Classification of Diseases 10th Revision (ICD-10) code for legal intervention deaths, defined as deaths due to injuries inflicted by the police or other law enforcing agents in the course of arresting or attempting to arrest lawbreakers, suppressing disturbances, maintaining order, or other legal action without regard to intent or legality, exists,¹⁸ these ICD-10 codes have also been found to underreport legal intervention deaths when compared to other systems.¹⁹⁻²¹ For a death to be assigned the ICD-10 code for a legal intervention death, the death certifier (i.e., coroner or medical examiner) must indicate LE involvement on the death certificate (DC), in addition to the external cause of death. Therefore, underreporting of these deaths might occur due to failure of the death certifier to indicate police involvement on the DC, or inaccurate manual assignment of ICD-10 codes to the death by the nosologist, a professional coder of deaths (legal intervention deaths are currently not able to be coded by CDC's SuperMICAR²² cause of death computer system).

The National Violent Death Reporting System (NVDRS) is an active surveillance system of violent deaths that provides a census of violent deaths in participating states and entities, using data from DCs, medical examiners, and LE.^{23,24} A recent comparison of counts from NVDRS, NVSS, and SHR found that NVDRS type of death had 98% sensitivity for legal intervention deaths. Counts from NVSS and SHR were 58% and 48% sensitive, respectively.¹⁹ However,

currently NVDRS is not a national system (currently funded in 40 states, Washington D.C., and Puerto Rico), and has a three year reporting lag, as data collection can take 16–18 months.

New York City (NYC) is an independent vital registration jurisdiction with an electronic vital events registration system, in-house nosologists, epidemiologists, and statisticians, and a chief medical examiner with a lifetime appointment. Further, the NYC Department of Health and Mental Hygiene (DOHMH) is committed to promoting health equity among all New Yorkers. The homicide death of Eric Garner, an unarmed black man in NYC, prompted health commissioner Mary T. Bassett to publicly state her “moral and professional obligation to encourage critical dialogue and action on issues of racism and health.”²⁵ In light of the need for timely and accurate counts of persons killed during or as a result of LE interaction, uniform case definitions for LE-related deaths, and the possibility of increasing case ascertainment, we sought to create and pilot new case definitions for LE-related deaths. We then applied these definitions to cases occurring in NYC during 2010–2015 and identified opportunities for improvements to the quality of reporting for these causes of death.

METHODS

Data Sources for Case Identification

Death Certificates

We queried New York City DCs for underlying cause of death ICD-10 codes for legal intervention (Y35.0–35.4, Y35.6, Y35.7) or sequelae of legal intervention (Y89.0) or mention of “police” or “officer” in the DC literals field describing how the injury occurred.

Media Reports

We used *Fatal Encounters*,²⁶ an open access online database containing records of deaths through police interaction during 2000–present. All records include links to news articles

reporting on the incident. A preliminary analysis conducted by NYC DOHMH demonstrated that Fatal Encounters identified the same deaths as those identified by *The Guardian* that occurred in New York City during 2015. We used a dataset finalized on January 24, 2017, and restricted to cases with injury date during January 1, 2010–December 31, 2015 with location of injury in New York City.

Data Sources for Abstraction

All suspected cases identified by DC or media report query were entered into a secure database.

Death Certificates

DCs for all suspected cases were matched by name and date of death. DC variables (date of death, age, race, ethnicity, injury date, how injury occurred [literal], manner of death, and underlying cause of death ICD-10 code) were automatically uploaded into the database.

Media Reports

In addition to media reports identified by *Fatal Encounters*, we used Google to manually search for additional media accounts reporting on the same cases by decedent name, date of injury, and location of injury, and abstracted variables (independent date of injury, borough of injury, geocoded address [coordinates and census tract] of injury, narrative description of event, officer acting in the line of duty, officer on- or off-duty, and decedent armed) into the secure database.

Office of Chief Medical Examiner (OCME)

We abstracted a narrative description of the event, whether the officer was acting in the line of duty, the type of injury, toxicology test results, and history of mental health problems into the secure database.

Case Classification

Two independent reviewers classified suspected cases using information from medical examiner investigations. Manner of death, determined by the medical examiner in all cases, was abstracted from the death certificate. Data from media reports supplemented this when data fields were missing from medical examiner reports.

Case Definition

We defined LE-related deaths as all manners of death that occur as a result of or during an interaction with LE (i.e., a person with specified legal authority to use deadly force) acting in the line of duty (i.e., in the course of arresting or attempting to arrest lawbreakers, suppressing disturbances, maintaining order, or other legal action), with injury location in New York City. Physical custody does not have to be established for cases to be LE-related deaths. This definition is more expansive than used for ICD-10 coding of legal intervention¹⁸ or justifiable homicides reported by SHR,¹⁰ which are limited generally to cases with homicide manner of death, but similar in scope to ARD^{9,27} and NVDRS which allow for homicide and non-homicide manners of death.²⁸ In order to reconcile counts of cases resulting from the various case definitions, we defined three subtypes of LE-related deaths and explicitly included deaths of community members or bystanders, which are not routinely enumerated by existing programs.

We defined legal intervention deaths as a subtype of LE-related deaths with a homicide manner of death where the person delivering the force is a LE officer acting in the line of duty. These deaths are consistent with the ICD-10 codes Y35.0–35.4, Y35.6, Y35.7, or Y89.0 but also include deaths coded otherwise but with circumstances as described in the literals fields of DCs or medical examiner investigation (or media reports if not apparent from the medical examiner investigation) consistent with the above definition.

We defined arrest-related deaths²⁷ as deaths with any manner of death where the event causing the death (e.g., gunshot wound, self-inflicted injury, cardiac arrest, fall from a height, etc.) occurs during an interaction with a LE officer during the process of arrest or during an attempt to obtain custody (including during the process of apprehension), while in the custody of LE (even if the decedent was not formally under arrest), during transport to or from LE or medical facilities, while detained for questioning, while confined in lockups or booking centers, or during an interaction with LE personnel during response to medical or mental health assistance, and not classified as a legal intervention death.

We defined community/bystander deaths as deaths with any manner of death that result from LE action, where the decedent was not the intended suspect of LE action.

The case definition excludes executions. Individuals killed as a result of a LE officer's actions while not acting in the line of duty (e.g., domestic dispute resulting in homicide where the person delivering the force happens to be a LE officer; person killed by an off-duty officer who him- or herself is the only victim of the decedent) are excluded.¹⁹

Inter-rater reliability

We calculated Cohen's kappa (κ) using initial reviewer classifications for all cases to assess inter-rater reliability.

Data Analysis

Average annual incidence rates

We used non-age adjusted rates to calculate legal intervention death incidence rates stratified by borough and race/ethnicity category, using the intercensal midpoint population estimate. We

calculated incidence rate ratios (IRR) with corresponding 95% confidence intervals (95% CI) by race/ethnicity category after constructing 2x2 contingency tables.

Capture-Recapture Analysis

To estimate the total universe of legal intervention deaths based on the probability of ascertainment from two independent data sources, we used capture-recapture analysis, in which one capture was done using DCs and the other was done using media reports.^{11,29} We used a log-linear model and defined a contingency table in which all decedents were classified into $k=4$ mutually exclusive capture profiles (i.e., identified by both DCs and media reports, DCs only, media reports only, or not identified by either DCs or media reports [estimate]). We performed a sensitivity analysis using the Lincoln-Peterson estimator which produced the same point estimates with slightly narrower confidence limits, so we conservatively present the results of the log-linear model only.

RESULTS

LE-related deaths

We successfully matched all suspected cases (100%) identified by *Fatal Encounters* or NYC DCs with NYC DCs and ME investigation reports. We identified 105 LE-related deaths in New York City during 2010–2015 (age-adjusted average annual incidence rate = 0.20 per 100,000) among all five boroughs (Table 1). The majority (91%) of cases were among men.

Approximately half (47.7%) were aged 18–34, although there were deaths in all age categories.

There was no clear trend over time (Cochrane-Armitage test of trend $P = 0.57$). Persons of black, non-Hispanic race/ethnicity accounted for 54% of all LE-related deaths. Homicide was the manner of death in two thirds of the cases ($n = 70$). Half of LE-related deaths ($n = 54$) were

identified by both DCs and media reports, 22% (n = 23) were identified by DCs alone, and 28 (27%) were identified by media reports alone. More than half of cases (n = 61 [58%]) were legal intervention deaths; a smaller proportion were arrest-related deaths (n = 31 [30%]) or community/bystander deaths (n = 13 [12%]). Inter-rater reliability for classifying cases was high ($\kappa = 0.95$; 95% CI: 0.91–1.00).

Legal intervention deaths

The age-adjusted average annual incidence rate of deaths due to legal intervention was 0.11 per 100,000 population. Legal intervention deaths were more likely to have been ascertained from both DC and media reports than other LE-related deaths (71% ascertained by both sources); however, unique cases were identified by both sources and would be missed if a hybrid surveillance approach were not used. Three quarters of legal intervention deaths (n = 46 [75%]) had mention of “police” or “officer” on the DC, which is required for cases to be assigned the corresponding legal intervention ICD-10 codes (Table 2). Only two thirds (n = 41 [67%]) of legal intervention deaths identified were assigned an ICD-10 code for legal intervention death. Using capture-recapture analysis, we estimated a total universe of legal intervention deaths during the period to be 62.5 (predicted number of decedents not detected by either source = 1.5; upper and lower confidence limits 0.5, 4.4) (Table 3).

The average annual incidence rate for legal intervention deaths was highest among black, non-Hispanic persons (Table 4). The incidence rate was significantly higher among black, non-Hispanic persons when compared to white, non-Hispanic persons (IRR 4.9; 95% CI: 2.4–10.0). There were differences in the circumstances of LE interaction by race/ethnicity category (Table 5). All white, non-Hispanic persons killed by legal intervention in New York City were armed, and the officer acted in self-defense, whereas 18% (n = 6) of black, non-Hispanic persons and

38.5% (n = 5) or Hispanic persons were unarmed when they were killed. The proportion of persons with history of mental health problems documented by the medical examiner was similar across groups.

Arrest-related deaths

Arrest-related deaths occurred across all manners of death and were detected more often by DC query alone (51.6%) than by media sources. Most arrest-related deaths occurred during the process of apprehension of pursuit (n = 25 [81%]), of which most of these deaths were ruled accidental manners of death (n = 19 [76%]). A smaller number of cases occurred in booking or in custody (n = 6 [19%]) due to natural causes (n = 3), accidents (n = 2), or suicide (n = 1).

Community/Bystander deaths

Approximately half (46.2%) of community/bystander deaths were detected by media reports alone. Unlike other subtypes of LE-related deaths, approximately half of the decedents were women, and a higher proportion were <18 years old or ≥55 years old than for other subtypes. Almost all deaths were either homicide (61.5%) or accident (30.8%). Four decedents (30.8%) shot by police were not the intended suspects of LE action. More than half of decedents (61.2%), including four pedestrians, died during motor vehicle accidents.

DISCUSSION

We created new case definitions to classify LE-related deaths, which are specialized causes of death. Using a hybrid surveillance approach, we identified 98% of the estimated universe of legal intervention deaths in New York City during 2010–2015, including an additional 21% deaths that would not have been detected by querying DCs alone. Despite these improvements in case

ascertainment of legal intervention deaths over existing methods, the incidence of legal intervention deaths in NYC was relatively low. When compared to a recent analysis of 16 NVDRS states using a similar case definition for legal intervention deaths, NYC had a lower incidence rate (0.11 per 100,000) for all but Massachusetts (0.09 per 100,000).¹⁹ The annual incidence of all law enforcement-related deaths (0.2 per 100,000) was similar to the incidence of police killings as calculated by *Mapping Police Violence* (0.2 per 100,000), which counts police killings (defined as a death resulting from “being chased, beaten, arrested, restrained, shot, pepper sprayed, tasered, or otherwise harmed by police officers, whether on-duty or off-duty, intentional or accidental”) occurring in the nation’s 100 largest police departments, and found NYC to have the 8th lowest rate of police killings among these departments.³⁰ We found that only two thirds of legal intervention deaths had the correct ICD-10 code. Incorrect coding of this subtype of LE-related deaths was due to lack of mention of police involvement in the DC literals (26% of cases) or miscoding of manually-coded DCs by nosologists (11% of cases). These findings are consistent with research demonstrating underreporting of violent deaths, including deaths by legal intervention, due to limited description of the circumstances of deaths on DCs.²¹ Interventions to improve quality cause of death coding, including training of medical examiners to ensure that they indicate police involvement on the DC when it occurred and training nosologists to assign the correct legal intervention ICD-10 code for homicide deaths for cases in which police involvement was indicated, might enhance the ability of vital statistics data to provide timely and accurate counts for public health and LE officials. NYC DOHMH has conducted vital statistics quality assurance activities, which included meetings with stakeholders and an online eLearning course for physicians completing DCs, leading to significant improvements in the accuracy of DC coding of underlying cause of death.³¹

CDC's NVDRS enumerates legal intervention deaths consistent with the ICD-10 code but also include as legal intervention deaths specific scenarios including incidents in which the decedent was killed while fleeing from/being pursued by LE but was not directly injured by LE officers and incidents in which the decedent died as the result of force applied by LE officers without clear lethal intent.³² We found that these deaths were often assigned an accidental manner of death by the medical examiner, and were thus classified as arrest-related. Because these deaths are not homicides, suicides, or undetermined manners of death, i.e. the manners of death tracked by NVDRS, these cases might be systematically underreported to NVDRS. In a recent analysis of legal intervention death data by NVDRS, 2.1% of cases were fatal injuries while in custody, 2.0% were fatal injuries from capture or restraint, 1.5% were accidental deaths while fleeing, and 0.6% were deaths of bystanders.²⁸ By comparison, we found 29.5% of LE-related deaths to occur either in custody or due to non-homicide manners during interactions with police (i.e., arrest-related deaths), and 12.4% of cases to be community/bystanders. These data suggest that NVDRS estimates of these case subtypes are underestimated. Although capture-recapture analysis suggests that we identified 90% of all LE-related deaths in NYC (and 97.6% of legal intervention deaths), we estimated that we were more likely to miss arrest-related deaths (43.6% missed) than other subtypes.

Similar to nationwide estimates from a variety of data sources,^{19,28,33-36} we found that the incidence rate of legal intervention deaths was approximately five times higher among non-Hispanic blacks versus non-Hispanic whites NYC, despite lower incidence rates among all race/ethnicity strata than observed among NVDRS states.²⁸ Some authors have suggested that the higher rate of legal intervention deaths among non-Hispanic blacks than non-Hispanic whites might be accounted for by increased numbers of interactions with LE.^{37,38} One study found that

given higher stop/arrest rates among non-Hispanic blacks, native Americans, and Hispanics, there was no racial/ethnic disparity in the probability of death among persons who are stopped/arrested by police.³⁸ We used medical examiner investigation data to understand further the circumstances of legal intervention deaths, stratified by race. All non-Hispanic white persons killed by police officers were armed and the officer was acting in self-defense, whereas 18% of non-Hispanic black persons were unarmed and the officer was acting in self-defense in only 74% of cases. This disparity in circumstances was also true of Hispanic persons, who were unarmed in 39% of instances and in which the officer was acting in self-defense only 62% of the time. This observed disparity might result from differences in the ways that LE officers interact with persons of different races,³⁹ the neighborhood context in which an encounter occurs,⁴⁰ or implicitly held ideas that might bias associations between race and perceived threat.⁴¹

There are several limitations to the surveillance we describe. Although ascertainment of legal intervention deaths was high, we likely underascertained arrest-related deaths. Mention of police involvement, or location of injury in custody, on DCs might increase the ability to identify arrest-related deaths despite there being no specific ICD-10 code for them. Our findings cannot be generalized to other jurisdictions; local rates of legal intervention deaths vary widely. This surveillance is labor intensive, requiring matching of various independent data sources, abstraction, and case classification, and requires the jurisdiction to have an electronic vital event registration data in place. New York City is unique because it has a medical examiner with a lifetime appointment; jurisdictions with fewer resources or with elected medicolegal officers (i.e., elected coroners)⁴² might have less detailed circumstance data which could result in different case classifications.²³ Further work needs to be done in order to ensure alignment of

case definitions for legal intervention, which is defined differently by the ICD-10,¹⁸ NVDRS,^{28,32} academic researchers,¹⁹ and in the current surveillance.

In spite of these limitations, we were able to demonstrate that vital statistics surveillance can be enhanced using media reports to produce timely and accurate case counts, and an expansive case definition allows for the identification of LE-related deaths that are likely underascertained by other systems. NVDRS jurisdictions might be able to implement specialized surveillance to increase ascertainment, particularly for accidental manner LE-related deaths that occur during the process of pursuit or arrest. We identified specific processes during death certification and coding that might improve quality cause of death coding and the ability for vital statistics surveillance systems to accurately ascertain legal intervention deaths. We are using these insights to inform the development of prospective surveillance.⁴³ Timely, accurate, surveillance data can be shared with injury programs and partner agencies, including LE, to inform prevention efforts.

REFERENCES

1. Bylander J. Civil Unrest, Police Use Of Force, And The Public's Health. *Health Aff (Millwood)*. 2015;34(8):1264-1268.
2. U.S. Department of Justice Civil Rights Division and U.S. Attorney's Office Northern District of Illinois. *Investigation of the Chicago Police Department*. . 2017; <https://www.justice.gov/opa/file/925846/download>. Accessed 5/31/2017.
3. U.S. Department of Justice Civil Rights Division. *Investigation of the Ferguson Police Department*. 2015; https://www.justice.gov/sites/default/files/opa/press-releases/attachments/2015/03/04/ferguson_police_department_report.pdf. Accessed 5/31/2017.
4. Wines M, Cohen S. Police killings rise slightly, though increased focus may suggest otherwise. *New York Times* 2015; https://www.nytimes.com/2015/05/01/us/no-sharp-rise-seen-in-police-killings-though-increased-focus-may-suggest-otherwise.html?_r=0. Accessed May 31, 2017.
5. Jee-Lyn Garcia J, Sharif MZ. Black Lives Matter: A Commentary on Racism and Public Health. *American journal of public health*. 2015;105(8):e27-30.
6. Krieger N, Chen JT, Waterman PD, Kiang MV, Feldman J. Police Killings and Police Deaths Are Public Health Data and Can Be Counted. *PLoS medicine*. 2015;12(12):e1001915.
7. Death in Custody Reporting Act of 2000 (P.L. 106-297). 2000.
8. Death in Custody Reporting Act of 2013 (P.L. 113-242). 2013.
9. Bureau of Justice Statistics. Arrest-Related Deaths. 2017; <https://www.bjs.gov/index.cfm?ty=tp&tid=82>. Accessed May 26, 2017.
10. Federal Bureau of Investigation. Uniform Crime Reports: Supplementary Homicide Report. 2015; <https://www.fbi.gov/about-us/cjis/ucr/nibrs/addendum-for-submitting-cargo-theft-data/shr>. Accessed 1/6/2016.
11. Banks D, Couzens L, Blanton C, Cribb D. Arrest-Related Deaths Program Assessment: Technical Report (NCJ 248543). 2015; <https://www.bjs.gov/content/pub/pdf/ardpatr.pdf>. Accessed May 26, 2017.
12. Banks D, Ruddle P, Kennedy E, Planty MG. Arrest-Related Deaths Program Redesign Study, 2015–16: Preliminary Findings (NCJ 250112). 2016; <https://www.bjs.gov/content/pub/pdf/ardprs1516pf.pdf>. Accessed May 26, 2017.
13. Davis JP, Vergeront JM. The effect of publicity on the reporting of toxic-shock syndrome in Wisconsin. *The Journal of infectious diseases*. 1982;145(4):449-457.
14. Planty MG, Burch AM, Banks D, Couzens L, Blanton C, Cribb D. Arrest-Related Deaths Program: Data Quality Profile (NCJ 248544). 2015; <https://www.bjs.gov/content/pub/pdf/ardpdqp.pdf>. Accessed May 23, 2017.
15. The Guardian. The Counted: people killed by the police in the US. 2015; <http://www.theguardian.com/us-news/series/counted-us-police-killings>. Accessed 1/6/2016.
16. Washington Post. Police Shootings. 2015; <https://www.washingtonpost.com/graphics/national/police-shootings/>. Accessed 1/13/2016.
17. Federal Bureau of Investigation. Uniform Crime Reports: Expanded Homicide Data Table 14 (Justifiable Homicide: by Weapon, Law Enforcement, 2010–2014). 2017; https://ucr.fbi.gov/crime-in-the-u.s/2014/crime-in-the-u.s.-2014/tables/expanded-homicide-data/expanded_homicide_data_table_14_justifiable_homicide_by_weapon_law_enforcement_2010-2014.xls. Accessed May 26, 2017.

18. World Health Organization. Chapter XX. External causes of morbidity and mortality. 2005; <http://apps.who.int/classifications/apps/icd/icd10online2005/fr-icd.htm?gy35.htm+>. Accessed May 26, 2017.
19. Barber C, Azrael D, Cohen A, et al. Homicides by Police: Comparing Counts From the National Violent Death Reporting System, Vital Statistics, and Supplementary Homicide Reports. *American journal of public health*. 2016;106(5):922-927.
20. Comstock RD, Mallonee S, Jordan F. A comparison of two surveillance systems for deaths related to violent injury. *Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention*. 2005;11(1):58-63.
21. Loftin C, Wiersema B, McDowall D, Dobrin A. Underreporting of justifiable homicides committed by police officers in the United States, 1976-1998. *American journal of public health*. 2003;93(7):1117-1121.
22. Centers for Disease Control and Prevention National Center for Health Statistics. MMDS Software Documentation. 2015; <https://www.cdc.gov/nchs/data/dvs/helpfile.pdf>. Accessed May 23, 2017.
23. Blair JM, Fowler KA, Jack SP, Crosby AE. The National Violent Death Reporting System: overview and future directions. *Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention*. 2016;22 Suppl 1:i6-11.
24. Lyons BH, Fowler KA, Jack SP, Betz CJ, Blair JM. Surveillance for Violent Deaths - National Violent Death Reporting System, 17 States, 2013. *MMWR Surveill Summ*. 2016;65(10):1-42.
25. Bassett MT. #BlackLivesMatter--a challenge to the medical and public health communities. *The New England journal of medicine*. 2015;372(12):1085-1087.
26. Fatal Encounters. 2016; www.fatalencounters.org. Accessed January 5, 2017.
27. Bureau of Justice Statistics. Arrest-Related Deaths (ARD) Program. In: Justice USDo, ed2016.
28. DeGue S, Fowler KA, Calkins C. Deaths Due to Use of Lethal Force by Law Enforcement: Findings From the National Violent Death Reporting System, 17 U.S. States, 2009-2012. *American journal of preventive medicine*. 2016;51(5S3):S173-S187.
29. Gignoux E, Idowu R, Bawo L, et al. Use of Capture-Recapture to Estimate Underreporting of Ebola Virus Disease, Montserrado County, Liberia. *Emerging infectious diseases*. 2015;21(12):2265-2267.
30. Mapping Police Violence. Police Accountability Tool. 2017; <https://mappingpoliceviolence.org/compare-police-departments/>. Accessed September 4, 2016.
31. Madsen A, Begier E. Improving quality of cause-of-death reporting in New York City. *Preventing chronic disease*. 2013;10:E118.
32. Centers for Disease Control and Prevention. National Violent Death Reporting System (NVDRS) Coding Manual Revised 2015; http://www.cdc.gov/violenceprevention/pdf/nvdrs_web_codingmanual.pdf. Accessed May 23, 2017.
33. Krieger N, Kiang MV, Chen JT, Waterman PD. Trends in US deaths due to legal intervention among black and white men, age 15-34 years, by county income level: 1960-2010. *Harvard Public Health Review*. 2015;3:1-5.
34. Ross CT. A Multi-Level Bayesian Analysis of Racial Bias in Police Shootings at the County-Level in the United States, 2011-2014. *PloS one*. 2015;10(11):e0141854.
35. Buehler JW. Racial/Ethnic Disparities in the Use of Lethal Force by US Police, 2010-2014. *American journal of public health*. 2016:e1-e3.
36. Feldman JM, Chen JT, Waterman PD, Krieger N. Temporal Trends and Racial/Ethnic Inequalities for Legal Intervention Injuries Treated in Emergency Departments: US Men and Women Age 15-

- 34, 2001-2014. *Journal of urban health : bulletin of the New York Academy of Medicine*. 2016;93(5):797-807.
37. Sikora AG, Mulvihill M. Trends in mortality due to legal intervention in the United States, 1979 through 1997. *American journal of public health*. 2002;92(5):841-843.
38. Miller TR, Lawrence BA, Carlson NN, et al. Perils of police action: a cautionary tale from US data sets. *Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention*. 2016.
39. Worden R. The causes of police brutality: theory and evidence on police use of force. In: Geller W, H T, eds. *Police Violence: Understanding and Controlling Police Abuse of Force*. New Haven, CT: Yale University Press; 1996:23-51.
40. Terrill W, Reisig M. Neighborhood context and police use of force. *J Research Crime and Delinquency*. 2003;40(3):291-321.
41. President's Task Force on 21st Century Policing. *Final report of the President's task force on 21st century policing*. Washington, DC: Office of Community Orienting Policing Services;2015.
42. Centers for Disease Control and Prevention. Public Health Law Program: Coroner/Medical Examiner Laws, by State. 2015; <http://www.cdc.gov/phlp/publications/topic/coroner.html>. Accessed 1/6/2016.
43. Watson Developer Cloud. Discovery News. 2017; <https://www.ibm.com/watson/developercloud/discovery-news.html>. Accessed May 31, 2017.

Table 1**Characteristics of Law Enforcement-Related Deaths — New York City, 2010–2015 (n, [column %])**

(n, [column %])	Law enforcement-related death (n = 105)	Legal intervention death (n = 61)	Arrest-related death (n = 31)	Community /bystander death (n = 13)
Borough of injury				
Manhattan	24 (22.9)	12 (19.7)	7 (22.6)	5 (38.5)
Bronx	24 (22.9)	15 (24.6)	8 (25.8)	1 (7.7)
Brooklyn	39 (37.1)	21 (34.4)	12 (38.7)	6 (46.2)
Queens	13 (12.4)	11 (18.0)	1 (3.2)	1 (7.8)
Staten Island	5 (4.8)	2 (3.3)	3 (9.7)	0 (0.0)
Year of injury				
2010	16 (15.2)	19 (16.4)	3 (9.7)	3 (23.1)
2011	15 (14.3)	8 (13.1)	6 (19.4)	1 (7.7)
2012	25 (23.8)	17 (27.9)	7 (22.6)	1 (7.7)
2013	21 (20.0)	8 (13.1)	9 (29.0)	4 (30.8)
2014	16 (15.2)	11 (18.0)	2 (6.5)	3 (23.1)
2015	12 (11.4)	7 (11.5)	4 (12.9)	1 (7.7)
Sex				
Male	95 (90.5)	58 (95.1)	30 (96.8)	7 (53.9)
Race/ethnicity*				
White, non-hispanic	16 (15.4)	10 (16.4)	4 (13.3)	2 (15.4)
Black, non-hispanic	56 (53.9)	34 (55.7)	16 (53.3)	6 (46.2)
Hispanic	26 (25.0)	13 (21.3)	10 (33.3)	3 (23.1)
Other	6 (5.8)	4 (6.6)	0 (0.0)	2 (15.4)
Age*				
<18	5 (5.7)	3 (4.9)	1 (3.2)	2 (15.4)
18 to <24	26 (24.8)	13 (21.3)	10 (32.3)	3 (23.1)
25 to <34	24 (22.9)	17 (27.9)	5 (16.1)	2 (15.4)
35 to <45	17 (16.2)	8 (13.1)	6 (19.4)	3 (23.1)
45 to <55	22 (21.0)	13 (21.3)	8 (25.8)	1 (7.7)
55+	10 (9.5)	7 (11.5)	1 (3.2)	2 (15.4)
Manner of Death				
Natural	5 (4.8)	0 (0.0)	4 (12.9)	1 (7.7)
Accident	25 (23.8)	0 (0.0)	21 (67.7)	4 (30.8)
Suicide	4 (3.8)	0 (0.0)	4 (12.9)	0 (0.0)
Homicide	70 (67.7)	61 (100.0)	1 (3.2)	8 (61.5)
Undetermined	1 (0.95)	4 (0.0)	1 (3.2)	0 (0.0)
Ascertainment source				
Death certificate and media report	54 (51.4)	43 (70.5)	6 (19.4)	5 (38.5)
Death certificate only	23 (21.9)	5 (8.2)	16 (51.6)	2 (15.4)
Media report only	28 (26.7)	13 (21.3)	9 (29.0)	6 (46.2)

*From death certificate data

Table 2

Death Certificate International Classification of Disease, 10th Revision (ICD-10) Codes for Legal Intervention and Literals Fields Indicating Police Involvement for Legal Intervention Deaths — New York City, 2010–2015

		Mention of “Police” or “Officer” in Death Certificate Literals		Total
		Yes	No	
ICD-10 code for legal intervention	Yes	39	2	41 (67%)
	No	7	13	20 (33%)
	Total	46 (75%)	15 (25%)	61 (100%)

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Table 3

Estimated universe of law enforcement-related deaths, by case definition — New York City, 2010–2015

	Number detected by either death certificates or media reports	Predicted number missed by both death certificates and media reports* (lower and upper confidence limit)	Estimated total number of deaths† (lower and upper confidence limit)	Percent missed
Legal intervention deaths	61	1.5 (0.5–4.4)	62.5 (61.5–65.9)	2.4%
Arrest-related deaths	31	24.0 (7.7–75.3)	55.0 (38.7–106.3)	43.6%
Community/bystander deaths	13	2.4 (0.4–14.9)	15.4 (13.4–27.9)	15.6%
Law enforcement-related deaths (total)‡	105	11.9 (6.5–22.0)	116.9 (111.5–127.0)	10.2%

*Predicted estimates the result of log-linear capture-recapture model, using the predicted probability of each case by each data source

†Sum of the number of cases detected by either death certificates or media reports and the predicted number missed by both death certificates and media reports with upper and lower confidence limits

‡Modeled independently of case definitions

Table 4**Average Annual Incidence* of Legal Intervention Deaths by Race/Ethnicity — New York City, 2010–2015**

	Incidence rate per 100,000	Incidence rate ratio (95% confidence interval)
White, non-hispanic	0.06	REF
Black, non-hispanic	0.30	4.9 (2.4–10.0)
Hispanic	0.09	1.5 (0.6–3.4)
Other	0.05	0.8 (0.3–2.7)
Overall	0.12	N/A

*Incidence calculated using the midpoint (average of 2012 and 2013) intercensal population estimates by race/ethnicity strata, American Community Survey 2010–2015

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Table 5

Legal Intervention Death Circumstances, stratified by race — New York City, 2010–2015 (n [Col %])

	All (n = 61)	White, non- hispanic (n = 10)	Black, non- hispanic (n = 34)	Hispanic (n = 13)	Other (n = 4)
Decedent unarmed*	11 (18.0)	0 (0.0)	6 (17.7)	5 (38.5)	0 (0.0)
Officer acted in self-defense*	45 (73.8)	10 (100.0)	25 (73.5)	8 (61.5)	2 (50.0)
Decedent with history of mental health problem†	8 (13.1)	1 (10.0)	4 (11.8)	2 (15.4)	1 (25.0)

*From the investigation by the New York City Office of Chief Medical Examiner (NYC OCME); if no value determined by the medical examiner office, then populated using media reports

†From the NYC OCME only

Table S1 — Factors Associated with Legal Intervention Death Cases Not Being Identified by Death Certificate Query

(n, [Row %])	n (%)	Fisher's Exact Test* <i>P</i>	Multivariable Log Binomial Fixed Effect† <i>P</i>
Borough of injury			
Manhattan	2 (16.7)	0.06	0.75
Bronx	1 (6.7)		
Brooklyn	4 (30.8)		
Queens	6 (54.6)		
Staten Island	0 (0.0)		
Sex			
Male	95 (90.5)	1.0	0.79
Year			
2010	4 (40.0)	0.04	0.64
2011	1 (12.5)		
2012	1 (5.9)		
2013	0 (0.0)		
2014	4 (36.4)		
2015	3 (42.9)		
Race/ethnicity‡			
White, non-hispanic	4 (40.0)	0.31	0.97
Black, non-hispanic	5 (14.7)		
Hispanic	3 (23.1)		
Other	1 (25.0)		
Age			
<18	0 (0.0)	0.91	0.88
18 to <24	3 (15.4)		
25 to <34	4 (23.5)		
35 to <45	2 (25.0)		
45 to <55	4 (30.8)		
55+	1 (14.3)		

*Fisher's exact test used as a bivariate measure of association between each covariate and not being identified by death certificate query, given small cell sizes.

†Type III fixed (overall) effect of each variable in a multivariable log binomial regression of covariates in Table 6 on the outcome (case not identified by death certificate query).

‡From death certificate