




A Typology of Civilians Shot and Killed by US Police: a Latent Class Analysis of Firearm Legal Intervention Homicide in the 2014–2015 National Violent Death Reporting System

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Abstract Approximately 1000 people are killed by police acting in the line of duty each year. Historically, research on these deaths, known as legal intervention homicides (LIH), has been limited by data that is either contextually rich but narrow in scope and not readily available to the public (e.g., police department reports from a single city), or detail-poor but geographically broad, large, and readily available (and maintained by federal agencies) (e.g., vital statistics and supplemental homicide reports). Over the past 5 years, however, researchers have turned to the National Violent Death Reporting System (NVDRS), which captures nearly all lethal police shootings in participating states while providing detailed incident and victim

information. The current study extends prior work on police-involved lethal shootings in three important ways. First, we use latent class analysis to construct a data-driven, exhaustive, mutually exclusive typology of these events, using NVDRS data 2014–2015. Second, rather than fitting some, but not all cases into predefined sub-types, every case is assigned membership to a particular emergent class. Third, we use a validated case identification process in NVDRS to identify incidents of lethal police-involved shootings. Seven classes emerge. Classes differ across important incident and victim characteristics such as the event that brought the victim and law enforcement together, the highest level of force used by the victim against law enforcement, and the kind of weapon, if any, used by the victim during the incident. Demographic variables do not distribute uniformly across classes (e.g., the latent class in which the victim appeared to pose minimal threat to law enforcement was the only class in which the plurality of victims was a non-white race). Our approach to generating these typologies illustrates how data-driven techniques can complement subjective classification schemes and lay the groundwork for analogous analyses using police encounter data that include fatal and non-fatal outcomes.

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Introduction

Police officers kill approximately 1000 civilians annually while acting in the line of duty [1, 2]. These incidents, often referred to as legal intervention homicides (LIH), have been a topic of intense public and scholarly interest for several decades. High profile LIH, such as the killings of Michael Brown in Ferguson, Missouri, and Stephon Clark in Sacramento, California, have increased the public's awareness of and interest in such incidents.

Academic research on the situational and dynamic characteristics of LIH can be broadly divided into those that use (1) longstanding public health surveillance data, maintained by the federal government; (2) police department data, and, more recently (3) open-source, primarily media-derived data collected by independent groups with a focus on "fatal encounters" between police and civilians [1, 3–12].

Each of these types of data has significant limitations. The National Vital Statistics System (NVSS) and FBI's Supplementary Homicide Reports substantially undercount LIH and provide no (NVSS) or scant (SHR) incident-related contextual information [1, 13]. Police data, while richer in detail, are not publicly available, and are generally limited to single police departments in large cities. Open-source efforts, such as Mapping Police Violence, or the Washington Posts' Fatal Force project, while comprehensive, are largely unvalidated, especially with respect to incident characteristics.

Scholars have recently turned to the National Violent Death Reporting System (NVDRS) as an alternative source of data for understanding LIH and for elucidating LIH subtypes [2, 8, 14]. Two recent studies of LIH using NVDRS illustrate its usefulness in this regard [2, 14]. Vivian Lord studied a single category of LIH, "suicide-by-cop" (SbC), defined, by Lord, as cases in which the victim purposefully elicits deadly force by law enforcement as a way to complete suicide [2]. Based on reviewing incident narratives summarizing coroner/medical examiner (CME) and law enforcement (LE) records, Lord reported that 29% of the LIH were SbC incidents. In SbC incidents, it was less likely that an actual crime precipitated the interaction and, among armed victims, less likely that the victim was armed with a firearm (compared with non-SbC incidents) [2].

Degue et al. used 2009–2012 NVDRS incident narratives to characterize cases as belonging to one of four non-mutually exclusive, a priori-defined subtypes of LIH

(unintentional; "suicide-by-cop"; intimate partner violence related (IPV); and mental health or substance-induced behavior (MH)) [14]. Using these categories, Degue et al. found that unintentional deaths were rare (6% of the sample) and that compared to all cases, SbC incidents (18% of cases) were more likely to occur in the home, IPV incidents (14% of cases) were more likely to involve an immediate threat to a civilian, and MH-related incidents (22% of cases) were less likely to result in an injury to law enforcement. However, Degue et al. could not place more than half of the incidents in one or more of these categories [14]. They concluded that the conception, design, and implementation of future prevention strategies would be advanced if future analyses "further examine the possibility of statistically distinct subtypes of legal intervention cases..." [14].

The current paper differs from prior work on LIH in three important ways. First, we use latent class analysis (LCA) to construct an exhaustive, mutually exclusive typology of firearm LIH using NVDRS data (i.e., rather than fitting some, but not all, cases into predefined subtypes of LIH, every case is assigned membership to a mutually exclusive sub-type of LIH). Second, we use a validated (and improved) case identification process in NVDRS (described more fully in the methods section) to identify LIH incidents [1]. Third, we restrict our sample to include only firearm LIH (which make up over 90% of LIH), because ascertainment of firearm LIH using NVDRS has been validated as a nearly complete census of such events, whereas NVDRS has not been validated as a reliable source for non-firearm LIH [7].

Methods

Data and Case Identification

Data for this study come from the 2014 and 2015 National Violent Death Reporting System (NVDRS). NVDRS, established in 2003 by the Centers for Disease Control and Prevention (CDC), captures all violent deaths in participating states that result from suicide, homicide, unintentional shooting, injuries of unknown intent, and legal intervention (excluding legal execution). In 2014, 16 states participated in NVDRS, and in 2015, NVDRS expanded into 11 additional states (see Appendix Table 3 for a complete list of states.)

For each death, state-based abstractors code standardized variables about the victim and incident using

death certificates, law enforcement (LE) reports, and coroner/medical examiner (CME) reports as a source. In addition, each abstractor writes two brief incident narratives, one summarizing the LE report, the other summarizing the CME report.

Following the case definition used in Barber et al., case identification relied both on variables that are coded in NVDRS and a review of the LE and CME incident narratives [1]. We first flagged for review all cases for which any of the following were true: The abstractor-coded variable for type of death is “legal intervention”; the relationship of victim to suspect is “50-Victim injured by law enforcement officer”; the underlying cause of death code indicates legal intervention (Y35.0–Y35.4, Y35.6, Y35.7, and Y89.0, excluding legal executions); the victim in custody variable is coded as “in jail or prison,” “under arrest but not in jail,” “injured prior to arrest,” or “other” AND the death certificate manner of death is homicide or legal intervention; homicide circumstance is “justifiable homicide” and relationship of victim to suspect is missing.

All cases meeting the above criteria were reviewed to ensure that they met the case definition, which requires all three of the following to be true: (1) manner of death (on case review) is homicide, not suicide, accident, or natural; (2) suspect is a law enforcement officer. This includes local, state, federal, or military law enforcement agents. Corrections officers, but not private security guards, are included; (3) the incident occurs in the line of duty. An off-duty officer who intercedes as an officer is acting in the line of duty. However, an officer who kills his or her spouse during an argument is not acting in the line of duty regardless of whether the officer is on or off duty at the time.

For each case meeting the case definition, two members of the research team independently read both the LE and CME incident narratives and, while doing so, recorded 13 LIH-specific data elements (see Fig. 1). These additional data elements reflect situational and individual characteristics previously identified in the LIH literature as relevant to a comprehensive understanding of these events (e.g., continuum of force used by LE officers, force used by victims against LE, reasons for contact, etc.) [2, 5, 15–19]. Interrater reliability averaged 87.1%. When reader 1 and reader 2 differed in their coding, the discrepancy was resolved by a third member of the research team.

To construct typologies based on structural characteristics of the incident, as well as the behavior and

actions of law enforcement and the victim alike during the course of the incident, following Wurpts and Geiser’s advice on improved LCA model performance, we further reduced the 13 data elements to 11 binary indicators and 2 polytomous categorical variables (see Fig. 2) [20].

Victim characteristics not used for the construction of the typologies (and not LIH specific) are reported (by typology class and overall) using routinely collected data from NVDRS. These include demographics, mental health, and substance use indicators, and the type of location where the incident occurred.

To contextualize these characteristics across typologies, we provide information on the US general population for sex, race and ethnicity, education, marital status, and veteran status from the 2015 American Community Survey (ACS) 1-year estimates [21]. General population marital status estimates are restricted to the 2015 US population 15 years of age and older, and veteran status estimates are restricted to the 2015 US population 18 years of age and older. Because the ACS did not aggregate age groups in the ways we do, the 2015 US general population age distribution estimate comes from the CDC’s WISQARS online database [22].

Cases with no or insufficient information in the narratives (4.7% of cases) were excluded from analyses.

Statistical Analysis

The goal of latent class analysis (LCA) is to identify an unobserved (latent) categorical variable such that the pattern of covariation among the observed variables can be explained by a unique category, or “class,” of the latent variable [23]. Accordingly, we use latent class analysis as a method for exploratory typological analysis, to describe exhaustive, mutually exclusive classes of LIH.

We sought to identify the most parsimonious model using the least number of latent classes possible to best separate LIH cases into conceptually distinct and meaningful typologies [23]. Relevant statistics for assessing model fit in LCA include a number of related but different “information criterion” (e.g., Akaike Information Criterion, Consistent Akaike Information Criterion, Bayesian Information Criterion, Sample-size Adjusted Bayesian Information Criterion) [24]. We chose to use the sample-size adjusted Bayesian Information Criterion (SABIC) given its superior ability to handle, with sample sizes similar to ours, unequal class sizes and

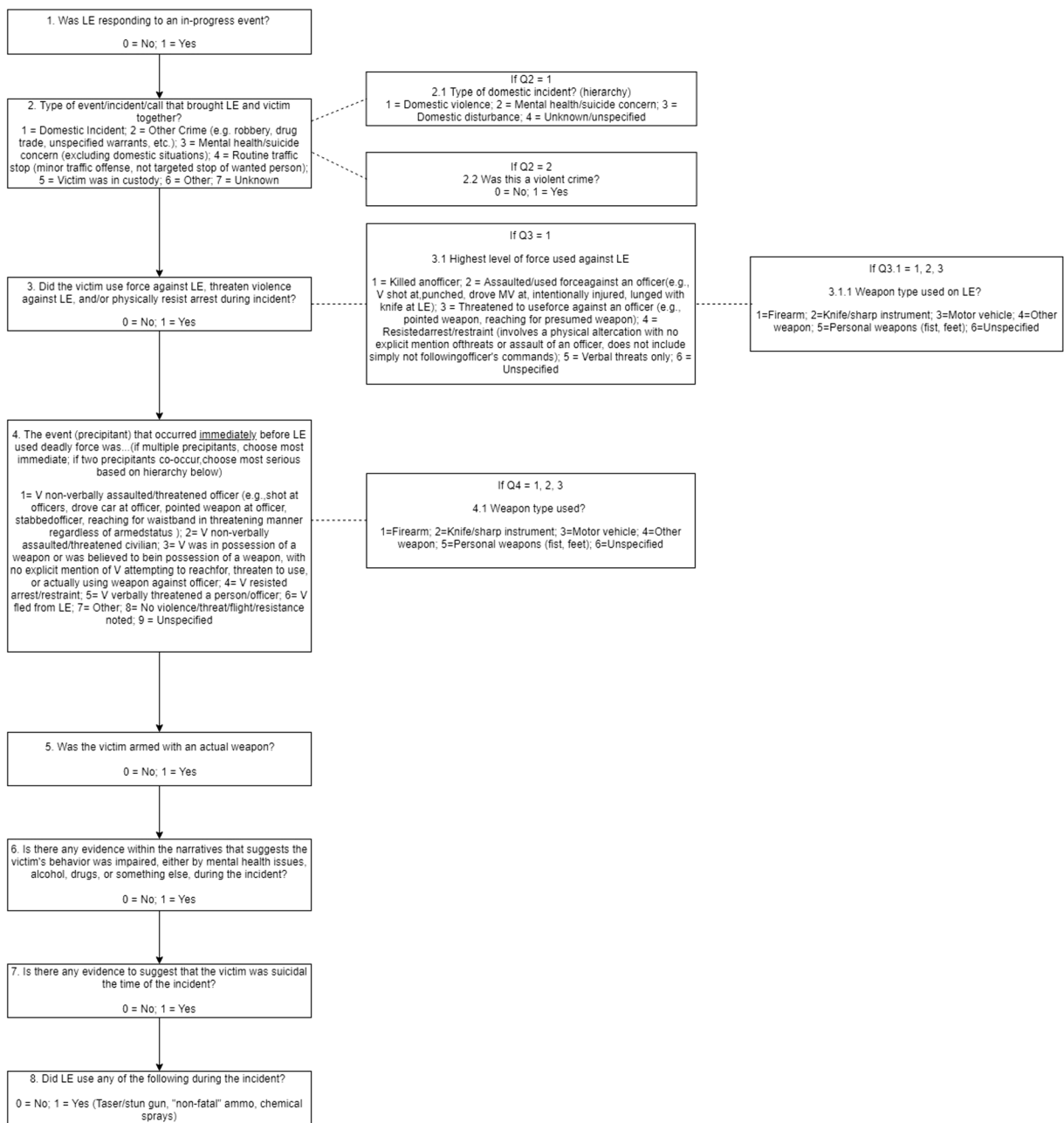


Fig. 1 Additional data elements collection tool

endorsement probabilities which are high or low across multiple classes [24]. All analyses were performed using MPlus Version 8.1 Statistical Software (Muthén & Muthén, Los Angeles, CA) [25].

We report the item response probabilities for each of the 13 variables used in the model by latent class. These values indicate the probability that a representative case of that class would exhibit that characteristic [23].

Additionally, we report the proportion of cases in our sample with each characteristic.

Results

There were 616 deaths in the 2014 and 2015 NVDRS data that met our definition of LIH by firearm. Thirteen

Reduced Variables	Response Options	Original Variable(s) Used
1. The event that brought LE and the victim together was domestic violence or a violent crime	0. No/Unknown 1. Yes	Q2, Q2.1, Q2.2
2. The event that brought LE and the victim together was in-progress	0. No/Unknown 1. Yes	Q1
3. LE used less than lethal force during the incident (e.g. Taser, pepper spray, other chemical sprays, etc.)	0. No/Unknown 1. Yes	Q8
4. The precipitating event, i.e. what occurred immediately before LE inflicted the fatal injury, involved the victim assaulting or threatening LE officer(s) or civilians with use of force	0. No/Unknown 1. Yes	Q4
5. The victim used a (real, fake, or what was believed to be a) firearm against LE during the course of the incident	0. No/Unknown 1. Yes	Q3, Q3.1, Q3.2
6. The victim used a (real, fake, or what was believed to be a) knife or another sharp object against LE during the course of the incident	0. No/Unknown 1. Yes	Q4, Q4.1
7. The victim drove a motor vehicle aggressively towards LE during the course of the incident	0. No/Unknown 1. Yes	Q4, Q4.1
8. The victim was armed with a real weapon	0. No/Unknown 1. Yes	Q5
9. The narratives contain information that suggests the victim's behavior was impaired, perhaps by drugs, alcohol, mental illness, or something else	0. No/Unknown 1. Yes	Q6
10. The narratives contain information that suggest the victim was suicidal at the time of the fatal encounter, (e.g. the victim expressed suicidal ideation, threatened suicide, attempted suicide, left a note, made "suicide by cop" statements, etc.)	0. No/Unknown 1. Yes	Q7
11. Description of event that brought LE and the victim together	1. Domestic Incident 2. Crime 3. Routine Traffic Stop 4. Other (e.g. mental health or suicide concern outside of the domestic setting, victim was already in police custody, reported suspicious person or vehicle, unknown)	Q2
12. The highest level of force used against LE by the victim	1. Killed an officer 2. Assaulted an officer (e.g. shot at with a firearm, lunged at with knife or other sharp object, drove a motor vehicle at, etc.) 3. Threatened to use force against an officer (e.g. reaching for a (real or fake) firearm, refusing to put down a (real or fake) firearm, brandishing a knife, etc.) 4. Other or unspecified level of force 5. No threat or use of force against LE	Q3, Q3.1

Fig. 2 Reduced variables used for latent class analysis models

of these deaths were excluded because of narratives that contained insufficient information for coding. Accordingly, our final sample was 603 firearm LIH (Table 2). All states participating in NVDRS during the study period had at least one firearm LIH included (see Appendix Table 3.)

Typologies (Table 1)

We identified 7 mutually exclusive and collectively exhaustive classes, or “types,” of firearm legal intervention homicides. While larger models (8 and 10-class models) had lower SABIC’s, the reductions in the SABIC beyond the 6 to 7 class transition were small and without meaningful interpretative value (i.e., they were beyond the “elbow” of the information criterion graph [24, 26]; see Appendix Table 4 for model SABIC’s.)

The seven subtypes to emerge can be described as follows:

- Class 1 LIH are instigated by violent, in-progress events in which the victims wield firearms against law enforcement.
- Class 2 LIH differ in being instigated by domestic violence in particular, and rather than wielding firearms, the victims threaten and assault LE with knives. LE has a relatively high probability of using less than lethal force during class 2 incidents (though this is still infrequent).
- Class 3 LIH, like class 1, are instigated by in-progress events, though these are non-violent, and the victims are killed immediately after threatening or assaulting LE with a firearm (one in three victims are suicidal, a relatively high proportion).
- Class 4 LIH are like class 3 in that a non-violent, in-progress event brings LE and the victim together, but class 4 victims attack LE with a knife and are the most likely, across all classes, to be impaired, suicidal, or both at the time of

Table 1 Incident characteristic probabilities by latent class, 603 Firearm LIH cases in NVDRS 2014–2015

Latent class	1	2	3	4	5	6	7	Overall
	26.5%	10.3%	21.6%	8.3%	14.8%	8.0%	10.6%	100%
	(160)	(62)	(130)	(50)	(89)	(48)	(64)	(603)
Description of event that brought LE and victim together								
Domestic incident	0.574	0.709	0.260	0.146	0.014	0.227	0.066	0.323
Crime	0.426	0.291	0	0.218	0.677	0.317	0.530	0.348
Routine traffic stop	0	0	0.260	0.052	0	0.042	0.202	0.083
Other	0	0	0.480	0.584	0.309	0.413	0.202	0.245
Event was domestic violence or other violent crime	0.967	0.869	0	0	0.204	0.372	0.222	0.439
Event was “in-progress”	0.939	0.912	1	0.770	0.143	0.592	0.618	0.755
Highest level of force against LE by victim during the incident								
Killed/assaulted an officer	0.423	0.615	0.425	0.722	0.533	0.029	0.902	0.506
Threatened to use force against an officer	0.523	0.227	0.561	0.278	0.467	0	0.079	0.383
Other	0.018	0	0	0	0	0.359	0.020	0.035
None	0.035	0.158	0.014	0	0	0.612	0	0.076
LE used less than lethal force during incident	0.065	0.167	0.066	0.319	0.097	0.064	0.127	0.108
Immediately prior to fatal injury, victim assaulted or threatened an officer or a civilian	0.927	0.984	0.918	0.911	0.901	0.081	0.942	0.862
Highest level of force and/or precipitating event involved a firearm or what was thought to be a firearm	0.927	0	0.957	0	0.990	0.024	0	0.600
Highest level of force and/or precipitating event involved a knife or what was thought to be a knife	0	1	0	0.888	0	0.022	0	0.177
Highest level of force and/or precipitating event involved victim using a motor vehicle aggressively	0.004	0	0	0.021	0	0	0.642	0.073
Victim was armed with a real weapon	0.919	1	0.953	1	0.932	0.273	0.123	0.806
Evidence in narrative suggests the victim’s behavior was impaired at time of incident	0.348	0.422	0.335	0.454	0.036	0.125	0.202	0.282
Evidence in narrative suggests victim was suicidal at time of incident	0.236	0.176	0.357	0.436	0.115	0.102	0.054	0.222

Class membership brief characterization: class 1—violent, in-progress events involving victims armed with firearms; class 2—violent, in-progress (usually domestic) events involving victims armed with knives; class 3—non-violent, in-progress events involving (suicidal) victims armed with firearm; class 4—non-violent, in-progress events involving (impaired and/or suicidal) victims armed with a knife; class 5—events involving warrants and wanted people armed with firearms; class 6—events without apparent objective threat to LE involving unarmed victims; class 7—motor vehicle assaults on LE

the incident. Similar to class 2, LE has a relatively high probability of using less than lethal force during class 4 LIH.

Class 5 LIH are incidents that began with LE attempting to contact a wanted person and at some subsequent point, the victim responded to LE with force, namely by wielding a firearm.

Class 6 LIH are characterized by a notable lack of apparent threat or assault by the victim precipitating the use of lethal force by LE.

Class 7 LIH are incidents in which the victims, most of whom are unarmed, were killed because they

maneuvered a motor vehicle in a way LE perceived as threatening or assaultive.

Nearly half of our sample (290/603, 48.1%) belonged to either class 1 (violent in-progress events with guns) or class 3 (suicidal, threatening with guns); almost two-thirds belong to classes 1–4 (491/603).

Distribution of Characteristics Across Typologies (Table 2)

For many victim characteristics (e.g., sex and educational attainment of the victim), the proportions

within classes resemble those observed in the overall sample. However, relative to all other classes, class 7 (motor vehicle assaults on LE) victims were young (78.2% < 40 years vs 62.1% < 40 years), and class 4 (impaired, suicidal, threatening with knives) victims were old (48.0% ≥ 40 years vs 38.0% ≥ 40 years).

While the majority of victims in the overall sample were white, non-Hispanics (53.6%), the majority of victims in classes 5 (warrants and wanted people with guns), 6 (low threat, likely unarmed), and 7 (motor vehicle assaults on LE) were non-white, mostly as a result of relatively high proportions of black, non-Hispanics. In fact, class 6 (low threat, likely unarmed) was the only class in which non-white victims (black, non-Hispanic) were the plurality.

Married victims made up a greater proportion of victims in class 1 (violent in-progress events with guns) and class 3 (suicidal, threatening with guns) (32.5% and 36.2%, respectively) compared with all other classes (range of 16.1–20.3%). Similarly, class 1 (violent in-progress events with guns) and class 3 (suicidal, threatening with guns) also had the highest proportion of victims who had served in the military (17.0% and 19.2%, respectively, compared with a range across other classes of 4.8–11.3%).

Current and lifetime mental health and substance abuse problems varied widely across classes. For example, class 2 (in-progress (domestic) violence with knives) and class 4 (impaired, suicidal, threatening with knives) had high proportions of victims with mental health problems at the time of the incident (41.9% and 36.0%, respectively) relative to the overall sample (19.6%). Conversely, class 5 (warrants and wanted people with guns) and class 6 (low threat, likely unarmed) had very low proportions of victims with current mental health problems (5.6% and 6.3%, respectively). Lifetime mental health and substance use problems followed this pattern—classes 2 (in-progress (domestic) violence with knives) and 4 (impaired, suicidal, threatening with knives) had the highest prevalence of historical treatment for mental health and substance abuse problems (32.3% and 38.0%), while classes 5 (warrants and wanted people with guns) and 6 (low threat, likely unarmed) had the lowest (4.5% and 6.3%, respectively).

On average 15.1% of victims had experienced a recent crisis, ranging from a low of 6.3% in class 7 (motor vehicle assaults on LE) to a high of 18.1% in class 1 (violent in-progress events with guns.)

Overall, 1 in 3 victims were injured at their place of residence (33.2%), though this ranged from lows of 12.5% and 7.8% in classes 6 (low threat, likely unarmed) and 7 (motor vehicle assaults on LE), respectively, to a high of 58.1% in class 2 (in-progress (domestic) incidents with knives).

Discussion

We identified 7 distinct types of firearm legal intervention homicides using latent class analysis. Succinctly characterized, they are as follows: (1) violent, in-progress events involving victims armed with firearms; (2) violent, in-progress (usually domestic) events involving victims armed with knives; (3) non-violent, in-progress events involving (suicidal) victims armed with a firearm; (4) non-violent, in-progress events involving (impaired and/or suicidal) victims armed with a knife; (5) events involving warrants and wanted people armed with firearms; (6) events without apparent objective threat to LE involving unarmed victims; and (7) motor vehicle assaults on LE. Whereas classes 1–4 differ from one another based largely on permutations of weapon type and the type of event that brought LE and the victim together, membership in classes 5–7 depends more on the dynamics involving one of the less common event types bringing LE and the victim together, absence of clear threat posed by the victim, and/or use of a motor vehicle as a weapon.

We believe our study is the first to empirically derive a typology of LIH [2, 5, 7, 14]. Unlike previous studies, our analyses did not rely on a priori assumptions about the presence or characteristics of subtypes of LIH. Moreover, all incidents within our sample were used to inform the characteristics of the subtypes of LIH and all cases were assigned membership into one latent class.

Comparing our empirically derived typology of firearm LIH with previous typologies that are based on a priori-defined categories suggests that combinations of the dynamics that initially brought law enforcement and the victim together and the type of weapon used by the victim to threaten (or assault) LE discriminate between distinct classes of LIH better than preconceived features considered as single-item characteristics. For example, suicide-by-cop incidents have long been considered an important subset of LIH [2, 14, 17]. Overall, 22% of our sample contained evidence that the victim was suicidal at the time of the incident, a result generally consistent

Table 2 Victim and incident characteristics of 603 Firearm LIH cases in NVDRS 2014–2015

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Overall	General population (%)
Year in which the incident occurred									
2014	31.9% (51)	32.3% (20)	36.9% (48)	42.0% (21)	41.6% (37)	37.5% (18)	39.1% (25)	36.5% (220)	
2015	68.1% (109)	67.7% (42)	63.1% (82)	58.0% (29)	58.4% (52)	62.5% (30)	60.9% (39)	63.5% (383)	
Sex of victim¹									
Male	98.1% (157)	95.2% (59)	93.9% (122)	96.0% (48)	94.4% (84)	97.9% (47)	92.2% (59)	95.5% (576)	49.2
Female	1.9% (3)	4.8% (3)	6.2% (8)	4.0% (2)	5.6% (5)	2.1% (1)	7.8% (5)	4.5% (27)	50.8
Age of victim²									
<25	20.6% (33)	14.5% (9)	16.9% (22)	16.0% (8)	13.5% (12)	35.4% (17)	26.6% (17)	19.6% (118)	32.6
25–39	35.6% (57)	45.2% (28)	40.8% (53)	36.0% (18)	56.2% (50)	35.4% (17)	51.6% (33)	42.5% (256)	20.1
40–54	26.3% (42)	27.4% (17)	29.2% (38)	38.0% (19)	16.9% (15)	20.8% (10)	17.2% (11)	25.2% (152)	19.7
55+	17.5% (28)	12.9% (8)	13.1% (17)	10.0% (5)	13.5% (12)	8.3% (4)	4.7% (3)	12.8% (77)	27.6
Race and ethnicity¹									
White, non-Hispanic	60.0% (96)	53.2% (33)	57.7% (75)	60.0% (30)	49.4% (44)	33.3% (16)	45.3% (29)	53.6% (323)	62.3
Black, non-Hispanic	20.0% (32)	19.4% (12)	21.5% (28)	16.0% (8)	34.8% (31)	35.4% (17)	35.9% (23)	25.0% (151)	12.3
Hispanic	13.8% (22)	17.7% (11)	13.9% (18)	18.0% (9)	12.4% (11)	22.9% (11)	15.6% (10)	15.3% (92)	17.1
Other	6.3% (10)	9.7% (6)	6.9% (9)	6.0% (3)	3.4% (3)	8.3% (4)	3.1% (2)	6.1% (37)	8.3
Education¹									
< High school or Unk	34.0% (53)	33.9% (21)	26.2% (33)	38.0% (19)	27.9% (24)	27.9% (12)	35.5% (22)	31.5% (184)	31.8
High school	42.3% (66)	46.8% (29)	47.6% (60)	38.0% (19)	51.2% (44)	60.5% (26)	43.6% (27)	46.3% (271)	21.9
> High school	23.7% (37)	19.4% (12)	26.2% (33)	24.0% (12)	20.9% (18)	11.6% (5)	21.0% (13)	22.2% (130)	46.3
Marital status^{1,3}									
Married	32.5% (52)	16.1% (10)	36.2% (47)	18.0% (9)	19.1% (17)	18.8% (9)	20.3% (13)	26.0% (157)	47.5
Divorced/separated	17.5% (28)	17.7% (11)	16.9% (22)	20.0% (10)	18.0% (16)	16.7% (8)	10.9% (7)	16.9% (102)	13.1
Single, other, Unk	50.0% (80)	66.1% (41)	46.9% (61)	62.0% (31)	62.9% (56)	64.6% (31)	68.8% (44)	57.1% (344)	39.3
Veteran status^{1,4}									
Veteran	17.0% (27)	11.3% (7)	19.2% (25)	8.0% (4)	7.9% (7)	6.3% (3)	4.8% (3)	12.7% (76)	7.6
Identified as currently having a mental health problem									
Yes	17.5% (28)	41.9% (26)	23.9% (31)	36.0% (18)	5.6% (5)	6.3% (3)	10.9% (7)	19.6% (118)	
Alcohol or substance use problem									
Yes	30.6% (49)	22.6% (14)	28.5% (37)	32.0% (16)	25.8% (23)	18.8% (9)	31.3% (20)	27.9% (168)	

Table 2 (continued)

	Class 1 26.5% (160)	Class 2 10.3% (62)	Class 3 21.6% (130)	Class 4 8.3% (50)	Class 5 14.8% (89)	Class 6 8.0% (48)	Class 7 10.6% (64)	Overall 100% (603)	General population (%)
History of ever being treated for a mental health or substance abuse problem									
Yes	16.3% (26)	32.3% (20)	18.5% (24)	38.0% (19)	4.5% (4)	6.3% (3)	10.9% (7)	17.1% (103)	
Recent crisis									
Yes	18.1% (29)	17.7% (11)	16.9% (22)	14.0% (7)	15.7% (14)	8.3% (4)	6.3% (4)	15.1% (91)	
Place where injury occurred									
Residential location	51.9% (83)	74.2% (46)	44.6% (58)	44.0% (22)	46.1% (41)	27.1% (13)	17.2% (11)	45.4% (274)	
Motor vehicle, roadway, parking lot, etc.	35.6% (57)	21.0% (13)	42.3% (55)	34.0% (17)	33.7% (30)	45.8% (22)	76.6% (49)	40.3% (243)	
Jail, prison, detention facility, etc.	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	2.1% (1)	0% (0)	0.2% (1)	
Other, unknown	12.5% (20)	4.8% (3)	13.1% (17)	22.0% (11)	20.2% (18)	25.0% (12)	6.3% (4)	14.1% (85)	
Injury occurred at victim's residence									
Yes	36.9% (59)	58.1% (36)	38.5% (50)	32.0% (16)	31.5% (28)	12.5% (6)	7.8% (5)	33.2% (200)	

Class membership brief characterization: class 1—violent, in-progress events involving victims armed with firearms; class 2—violent, in-progress (usually domestic) events involving victims armed with knives; class 3—non-violent, in-progress events involving (suicidal) victims armed with firearm; class 4—non-violent, in-progress events involving (impaired and/or suicidal) victims armed with a knife; class 5—events involving warrants and wanted people armed with firearms; class 6—events without apparent objective threat to LE involving unarmed victims; class 7—motor vehicle assaults on LE

¹ General population proportion comes from the 2015 American Community Survey 1-Year Survey [21]

² General population proportion comes from WISQARS [22]

³ General population proportion of Americans 15 years of age and older [21]

⁴ General population proportion of Americans 18 years of age and older [21]

with the findings of both Degue et al. and Lord [2, 14]. In our study, however, incidents characterized by suicidal behavior distributed across every latent class but did not emerge as a distinct typology. In fact, no single class captured the majority of these incidents, although two of the seven classes do have notably high probabilities that victims were suicidal at the time of the incident (35.7% and 43.6%, classes 3 (suicidal, threatening with guns) and 4 (impaired, suicidal, threatening with knives), respectively, see Table 1).

Another subset of LIH that has been the focus of attention is the killing of unarmed, black men [5, 27, 28]. In our study black, non-Hispanic people are roughly twice as likely to be victims of LIH compared with their representation in the general US population [21]. Moreover, black, non-Hispanic victims are disproportionately represented across every class, though not to equal extents. For example, only 16% of class 4 (impaired, suicidal, threatening with knives) LIH victims were black, non-Hispanic. Conversely, class 6 (low threat, likely unarmed), which are LIH characterized by an apparent absence of force used by the victim, is the only class in which the plurality of victims is a non-white race (black, non-Hispanic). This finding comports with prior LIH research that finds that black Americans are not only disproportionately likely to be killed by law enforcement but are disproportionately unlikely to present an objective threat of deadly force (as measured both directly by mention of use of force by victim in incident narratives and by proxy through victim's armed status) [5]. Furthermore, and consistent with Degue et al.'s finding that blacks are less likely to be involved in suicide-by-cop and mental health-related incidents relative to whites, we find that the greatest proportions of black, non-Hispanic victims in our sample were in classes 5 (warrants and wanted people with guns), 6 (low threat, likely unarmed), and 7 (motor vehicle assaults on LE)—classes with the lowest probabilities for suicidal or impaired victims [2, 14].

Limitations

Our paper should be interpreted with limitations in mind. First, because we focus on firearm LIH only, the latent classes we identify pertain to these types of incidents only. A small proportion of LIH result from tasers, restraint, or motor vehicle collisions; a larger but not well-characterized

proportion of civilian deaths occur in an encounter with police but are not determined by medical examiners to be homicides [7]. Efforts to describe classes of these less common types of incidents may be warranted.

Second, all states were not part of NVDRS in 2014–2015. Although the states in the NVDRS database are quite diverse, our results may not be generalizable to the USA as a whole. As of 2019, all 50 US states are now funded to participate in NVDRS. Once all states begin to provide data, future studies could explore whether, and if so to what extent, geographic variation in LIH affects the results reported here.

Third, the level of detail within the incident narratives from which we coded incident characteristics varied widely and this variation, could, to an unknown extent, affect our results. Fortunately, information for most of what scholars agree are key variables (e.g., whether the victim was armed, what the victim did immediately before LE inflicted the fatal firearm injury) [2, 5, 6, 14, 15, 17, 18, 29, 30] were typically provided in the narratives, suggesting any such effect is likely to be modest.

Fourth, NVDRS contains little information about the officer(s) who inflicted the fatal injury. As a result, we do not report even basic information on the police officers involved in LIH incidents. When possible, for all homicides captured within NVDRS, abstractors are supposed to report basic information on the suspected shooters (sex, age, race, etc.). We join previous authors in calling upon NVDRS to improve upon this aspect of its surveillance system [14].

Fifth, our findings do not speak to whether any particular shooting was justified or preventable. That a victim was shot by police, whether armed or not, does not, in itself, justify police use of force, imply that the victim was *ipso facto* a criminal, or speak to whether the victim posed a credible threat to the life of the officer(s) or civilians.

Finally, our sample includes only those encounters with police in which individuals were killed. Incidents of police shooting (or shoot at) but not killing civilians may differ across important dimensions from incidents in which someone is killed [31, 32]. Because we do not have data on non-fatal incidents, the classes we identify using fatal police shooting incidents may differ from

those that would have been produced if we had the full complement of incidents (fatal and non-fatal). As a result, the characteristics (e.g., race, mental illness) we identify as disproportionately present or absent from a given latent class should not be considered risk factors for legal intervention firearm homicide victimization.

These caveats notwithstanding, the typology of LIH we report could be used as a framework to explore the relationship between variation in policing policies, across jurisdictions, or changes in policies within jurisdictions over time, and the distribution across subtypes of LIH. For example, the New York Police Department adopted a policy in the 1970s prohibiting officers from shooting into moving vehicles unless the occupants are using deadly force other than the vehicle itself [33]. As such, one might expect that class 7 (motor vehicle assaults on LE) LIH would be less common in New York after implementation of this policy, as well as constituting a smaller proportion of the LIHs than in other large cities without this policy. In fact, there was a sharp reduction in officer-involved shootings following the implementation of this policy in New York (and, importantly, no increase in the number of officers seriously injured or killed in these events) [33].

Conclusion

The seven classes of police-involved fatal shootings we identify highlight common patterns of incident and victim characteristics that co-occur, as well as the complex dynamics of these incidents that are distinct from subjectively derived, commonly discussed subtypes of LIH, such as “suicide-by-cop.” Our approach to generating these typologies illustrates how data-driven techniques can complement thoughtful but subjective classification schemes and suggests that a logical next step to better understanding police-involved shootings is to conduct similar analyses of police encounter data that include fatal and non-fatal outcomes.

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Appendix

Table 3 Total number of firearm LIH in NVDRS with sufficient narrative information to extract additional data elements by state and year

State	2014	2015
Alaska	2	4
Arizona	0	35
Colorado	19	25
Connecticut	0	2
Georgia	23	29
Hawaii	0	2
Kansas	0	9
Kentucky	15	14
Maine	0	2
Maryland	18	16
Massachusetts	4	10
Michigan	0	16
Minnesota	0	13
New Hampshire	0	2
New Jersey	10	15
New Mexico	18	20
New York	0	16
North Carolina	21	23
Ohio	0	28
Oklahoma	27	32
Oregon	16	16
Rhode Island	1	0
South Carolina	10	15
Utah	14	11
Vermont	0	1
Virginia	13	16
Wisconsin	9	11
Total	220	383

Table 4 Sample-size adjusted Bayesian Information Criterion and Entropy Values for the 2–10 class latent class analysis models using 603 Firearm Legal Intervention Homicides from the 2014–2015 NVDRS

Model	SABIC	Entropy
2 class	8342.596	1
3 class	8005.478	0.973
4 class	7839.939	0.941
5 class	7760.342	0.933
6 class	7718.645	0.97
7 class	7632.396	0.932
8 class	7619.772	0.944
9 class	7655.763	0.924
10 class	7622.172	0.934

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