



University of Kentucky
UKnowledge

Theses and Dissertations--Public Health (M.P.H.
& Dr.P.H.)

College of Public Health

2016

ANALYSIS OF FIREARM LEGISLATION AND LAW ENFORCEMENT SUICIDES IN NVDRS-FUNDED STATES

Meagan L. Hurst
University of Kentucky

Follow this and additional works at: https://uknowledge.uky.edu/cph_etds



Part of the [Public Health Commons](#)

[Right click to open a feedback form in a new tab to let us know how this document benefits you.](#)

Recommended Citation

Hurst, Meagan L., "ANALYSIS OF FIREARM LEGISLATION AND LAW ENFORCEMENT SUICIDES IN NVDRS-FUNDED STATES" (2016). *Theses and Dissertations--Public Health (M.P.H. & Dr.P.H.)*. 129.
https://uknowledge.uky.edu/cph_etds/129

This Dissertation/Thesis is brought to you for free and open access by the College of Public Health at UKnowledge. It has been accepted for inclusion in Theses and Dissertations--Public Health (M.P.H. & Dr.P.H.) by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

STUDENT AGREEMENT:

I represent that my capstone and abstract are my original work. Proper attribution has been given to all outside sources. I understand that I am solely responsible for obtaining any needed copyright permissions. I have obtained needed written permission statement(s) from the owner(s) of each third-party copyrighted matter to be included in my work, allowing electronic distribution (if such use is not permitted by the fair use doctrine) which will be submitted to UKnowledge as Additional File.

I hereby grant to The University of Kentucky and its agents the irrevocable, non-exclusive, and royalty-free license to archive and make accessible my work in whole or in part in all forms of media, now or hereafter known. I agree that the document mentioned above may be made available immediately for worldwide access unless an embargo applies.

I retain all other ownership rights to the copyright of my work. I also retain the right to use in future works (such as articles or books) all or part of my work. I understand that I am free to register the copyright to my work.

REVIEW, APPROVAL AND ACCEPTANCE

The document mentioned above has been reviewed and accepted by the student's advisor, on behalf of the advisory committee, and by the Director of Graduate Studies (DGS), on behalf of the program; we verify that this is the final, approved version of the student's capstone including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Meagan L. Hurst, Student

Steven Browning, PhD, MSPH, Committee Chair

Corrine Williams, ScD, MS, Director of Graduate Studies

**ANALYSIS OF FIREARM LEGISLATION AND LAW ENFORCEMENT SUICIDES IN
NVDRS-FUNDED STATES**

CAPSTONE PROJECT PAPER

**A paper submitted in partial fulfillment of the requirements for the degree of Master of
Public Health in the University Of Kentucky College Of Public Health**

By

Meagan L. Hurst, B.S., CHES

Winchester, KY

Lexington, Kentucky

June 28, 2016

Steven R. Browning, Ph.D. Chair

Glyn Caldwell, Ph.D.

Sabrina Brown, DrPH

TABLE OF CONTENTS

ABSTRACT.....	3
INTRODUCTION.....	5
LITERATURE REVIEW.....	6
<i>Law Enforcement Suicides</i>	6
<i>Firearm Regulations and Potential Impact on Suicides</i>	8
METHODS AND MATERIALS.....	11
Data Collection.....	11
Data Analysis.....	12
Results.....	13
Discussion.....	15
Limitations.....	16
Conclusions, Recommendations and Future Directions.....	17
References.....	19
Biographical Sketch.....	22
Acknowledgements.....	23
Appendix.....	24
Table 1.....	24
Table 2.....	26
Table 3.....	27
Table 4.....	28
Figure 1.....	29

ABSTRACT

BACKGROUND:

The purpose of this study was to evaluate firearm-related suicides among law enforcement members and identify potential differences between decedents and firearm legislation grades from National Violent Death Reporting System (NVDRS) funded states

METHODS:

Descriptive and regression analyses were conducted using suicide data from 820 decedents who worked within law enforcement at the time of death. Data were collected over a ten-year period (2003-2013) from the NVDRS. Multivariable logistic regression and Pearson's chi-square were used to identify if differences existed among firearm-related suicides and other means using variables such as age, marital status, occupation, mental health, and firearm legislation scores. Backwards elimination was used to find the best fitting model.

RESULTS

Due to missing data among the sample, 40 cases were removed, yielding a final sample size of 820. Of reported suicides, 678 (83%) died by firearm while 142 (17%) used other means. Individuals aged 66 and older had more than 2.5 times the odds of dying by suicide with a firearm compared to those aged 36-50. Occupation, while not statistically significant, showed a protective effect among corrections officers and those listed as "other" compared to members in leadership positions. Mental health status displayed a protective effect among law enforcement suicides. Analysis of the key variable of interest, firearm legislation scores, showed a statistical association between firearm suicides and the lowest firearm legislation score (OR=1.83, p-value<0.05).

CONCLUSIONS

No statistically significant correlation was identified between occupation and firearm-related suicides. Findings indicate that states with the lowest scores on firearm legislation increased the odds of firearm suicides versus use of other methods. Recommendations include: (1) review of current regulations among states with low firearm regulations to prevent firearm access, (2) increase and improve mental health services provided to law enforcement members, and (3) regulate reporting mechanisms for NVDRS data entry.

Introduction

In 2013, suicide was the tenth leading cause of death among Americans of all ages.¹ Males are four times more likely to die of suicide than females.² Males and females alike are all vulnerable to the mental, physical and emotional stressors that one may face prior to the event; however this study seeks to identify the risks a particular occupation, law enforcement, may play in suicide occurrence nationwide.

Law enforcement has long been assumed to carry the heavy burden of increased suicide among its members, however significant research supporting this assumption is lacking.⁸ One study found that 18.1 per 100,000 members of law enforcement will die of suicide each year, yet researchers continually argue that this occupation alone does not have a more predisposing risk compared to others.³ While most risk factors are unavoidable, such as age, sex and race; one potentially influential risk is firearm legislation. Firearm legislation is a sensitive subject in today's society. Popular belief is that increased gun control will impact rates of mass shootings and suicides across the United States, despite very few studies having been conducted to support that notion. Nationally, it has been recognized that firearm legislation could impact suicide rates; however few studies could be identified that seek to find significant risk among such highly susceptible populations.

Few studies have been conducted on firearms due a 10 year ban on firearm research, however the recent executive order issued by President Obama to lift the research ban may contribute to a greater idea of firearm impact on society. With the President's executive order, federal agencies such as the CDC, Institute of Medicine and National Research Council would be charged to improve the knowledge of causes of firearm violence, prevention interventions and reduction strategies to decrease the burden on public health. The intervention of these agencies could not only strengthen the war on firearms, but improve the existing data gathered on firearm

violence occurrence, identify data that is lacking within violent death records and provide a more credible source of data for extensive literature.³³

When reviewing current research conducted among NVDRS reporting states, it is fairly evident that a suicide epidemic has occurred over time within these regions. In all 18 states, suicides outnumbered homicides, with three states having five times the number of homicides (Alaska, Oregon and Utah). Some states displayed far worse firearm-related suicide rates than others, such as Alaska, Kentucky and Oklahoma all of which reported firearms being used in more than 60% of reported suicides. Many of the states also displayed patterns among decedents when reviewing other predisposing risk factors, such as mental health and denoted intimate partner problems. About 34% of decedents within the NVDRS database were diagnosed with a mental health problem; however rates varied by state, with some states only reporting less than 15% and others greater than 50%. On average, 28% of suicide victims within the 18 reporting states were identified as having problems with an intimate partner prior to the event.³⁴

The main study hypothesis is that a lack of increased state level regulation of firearms (i.e., inclusion of policies such as background checks, dealer regulations, gun owner accountability, waiting periods) will result in higher rates of firearm suicides among this highly susceptible population. The study seeks to determine if an association exists between increased firearm-related suicides among law enforcement members who live within low scoring legislation states. A low score is defined as states that receive grades of F-C (numeric scores of 0-5) as scored by the Law Center to Prevent Gun Violence and the Brady Campaign. Additional analysis into which risk factors contribute to these suicides is also of interest and will be examined as part of the bivariate and logistic regression analyses. Variables that will be considered throughout the study are age, sex, race, ethnicity, marital status, education level, denoted mental health change, altercation, physical health problem and firearm legislation score.

Literature Review

The following review of recently published literature is a brief summary of concepts such as mental change, physical status, intimate partner violence and gun law severity as they pertain to potentially higher rates of law enforcement suicides. The review also seeks to provide greater insight into the world of gun ownership and availability across 18 states that are funded by the CDC to report violent death data to the NVDRS. The publications found within this review are from various sources, ranging from journal articles, doctoral theses and books and were also found through differing databases including OMICS, PubMed and the National Criminal Justice Reference Service. Key words used to build this literature review include: law enforcement officer, police officer, sheriff, deputy, suicide, gun, firearm, violence, firearm legislation, NVDRS, depression, intimate partner violence, and substance use.

Law Enforcement Suicides

Law enforcement as an occupation has drawn national media attention due to the risk of death in many forms, but rarely recognizes suicides. Upon reviewing other sources of literature, one will find some shy away from mentioning suicide among this population due to the “masculinity” that is expected among its members. Bergen, Deutch and Best, authors of “Police Suicide: Why are the rates in some places so low?” present a number of reasons why suicide rates may differ among various locations. Law enforcement members typically discover their fallen colleagues therefore, death scene investigations are sometimes interpreted differently to save the deceased’s dignity.⁴ This assumption is commonly seen as a theory among criminal justice researchers.⁵

Violanti, a prominent researcher in the field of criminal justice, analyzed suicides among various sized departments and suggests that falsifying deaths on medical records is nothing but a conspiracy theory. To prevent falsification, constant surveillance of the media as well as the

police union is needed.⁵ Federal mandates as outlined by Lynzy Wright, indicate that under no circumstance is a police officer suicide to be reported as anything other than what it is. This further supports that the collection of data regarding suicide rates in law enforcement can be tedious at best and make it almost impossible to calculate true rates.⁶ Researcher Michael Campion also made note of the victimization that typically occurs among law enforcement when suicides do occur. As numerous media outlets flock to report headlines that focus on the troubled past of the law enforcement member, few take a moment to reflect on the success and contributions they had once made in the line of duty.⁷

Throughout the literature, the comment “more officers die by their own hand than are killed in the line of duty” is mentioned on numerous occasions.⁸ Researchers Violanti, Vena and Marshall found that male police officers alone have a suicide risk of 8.3 times that of homicide and 3.1 times that of work accidents.⁹ Risk factors continually bombard these men and women as they face numerous traumatic events throughout the course of the day.^{10, 11} Extensive research into appropriate counseling services and prevention methods would be of great benefit to the officer and are highly supported in the literature.

While the statement that more police officers die by suicide than by other means is often referenced; the importance of prevention and availability of mental health services play a vital role in the decrease of suicide rates among the study population. In the research conducted by Vermette and coworkers, primary analysis found that catering services to the needs and capacities of officers worked efficiently within the sample population. In this study, researchers identified that while level of education had little impact on study outcomes, officers reported services should provide more mental health education.¹² The International Association of Chiefs of Police (IACP) assembled a resource guide for developing mental health service teams geared towards preventing law enforcement suicides. A main concept of the guide is to help officers

assisting colleagues to distinguish between anxiety and depression. To do so, the IACP has developed protocols on how to assist in different situations that may occur. Individuals who have participated in the numerous symposiums have found the services provided by the IACP valuable and provide individuals the opportunity to identify room for change in mental wellness services.¹³

In 1997, Violanti stated that in some circumstances, officers who do not have the ability to handle physiological strain, therefore they internalize and repress emotions instead of using coping mechanisms. These reactions can increase suicidal ideation or suicide. Further analysis into mental health status is of particular concern in all suicides, however for law enforcement deaths the risk poses significant interest as it can allow researchers to build stronger mental health services to for suicide prevention.¹⁴

One study conducted by O'Hara, Violanti and colleagues examined risk factors contributing to law enforcement suicide. Researchers found that males and females had steady rates when compared across three year periods (2008, 2008 and 2012). Clustering occurred more often in one age group (40-44) and among officers of lower rank. The study also noted that California and New York had the highest frequency of police suicide rates. This study further showed that mental health status and/or job stress are not the only factors that can impact ones decision to end their life, but location as well.¹⁵

Firearm Regulations and Potential Impact on Suicides

On average, more than 100 Americans die each day by suicide.² Kellerman, et al. determined that possession of a firearm lead to a 4.8 time risk increase for dying by firearm-related suicide.¹⁶ With these alarming figures, it is vital that local, state and federal political leaders work to evaluate all viable options to decrease the opportunity for self-injury by use of firearm. One option in particular, firearm regulation, has been identified in numerous studies as

an independent risk factor for suicide and is continually referenced by politicians as an area in need of change.^{17, 18} Robert Spitzer, author of “Politics of Gun Control” identifies that not only public opinion must impact the move towards a change in firearm regulation. The prevalence of single-issue groups, grassroots activists, public opinion and political party all shape the potential for change in firearm regulation, whether the decision supports popular opinion or not.¹⁸

Regulations vary greatly across each state, and with that varying levels of severity. This diversification among gun control laws provides the perfect setting for further analysis of higher versus lower controlled environments.

Researchers at the University of Mississippi found a significant association between decreased firearm suicide rates overall and a state’s activation of four gun laws (waiting periods, universal background checks, gun locks and open carry regulations). Researchers also saw a decrease in suicide rates overall in the states that continued implementation of these laws while one state that repealed one of the four laws had a slight increase in rates.¹⁹

Gun ownership and mental health form an important relationship requiring review when identifying the need for legislation reform. Researchers with Harvard School of Public Health found that firearm ownership, independent of mental health status, increased the odds of suicide rates compared to controls with lower firearm ownership.²⁰ Mental health status has the potential to greatly impact future firearm legislation nationwide. Numerous studies have found an association between ease of access to firearms and increased suicides.^{21, 22, 23} One study for example, found that in middle-aged and older adults who died by suicide, the storage of the firearm, whether the gun was loaded and if the firearm was unlocked were all independent predictors of suicide risk. The ease of access denoted in the study contributed to the occurrence of the suicides, supports more restriction of handguns as well as increased education on dangers of having a firearm in the home.²²

In a study conducted to investigate gun storage as well as access and mental health status, researchers found that when individuals had both ease of access and mental health impairment, suicide rates increased. On the other hand, homes with members that had attempted suicide were less likely to have simple access to a firearm. From a legal standpoint, the ability of individuals to access a firearm with little background work required is prominent in most states.²⁴

Boor and Bair (1990) found in their research that state laws regulating handgun ownership are fairly lenient. While laws have been created to protect the public from either self-injury or criminal mischief, few states had enacted a regulated baseline of control laws at the time. Both researchers also found that states had “considerable latitude” for increasing regulatory guidelines for the purchasing of handguns in hopes of preventing firearm-related suicides.²⁵

Another factor regarding firearm legislation is when and how change will be made. As author Danielle Kurtzleben states in her article on National Public Radio (NPR), “there is a national stall on firearm legislation and the president is advocating for state and local governments to take charge in the fight to bear arms”. Within the article, maps are displayed to show that from state to state, as mentioned above, laws and regulations for firearms differ drastically. Not only does this article show the need for a more regulated system, but also supports other findings within published literature.²⁶ Sumner and co-workers discovered that in states that require background checks prior to purchase, reduced rates of firearm suicides were reported. Researchers also determined that improved methods of increasing the frequency of background checks at the local level would also aid in reducing these events.²⁷

Materials and Methods

Data Collection

This is a cross sectional study, using data from the NVDRS that was coded from coroners', police, crime, laboratory and toxicology reports as well as death certificates between

2003-2013. The NVDRS analyzes variables including, but not limited to: manner of death, mechanism of injury, circumstances preceding injury, whether the decedent was a victim, whether the decedent was a subject, whether the decedent was both a suspect and a victim, the possibility of an isolated incident and the type of incident. The database is formed from an incident-based system and classifies each death within five abstractor-assigned manners of death. For this study, NVDRS classification of suicide was defined as a death resulting from the use of force against oneself when a preponderance of the evidence indicates that the use of force was intentional. Risks included in this subcategory of death include those associated with risk-taking behavior without clear intent to inflict fatal injury but associated with high risk of death, and those acts involving only passive assistance to the decedent.³²

The primary purpose of this study was to determine potential risk factors for law enforcement suicides while also examining the efficiency of firearm legislation in NVDRS participating states. Analysis of secondary data reported to the NVDRS provided insight about risk factors surrounding the event, such as age, gender, race, education level, marital status, signs/history of altercations prior to suicide and mental status. The variables chosen for analysis were supported by literature published in criminology, suicidology and psychology journals.

During the study period, 18 states reported data to the system. These states included: Alaska, Colorado, Georgia, Kentucky, Maryland, Massachusetts, Michigan, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Utah, Virginia and Wisconsin.²⁸ State regulation data included a scoring system determined by the Law Center to Prevent Gun Violence and the Brady Campaign.²⁹ The Law Center to Prevent Gun Violence and the Brady Campaign joined forces to build a strong legal background that collaborates and elaborately educates the public on firearm legislation laws in their states, and to do so, developed a scoring rubric for each concept that composes firearm regulation per state.

Law enforcement decedents were chosen for analysis for many reasons primarily because of the lack of literature about this highly susceptible population. The primary purpose of this study was to identify potential risk factors that this population may encounter either demographically or by exposure to a high-stress work environment. To identify the sample population, inclusion and exclusion criteria were determined which are displayed in Figure 1. After extraction of 1,125 law enforcement titles from the national database, 860 individuals were identified as having died of a self-inflicted wound. Due to missing values among some of the observations, 40 were dropped from the entire study sample, yielding a final sample size of 820.

Variables were examined and collapsed into categories to increase statistical power for each stratum. Two variables in particular, *Noted Difference in Mental Status* and *Altercation* were combinations of two reportable NVDRS variables. *Noted Difference in Mental Status* is defined as 1.) the decedent either having been diagnosed with a mental health disorder (i.e., depression) or 2.) a bystander at the scene (typically a family member or close friend) reported the individual displaying a depressed or abnormal mood in recent months. The *Altercation* variable is further defined as 1.) any criminal or known history of intimate partner problems (IPP) or, similarly to that of mental health status, 2.) a bystander (again, family member or close friend) present at the scene having denoted a possible argument prior to the event.

Variables that were aggregated into “*Other*” categories included race, marital status and occupation. In the race category, “*Other*” includes individuals identified as Asian, Pacific Islander or other. In the marital status category “*Other*” includes individuals reported as married, but separated, single or unknown. The final “*Other*” category for occupation includes law enforcement members who were military officers, retired/suspended/disabled/unemployed and those who held administrative positions.

Data Analysis

SAS version 9.3 was used to calculate descriptive (Table 1) and regression analyses (Table 3) of the study population. OpenEpi, an epidemiology-specific software developed by researchers at Emory University, was used for crude bivariate odds ratios represented in Table 2.³⁰ To summarize study variables, a descriptive analysis was conducted for all individuals who died by suicide, which was stratified by those who used firearms and those who did not. Table 3 demonstrates results of the final regression model, including all variables that met criteria for inclusion.

Crude odds ratios and their associated confidence intervals were used in bivariate analyses to describe the associations between potential risk factors and firearm-related suicides. Backwards elimination was used to identify and remove other non-significant variables. Unconditional multivariable logistic regression and Pearson's chi-square were used to find the adjusted odds ratios (prevalence-odds ratios), confidence intervals and p-values. Interpretation of both unadjusted and adjusted odds ratios provided in Table 4 aided in the identification of potential confounding among study variables. Firearm legislation scores of the 18 NVDRS states were included in the final model, as it is the key variable of interest within this study.

The dependent variable used in the regression analysis was firearm-related suicides while independent variables were age, marital status, occupation, noted difference in mental status and firearm legislation scores. Aggregated groups within variables were supported by literature within the field helped in identifying controls for study variables.

Results

Of the 1125 law enforcement decedents that were included among the NVDRS database, 265 (23.6%) individuals died of homicide or other deaths while 860 (76.4%) individuals died of suicide. Individuals who died of homicide or other denoted manners of death were excluded

from the final study sample, as they lacked the key inclusion criteria contributing to study outcomes. Forty (4.7%) of the total 860 were excluded from the study due to missing records among important study variables for that observation. Missing data were excluded all together from the study to prevent varying sample sizes across each stratum. Of those that died by suicide, 82.7% involved a firearm while 17.3% used other methods.

Table 1 displays the results of the descriptive analysis conducted using SAS 9.3. Of those who died by suicide using a firearm, gender was heavily skewed towards males (92% males, 8% females), with a relatively even distribution among age (26% 20-35, 29% 36-50, 24% 51-60, and 21% 66+). Of those who used firearms, 86% identified as white (10% Black, 2% Other, 2% Unidentified). Marital status among those included in the firearm victim strata predominately identified as married (55%). The frequency of various law enforcement occupations included in the sample was predominately police officers (58%), followed by individuals working only corrections (23%) and those in leadership positions (15%). Individuals with a noted difference in mental health status composed 46% of the firearm population.

Table 2 summarized the results of the bivariate analysis as well as baseline information pertaining to potential confounding among the sample. Of those who used firearms, the youngest and oldest age groups (20-35 and 66+) had at least 2.44 the odds of using firearms when dying by suicide compared to those aged 36-50. Marital status among those who died by suicide varied among the strata, but did show that those who were never married had higher odds than any other status when compared to those listed as other (OR=1.51, 95% CI=0.68-3.38). The divorce strata showed a protective effect of firearm suicide when compared to those identifying as other. To strengthen the statistical significance of the variables within the “Marital Status” variable, different statuses were aggregated to increase sample sizes. Police officers had almost one and a half the odds of firearm suicide compared to those in leadership positions while those in

corrections officers and occupations identified as other had protective effects (OR=0.6, 95% CI=0.34-1.05 and OR=0.74, 95% CI=0.3-1.88, respectively). A denoted change in mental health status showed a protective effect for individuals dying by suicide by firearms (OR=0.45, 95% CI=0.31-0.66).

Table 3 summarizes the results of the final adjusted logistic regression model using firearm suicides as the outcome of interest. Sex, race, ethnicity, education level, altercation and physical health problem were removed from the model because they were statistically insignificant and posed no extreme value to study outcomes. Variables meeting the significance level of $p < 0.5$ include age, denoted mental health status and firearm legislation. Non-significant odds were identified among marital status and occupation. In the logistic model, denoted mental health status again displayed a protective effect among firearm suicide decedents (95% CI= 0.31-0.69, $p < 0.0001$). Firearm legislation score was the primary variable of interest. Although most scores provided for the states within the NVDRS data set rendered non-significant values, the lowest score possible, 0 (character value “F”), provided the one significant value. Of firearm suicides among NVDRS states, individuals residing in states with a legislation score of “0” (Georgia, North Carolina, Oklahoma, South Carolina, New Mexico, Utah, Kentucky, and Alaska) had 1.83 times the odds of dying by suicide by use of firearm than those in higher scoring states (95% CI=1.12-3.00, $p < 0.02$).

Table 4 provides an overview of crude and adjusted odds ratios to determine the presence of confounding among study variables. Most variables within the final model showed not difference among adjusted and unadjusted ratios, however three firearm legislation scores had slightly varying outcomes, suggesting a reaction among the scoring. A score of “0”, “5” and “9” all had crude and adjusted odds ratios that differed significantly.

Discussion

The aim of this study was to determine potential associations among firearm suicides among law enforcement members and legislation scores across NVDRS reporting states. A secondary aim was to identify potential risk factors associated with dying by firearm suicide.

Over the 10-year period, decedents were predominately white, male, police officers, age 36-50, with no denoted altercation or mental/physical health problem known at the time of death. Significant findings of the study pertain to occupation, denoted mental health status and firearm legislation score variables. The first finding was that no statistical significance was identified among law enforcement occupations. Individuals that work as corrections officers and were aggregated within the “other” category had protective odds ratios (OR=0.56, OR=0.58, respectively) although no statistical significance was detected. Police officers did have higher odds (OR=1.31, 95% CI= 0.74-2.31) when compared to leadership members, however these roles were also non-significant. This result did not support the literature found and referenced above. The second significant finding was that denoted mental health status held a protective effect throughout the analysis. Despite the small sample size identified for the coded variable, it is possible to theorize that improved mental services or an extension of current services be continued to prevent further firearm-related fatalities. The final significant finding supports the overall research outcome of whether firearm legislation impacts firearm-related suicides. Among firearm-related suicide decedents, individuals residing among states with the weakest level of gun control had higher odds of dying by suicide using firearms (OR=1.83, $p<0.02$) when compared to states with the strongest regulations. This finding supports a possible notion for further review of firearm legislation laws among states to identify possible shortcomings within firearm access policies.

Limitations

The most important limitation to note is the absence of knowledge pertaining to gun ownership. Data regarding the firearm's origins would have strengthened the argument regarding increasing legislation restrictions; however at the time of the death investigation, this facet was not of main concern. Few reports noted the caliber of the firearm used, which could have been an indicator for origin, however precise information could not be identified from those records.

A second limitation that greatly impacts the findings of this study is its generalizability. Although 18 states of varying law enforcement population sizes were included in the reporting samples, results cannot be generalized to the national law enforcement population. It is possible that if the sample of states were larger, the significance of some variables may have changed. An equally important limitation is the design of the study itself. Because the nature of a cross-sectional study considers a snapshot in time, inferences of causality cannot be made.

Other limitations that could have varying effects on study outcomes include method of extraction of law enforcement titles and categorization of job titles among the occupation stratum. When reviewing the occupations extracted from the NVDRS database, the possibility of some law enforcement occupations having been neglected could have occurred. If this were to have occurred, the sample size would have been lower, thus slightly decreasing statistical power. The categorization of officer titles is also up to author interpretation. While most titles match stratum names, one form of occupation was included within the "Leadership" category that could have been interpreted differently. Individuals listed as sheriff's deputies, deputies, and other similar titles were included as leadership members, however requirements of the position better belong among the "Police Officer" category. This change in sample size from one category to the other could possibly lead to a statistically significant result among the occupation variable, however research was not continued to evaluate the change.

Another limitation to note is the potential for Healthy Worker Effect (HWE) bias. This bias could potentially contribute to the rates identified among the individuals falling within the “Denoted Change in Mental Health Status” variable. Due to this bias, there is a greater likelihood that individuals with severe mental or physical impairments were excluded from the study population. If this bias is present and contributes to the effect found among law enforcement suicides and those with a change in mental health status, the perceived significance could be altered.

A final limitation pertains to the differences in reporting among NVDRS sites. While a formal guideline exists for data entry, such as collection methods and coding, data entry from narratives collected from reports was neglected. After reviewing multiple narratives and reviewing observations within the dataset, it was evident that data was noted within the written portion, but not properly coded for among the data set. This could have contributed to a decrease in cases included in the analysis due to missing values required for study inclusion.

Conclusions

This study addressed the suicide rates among law enforcement members in association to firearm legislation in each prospective state as well as other predisposing risk factors for firearm-related suicides. There was no significance in regard to occupational exposure among law enforcement decedents, but potential for firearm legislation change among low scoring states was identified. The significance found between comparing lowest scoring to highest scoring states raises questions in regards to necessary firearm regulation improvements. A review of current regulations among states with few firearm laws could lead to limited or no access to a firearm for those with mental illness. While studies have reviewed the effect of banning handgun purchases all together, a baseline review of legislation in each NVDRS state would be necessary to make the statement valid for these regions.³¹ This study is one of few to evaluate the

relationship between occupation risk and firearm access legislation. It is important to note that while the main variable of focus showed no significant result, the expected rate of suicide by firearm was witnessed among law enforcement members and the result of firearm legislation on firearm-related suicides supports statements commonly made across criminal justice literature. Mental health status also provided data that was protective in nature. The protective nature of this variable supports many arguments proposed in cited literature above. Although there is room for bias, there is also great potential for improvements within the occupational community to ensure individual access to mental wellness services prior to suicidal idealization onset.

Recommendations and Future Directions

Following the study, a few recommendations could be made regarding the regulation of firearm access, mental health services provided and data entry for the NVDRS. Although these recommendations are subjective, they could potentially lead to a decrease in suicides as well as improve research for present and future studies.

The first recommendation is to conduct a comprehensive review of firearm regulations. By doing this, surprising deficits could be identified in the screening processes required for access to weapons. The second recommendation is in regards to mental health services. The need for extensive mental health services as well as the level to which those providing them are trained is of imperative value. If improved services are provided to at risk populations such as law enforcement members, then a decrease in suicides overall could potentially be witnessed. These services are not just for those who have reached the breaking point. The availability of these improved services allows individuals not only to protect themselves, but also protect their colleagues while in the field. A final recommendation pertains to the regulation of reporting mechanisms used for NVDRS data entry. To improve the accuracy of characteristic rates within

decedents within NVDRS-funded states, a mandated transposing of narrative data to coded record would be beneficial.

For further studies, one could use a similar study design but look at the totality of suicides in a larger population, such as adolescents or young adults. Although the purpose here was to identify a highly debated occupational risk, a review of overall risk among all suicides reported to the NVDRS and firearm legislation among those same states would potentially yield interesting results. One could also identify firearm legislation risk among individual states by examining state wide rates of suicides (either occupation based or all inclusive) and compare with other reporting states.

References

- ¹ Centers for Disease Control and Prevention. 10 Leading Causes of Death by Age Group, United States - 2013. Retrieved May 5, 2016, from http://www.cdc.gov/injury/wisqars/pdf/leading_causes_of_death_by_age_group_2013-a.pdf
- ² Save Awareness Voices of Education. Suicide Facts. (n.d.). Retrieved May 5, 2016, from <http://www.save.org/index.cfm?>
- ³ Aamodt, M. G., & Stalnaker, N. A. (2001). Police officer suicide: Frequency and officer profiles. In Shehan, D. C., & Warren, J. I. (Eds.) *Suicide and Law Enforcement*. Washington, D.C.: Federal Bureau of Investigation.
- ⁴ Bergen, M., Deutch, A., Best, S. (2001). Police Suicide: Why are the rates in some places so low? *Suicide and Law Enforcement*, 407-415. Retrieved May 5, 2016, from <https://www.ncjrs.gov/pdffiles1/193528-193589.pdf>.
- ⁵ Violanti, J.M. (1996). *Police suicide: Epidemic in blue*. Springfield, IL: Charles C. Thomas.
- ⁶ Wright, L. (1997). Using Civil Law Occupational Death Procedures in Police Suicide Reporting. *Suicide and Law Enforcement*, 465-468. Retrieved May 5, 2016, from <https://www.ncjrs.gov/pdffiles1/193528-193589.pdf>.
- ⁷ Champion, M. (1999). Police Suicide and Small Departments: A Survey. *Suicide and Law Enforcement*, 417-430. Retrieved May 5, 2016, from <https://www.ncjrs.gov/pdffiles1/193528-193589.pdf>.
- ⁸ Miller L. Police officer suicide: causes, prevention, and practical intervention strategies. *Int J Emerg Ment Health*. 2005 Spring;7(2):101-14. PubMed PMID: 16107042.
- ⁹ Violanti JM, Vena JE, Marshall JR. Suicides, homicides, and accidental death: a comparative risk assessment of police officers and municipal workers. *Am J Ind Med*. 1996 Jul;30(1):99-104. PubMed PMID: 8837691.
- ¹⁰ Garbarino S, Magnavita N (2015) Work Stress and Metabolic Syndrome in Police Officers. A Prospective Study. *PLoS ONE* 10(12): e0144318 doi:10.1371/journal.pone.0144318
- ¹¹ Ma CC, Andrew ME, Fekedulegn D, Gu JK, Hartley TA, Charles LE, Violanti JM, Burchfiel CM. Shift work and occupational stress in police officers. *Saf Health Work*. 2015 Mar;6(1):25-9. doi: 10.1016/j.shaw.2014.10.001. Epub 2014 Oct 20. PubMed PMID: 25830066; PubMed Central PMCID: PMC4372186.
- ¹² Vermette HS, Pinals DA, Appelbaum PS. Mental health training for law enforcement professionals. *J Am Acad Psychiatry Law*. 2005;33(1):42-6. PubMed PMID: 15809237.

- ¹³ IACP (International Association of Chiefs of Police). 2014. *IACP National Symposium on Law Enforcement Officer Suicide and Mental Health: Breaking the Silence on Law Enforcement Suicides*. Washington, DC: Office of Community Oriented Policing Services.
- ¹⁴ Violanti, J.M. (1997). Residuals of police occupational trauma. *The Australasian Journal of Disaster and Trauma Studies*, 3.
- ¹⁵ O'Hara AF, Violanti JM, Levenson RL Jr, Clark RG Sr. National police suicide estimates: web surveillance study III. *Int J Emerg Ment Health*. 2013;15(1):31-8. PubMed PMID: 24187885.
- ¹⁶ Kellermann AL, Rivara FP, Somes G, Reay DT, Francisco J, Banton JG, Prodzinski J, Fligner C, Hackman BB. Suicide in the home in relation to gun ownership. *N Engl J Med*. 1992 Aug 13;327(7):467-72. PubMed PMID: 1308093.
- ¹⁷ McGinty EE, Webster DW, Barry CL. Gun policy and serious mental illness: priorities for future research and policy. *Psychiatr Serv*. 2014 Jan 1;65(1):50-8. doi: 10.1176/appi.ps.201300141. Review. PubMed PMID: 23852317.
- ¹⁸ Spitzer, R. J. (1995). *The politics of gun control*. Chatham, NJ: Chatham House.
- ¹⁹ Michael D. Anestis and Joye C. Anestis. Suicide Rates and State Laws Regulating Access and Exposure to Handguns. *American Journal of Public Health*: October 2015, Vol. 105, No. 10, pp. 2049-2058. doi: 10.2105/AJPH.2015.302753
- ²⁰ Miller, M., Barber, C., White, R. A., & Azrael, D. (2013). Firearms and Suicide in the United States: Is Risk Independent of Underlying Suicidal Behavior? *American Jnl of Epidemiology* 178:946-955. Retrieved May 5, 2016, from <http://aje.oxfordjournals.org/content/early/2013/08/22/aje.kwt197.abstract?cited-by=yes>
- ²¹ Swanson JW, Easter MM, Robertson AG, Swartz MS, Alanis-Hirsch K, Moseley D, Dion C, Petrla J. Gun Violence, Mental Illness, And Laws That Prohibit Gun Possession: Evidence From Two Florida Counties. *Health Aff (Millwood)*. 2016 Jun 1;35(6):1067-75. doi: 10.1377/hlthaff.2016.0017. PubMed PMID: 27269024.
- ²² Conwell Y, Duberstein PR, Connor K, Eberly S, Cox C, Caine ED. Access to firearms and risk for suicide in middle-aged and older adults. *Am J Geriatr Psychiatry*. 2002 Jul-Aug;10(4):407-16. PubMed PMID: 12095900.
- ²³ Fleeger, EW., Lee, LK., Monuteauz, MC., Hemenway, D., Mannix, R. Firearm Legislation and Firearm-Related Fatalities in the United States. *JAMA*.2013 Mar, 06.
- ²⁴ Ilgen MA, Zivin K, McCammon RJ, Valenstein M. Mental illness, previous suicidality, and access to guns in the United States. *Psychiatr Serv*. 2008 Feb;59(2):198-200. doi: 10.1176/appi.ps.59.2.198. PubMed PMID: 18245165.
- ²⁵ Boor M, Bair JH. Suicide rates, handgun control laws, and sociodemographic variables. *Psychol Rep*. 1990 Jun;66(3 Pt 1):923-30. PubMed PMID: 2377713.

- ²⁶ Kurtzleben, D., *Here's Where Gun Laws Stand In Your State*. (2015, December 9). Retrieved December 9, 2015, from http://www.npr.org/2015/12/09/458829225/heres-where-gun-laws-stand-in-your-state?utm_source=facebook.com&utm_medium=social&utm_campaign=npr&utm_term=npr-news&utm_content=202709
- ²⁷ Sumner SA, Layde PM, Guse CE. Firearm death rates and association with level of firearm purchase background check. *Am J Prev Med*. 2008 Jul;35(1):1-6. doi: 10.1016/j.amepre.2008.03.023. Epub 2008 May 14. Erratum in: *Am J Prev Med*. 2008 Dec;35(6):611. PubMed PMID: 18482823
- ²⁸ National Violent Death Reporting System. (2016, June 08). Retrieved May 29, 2016, from <http://www.cdc.gov/ViolencePrevention/NVDRS/index.html>
- ²⁹ Law Center to Prevent Gun Violence - *Annual Gun Law State Scorecard 2015*. (2015). Retrieved May 5, 2016, from <http://gunlawscorecard.org/>
- ³⁰ Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.OpenEpi.com, updated 2013/04/06, accessed 2016/06/21.
- ³¹ Hahn, R. A., Bilukha, O. O., Crosby, A., Liberman, A., Moscicki, E. K., Snyder, S., . . . Briss, P. (2003, October 03). First Reports Evaluating the Effectiveness of Strategies for Preventing Violence: Firearms Laws. *Morbidity and Mortality Weekly Report*. doi:10.1037/e545902006-
- ³² Karch DL, Logan J, McDaniel D, Parks S, Patel N; Centers for Disease Control and Prevention (CDC). Surveillance for violent deaths--National Violent Death Reporting System, 16 states, 2009. *MMWR Surveill Summ*. 2012 Sep 14;61(6):1-43. PubMed PMID: 22971797.
- ³³ Institute of Medicine and National Research Council; *Priorities for a Public Health Research Agenda to Reduce the Threat of Firearm-Related Violence*. 2013 June 4;
- ³⁴ Brown S, Casanave L, Yang Y, Haddad D and Stromberg A. *Deaths from Violence: A Look at 18 States-- Data from the National Violent Death Reporting System*. September 2013

BIOGRAPHICAL SKETCH

Meagan L. Hurst earned a Bachelor of Science degree in Public Health with a concentration in Community Health from Eastern Kentucky University, in Richmond, KY in May of 2014. Ms. Hurst continued her education at the University of Kentucky where she is currently a candidate for the Master of Public Health degree with a concentration in Epidemiology. Ms. Hurst became employed with Oldham County Health Department as county epidemiologist during her time in the College of Public Health. The author's contact information includes phone number (859-940-2658) and email address MeaganL.Hurst@ky.gov.

ACKNOWLEDGEMENTS

I would like to extend my gratitude to my capstone chair, Dr. Browning, and committee members, Dr. Brown, Dr. Chesnut, and Dr. Caldwell, for providing assistance and support throughout this experience. I would also like to thank Dr. Brown for providing me with the NVDRS data. Another “thank you” is extended to Jacqueline Seals for readying the data for my use and answering my SAS programming questions throughout the capstone process. Finally, I would like to thank my friends and family for their relentless encouragement, love and support.

There are no financial or material disclosures for this capstone project.

GRANT NUMBER 424128 from the: CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

APPENDIX

Table 1. Demographic variables of law enforcement suicides among NVDRS funded states, by manner of death.

		Firearm Victim		Other Methods Victim		Total	
		Number (n)	%	Number (n)	%	Number (n)	%
Sex	Male	625	92.18	127	89.44	752	91.71
	Female	53	7.82	15	10.56	68	8.28
Age	20-35	173	25.52	24	16.9	197	24.00
	36-50	195	28.76	66	46.48	261	31.83
	51-65	166	24.48	35	24.65	201	24.51
	66+	144	21.24	17	11.97	161	19.63
Race	White	585	86.28	121	85.21	706	86.10
	Black	66	9.73	13	9.15	79	9.62
	Other*	12	1.77	6	4.23	18	2.20
	Unspecified	15	2.21	2	1.41	17	2.07
Ethnicity	Not Hispanic	567	83.63	118	83.10	685	83.54
	Of Hispanic Origin	104	15.34	24	16.90	128	15.61
	Other	7	1.03	0	0	7	0.85
Marital Status	Married	376	55.46	66	46.48	442	53.90
	Never Married	110	16.22	15	10.56	125	15.24
	Widowed	39	5.75	8	5.63	47	5.73
	Divorced	129	19.03	48	33.80	177	21.59
	Married, but Separated	15	2.21	3	2.11	18	2.20
	Single Unless Not Specified	4	0.59	2	1.41	6	0.73
	Unknown	5	0.74	0	0	5	0.61
Education Level**	High School Degree or Less	143	21.09	30	21.13	173	21.09
	Some College or More	215	31.71	39	27.46	254	30.98
	Unknown	320	47.20	73	51.41	393	47.93
Occupation	Police Officer	390	57.52	58	40.85	448	54.63
	Leadership***	101	14.90	21	14.79	122	14.88
	Corrections Officer	158	23.30	55	38.73	213	25.98
	Military Officer	3	0.44	0	0	3	0.37
	Retired/Suspended/Disabled/Unemployed	26	3.83	7	4.93	33	4.02
	Other	0	0	1	0.70	1	0.12
Denoted Change in Mental Health Status	Yes	312	46.02	93	65.49	405	50.61
	No	366	53.98	49	34.51	415	49.39

Continued

Table 1. Demographic variables of law enforcement Suicides among NVDRS funded states, by manner of death.

Altercation							
Yes	256	37.76	50	35.21	306	37.32	
No	422	62.24	92	64.79	514	62.68	
Physical Health Problem							
Yes	175	25.81	30	21.13	205	25.00	
No	503	74.19	112	78.87	615	75.00	
Firearm Legislation Score****							
0	272	40.12	42	29.58	314	38.29	
2	79	11.65	11	7.75	90	10.98	
3	40	5.90	9	6.34	49	5.98	
4	47	6.93	18	12.68	65	7.93	
5	50	7.37	17	11.97	67	8.17	
7	9	1.33	2	1.41	11	1.34	
9	54	7.96	21	14.79	75	9.15	
10	127	18.73	22	15.49	149	18.17	

*Race category "Other" includes Pacific Islander, Asian, and those identifying as unknown.

**Education Level variables were condensed to strengthen power among stratum.

***Occupation category "Leadership" includes sergeants, captains, sheriffs, sheriff's deputies, deputies.

****Firearm Legislation Scores range from 0-10, with a score of "0" being a character score of "F" and a score of "10" being a character score of "A-".

Table 2. Bivariate analysis of law enforcement suicides among NVDRS funded states, by manner of death.

		Firearm Victim		Other Methods Victim		Bivariate Analysis	
		Number	%	Number	%	Odds Ratio	CI (95%)
		(n)		(n)			
Sex							
	Male	625	92.18	127	89.44	1.39	(0.76-2.55)
	Female	53	7.82	15	10.56	<i>REF</i>	-
Age							
	20-35	173	25.52	24	16.90	2.44	(1.47-4.10)
	36-50	195	28.76	66	46.48	<i>REF</i>	-
	51-65	166	24.48	35	24.65	1.61	(1.01-2.54)
	66+	144	21.24	17	11.97	2.87	(1.61-5.10)
Race*							
	White	585	86.28	121	85.21	1.47	(0.65-3.31)
	Black	66	9.73	13	9.15	0.81	(0.33-2.04)
	Other	27	3.98	8	5.63	<i>REF</i>	-
Ethnicity							
	Not Hispanic	567	83.63	118	83.10	1.11	(0.67-1.79)
	Of Hispanic Origin	104	15.34	24	16.90	<i>REF</i>	-
	Other	7	1.03	0	0	-	-
Marital Status**							
	Married	376	55.46	66	46.79	1.18	(0.61-2.30)
	Never Married	110	16.22	15	10.56	1.51	(0.68-3.38)
	Divorced	129	19.03	48	33.20	0.60	(0.28-1.00)
	Other	63	9.29	13	9.15	<i>REF</i>	-
Education Level							
	High School Degree or Less	143	21.09	30	21.13	1.09	(0.68-1.74)
	Some College or More	215	31.71	39	27.46	1.26	(0.82-1.92)
	Unknown	320	47.20	73	51.41	<i>REF</i>	-
Occupation***							
	Police Officer	390	57.52	58	40.85	1.40	(0.81-2.41)
	Leadership	101	14.90	21	14.79	<i>REF</i>	-
	Corrections Officer	158	23.30	55	38.73	0.60	(0.34-1.05)
	Other	29	4.27	8	5.63	0.74	(0.30-1.88)
Denoted Change in Mental Health Status							
	Yes	312	46.02	93	65.49	0.45	(0.31-0.66)
	No	366	53.98	49	34.51	<i>REF</i>	-
Altercation							
	Yes	256	37.76	50	35.21	1.12	(0.77-1.63)
	No	422	62.24	92	64.79	<i>REF</i>	-
Physical Health Problem							
	Yes	175	25.81	30	21.13	1.30	(0.84-2.01)
	No	503	74.19	112	78.87	<i>REF</i>	-

Continued

Table 2. Bivariate analysis of law enforcement suicides among NVDRS-funded states, by manner of death.

Firearm Legislation Score						
0	272	40.12	42	29.58	1.12	(0.64-1.96)
2	79	11.65	11	7.75	1.24	(0.57-2.70)
3	40	5.90	9	6.34	0.77	(0.33-1.81)
4	47	6.93	18	12.68	0.45	(0.22-0.92)
5	50	7.37	17	11.97	0.51	(0.25-1.04)
7	9	1.33	2	1.41	0.78	(0.16-3.85)
9	54	7.96	21	14.79	0.45	(0.23-0.88)
10	127	18.73	22	15.49	<i>REF</i>	-

**Race category "other" includes Pacific Islander, Asian, Unknown and Unspecified.*

***Marital Status category "other" includes Single unless otherwise noted, Widowed, Married but separated and unknown.*

****Occupation category "other" includes military officers, retired/suspended/disabled/unemployed individuals, and administrative members.*

Table 3. Multivariable logistic regression of risk factors for law enforcement suicides across NVDRS states.

	AOR	95% CI	p-Value
Age			
20-35	1.93	(1.12-3.34)	0.02
36-50	<i>REF</i>	-	-
51-65	1.64	(1.01-2.66)	0.05
66+	2.61	(1.41-4.86)	0.002
Marital Status			
Married	1.51	(0.75-3.04)	0.25
Never Married	2.10	(0.88-5.18)	0.09
Divorced	0.75	(0.36-1.56)	0.43
Other	<i>REF</i>	-	-
Occupation			
Leadership	<i>REF</i>	-	-
Police Officer	1.31	(0.74-2.31)	0.36
Corrections Officer	0.56	(0.31-1.02)	0.58
Other	0.58	(0.21-1.61)	0.29
Denoted Change in Mental Health Status			
Yes	0.46	(0.31-0.69)	0.0001
No	<i>REF</i>	-	-
Firearm Legislation Score			
0	1.83	(1.12-3.00)	0.02
2	1.40	(0.77-2.53)	0.27
3	0.93	(0.38-2.28)	0.87
4	0.89	(0.44-1.76)	0.75
5	1.27	(0.55-2.94)	0.58
7	1.05	(0.19-5.82)	0.96
9	1.45	(0.27-7.81)	0.67
10	<i>REF</i>	-	-

Table 4. Visual assessment tool for potential identification of confounding among variables used in the final logistic regression model.

		Bivariate Analysis		Multivariable Analysis		
		OR	95% CI	AOR	95% CI	p-Value
Age						
	20-35	2.44	(1.47-4.10)	1.93	(1.12-3.34)	0.02
	35-50	<i>REF</i>	-	<i>REF</i>	-	-
	51-65	1.61	(1.01-2.54)	1.64	(1.01-2.66)	0.05
	66+	2.87	(1.61-5.10)	2.61	(1.41-4.86)	0.002
Marital Status						
	Married	1.18	(0.61-2.30)	1.51	(0.75-3.04)	0.25
	Never Married	1.51	(0.68-3.38)	2.10	(0.88-5.18)	0.09
	Divorced	0.60	(0.28-1.00)	0.75	(0.36-1.56)	0.43
	Other	<i>REF</i>	-	<i>REF</i>	-	-
Occupation						
	Leadership	<i>REF</i>	-	<i>REF</i>	-	-
	Police Officer	1.40	(0.81-2.41)	1.31	(0.74-2.31)	0.36
	Corrections Officer	0.60	(0.34-1.05)	0.56	(0.31-1.02)	0.58
	Other	0.74	(0.30-1.88)	0.58	(0.21-1.61)	0.29
Denoted Mental Health Status						
	Yes	0.45	(0.31-0.66)	0.46	(0.31-0.69)	0.0001
	No	<i>REF</i>	-	<i>REF</i>	-	-
Firearm Legislation Score						
	0	1.12	(0.64-1.96)	1.83	(1.12-3.00)	0.02
	2	1.24	(0.57-2.70)	1.40	(0.77-2.53)	0.27
	3	0.77	(0.33-1.81)	0.93	(0.38-2.28)	0.87
	4	0.45	(0.22-0.92)	0.89	(0.44-1.76)	0.75
	5	0.51	(0.25-1.04)	1.27	(0.55-2.94)	0.58
	7	0.78	(0.16-3.85)	1.05	(0.19-5.82)	0.96
	9	0.45	(0.23-0.88)	1.45	(0.27-7.81)	0.67
	10	<i>REF</i>	-	<i>REF</i>	-	-

Figure 1: Sample Population Identification

