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Nationwide pediatric mortality: drug toxicology, unknown causes of death, and autopsy rates

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NATIONWIDE PEDIATRIC MORTALITY: DRUG TOXICOLOGY, UNKNOWN CAUSES OF DEATH, AND AUTOPSY RATES

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ABSTRACT

Deaths among the pediatric population encompass a small percentage of the total number of fatalities across the United States. Since the deaths of infants, children, and adolescents are rare, there is little forensic literature concerning this age group. Autopsies, if performed completely, can reveal additional information surrounding circumstances of a case and leads to a determination of a cause of death or a diagnosis of exclusion. Yet studies report that nationwide autopsy rates are low, despite an increase of drugs in the environment and the prevalence of ill-defined causes of death. With the use of the Centers of Disease Control and Prevention (CDC) internet database Wide-ranging Online Data for Epidemiologic Research (WONDER), all deaths of individuals 19 years old and under were analyzed for years 2000, 2005, and 2010. The three main areas that were examined through the WONDER database were poisoning deaths for all ages, ill-defined causes of death for the infant age group, and overall autopsy rates for the three age groups with the highest crude rate of death.

The crude death rate for all pediatric age groups have decreased within the examined decade. The infant age group comprised the majority of all

pediatric fatalities and had the highest crude death rate. Individuals in the 15 to 19 year age group had the second highest crude death rate of the pediatric population. With a low number of total pediatric poisoning deaths, there has been a steady increase in crude death rate over the decade. The 15-19 age group encompassed the majority of these types of fatalities, with a total of 942 in 2010. It was also discovered that not every pediatric victim was autopsied when a death was diagnosed as a poisoning death when examined by a forensic pathologist. Infant ill-defined causes of death consisted of just over 12% nationwide for all years studied. However approximately 70% of all infant ill-defined causes of death were diagnosed as Sudden Infant Death Syndrome (SIDS) in 2000 and 2010. When examining autopsy rates for the year 2010, autopsies were performed for 32.9% of infant deaths, 55.1% of child deaths between 1-4 years of age, and 59.8% of teenage deaths between 15-19 years of age. In 2010, implementation of autopsies is uncertain for 2,454 deaths under 1 year, 255 deaths between 1 and 4 years, and 666 between 15 and 19 years. Measures need to be put in place nationwide to increase the rate of autopsies for the pediatric population and there needs to be strict accountability when it is not reported on a death certificate whether or not an autopsy was performed. Standard operating procedures should be applied for all autopsies of pediatric victims, with a toxicology examination always being included in an investigation.

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1. INTRODUCTION

1.1 Pediatric Mortality

When looking at mortality data of all the age groups in the United States, the pediatric population consists of a very small proportion due to the low number of deaths in the country per year. Based on yearly mortality data for example, there were a total of 2,468,435 deaths reported in the United States in 2010, yet for those in the age group of 19 and under, there were just 45,068 deaths (1). This age group amounts to only 1.83% of the total mortality rate of 2010 nationwide, a percentage that is relatively consistent with previous years over the past decade (2). That ratio becomes even smaller when these age groups are then divided even further into separate age categories. In the age group of 5-9 for example, there were only 2,330 deaths in the U.S., 0.09% of the total morality rate within the country (1). Because the amount of deaths that occur annually within the pediatric population is very small, while a positive aspect, it leads to miniscule information for forensic science seeing as there are barely any forensic studies for this age group (3). When it comes to nationwide statistical evaluations, there is very little forensic literature that examines deaths of those 19 and under and information becomes more scarce when a specific age group needs to be observed. Since it is statistically uncommon for an infant, a child, or an adolescent to pass away before reaching adulthood, two main questions arise when it comes to this population. First, should autopsies always be conducted for this age group regardless of the circumstances surrounding the death. And

second, what standards and procedures should be applied when it comes to the performance of these autopsies during the medico-legal death investigation of the pediatric population.

1.2 Importance of Autopsies

It has been pointed out after a study carried out by Kumar et al. at Lutheran General Children's Hospital in Park Ridge Illinois that in more than one third of pediatric deaths, additional information can be discovered by results obtained from an autopsy (4). Furthermore, conditions and mechanisms of death that were previously undiagnosed and not discovered until after a completed autopsy could have potentially resulted in an improved survival chance of a pediatric patient if known before death (4,5). If performed efficiently, autopsies eliminate all doubt and a medical examiner or coroner can confidently determine and certify the true cause of death. While there are more journal articles discussing autopsies in the hospital setting, it should be illustrated that this information can be directly related to forensic science cases. Not only can autopsies potentially lead to the discovery of medical conditions, but could also indicate causes of death due to other means such as environmental hazards or even medical malpractice. If autopsies were done for every death within the pediatric population nationwide, medical examiners and coroners could construct federal standard operating procedures which could improve quality assurance within their jurisdictions with regards to confirming a cause of death.

Though there is plenty of available medical and forensic literature on the rates of autopsies in the pediatric age group, the vast majority of published studies deal with examinations conducted on small populations in a single state or jurisdiction. These journal articles emphasize the importance and benefits of performing autopsies, especially with the pediatric population (4,5). However it's agreed upon by the National Center for Health Statistics (NCHS) and by the Scientific Working Group on Medico-Legal Death Investigation (SWGMDI) that the overall autopsy rates in the United States is dreadfully low (6,7). Specifically, an autopsy was conducted for 29.1% of deaths due to ill-defined causes, 4.3% of deaths due to diseases, and 8.5% of all deaths in the United States (excluding Florida, Minnesota, New Mexico, and Pennsylvania) in the year 2007 (6). There are many reasons and arguments as to why autopsies are not commonly performed, most reasons relate to the issue of how expensive these examinations can be and the small number of forensic pathologists in the country to perform them. In the hospital setting, one study points to physicians not asking victim's families permission to carry out autopsies as a big factor to the decline in autopsy rates, which could be greatly increased by simply increasing the request rate (8). It is also understandable that some families will not allow an autopsy to be performed on their loved one because of the emotional nature of losing a loved one and the stress of organizing funeral arraignments. Unless foul play is suggested, sometimes religious objections are the reason which prevents a medical examiner or a coroner from conducting an autopsy.

1.3 Toxicology & Pharmacology

Deaths due to poisonings by drugs and other toxic substances are perfect illustrations of the need of specific definitions for what constitutes a good post-mortem examination. A toxicology screening test followed by a confirmatory test for the questioned chemical substance can reveal vital information regarding a cause and mechanism of a questioned or an ill-defined cause of death (9). Yet it is an unfortunate reality that many children that die in the U.S. are not autopsied, and even if they are, full toxicology analyses are not conducted (10). This is a big concern since it is stated in numerous publications that pharmaceutical exposures amongst the pediatric population, illicit or non-illicit, are a significant healthcare problem (9, 11-13).

With a research study carried out by Bond et al., it appears that since there is an increase in the number of pharmaceutical medications in the environment, the rate of pediatric poisoning is increasing as opposed to decreasing, preventive efforts are inadequate, and more children require immediate care at emergency department facilities (12). Both prescription drugs and especially over-the-counter drugs are included as important risk factors since the use of these medications are commonly widespread. There are many cases in which fatalities were attributed to familiar over-the-counter cold medications (10,14). Without toxicology analysis incorporated with autopsies, deaths caused by over-the-counter medications can go easily unnoticed. Moreover, it must be

stated that even though it is an overlooked and under-recognized area of child abuse, deliberate and malicious poisonings of the pediatric population does occur (13,15). According to Yin, since an intentional poisoning of a minor would not normally be voluntarily affirmed, there is at least a sevenfold under-reporting of this cause of fatalities to the National Poison Data System (13). Consequently, as long as there is no suspicion of illicit drug use surrounding a pediatric death case and a toxicology analysis is not performed during an autopsy, true poisoning deaths of infants and children can be easily missed and be recorded as either an ill-defined cause of death on certificates or any other reason that is factually incorrect. Fortunately pediatric toxicological exposures normally results in immediate treatment when reported and rarely lead to fatalities (12,16). However it is still a concern within pediatric forensics that should not be ignored.

1.3.1 Issues With Current Toxicology Databases

What makes information regarding deaths due to poisonings even more difficult is that there is very little data surrounding the issue. Even with the data that is available, it does not represent accurate un-skewed statistical information for literary research. In 1985, a pediatric toxicology registry was established by the National Association of Medical Examiners (N.A.M.E.) known as PedTox (10,17,18). The rationale of this database was to address questions such as what drugs are commonly seen in children, what effect does age have on

therapeutic, toxic, and lethal levels, what are the range of values that seem to have a high cause-and-effect relationship to toxic and/or lethal complications in a child at any age, and what is the range of signs of a particular toxic abuse (17). Although the information in the registry could be highly promising, PedTox does not consist of statistical representative data nationally since submitting figures into the database is only voluntary (10). It is not mandatory that medical examiners or coroners add toxicological findings of pediatric cases into the registry. If results from drug analyses and case reports are being inputted by only a few forensic pathologists, PedTox does not have much usefulness as a credible database. Furthermore, there are little published studies from information contained within the PedTox registry, and the published works that are present criticize the reliability of the database (18,19). There is no standardization of toxicology analyses in pediatrics since testing guidelines vary by state and by the susceptible elements of a case.

Toxicology Investigators Consortium (ToxIC) is another case registry established in 2009 by the American College of Medical Toxicology that effectively illustrates the problem of poisonings in the emergency health care department (20,21). The registry includes identifier information and clinical data including circumstances of exposure, substances involved, presence of clinical signs and symptoms, and treatments provided (20). What makes ToxIC useful in the medical care setting is that it provides records of drug poisonings where as databases maintained by other organizations, such as the American Association

of Poison Control Centers (AAPCC), would miss due to under-reporting of these cases (21). Yet it must be mentioned that currently not every hospital in the country has access to the ToxIC registry. Most of the facilities with the ToxIC registry are located at academic tertiary care institutions and thus the data might not be representative of the experience and practice in primary health care settings (20,21). Statistics obtained from ToxIC would only reflect the population of patients that attended these medical facilities. While this registry only reflects pre-mortem information and not post-mortem information, what is important is the indication of an increase of pediatric poisonings, the correlation of patterns of these poisonings and how they can easily be detected if the proper testing is conducted.

1.4 Unknown Causes of Infant Mortality

Standards and procedures applied to autopsies should be incorporated for determining deaths due to ill-defined causes. Sudden Infant Death Syndrome (SIDS) is a well known undetermined cause of death among the pediatric population. SIDS, which was originally proposed in 1969, is defined as the sudden unexpected death of an individual under 1 year of age, apparently occurring during sleep, that remains unexplained after a comprehensive investigation, including performance of a complete autopsy and review of the circumstances of death and the clinical history (22,23). Specifically with autopsies, there must be no evidence of potentially lethal pathologic findings,

unexplained trauma, abuse, neglect, unintentional injury, or substantial thymic stress, in addition to negative results from toxicology, microbiology, radiology, vitreous chemistry, and metabolic screening examinations (23). However, even with all the requirements listed to confirm death due to SIDS, it is not an official cause of death. Instead, SIDS is a diagnosis of exclusion that falls under the category of an ill-defined cause of death. Even when there is a thorough standard of what characterizes an infant death due to SIDS, how does the public know for certain the standards are being followed by every state in the country? If the nationwide autopsy rate is low and many children are not autopsied, or a complete autopsy with a toxicology examination is not performed, then it is possible that there are medical examiners and coroners in jurisdictions who record deaths due to SIDS without sufficient information to meet the diagnostic criteria. The objective of this research study is to examine pediatric deaths due to poisons and ill-defined causes, to observe state by state autopsy rates, and to identify the likelihood of anything that is missed by a state medical examiner or coroner when there is a death of a minor.

2. METHODS

2.1 Database Introduction

The information gathered for this research was obtained from the Centers of Disease Control and Prevention (CDC) internet database called Wide-ranging Online Data for Epidemiologic Research, otherwise known as WONDER (24). The data within is collected by the National Center for Health Statistics (NCHS), an agency of the CDC. This data collected by the NCHS is used to generate annual National Vital Statistics Reports. With regards to the focus on the deaths of infants, toddlers, and adolescents, the specific data analyzed within WONDER was the underlying cause of death data throughout the entire United States as well as the country's unincorporated territories. Many demographic variables can be viewed such as date, age group, location, race, sex, place of death, cause of death, and whether or not an autopsy was performed, as well as other categories.

2.2 Demographic Information

All deaths counted for in the United States by the NCHS for the years 2000, 2005, and 2010 were obtained, with 2010 being the most recent year in which information from CDC WONDER is available as of the beginning of 2014. The demographic information that was obtained for this research includes states, population, total deaths, age, and cause of death. More specifically, the total population of each state, the total number of deaths within those states, and the

crude death rate were obtained for every state in the country, as well as for the District of Columbia and nationwide values. The crude death rate defined by the CDC WONDER database is defined as the calculated number of death per 100,000 individuals with a population of a particular demographic (24). Population values in this database for years 2000 and 2010 are based on the United States Census Bureau data of the Department of Commerce for each corresponding year (25). Population values for the year 2005 is based on July 1 resident population estimates from the Census Bureau's bridged-race revised intercensal series, with state estimates being obtained by adding the county estimates, so state estimates are consistent with each other within a given year (24,25). The unincorporated territories of the United States, such as Puerto Rico, Guam, or the Virgin Islands for example, were not included in the database search. The data was then marginalized to only include persons between the ages of 0 to 19 years old. The examined population was further categorized into five different age groups: under 1 year, 1-4 years, 5-9 years, 10-14 years, and 15-19 years. A separate dataset obtained from CDC WONDER was further analyzed for the infant population to examine deaths in 2010 of four different age categories; under 1 day, 1-6 days, 7-27 days, and 28-364 days. The crude death rate per 100,000 individuals were calculated for all corresponding age groups nationwide, but only calculated for the total age group of 0-19 years and for the age group under 1 year statewide.

In addition, the drug and poison related causes of death for all these age groups were examined for each of these years through CDC WONDER on a national level. The National Vital Statistics Report indicates how the cause of death is categorized by codes classified in accordance with the International Classification of Diseases (ICD) (1,26). The report contains a specific section related to drug-induced mortality, however with use of CDC WONDER for this research, a specific list of selected ICD codes were used to identify the causes of death related to drugs and poisonings: X40-X49: Accidental Poisoning by and Exposure to Noxious Substances, X60-X69: Intentional Self-Poisoning by and Exposure to Noxious Substances, X85-X90: Assault Poisoning by and Exposure to Noxious Substances, Y10-Y19: Undetermined Poisoning by and Exposure to Noxious Substances, Y40-Y59: Drugs, Medicaments, and Biological Substances Causing Adverse Effects in Therapeutic Use, Y88.0: Sequelae of Adverse Effects Caused by Drugs, Medicaments and Biological Substances in Therapeutic Use. Two additional supplementary ICD codes separate from those listed previously were also chosen specifically for the pediatric population of those under 1 year of age; R95-R99: Ill-Defined and Unknown Causes of Mortality, and R95: Sudden Infant Death Syndrome (SIDS).

2.3 Medico-legal Death Investigation Systems

For each state, it was indicated whether each had either a medical examiner system, a coroner system, or a mixed system for death investigations

(27). A state with a mixed system is defined as having both medical examiners and coroners actively practicing in different counties, which varies amongst jurisdictions. Each state is also indicated whether or not the state has a specific provision for automatic autopsies of children fatalities when it comes to death reporting (28). Information for the number of deaths, nationwide and statewide, of age groups under 1 year, 1-4 years, and 15-19 years from the CDC WONDER database were taken and the number of autopsies for each representative age group were analyzed: whether an autopsy was performed, whether an autopsy was not performed, or information on whether or not an autopsy was performed is unknown. Age groups of 5-9 years and 10-14 years were omitted from this area of research since the total number of deaths for these demographics were very small both statewide and nationwide and it would be hard to obtain complete an accurate autopsy data for each state. The exception to this is when there was a diagnostic poisoning related death, regardless of the manner. For all poisoning related deaths, the number of autopsies conducted for each age demographic was analyzed. Autopsy rates were not obtained for the year 2000 since the CDC WONDER database first began examining autopsy rates in 2003 (24).

2.4 Federal Legal Ethics

The Public Health Service Act (42 U.S.C. 242m(d)) prohibits reporting of any and all death counts for each state in the country and category with a value of nine or lower (24,29). The addition of this code to the law was put in place to

protect the privacy of victims' families by prohibiting the use of information obtained from CDC WONDER for any other purpose besides health statistical reporting and analysis. Therefore even if a value for a certain data fact can be easily calculated by other data obtained from the database, it cannot be included anywhere in this report, including tables, figures, and appendixes. To compensate for this, any value under ten will be reported as "0-9" in charts to indicate that the data provided is solely for health statistical reporting and analysis purposes only. From the information contained in any portion of this thesis, no individual may make any attempts to learn the identities of any victim included within the data or make any disclosures or uses of the identity of a victim discovered inadvertently.

3. RESULTS

3.1 State Medico-Legal Systems

There are 22 states that utilizes a medical examiner system, 11 states that utilizes a coroner system, and 17 states that utilizes a mixed system as of September 2011. Each state's medico-legal death investigation system is shown in Appendix 1. There are 10 states that lack specific provisions for automatic autopsies of children fatalities. The medical examiner system states with no specific provisions consist of Connecticut, Delaware, New Hampshire, New Mexico, North Carolina, Rhode Island, and Vermont. Colorado and Wyoming are the only coroner system states with no specific provisions. Hawaii is the only mixed system state without specific provisions.

3.2 Population & Mortality Data

The United States population according to the Census Bureau was 281,421,906 during the year 2000 and 308,745,538 during the year 2010, an increase in 27,323,623 individuals within the decade. The estimated intercensal population was recorded at 295,516,599 for the year 2005. The overall number of deaths totaled to 2,403,351 in 2000, 2,448,017 in 2005, and 2,468,435 in 2010. The crude death rates per 100,000 individuals nationwide came to 854.0, 828.4, and 799.5 respectively. When condensed to the age group between 0 and 19, the population was 80,473,265 in 2000, 82,005,260 in 2005, and 83,267,556 in 2010. The total number of deaths within this population came to

53,990 in the year 2000, 53,501 in 2005, and 45,068 in 2010. Crude death rates per 100,000 individuals in the pediatric demographic nationwide came to 67.1, 65.2, and 54.1 respectively. Appendix 2 show the underlying population and mortality data for each corresponding year by individual states, with the District of Columbia included.

3.2.1 Population & Mortality Data by Age Demographic

The population for each age group for the year 2000 are as followed; 3,805,648 aged under 1 year old, 15,370,150 aged 1-4 years old, 20,549,505 aged 5-9 years old, 20,528,072 aged 10-14 years old, and 20,219,890 aged 15-19 years old. The total number of deaths for each age group and the percentage of total pediatric deaths in the U.S. are shown in Table 1.

Table 1. Nationwide Population and Mortality Statistics; 2000. The total population of each age group obtained from U.S. Census data, number of deaths obtained from CDC Wonder, and percentage of death calculated by total pediatric deaths in the year 2000 (n=53,900).

Age Group	Population	Number of Deaths	% of Deaths
<1 Year	3,805,648	28,035	51.93%
1-4 Years	15,370,150	4,979	9.22%
5-9 Years	20,549,505	3,253	6.03%
10-14 Years	20,528,072	4,160	7.71%
15-19 Years	20,219,890	13,563	25.12%

The population for each age group for the year 2005 are as followed; 4,004,393 aged under 1 year old, 15,913,007 aged 1-4 years old, 19,389,067 aged 5-9 years old, 21,212,579 aged 10-14 years old, and 21,486,214 aged 15-19 years old. The total number of deaths for each age group and the percentage of total pediatric deaths in the U.S. are shown in Table 2.

Table 2. Nationwide Population and Mortality Statistics; 2005. The total population of each age group obtained from U.S. Census data, number of deaths obtained from CDC Wonder, and percentage of death calculated by total pediatric deaths in the year 2005 (n=53,501).

Age Group	Population	Number of Deaths	% of Deaths
<1 Year	4,004,393	28,440	53.16%
1-4 Years	15,913,007	4,756	8.89%
5-9 Years	19,389,067	2,837	5.30%
10-14 Years	21,212,579	3,765	7.04%
15-19 Years	21,486,214	13,703	25.61%

The population for each age group for the year 2010 are as followed; 3,944,153 aged under 1 year old, 16,257,209 aged 1-4 years old, 20,348,657 aged 5-9 years old, 20,677,194 aged 10-14 years old, and 22,040,343 aged 15-19 years old. The total number of deaths for each age group and the percentage of total pediatric deaths in the U.S. are shown in Table 3.

Table 3. Nationwide Population and Mortality Statistics; 2010. The total population of each age group obtained from U.S. Census data, number of deaths obtained from CDC Wonder, and percentage of death calculated by total pediatric deaths in the year 2010 (n=45,068).

Age Group	Population	Number of Deaths	% of Deaths
<1 Year	3,944,153	24,586	54.55%
1-4 Years	16,257,209	4,316	9.58%
5-9 Years	20,348,657	2,330	5.17%
10-14 Years	20,677,194	2,949	6.54%
15-19 Years	22,040,343	10,887	24.16%

Underling data showing the distribution of population and mortality data of these separate age groups for each corresponding year are distributed by state, and the District of Columbia is contained in Appendix 3 and 4.

The state that had the highest death count of all pediatric age groups of each studied year was California, although it is also the state with the highest population in the nation so it doesn't necessarily mean that California has a high pediatric mortality rate. The crude death rate for California's pediatric population in 2010 was 43.5 per 100,000 individuals, lower than the national average of 54.1. In the same corresponding year, there were four states in the 1-4 age group, eleven states in the 5-9 age group, and six states in the 10-14 age group where the death count of those demographics were less than ten. The three

states in which death count of all three respective age groups were less than ten were Delaware, North Dakota, and Vermont. Furthermore, Vermont also had the lowest death count for both the age groups of under 1 year (n=26) and between 15 and 19 years old (n=15).

The crude death rate for the total U.S. population of the age group under 1 year of age during 2010 came to 623.4 deaths per 100,000 infants nationwide, the highest among all the combined age groups of the pediatric population. This is also consistent for the other two years examined, with the crude death rate being 736.7 in 2000 and 710.2 in 2005. When examining the rest of the pediatric population, the age group between 1 and 19 years, the crude death rate was just 25.8 deaths per 100,000 individuals in 2010, approximately 24 times lower when compared to the infant population. Table 4 illustrate the distribution of crude death rates for each age group nationwide.

Table 4. Nationwide Crude Death Rates By Age Group. The crude death rate of each age group was calculated by comparing the number of deaths and the total population, 1 death per 100,000 individuals. The crude rates match the values obtained from CDC WONDER.

Age Group	2000 Crude Death Rate	2005 Crude Death Rate	2010 Crude Death Rate
<1 Year	736.7	710.2	623.4
1-4 Years	32.4	29.9	26.6
5-9 Years	15.8	14.6	11.5
10-14 Years	20.3	17.8	14.3
15-19 Years	67.1	63.8	49.4

For all examined years, the 15-19 age group had the second highest crude death rate. The remaining three age groups had the smallest crude death rates. The one aspect that all age groups had in common were that the crude death rate decreased between 2000 to 2005 and between 2005 to 2010. Not a single examined age group had an increase in crude death rate in a five year time period.

3.3. Drug Related Causes of Mortality

Nationwide, there were 668 fatalities of individuals of the pediatric population recorded on a certificate by a forensic pathologist, relating to a death due to poisoning by any drug or other chemical substance during the year 2000. That count increased to 1,014 during the year 2005 and then slightly to 1,120 during the year 2010. The crude death rate due to poisonings per 100,000 individuals 19 and under was only 0.8 in 2000, 1.2 in 2005, and 1.3 in 2010. Tables 5, 6, and 7 display the poisoning death totals and crude death rates for each pediatric age group.

Table 5. Pediatric Poisoning Deaths Nationwide; 2000. The total population of each age group obtained from U.S. Census data while the number of poisoning deaths and crude death rate obtained from CDC Wonder.

Age Group	Population	Poisoning Deaths	Crude Death Rate Per 100,000
<1 Year	3,805,648	25	0.7
1-4 Years	15,370,150	38	0.2
5-9 Years	20,549,505	27	0.1
10-14 Years	20,528,072	53	0.3
15-19 Years	20,219,890	525	2.6
All Pediatric	80,473,265	668	0.8

Table 6. Pediatric Poisoning Deaths Nationwide; 2005. The total population of each age group obtained from U.S. Census data while the number of poisoning deaths and crude death rate obtained from CDC Wonder. Autopsy data from the total number of pediatric poisoning deaths were also obtained from CDC Wonder.

Age Group	Population	Poisoning Deaths	Crude Death Rate Per 100,000	Autopsies
<1 Year	4,004,393	43	1.1	36
1-4 Years	15,913,007	49	0.3	44
5-9 Years	19,389,067	32	0.2	26
10-14 Years	21,212,579	52	0.2	40
15-19 Years	21,486,214	838	3.9	666
All Pediatric	82,005,260	1,014	1.2	812

Table 7. Pediatric Poisoning Deaths Nationwide; 2010. The total population of each age group obtained from U.S. Census data while the number of poisoning deaths and crude death rate obtained from CDC Wonder. Autopsy data from the total number of pediatric poisoning deaths were also obtained from CDC Wonder.

Age Group	Population	Poisoning Deaths	Crude Death Rate Per 100,000	Autopsies
<1 Year	3,944,153	26	0.7	25
1-4 Years	16,257,209	67	0.4	60
5-9 Years	20,348,657	25	0.1	21
10-14 Years	20,677,194	60	0.3	57
15-19 Years	22,040,343	942	4.3	788
All Pediatric	83,267,556	1,120	1.3	951

The age group between 15 and 19 years compromised the vast majority of these poisoning deaths in each analyzed year. In 2000 there were 525 poisonings (78.6%), with the crude death rate at 2.6 fatalities per 100,000 individuals of this age group. In 2005 there were 838 poisonings (82.6%), with the crude death rate at 3.9 fatalities. In 2010 there were 942 poisonings (84.1%), with the crude death rate at 4.3 fatalities. With the remaining age groups, there were 143 deaths of children 14 years old and under during the year 2000. In 2005 there were 176 deaths of children 14 years old and under. In 2010 there were 178 deaths of children 14 years old and under.

In addition to the number of diagnostic poisoning deaths of the pediatric population, autopsy rates were able to be obtained for these fatalities for years 2005 and 2010. When examining the overall pediatric population, 80.1% of diagnosed poisoning deaths were autopsied in 2005 and 84.9% of diagnosed poisoning deaths were autopsied in 2010. For children 14 years old and under, 83.0% of diagnosed poisoning deaths were autopsied in 2005. That percentage increased in 2010 with 91.6% of diagnosed poisoning deaths autopsied for children 14 years old and under. Nonetheless, in every age group not every pediatric victim was autopsied when a death was ruled as a poisoning death when examined by a forensic pathologist. For this study, the manner of death (accident, homicide, suicide, etc.) was not analyzed when examining these poisoning fatalities in the WONDER database.

3.4 SIDS & Other Ill-Defined Causes of Mortality

For deaths of those under 1 year of age due to ill-defined and unknown causes of mortality (R95-R99), as shown in Table 8, there were a total of 3,572 fatalities in the U.S., which equals to 12.7% of the total death count of infants (n=28,035) nationwide during the year 2000. When examined further in the WONDER database, 2,523 SIDS deaths (R95) were recorded by forensic pathologists. Thus 9.0% of all infant fatalities in that year were diagnosed as a SIDS death, which equals 70.6% of the deaths due to ill-defined and unknown

causes of death. The other 1,049 deaths were not diagnosed as SIDS, but instead as an other ill-defined cause of mortality, which equals the remaining 29.4% of all unknown causes of infant fatalities in the year 2000. The same analysis was carried out for years 2005 and 2010.

Table 8. Nationwide Infant Deaths Due to Ill-Defined Causes and SIDS. Total number of deaths of individuals under 1 year of age, all unknown causes of death (R95-R99), and all SIDS deaths (R95) were obtained from CDC WONDER.

Under 1 Year of Age	**2000**	**2005**	**2010**
Total Deaths	28,035	28,440	24,586
# of All Unknown Causes of Death	3,572	3,523	2,984
% of Unknown Causes of Death	12.7%	12.4%	12.1%
# of SIDS Deaths	2,523	2,230	2,063
% of SIDS Deaths	9.0%	7.8%	8.4%
% of Unknown Causes of Death Ruled as SIDS	70.6%	63.3%	69.1%

The data in table 8 summarizes data contained in Appendix 5 of all infant deaths by ill-defined causes and by SIDS separated by state for each corresponding year. Texas, the second most populous state in the country, in

2005 and 2010 had the highest number of deaths due to ill-defined causes (n=386, n=324) and highest number of deaths due to SIDS (n=216, n=225). North Dakota, South Dakota, Vermont, Wyoming, and the District of Columbia had less than ten infant deaths due to ill-defined causes in 2010. In addition to the previously listed states above, Hawaii, Maine, Montana, Nevada, New Hampshire, New Mexico, and Rhode Island also had less than ten infant deaths due to SIDS in that same year.

3.5 Autopsy Rates

Out of the total number of fatalities occurring in 2010 for those under 1 year of age (nationwide, n=24,586), autopsies were confirmed to be performed on only 7,759 (31.6%) deceased infants. It is verified that autopsies were not conducted for 14,373 deaths for this age group. Of total deaths between the ages of 1 and 4 years (n=4,316), autopsies were confirmed to be performed on 2,309 (53.5%) deceased toddlers but not conducted for 1,752 deaths. And of total deaths between the ages of 15 and 19 years (n=10,887), autopsies were confirmed to be performed on 6,228 (57.2%) deceased adolescents but not conducted for 3,943 deaths. Table 9 and Figures 1, 2, and 3 demonstrate the percentage of confirmed 2010 autopsy rates for each medico-legal death investigation systems, separated by age groups under 1 year of age, 1 to 4 years of age, and 15 to 19 years of age. Pennsylvania was the only state left out of this analysis because of explanations stated in section 3.5.1.

Table 9. Autopsy Rates by Medico-Legal Investigation Systems; 2010. The number of poisoning deaths and number of autopsies performed were obtained from CDC Wonder and separated by the three different medico-legal investigation systems. A mixed system is one that incorporates both medical examiner and coroner systems.

Age Groups	Medical Examiner	Coroner	Mixed System	All Systems
<1 Deaths	8,198	2,833	12,444	23,475
<1 Autopsies	2,507	948	4,265	7,720
% Autopsies	30.6%	33.5%	34.3%	32.9%
1-4 Deaths	1,427	528	2,224	4,179
1-4 Autopsies	761	289	1,253	2,303
% Autopsies	53.3%	54.7%	56.3%	55.1%
15-19 Deaths	3,604	1,333	5,451	10,338
15-19 Autopsies	2,094	731	3,359	6,184
% Autopsies	58.1%	54.8%	61.6%	59.8%

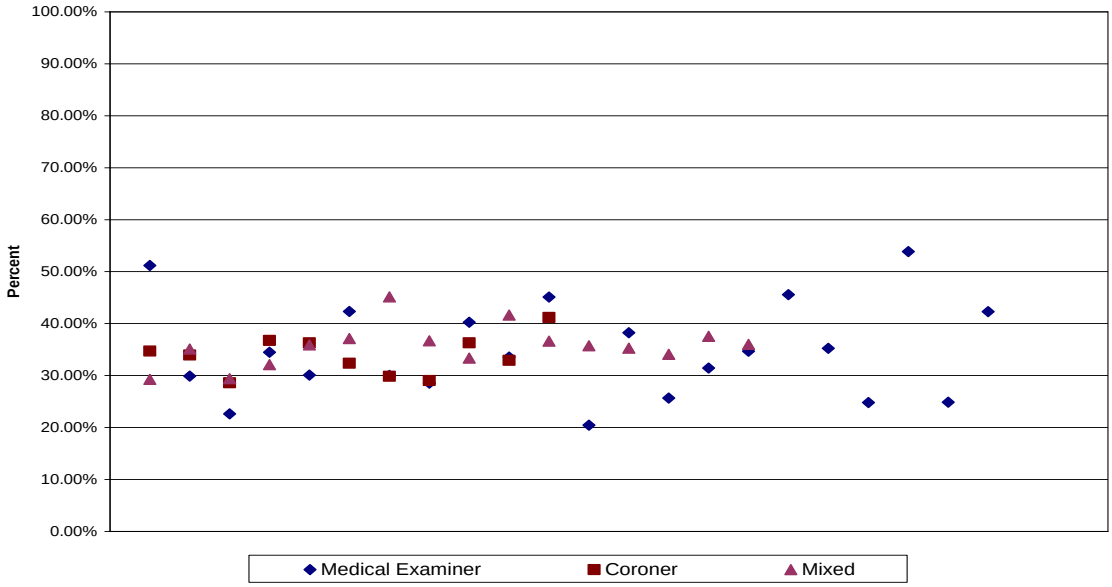

Figure 1. Autopsy Percentage for Deaths of Under 1 Year of Age; 2010. States are ordered by alphabetical order and categorized by what medico-legal death investigation system each state has. Examine Appendix 1 for each state's system.

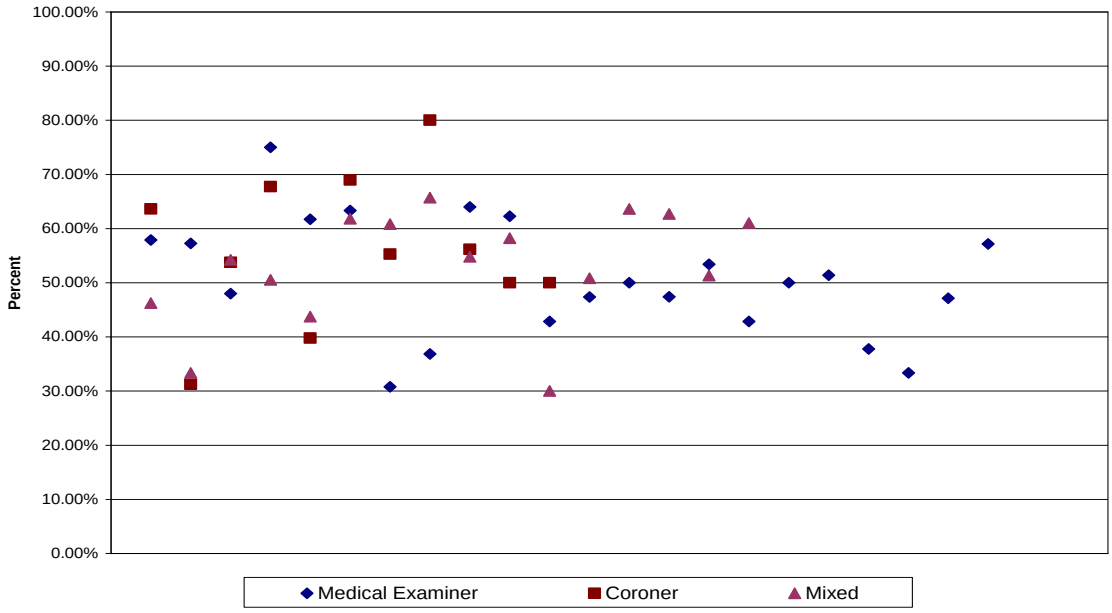

Figure 2. Autopsy Percentage for Deaths of 1-4 Years of Age; 2010. States are ordered by alphabetical order and categorized by what medico-legal death investigation system each state has. Examine Appendix 1 for each state's system.

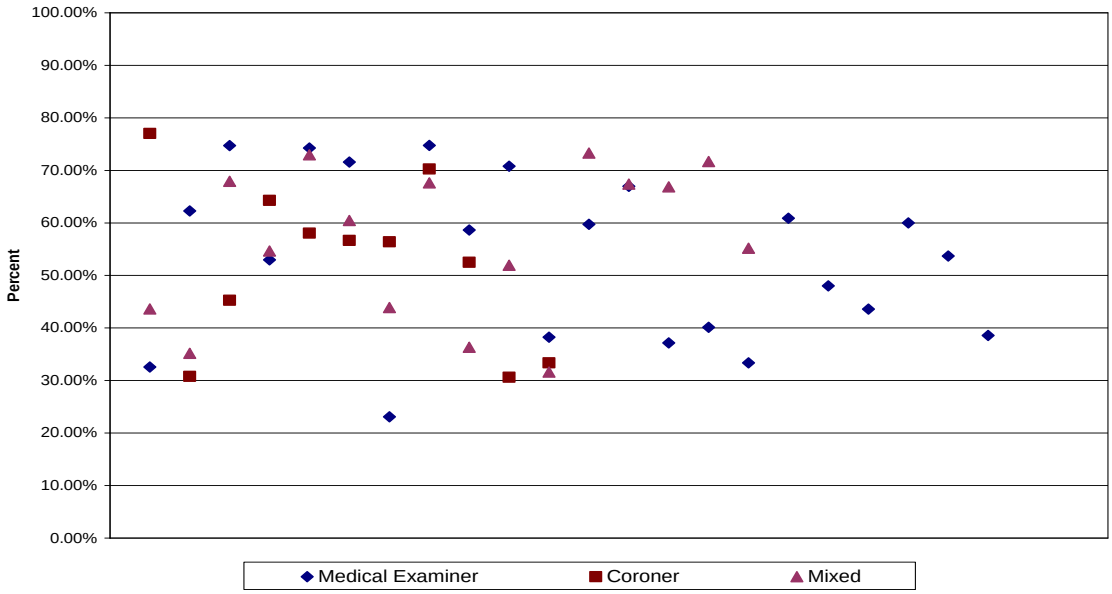

Figure 3. Autopsy Percentage for Deaths of 15-19 Years of Age; 2010. States are ordered by alphabetical order and categorized by what medico-legal death investigation system each state has. Examine Appendix 1 for each state's system.

In Figure 1, all states were situated between 20 and 60 percent. The proportion of infant autopsies conducted in most states fall between the 30 to 40 percent window, which correlate to the nationwide average of 32.9% shown in Table 9. But as shown in Figures 2 and 3 on the other hand, the data points were much more disparate, situated between 30 and 80 percent, with one medical examiner system outlier (Maine, 23.1%) for the 15 to 19 year age group. There was not any window in which most of the points fell in between when compared to Figure 1.

For the number of infant fatalities occurring in 2005 (n=28,440), autopsies were confirmed to be performed on 8,944 (31.5%) infants. It is verified that autopsies were not conducted for 16,129 deaths. For the 1-4 age group (n=4,756), autopsies were confirmed to be performed on 2,493 (52.4%) deceased toddlers but not conducted for 1,876 deaths. And for the 15-19 age group (n=13,703), autopsies were confirmed to be performed on 7,531 (55.0%) deceased adolescents but not conducted for 5,129 deaths. Looking at how many autopsies were performed nationwide in 2005 and 2010, the percentage values almost mimic one another for each examined age group.

3.5.1 Unconfirmed Autopsy Rates

The data becomes more complicated when the unknown category is examined. Appendix 6 provides the underlying data for the autopsy rate of the respective age groups for each state for each evaluated year, but indicates just how many deaths there are in which it is not known whether or not an autopsy was performed. When the number of unknown autopsy status is counted for each age group for the year 2010, the implementation of autopsies is uncertain for 2,454 deaths for the age group under 1 year, 255 deaths for the age group between 1 and 4 years, and 666 deaths for the age group between 15 and 19 years. In 2005, the implementation of autopsies is uncertain for a total of 3,367 deaths for the age group under 1 year, 387 deaths for the age group between 1 and 4 years, and 1,043 deaths for the age group between 15 and 19 years.

However, when Pennsylvania comes into consideration for both analyzed years, the outlier of the study in this particular area, the majority of unknown autopsy statuses comes solely from this state. With almost every death for all three age groups respectively (2005: <1 year; n=1,023, 1-4 years; n=164, 15-19 years; n=550) (2010: <1 year; n=1,011, 1-4 years; n=122, 15-19 years; n=443), it is uncertain whether or not autopsies were conducted in this state. When unknown autopsy status rates from Pennsylvania are omitted, the unknown autopsy rate declines. Additionally when New Mexico is factored in for the year 2005, it is another state in which unknown autopsy rates were much higher than known autopsy rates (<1 year; n=159, 1-4 years; n=43, 15-19 years; n=116).

Nonetheless, factoring out the Pennsylvania deaths, the implementation of autopsies in 2010 is still uncertain for 1,443 deaths for the age group under 1 year, 133 deaths for the age group between 1 and 4 years, and 223 deaths for the age group between 15 and 19 years. When Pennsylvania and New Mexico autopsy status values are omitted for the 2005 year, the implementation of autopsies is uncertain for 2,185 deaths under 1 year of age, 180 deaths between 1 and 4 years of age, and 377 deaths between 15 and 19 years of age.

Other than Pennsylvania, there are seventeen additional states in 2010 and twenty-six additional states in 2005 where it is unknown whether or not an autopsy was performed for at least ten fatalities of infants under 1 year. Six of those states in 2010 and nine of those states in 2005 there are unknown autopsy statuses for more than 100 fatalities, with Virginia having the highest for both

years at 264 in 2010 and 289 in 2005. Alabama, New Jersey, North Carolina, Tennessee, and Virginia are the five states in 2010 in which there are more than ten fatalities of the pediatric age group between 1 and 4 where autopsy statuses are unknown. There are seven states in 2005 with more than ten unknown autopsy statuses of this age group. Lastly there are eight states in 2010 and fourteen states in 2005 in which at least ten fatalities of adolescents between the ages of 15 and 19 where autopsy statuses are unaccounted for, with North Carolina having the highest number with 39 in 2010 and Indiana having the highest number with 72 in 2005.

4. DISCUSSION

4.1 Pediatric Age Demographics Comparison

The prevalence of pediatric fatalities occurring mostly with infants was the least surprising aspect of this research study. With a range between 51% and 55% of pediatric deaths exclusively under 1 year of age for all three examined years, the data confirms that infants are the among the most vulnerable when examining mortality within the pediatric population. Deaths due to SIDS and other ill-defined causes of death comprised just above 12% of all deaths within this age group. Specifically in 2010 alone, 2,063 fatalities of those under 1 year of age were recorded as a death due to SIDS while 921 fatalities were recorded as other ill-defined causes of death. With the number of risk factors for SIDS, there are also numerous mechanisms and circumstances of death that can rule out ill-defined causes of death (23). Even though the rate of all ill-defined and unknown causes of death among the infant population were fairly consistent within each examined decade, ill-defined deaths ruled as SIDS is more varied. While there was a decrease in ill-defined deaths ruled as SIDS from 70.6% (n=2,523) in 2000 to 63.3% (n=2,230) in 2005, that percentage increased again five years later to 69.1% (n=2063) in 2010.

The advantage of analyzing the mortality rates of infants through the CDC WONDER database is the ability to examine deaths of other age demographics. In addition to looking up any cause of death for any age group anywhere in the country, the database can inform an individual whether an infant died within the

day of childbirth, just reaching their first month of age, or in between. As seen in Appendix 7 and Figure 4, the data separates the infant deaths into these further age groups to show the timing of when these deaths commonly occur.

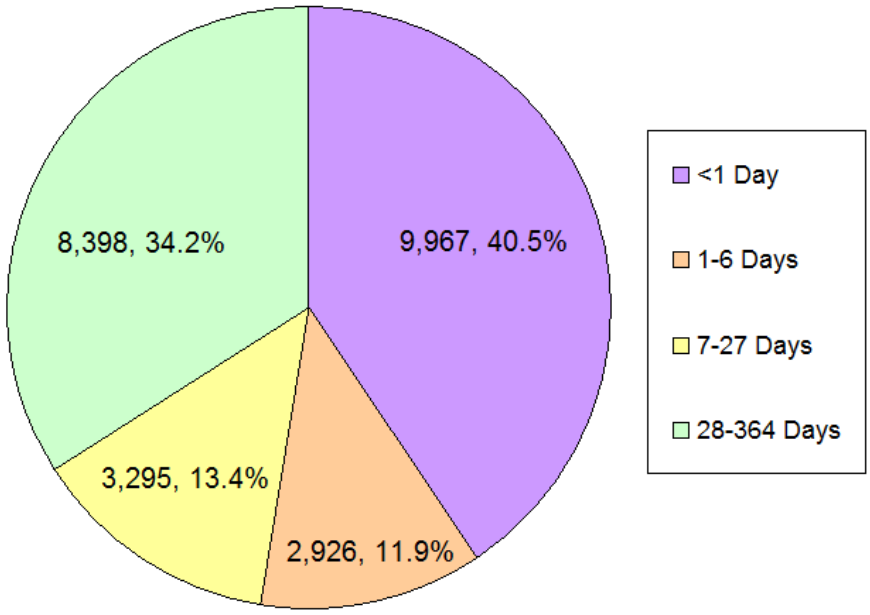

Figure 4. Infant Death by Age in Number of Days; 2010. The total number of deaths in each corresponding age group obtained from CDC WONDER. Percentages calculated from all infant deaths in the year 2010.

It is important to notice using the data from CDC WONDER that 40.5% of infant deaths in 2010 (n=9,967) occurred within twenty-four hours of childbirth, and an additional 11.9% (n=2,926) did not survive the first week. These large numbers of infant fatalities within the small time window explains why the overall infant death rate is very high when compared to the other age groups of the pediatric population. When evaluating the cause of death due to SIDS, one

would examine the 28-364 day range, which consists of 34.2% of the total infant death count for 2010 (n=8,398). All the other infant deaths 27 days and under could be factored out from the analysis of SIDS deaths since that age range does not fall into the prime category of what constitutes this type of fatality (23). Though even when omitting less than week old deaths from the dataset, pinpointing the common age between one month and twelve months where the majority of fatalities occur can further address why infant deaths are still much more frequent among the other age groups of the pediatric population.

4.2 Ill-Defined Causes of Mortality by State

What is surprising is the frequency of ruling a death due to SIDS among the different states. In Figures 5 and 6, every state in the nation in which there were more than 10 deaths diagnosed as SIDS in both 2005 and 2010 were selected and the ill-defined causes of infant deaths were analyzed. As seen previously in Table 8, the nationwide average of infant deaths ruled as SIDS was 7.8% in 2005 and 8.4% in 2010. It would normally appear that the states below these percentages are more likely, than states above the national average, to correctly establish a cause and mechanism of death assuming that a complete autopsy has been performed.

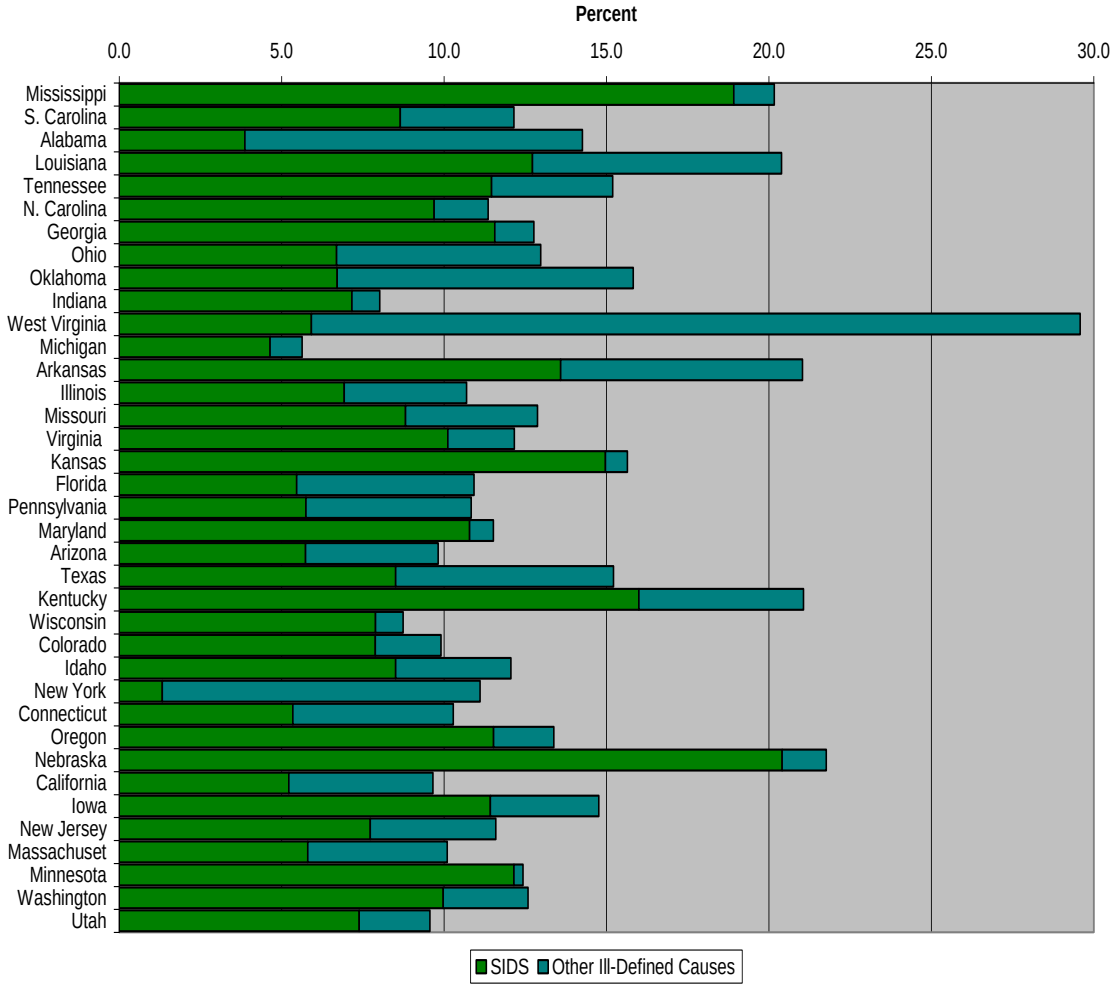

Figure 5. State Correlation of Ill-Defined Causes of Infant Death; 2005. States are listed in this figure from highest to lowest infant crude death rate. Data pertaining information of infant deaths due to SIDS and other ill-defined causes of death obtained from CDC WONDER.

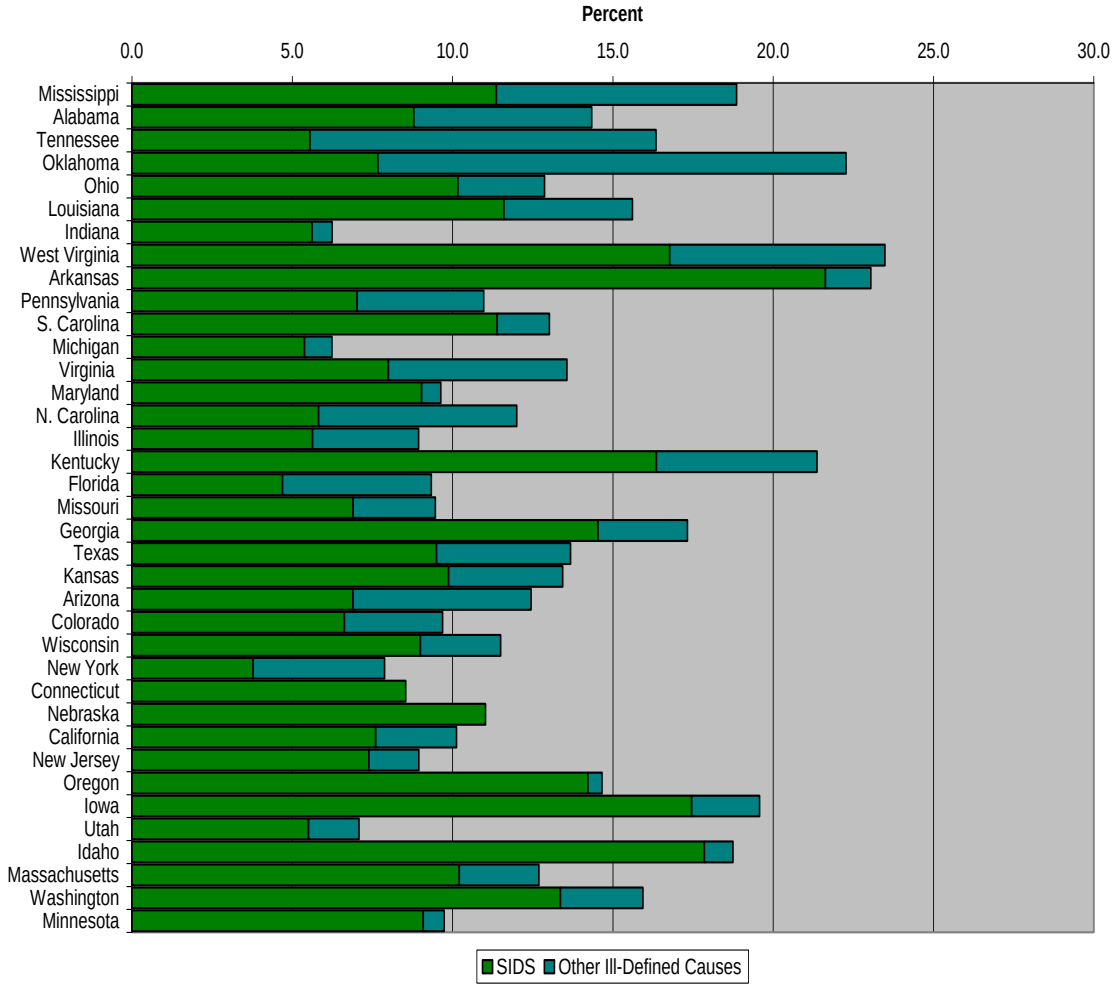

Figure 6. State Correlation of Ill-Defined Causes of Infant Death; 2010. States are listed in this figure from highest to lowest infant crude death rate. Data pertaining information of infant deaths due to SIDS and other ill-defined causes of death obtained from CDC WONDER.

Out of the 37 states analyzed for Figures 5 and 6, only four in 2005 and 2010 had less than 50% of all ill-defined causes of death diagnosed as SIDS by medical examiners and coroners. New York was the only state in both years where less than 5% of all infant deaths were diagnosed as SIDS. In 2005, the state ruled in a fatality of an infant to be caused by SIDS in 19 cases out of 159 total unknown causes of death in that age group. Additionally, Alabama and Michigan were the other two states where less than 5% of all infant deaths were diagnosed as SIDS in 2005. Florida was the only other state where less than 5% of all infant deaths were diagnosed as SIDS in 2010.

In both years there were many states were almost every ill-defined cause of death were diagnosed as SIDS. If the diagnosis of SIDS is defined as the sudden unexpected and unexplained death of an infant after a comprehensive investigation with no evidence of pathologic findings, trauma, abuse, neglect, unintentional injury, or thymic stress, in addition to negative results from toxicology, microbiology, radiology, vitreous chemistry, and metabolic screening examinations (22,23), then it should be a diagnosis of exclusion that should only be used in rare instances of ill-defined causes of death. Yet regardless of what medico-legal death investigation system a state has, Figures 5 and 6 appear to show exactly the opposite with the large percentage of deaths being diagnosed and reported as SIDS.

Credit should be given to states like Oklahoma for example because even though 22.3% (n=90/404) of deaths were ruled as an ill-defined cause of death in

2010, only 7.67% (n=31) of deaths were ruled as SIDS. But then there are states with alarming statistics such as Arkansas. Not only were 23.1% (n=65/282) of infant deaths in this state ruled as an ill-defined cause of death, 21.6% (n=61) were ruled as SIDS. Only four deaths had an ill-defined cause of death other than SIDS. Given that there are discrepancies between deaths due to SIDS and deaths due to other ill-defined causes, the analysis of these states and the nationwide increase of deaths ruled as SIDS by 5.8% in a span of five years makes it seem that many states in the nation either do not have a clear set of standards for diagnoses of exclusions or those standards are not rigorously followed by the forensic pathologists.

4.3 Nationwide Pediatric Poisoning Mortality

Poisoning deaths by drugs and other chemical substances were low in this research study. It might be expected that most poisoning fatalities would occur among the adolescent population between the ages of 15 and 19 since it is the age where these individuals most likely have their first time exposures with alcohol and other illicit-drugs. The possibility of deaths due to prescription drug use is included regardless of the manner and circumstances of death. Yet with only 942 diagnosed poisoning deaths among 10,887 total deaths of teenagers between 15 and 19 years old in 2010, the crude rate of death at 4.3 fatalities per 100,000 individuals is still small. But what is still alarming is that the crude death rate was lower in 2005 at 3.9 with a total of 838 poisoning deaths, and much

lower in 2000 at 2.6 with a total of 525 poisoning deaths. This increase in deaths within the span of a decade indicates that deaths due to illicit drugs, alcohol, and other toxic substances are continually on the rise among the population of those in their mid and late teenage years.

Moving on to the younger portion of the pediatric population during the year 2010, there were only 178 poisoning deaths among 34,181 total deaths of individuals under 15 years of age. Furthermore, there were merely 26 deaths among 24,586 total deaths of infants under 1 year of age. The values are similar for the year 2005, with 176 poisoning deaths of individuals under 15 years of age, but 43 of those deaths were of those under 1 year of age. Poisoning deaths are a bit lower in 2000, with 143 deaths of those under 15 years and 25 deaths of those under 1 year. These low mortality rates of poisoning deaths within the pediatric population are probably due to the high survival rate of acute chemical exposure (12,16). If it is assumed that no pediatric deaths in this category were missed, then the number of pediatric poisoning deaths recorded are low and perhaps will continue to drop.

However as stated in Tables 6 and 7, not every victim of a poisoning fatality had an autopsy conducted by a forensic pathologist. Even in this decade, 15.1% of all pediatric poisoning deaths are still not confirmed with an autopsy being conducted. One should figure that an important quality assurance factor of medico-legal death investigation systems is that no matter how obvious a cause of death may be, any drug related death of an infant, child, or teenager must

require a thorough investigation that includes a complete autopsy with a toxicology screening.

4.3.1 Toxicology Limitations

Limitations of toxicology examinations do need to be taken into consideration when it comes to poisoning deaths of the pediatric population. Defining what constitutes a toxicology screening can be difficult since there are no standard definitions due to the multiple examination types for many different drug categories (30). With an example stated by Hoffman et al., toxicology examinations for drugs in the benzodiazepine category normally tests for the presence of the metabolite oxazepam. However there are some anti-anxiety medications such as alprazolam and lorazepam that fall under the benzodiazepine category but do not metabolize into oxazepam, thus these two drugs would be easily missed by a generic benzodiazepine screening. Another limitation to consider is that performing a toxicology examination on a deceased person can potentially give different results than when performed on a living individual since a corpse is not a static environment (31,32). For instance, gamma-hydroxybutyric acid (GHB) can be produced after a death occurs due to the endogenous metabolism of the gamma-aminobutyric acid neurotransmitter, which would increase blood levels by up to 100 mg/L (32). Since GHB can also be a synthetic illicit drug, a medical examiner or coroner needs to be careful when interpreting these levels. In addition, autolysis and putrefaction during

decomposition of a corpse could also increase or decrease drug levels during a toxicology examination (31,33). In addition to the postmortem generation of alcohol by bacteria, drug levels could decrease mainly because bacteria may break down drugs and their metabolites with progressive reduction in levels until detection may become absent (33).

The main issue that needs to be recognized by forensic pathologists when conducting and interpreting toxicology examinations during autopsies of the pediatric population is that infants and small children metabolize chemicals differently from adults (34-37). Including weight, children and adults differ when it comes to metabolic aspects such as gastric emptying time, exocrine pancreatic function, bile acids, and bacterial flora (34). Such toxicokinetic differences can significantly affect a chemical's onset of action as well as the bioavailability of the chemical. Additionally, as stated by Middleburg (34), there are two main factors that influence the distribution of chemicals in a child; high concentrations of body weight consisting of water, and low concentrations of proteins binding to toxins. With regards to the infant population, enzyme activity changes profoundly throughout development after childbirth and often results in different disposition pathways than those in adults (35,37). There are approximately 50 cytochrome P450 (CYP) isoenzymes that have been identified in the human body, with CYP3A4 being the most common for drug metabolism since there are many different drug types identified that are associated with this particular isoenzyme (37). At one month after child birth, infants will only have 30% of CYP3A4 levels

compared to a healthy adult. Thus the difference in CYP3A4 levels between infants and adults is going to radically affect the metabolism of a variety of different drugs, even over-the-counter acetaminophen. Moreover, when there are plenty of genetic abnormalities surrounding CYP isoenzymes, it can significantly alter the way individuals metabolize certain drugs, regardless of anyone's age (38).

4.4 Nationwide & Statewide Autopsy Rates

Though the most important aspect of this research study is the correlation between the number of deaths of certain age groups of the pediatric population and how many autopsies were performed in each state. While there is not any pattern that differentiates between states with medical examiner systems, states with coroner systems, or states with mixed systems, it is important to note that the statistics on state autopsy rates for all three age groups vary considerably. On average nationwide it is seen that the autopsy rate is about the same low percentage of 31.5% for the infant population in both 2005 and 2010. There is an increase in the autopsy rate to 52.4% in 2005 and 53.5% in 2010 for the pediatric ages between 1 and 4. For the ages of 15 to 19 years there is a slight increase with a rate of 55.0% in 2005 and 57.2% in 2010. As stated before about the different ages of infant deaths, a large portion of these deaths occur within the first week of life, with the majority occurring less than twenty-four hours of childbirth. Since these types of deaths would most likely happen in a healthcare

setting in the presence of a medical professional witnessing every aspect of the event leading to death, it would be understandable as to why an autopsy would not be performed for these cases. This helps to explain why autopsy rates for the infant population is much lower than the other analyzed age demographics. For the rest of the pediatric population amid the exception of miniscule percentage increases, the rate of forensic pathologists performing autopsies within these age groups has been the same between the five year time-frame, meaning that there has not been any successful efforts made which to raise the autopsy rate.

Clearly this is not representative of each state. When comparing Figures 1, 2, and 3 for the year 2010, there are numerous states in which the autopsy rate for the 1-4 age group is higher than the 15-19 age group and even a few states where the autopsy rate for the under 1 age group is higher than either of the other two age groups. Yet there remain states in which the autopsy status of any individual of the pediatric population is unknown. Pennsylvania is the only state in the nation with more deaths where the autopsy status is unknown than confirmed with no clear explanation as to why this occurs. New Mexico may have had the same issue in 2005, however the state resolved this by 2010 to have clearer answers on death certificates regarding whether or not autopsies were performed. Although it is relieving that there are less unknown pediatric autopsy status in 2010 compared to five years prior, the fact that there are some states where the autopsy status of infants, children, and adolescents would be

recorded as unknown on death certificates with no investigation is still a scary thought. Even though it is well established that additional information can be obtained from an autopsy in more than one third of pediatric deaths (4), it seems like standards are not yet in place nationwide to increase autopsy rates or to obtain clearer information about deaths of this vulnerable population.

5. CONCLUSIONS

5.1 Takeaways of Thesis Research

Throughout the increasing pediatric population, it appears that the death rate is decreasing. When analyzing the examined years, there is a noticeable decrease in crude death rate for all age groups between the years 2000 and 2005, followed by a significant decrease in crude rate between 2005 and 2010. This points out that as the years go by, the mortality of the pediatric population reduces overtime and a special concern is needed when studying this age group in forensic science. The death of an infant, child, or adolescent cannot partake in the same medico-legal death investigation process as a death of an adult.

Despite numerous journal articles emphasizing the significant health care problem of pediatric poisonings (9, 11-13), the number of diagnosed drug related fatalities within the pediatric population was low compared to all pediatric deaths nationwide, especially for those fourteen years old and under. From the scientific literature and the analysis of the CDC WONDER database, this could be attributed to two of these factors. First, cases of poisoning among the pediatric population, when reported, usually results in immediate treatment in a healthcare setting and leads to a high rate of survivability (12,16). If thorough examinations of pediatric victims are truly being performed nationwide, then this is surely the positive outcome as to why the crude pediatric poisoning death rate is low.

The other alternative factor can be that the rate of all types of pediatric poisoning are not being disclosed to healthcare professionals or to forensic

investigators. There may be a seven-fold under-reporting of pediatric poisoning fatalities since there are cases where intentional poisonings of minors are usually never confirmed by the assailant (13). If no signs of a drug intake by a pediatric victim are present, then a poisoning related fatality can be easily missed if no toxicology examination is conducted during a medico-legal death investigation. In view of the fact that pediatric poisonings remain a significant healthcare problem that is progressively getting worse, especially among the older demographics of the pediatric population, it is hard to believe that poisoning deaths were not missed anywhere in the country (9-14).

Extra precaution needs to be taken into consideration during the death investigation of infants, especially the age group between 28 and 364 days. Because of the occurrence of SIDS deaths and other ill-defined causes of mortality, a thorough death investigation complete with a full autopsy and toxicology examination should be performed to confidently report that the undetermined fatality is a diagnosis of exclusion. This is the principal method to make sure with high certainty that a mechanism of death is not being masked by an apparent ill-defined death. It is understandable that fatalities of infants less than a week old are most likely witnessed in a healthcare setting and assuming there is no malpractice, the manner of death can be easily diagnosed as natural.

The greatest concern of this thesis research was the disparity of ill-defined cause of death diagnosed as SIDS and the pediatric autopsy rates among the different states in the nation. The analyzed data demonstrated in both Figures 5

and 6, for states where forensic pathologists are very cautious to diagnose a infant death as SIDS, there are other states where forensic pathologists would rule ill-defined infant deaths as SIDS much more frequently. If each state were held to federal standard operating procedures for medico-legal death investigations of pediatric victims, then the percentages of infant fatalities diagnosed as SIDS and other ill-defined causes of death would be evenly distributed nationwide.

In addition, measures need to be put in place nationwide to increase the rate of autopsies for the pediatric population and there needs to be strict accountability when it is not reported on a death certificate whether or not an autopsy was performed. Clearly each and every pediatric fatality has to be examined on a case by case basis. Deaths of infants under one day of age can be easily diagnosed and observed by medical professionals, thus forensic pathologists conducting mandatory autopsies for all infants less than a day old would be very excessive and costly. Yet at the same time, when the reported poisoning deaths is low nationwide and the rate of infant deaths diagnosed as SIDS varying statewide, an increase the number of complete autopsies with toxicology examinations can show if there are any changes to the diagnosis of undermined causes of death and poisoning deaths. Regardless of what is decided upon to determine what circumstance requires an autopsy of a pediatric victim, a toxicology examination should always be included for an investigation.

5.2 Future Directions

While this research provided a great amount of data related to poisoning deaths, ill-defined deaths, and autopsy rates statewide and nationwide, the information obtained from the analysis of the WONDER database is still broad compared to what could be examined. For the purpose of this thesis project, gathering more categories of pediatric fatalities would have made this presentation of data more cluttered and complex. It is also understandably difficult to pin point specific pieces of information when the database examined cannot explain certain questions, such as if the autopsies conducted consisted of toxicology examinations, or why are there states where numerous autopsy statuses are unknown. It would be brilliant to see future research carried out in this area of forensic science. One suggestion would be a thesis project further examining infant deaths nationwide and comparing the mechanisms of death, the manners of death, and the rate of deaths diagnosed as an ill-defined cause. Once more recent mortality data is able to be published by the CDC, professionals will be able to get a clearer idea of the current trends of pediatric mortality in this decade and what can be done nationwide to improve quality assurance and standard operating procedures for determining when to perform an autopsy and what the definition of a complete autopsy should entail.

Appendix 1: State Medico-Legal Systems; 2011

State	Medico-Legal Death Investigation Systems	State	Medico-Legal Death Investigation Systems
Alabama (AL)	Mixed	Montana (MT)	Mixed: CC/MeS
Alaska (AK)	Medical Examiner State	Nebraska (NE)	Coroner
Arizona (AZ)	Medical Examiner County	Nevada (NV)	Coroner
Arkansas (AR)	Mixed: CC/MeS	New Hampshire (NH)	Medical Examiner State
California (CA)	Mixed	New Jersey (NJ)	Medical Examiner C&S
Colorado (CO)	Coroner	New Mexico (NM)	Medical Examiner State
Connecticut (CT)	Medical Examiner State	New York (NY)	Mixed
Delaware (DE)	Medical Examiner State	North Carolina (NC)	Medical Examiner State
Florida (FL)	Medical Examiner (District)	North Dakota (ND)	Coroner
Georgia (GA)	Mixed	Ohio (OH)	Mixed
Hawaii (HI)	Mixed	Oklahoma (OK)	Medical Examiner State
Idaho (ID)	Coroner	Oregon (OR)	Medical Examiner State
Illinois (IL)	Mixed	Pennsylvania (PA)	Mixed
Indiana (IN)	Coroner	Rhode Island (RI)	Medical Examiner State
Iowa (IA)	Medical Examiner C&S	South Carolina (SC)	Coroner
Kansas (KS)	Coroner (District)	South Dakota (SD)	Coroner
Kentucky (KY)	Mixed: CC/MeS	Tennessee (TN)	Medical Examiner County
Louisiana (LA)	Coroner	Texas (TX)	Mixed

Maine (ME)	Medical Examiner State	Utah (UT)	Medical Examiner State
Maryland (MD)	Medical Examiner State	Vermont (VT)	Medical Examiner State
Massachusetts (MA)	Medical Examiner State	Virginia (VA)	Medical Examiner State
Michigan (MI)	Medical Examiner County	Washington (WA)	Mixed
Minnesota (MN)	Mixed	West Virginia (WV)	Medical Examiner State
Mississippi (MS)	Mixed	Wisconsin (WI)	Mixed
Missouri (MO)	Mixed	Wyoming (WY)	Coroner

Appendix 2a: Statewide Population and Mortality Statistics; 2000

State	Total Population	Total Deaths	Total Crude Death Rate	Under 19 Population	Under 19 Deaths	Crude Death Rate Under 19
AL	4,447,100	45,062	1,013.30	1,256,169	1,130	90
AK	626,932	2,914	464.8	208,117	187	89.9
AZ	5,130,632	40,500	789.4	1,518,188	1,138	75
AR	2,673,400	28,217	1,055.50	760,509	679	89.3
CA	33,871,648	229,551	677.7	10,234,571	5,622	54.9
CO	4,301,261	27,288	634.4	1,224,668	776	63.4
CT	3,405,565	30,129	884.7	925,702	486	52.5
DE	783,600	6,875	877.4	218,250	184	84.3
FL	15,982,378	164,395	1,028.60	4,048,632	2,841	70.2
GA	8,186,453	63,870	780.2	2,414,770	2,010	83.2
HI	1,211,537	8,290	684.3	327,251	209	63.9
ID	1,293,953	9,563	739.1	413,865	286	69.1
IL	12,419,293	106,634	858.6	3,605,506	2,685	74.5
IN	6,080,485	55,469	912.2	1,763,386	1,341	76
IA	2,926,324	28,060	958.9	827,983	544	65.7
KS	2,688,418	24,717	919.4	798,418	570	71.4
KY	4,041,769	39,504	977.4	1,113,644	819	73.5
LA	4,468,976	41,138	920.5	1,368,029	1,215	88.8
ME	1,274,923	12,354	969	335,485	171	51
MD	5,296,486	43,753	826.1	1,492,965	1,035	69.3
MA	6,349,097	56,681	892.7	1,675,113	724	43.2
MI	9,938,444	86,953	874.9	2,884,065	2,019	70
MN	4,919,479	37,690	766.1	1,434,845	754	52.5
MS	2,844,658	28,654	1,007.30	873,214	930	106.5
MO	5,595,211	54,865	980.6	1,594,172	1,215	76.2
MT	902,195	8,096	897.4	257,440	195	75.7
NE	1,711,263	14,992	876.1	504,336	354	70.2
NV	1,998,257	15,261	763.7	561,501	389	69.3
NH	1,235,786	9,697	784.7	344,165	166	48.2
NJ	8,414,350	74,800	889	2,284,107	1,235	54.1
NM	1,819,046	13,425	738	564,859	405	71.7
NY	18,976,457	158,203	833.7	5,211,251	2,877	55.2
NC	8,049,313	71,935	893.7	2,193,360	1,791	81.7
ND	642,200	5,856	911.9	183,464	113	61.6
OH	11,353,140	108,125	952.4	3,215,955	2,184	67.9
OK	3,450,654	35,079	1,016.60	1,002,280	802	80

OR	3,421,399	29,552	863.7	944,004	554	58.7
PA	12,281,054	130,813	1,065.20	3,270,584	2,000	61.2
RI	1,048,319	10,027	956.5	282,616	151	53.4
SC	4,012,012	36,948	920.9	1,135,778	943	83
SD	754,844	7,021	930.1	227,481	160	70.3
TN	5,689,283	55,246	971.1	1,561,032	1,381	88.5
TX	20,851,820	149,939	719.1	6,546,236	4,413	67.4
UT	2,233,169	12,364	553.7	810,977	485	59.8
VT	608,827	5,127	842.1	166,257	84	50.5
VA	7,078,515	56,282	795.1	1,937,086	1,274	65.8
WA	5,894,121	43,941	745.5	1,683,019	896	53.2
WV	1,808,344	21,114	1,167.60	454,715	363	79.8
WI	5,363,675	46,461	866.2	1,532,093	942	61.5
WY	493,782	3,920	793.9	145,346	102	70.2
DC	572,059	6,001	1,049.00	135,806	161	118.6
Total	**281,421,906**	**2,403,351**	**854.00**	**80,473,265**	**53,990**	**67.09**

Appendix 2b: Statewide Population and Mortality Statistics; 2005

State	Total Population	Total Deaths	Total Crude Death Rate	Under 19 Population	Under 19 Deaths	Crude Death Rate Under 19
AL	4,569,805	47,090	1,030.50	1,248,672	1,066	85.4
AK	666,946	3,168	475	205,778	145	70.5
AZ	5,839,077	45,827	784.8	1,693,743	1,317	77.8
AR	2,781,097	28,055	1,008.80	767,761	643	83.8
CA	35,827,943	237,037	661.6	10,441,553	5,788	55.4
CO	4,631,888	29,627	639.6	1,289,504	827	64.1
CT	3,506,956	29,467	840.2	939,226	439	46.7
DE	845,150	7,472	884.1	227,482	165	72.5
FL	17,842,038	170,791	957.2	4,426,511	3,198	72.2
GA	8,925,922	66,736	747.7	2,610,593	2,031	77.8
HI	1,292,729	9,136	706.7	331,125	184	55.6
ID	1,428,241	10,556	739.1	439,230	267	60.8
IL	12,609,903	103,974	824.5	3,552,913	2,305	64.9
IN	6,278,616	55,675	886.7	1,780,255	1,290	72.5
IA	2,964,454	27,811	938.1	809,750	447	55.2
KS	2,745,299	24,682	899.1	789,469	547	69.3
KY	4,182,742	40,223	961.6	1,119,269	801	71.6
LA	4,576,628	44,355	969.2	1,319,313	1,261	95.6
ME	1,318,787	12,868	975.7	328,883	194	59
MD	5,592,379	43,892	784.9	1,534,518	988	64.4
MA	6,403,290	53,874	841.3	1,654,917	683	41.3
MI	10,051,137	86,867	864.3	2,823,815	1,854	65.7
MN	5,119,598	37,535	733.2	1,429,877	687	48
MS	2,905,943	29,196	1,004.70	851,115	890	104.6
MO	5,790,300	54,656	943.9	1,591,905	1,167	73.3
MT	940,102	8,528	907.1	250,134	180	72
NE	1,761,497	14,963	849.4	503,481	303	60.2
NV	2,432,143	19,029	782.4	670,125	453	67.6
NH	1,298,492	10,194	785.1	345,256	148	42.9
NJ	8,651,974	71,963	831.8	2,332,099	1,101	47.2
NM	1,932,274	14,983	775.4	562,362	422	75
NY	19,132,610	152,427	796.7	5,053,118	2,577	51
NC	8,705,407	74,638	857.4	2,371,142	1,838	77.5
ND	646,089	5,744	889	171,700	111	64.6
OH	11,463,320	109,031	951.1	3,142,242	2,153	68.5
OK	3,548,597	36,180	1,019.60	992,206	825	83.1

OR	3,613,202	31,091	860.5	948,792	511	53.9
PA	12,449,990	129,532	1,040.40	3,226,468	2,058	63.8
RI	1,067,916	10,007	937.1	278,648	148	53.1
SC	4,270,150	38,707	906.5	1,167,061	994	85.2
SD	775,493	7,086	913.7	221,267	182	82.3
TN	5,991,057	57,260	955.8	1,612,057	1,299	80.6
TX	22,778,123	156,457	686.9	6,978,390	4,698	67.3
UT	2,457,719	13,432	546.5	854,507	465	54.4
VT	621,215	5,066	815.5	160,018	99	61.9
VA	7,577,105	57,855	763.6	2,033,460	1,354	66.6
WA	6,257,305	46,203	738.4	1,698,371	841	49.5
WV	1,820,492	20,780	1,141.40	439,884	345	78.4
WI	5,546,166	46,709	842.2	1,517,031	927	61.1
WY	514,157	4,099	797.2	140,105	105	74.9
DC	567,136	5,483	966.8	128,159	180	140.5
Total	**295,516,599**	**2,448,017**	**828.4**	**82,005,260**	**53,501**	**65.2**

Appendix 2c: Statewide Population and Mortality Statistics; 2010

State	Total Population	Total Deaths	Total Crude Death Rate	Under 19 Population	Under 19 Deaths	Crude Death Rate Under 19
AL	4,779,736	48,038	1,005.0	1,276,312	968	75.8
AK	710,231	3,728	524.9	207,840	127	61.1
AZ	6,392,017	46,762	731.6	1,819,641	999	54.9
AR	2,915,918	28,916	991.7	795,930	541	68
CA	37,253,956	234,012	628.2	10,452,042	4,549	43.5
CO	5,029,196	31,465	625.6	1,364,692	714	52.3
CT	3,574,097	28,692	802.8	915,776	348	38
DE	897,934	7,706	858.2	233,803	139	59.5
FL	18,801,310	173,791	924.4	4,512,990	2,569	56.9
GA	9,687,653	71,263	735.6	2,781,629	1,652	59.4
HI	1,360,301	9,617	707.0	338,301	184	54.4
ID	1,567,582	11,429	729.1	475,281	239	50.3
IL	12,830,632	99,931	778.8	3,496,522	2,005	57.3
IN	6,483,802	56,743	875.2	1,806,582	1,125	62.3
IA	3,046,355	27,745	910.8	820,510	373	45.5
KS	2,853,118	24,502	858.8	810,644	506	62.4
KY	4,339,367	41,983	967.5	1,146,204	733	64
LA	4,533,372	40,667	897.1	1,254,237	918	73.2
ME	1,328,361	12,750	959.8	310,959	150	48.2
MD	5,773,552	43,325	750.4	1,516,626	840	55.4
MA	6,547,629	52,583	803.1	1,621,143	581	35.8
MI	9,883,640	88,021	890.6	2,648,885	1,504	56.8
MN	5,303,925	38,972	734.8	1,431,211	650	45.4
MS	2,967,297	28,965	976.1	849,495	693	81.6
MO	5,988,927	55,281	923.1	1,601,411	981	61.3
MT	989,415	8,827	892.1	251,036	179	71.3
NE	1,826,341	15,171	830.7	512,472	266	51.9
NV	2,700,551	19,623	726.6	736,328	390	53
NH	1,316,470	10,201	774.9	325,802	114	35
NJ	8,791,894	69,495	790.4	2,291,204	908	39.6
NM	2,059,179	15,931	773.7	579,841	357	61.6
NY	19,378,102	146,432	755.7	4,897,511	2,202	45
NC	9,535,483	78,773	826.1	2,558,680	1,524	59.6
ND	672,591	5,944	883.7	171,935	117	68
OH	11,536,504	108,711	942.3	3,067,126	1,813	59.1
OK	3,751,351	36,529	973.8	1,041,610	756	72.6

OR	3,831,074	31,890	832.4	972,183	424	43.6
PA	12,702,379	124,596	980.9	3,179,390	1,813	57
RI	1,052,567	9,579	910.1	261,758	122	46.6
SC	4,625,364	41,614	899.7	1,224,425	798	65.2
SD	814,180	7,100	872.0	226,740	166	73.2
TN	6,346,105	59,578	938.8	1,676,121	1,120	66.8
TX	25,145,561	166,527	662.3	7,621,714	4,249	55.7
UT	2,763,885	14,776	534.6	962,537	472	49
VT	625,741	5,380	859.8	150,255	52	34.6
VA	8,001,024	59,032	737.8	2,083,685	1,138	54.6
WA	6,724,540	48,146	716.0	1,769,895	744	42
WV	1,852,994	21,275	1,148.1	439,213	288	65.6
WI	5,686,986	47,308	831.9	1,502,196	751	50
WY	563,626	4,438	787.4	151,513	97	64
DC	601,723	4,672	776.4	123,720	120	97
Total	**308,745,538**	**2,468,435**	**799.5**	**83,267,556**	**45,068**	**54.1**

Appendix 3a: Population and Mortality Statistics (0-4 Years); 2000

State	Population Under 1 Year	Deaths Under 1 Year	Population 1-4 Years	Deaths 1-4 Years
AL	59,101	596	236,891	97
AK	9,361	68	38,230	21
AZ	77,421	573	304,965	113
AR	36,065	316	145,520	75
CA	483,143	2,894	2,003,838	580
CO	60,823	404	236,682	72
CT	42,719	282	180,625	38
DE	10,286	102	41,245	16
FL	186,977	1,425	758,846	295
GA	120,992	1,126	474,158	178
HI	15,464	142	62,699	11
ID	19,700	153	77,943	19
IL	173,373	1,568	703,176	216
IN	84,517	685	338,698	144
IA	37,338	247	151,075	49
KS	37,977	268	150,731	63
KY	53,156	401	212,745	75
LA	64,092	608	253,300	130
ME	13,456	66	57,270	18
MD	69,647	562	283,746	82
MA	77,998	376	319,270	72
MI	131,188	1,119	540,817	173
MN	65,072	378	264,522	57
MS	41,217	470	163,147	100
MO	72,842	547	297,056	103
MT	10,732	67	44,137	19
NE	23,459	180	93,589	28
NV	29,046	201	116,771	39
NH	14,006	84	61,679	11
NJ	110,298	733	453,487	94
NM	26,335	180	104,293	31
NY	243,891	1,656	995,526	263
NC	110,654	1,038	428,855	145
ND	7,660	62	31,740	0-9*
OH	148,468	1,187	606,462	199
OK	47,533	425	188,820	66
OR	44,189	255	178,816	61
PA	141,431	1,039	586,373	161

RI	12,206	79	51,690	0-9*
SC	53,947	488	210,732	76
SD	10,239	57	40,830	18
TN	75,127	724	299,753	106
TX	330,770	2,065	1,293,858	483
UT	44,605	248	164,773	45
VT	6,381	39	27,608	0-9*
VA	92,708	682	369,274	114
WA	77,740	421	316,566	85
WV	20,176	158	81,629	27
WI	67,474	457	274,866	73
WY	6,130	42	24,810	0-9*
DC	6,518	92	26,018	15

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 3b: Population and Mortality Statistics (0-4 Years); 2005

State	Population Under 1 Year	Deaths Under 1 Year	Population 1-4 Years	Deaths 1-4 Years
AL	59,424	568	237,017	87
AK	10,197	62	38,732	0-9*
AZ	92,434	662	354,673	132
AR	38,707	309	151,050	71
CA	522,403	2,930	2,033,212	561
CO	66,747	444	264,110	83
CT	40,575	243	170,740	31
DE	11,199	105	43,617	14
FL	216,277	1,629	853,660	318
GA	135,578	1,159	534,129	181
HI	17,645	116	65,486	16
ID	22,898	141	88,138	32
IL	170,542	1,328	695,164	186
IN	85,050	698	344,567	132
IA	38,292	210	152,114	40
KS	38,483	294	154,514	45
KY	55,364	375	217,298	88
LA	64,616	613	258,462	132
ME	13,987	97	57,040	14
MD	73,599	547	293,314	64
MA	73,919	396	303,630	45
MI	125,647	1,012	520,905	173
MN	69,463	362	274,230	42
MS	41,713	481	165,620	77
MO	76,391	590	301,855	93
MT	11,411	81	45,649	18
NE	25,525	147	100,726	24
NV	36,070	215	139,637	57
NH	15,140	76	60,150	0-9*
NJ	109,349	595	454,484	86
NM	28,652	177	109,118	54
NY	236,929	1,431	943,816	226
NC	120,005	1,083	473,376	142
ND	8,066	50	30,815	0-9*
OH	143,887	1,225	590,044	162
OK	50,572	417	195,523	75
OR	45,313	269	180,804	47
PA	142,248	1,061	579,917	172

RI	12,003	82	49,662	15
SC	56,225	543	223,398	73
SD	11,154	83	42,233	17
TN	77,898	724	314,367	106
TX	371,038	2,537	1,456,306	446
UT	48,468	230	186,969	54
VT	6,287	42	26,669	0-9*
VA	101,257	781	399,579	109
WA	81,491	421	322,132	78
WV	20,749	169	82,889	29
WI	69,307	469	280,177	70
WY	6,979	49	26,459	0-9*
DC	7,220	112	24,831	10

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 3c: Population and Mortality Statistics (0-4 Years); 2010

State	Population Under 1 Year	Deaths Under 1 Year	Population 1-4 Years	Deaths 1-4 Years
AL	60,056	523	244,901	80
AK	10,828	43	43,168	19
AZ	87,557	522	368,158	124
AR	38,402	282	159,287	63
CA	494,058	2,420	2,037,275	439
CO	66,594	392	277,366	88
CT	38,012	199	164,094	25
DE	10,858	87	45,028	0-9*
FL	208,724	1,403	864,782	282
GA	133,178	860	553,607	194
HI	17,764	117	69,643	16
ID	23,610	112	98,162	32
IL	162,506	1,118	673,071	178
IN	84,277	640	349,798	93
IA	39,155	189	162,968	30
KS	40,786	253	164,706	62
KY	55,189	379	227,178	74
LA	61,882	474	252,378	88
ME	13,180	70	56,340	13
MD	71,523	498	292,965	57
MA	71,434	323	295,653	50
MI	114,751	817	481,535	114
MN	69,009	308	286,495	70
MS	40,260	387	170,696	73
MO	76,119	507	314,118	79
MT	12,157	71	50,266	20
NE	26,082	136	105,826	29
NV	36,505	201	150,973	38
NH	12,994	51	56,812	14
NJ	104,986	514	436,034	76
NM	28,179	157	116,802	46
NY	231,872	1,243	923,950	179
NC	123,336	858	508,704	154
ND	8,931	62	35,664	0-9*
OH	139,042	1,072	581,814	187
OK	51,949	404	212,177	88
OR	46,042	225	191,514	42
PA	141,550	1,039	587,988	128

RI	10,959	79	46,489	10
SC	58,999	430	243,298	73
SD	11,650	82	47,971	12
TN	79,016	630	328,797	109
TX	379,846	2,368	1,548,627	437
UT	52,675	254	211,249	45
VT	5,968	26	25,984	0-9*
VA	100,078	700	409,547	87
WA	87,016	389	352,641	76
WV	20,221	149	83,839	35
WI	69,446	400	288,997	59
WY	7,786	51	32,417	0-9*
DC	7,156	72	25,457	29

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 4a: Population and Mortality Statistics (5-19 Years); 2000

State	Population 5-9 Years	Deaths 5-9 Years	Population 10-14 Years	Deaths 10-14 Years	Population 15-19 Years	Deaths 15-19 Years
AL	315,345	55	320,252	83	324,580	299
AK	53,771	0-9*	56,661	19	50,094	71
AZ	389,869	76	378,211	85	367,722	291
AR	187,224	38	192,935	63	198,765	187
CA	2,725,880	372	2,570,822	474	2,450,888	1,302
CO	308,428	39	311,497	77	307,238	184
CT	244,144	27	241,587	37	216,627	102
DE	55,813	0-9*	55,274	16	55,632	41
FL	1,031,718	141	1,057,024	241	1,014,067	739
GA	615,584	108	607,759	142	596,277	456
HI	84,980	11	83,106	12	81,002	33
ID	100,756	22	104,608	22	110,858	70
IL	929,858	125	905,097	170	894,002	606
IN	443,273	74	443,416	92	453,482	346
IA	202,603	37	210,547	37	226,420	174
KS	195,574	26	204,018	49	210,118	164
KY	279,258	44	279,481	62	289,004	237
LA	336,780	81	347,912	86	365,945	310
ME	83,022	14	92,252	17	89,485	56
MD	391,318	53	392,135	85	356,119	253
MA	430,861	53	431,247	57	415,737	166
MI	745,181	128	747,012	137	719,867	462
MN	355,894	59	374,995	64	374,362	196
MS	216,920	46	218,742	73	233,188	241
MO	398,898	94	412,080	100	413,296	371
MT	61,963	16	69,298	23	71,310	70
NE	123,445	22	128,934	26	134,909	98
NV	149,322	25	139,193	28	127,169	96
NH	88,537	0-9*	93,255	16	86,688	48
NJ	604,529	68	590,577	87	525,216	253
NM	141,171	19	147,309	30	145,751	145
NY	1,351,857	166	1,332,433	189	1,287,544	603
NC	562,553	95	551,367	132	539,931	381
ND	42,982	0-9*	47,464	15	53,618	28
OH	816,346	135	827,811	191	816,868	472
OK	244,525	40	252,029	64	269,373	207
OR	234,474	36	242,098	40	244,427	162

PA	827,945	138	863,849	149	850,986	513
RI	71,905	13	71,370	12	75,445	39
SC	285,243	71	290,479	53	295,377	255
SD	54,486	18	59,463	18	62,463	49
TN	395,813	75	395,155	119	395,184	357
TX	1,654,184	296	1,631,192	331	1,636,232	1,238
UT	193,033	22	192,288	41	216,278	129
VT	41,101	0-9*	45,397	0-9*	45,770	30
VA	495,084	65	495,955	90	484,065	323
WA	425,909	60	434,836	75	427,968	255
WV	111,150	29	116,182	38	125,578	111
WI	379,484	71	403,074	72	407,195	269
WY	34,127	0-9*	38,376	10	41,903	34
DC	35,385	0-9*	30,018	0-9*	37,867	41

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 4b: Population and Mortality Statistics (5-19 Years); 2005

State	Population 5-9 Years	Deaths 5-9 Years	Population 10-14 Years	Deaths 10-14 Years	Population 15-19 Years	Deaths 15-19 Years
AL	298,450	48	323,028	79	330,753	284
AK	47,441	0-9*	54,644	20	54,764	48
AZ	401,892	83	425,230	78	419,514	362
AR	186,100	40	193,817	39	198,087	184
CA	2,426,913	300	2,775,085	414	2,683,940	1,583
CO	304,874	49	322,722	58	331,051	193
CT	228,703	26	250,704	33	248,504	106
DE	52,455	0-9*	58,728	0-9*	61,483	33
FL	1,024,540	155	1,152,946	220	1,179,088	876
GA	621,400	108	662,146	122	657,340	461
HI	76,612	0-9*	86,988	11	84,394	32
ID	106,074	15	109,718	18	112,402	61
IL	849,518	93	923,414	139	914,275	559
IN	432,642	83	454,815	89	463,181	288
IA	192,257	31	207,260	28	219,827	138
KS	189,816	41	197,574	34	209,082	133
KY	271,115	42	286,751	61	288,741	235
LA	310,508	64	336,469	103	349,258	349
ME	75,891	0-9*	87,574	17	94,391	59
MD	358,818	51	406,845	60	401,942	266
MA	388,264	31	429,288	37	459,816	174
MI	675,142	110	749,448	131	752,673	428
MN	338,562	36	365,866	65	381,756	182
MS	201,392	52	218,772	61	223,618	219
MO	378,291	51	410,991	82	424,377	351
MT	57,502	0-9*	64,442	15	71,130	60
NE	118,041	19	125,798	29	133,391	84
NV	163,452	19	172,504	41	158,462	121
NH	80,500	0-9*	93,144	11	96,322	53
NJ	567,678	64	614,396	84	586,192	272
NM	129,432	21	144,457	41	150,703	129
NY	1,180,763	141	1,326,966	189	1,364,644	590
NC	565,112	87	601,958	112	610,691	414
ND	38,755	11	42,713	0-9*	51,351	37
OH	757,828	124	821,312	140	829,171	502
OK	236,418	55	248,298	51	261,395	227
OR	227,049	26	243,214	42	252,412	127

PA	746,114	104	852,112	140	906,077	581
RI	64,089	0-9*	71,505	13	81,389	29
SC	273,450	59	298,023	68	315,965	251
SD	52,076	11	55,274	14	60,530	57
TN	390,176	59	414,943	89	414,673	321
TX	1,657,778	258	1,751,626	339	1,741,642	1,118
UT	210,046	28	199,638	44	209,386	109
VT	35,345	0-9*	42,709	13	49,008	31
VA	475,813	72	521,178	89	535,633	303
WA	404,933	38	441,148	67	448,667	237
WV	103,395	17	113,094	29	119,757	101
WI	357,345	50	394,312	79	415,890	259
WY	32,303	0-9*	35,448	0-9*	38,916	39
DC	26,004	0-9*	31,544	0-9*	38,560	47

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 4c: Population and Mortality Statistics (5-19 Years); 2010

State	Population 5-9 Years	Deaths 5-9 Years	Population 10-14 Years	Deaths 10-14 Years	Population 15-19 Years	Deaths 15-19 Years
AL	308,229	64	319,655	74	343,471	227
AK	50,887	0-9*	50,816	15	52,141	43
AZ	453,680	59	448,664	66	461,582	228
AR	196,877	33	197,559	35	203,805	128
CA	2,505,839	241	2,590,930	309	2,823,940	1,140
CO	348,603	31	332,654	42	339,475	161
CT	222,571	14	240,265	19	250,834	91
DE	56,486	0-9*	56,848	0-9*	64,583	34
FL	1,080,255	125	1,130,847	157	1,228,382	602
GA	695,161	103	689,684	118	709,999	377
HI	83,361	0-9*	81,539	0-9*	85,994	37
ID	121,195	14	116,955	16	115,359	65
IL	859,405	101	879,448	125	922,092	483
IN	444,821	57	452,171	61	475,515	274
IA	200,646	19	200,904	26	216,837	109
KS	202,447	37	198,884	28	203,821	126
KY	282,888	47	284,154	53	296,795	180
LA	306,362	41	306,836	72	326,779	243
ME	74,116	0-9*	79,013	11	88,310	52
MD	366,868	43	379,029	48	406,241	194
MA	385,687	28	405,613	35	462,756	145
MI	637,784	73	675,216	103	739,599	397
MN	355,536	46	352,342	50	367,829	176
MS	205,672	36	208,248	40	224,619	157
MO	390,463	46	396,925	66	423,786	283
MT	60,765	13	61,124	18	66,724	57
NE	128,928	18	122,706	23	128,930	60
NV	183,077	26	183,173	31	182,600	94
NH	77,756	0-9*	84,620	0-9*	93,620	34
NJ	564,750	40	587,335	67	598,099	211
NM	143,308	0-9*	141,691	24	149,861	121
NY	1,163,955	112	1,211,456	151	1,366,278	517
NC	635,945	66	631,104	88	659,591	358
ND	40,076	0-9*	39,790	0-9*	47,474	37
OH	747,889	81	774,699	108	823,682	365
OK	259,336	41	253,664	46	264,484	177
OR	237,214	24	242,553	28	254,860	105

PA	753,635	70	791,151	110	905,066	466
RI	60,440	0-9*	63,824	0-9*	80,046	23
SC	295,853	38	297,286	57	328,989	200
SD	55,531	0-9*	53,960	14	57,628	49
TN	412,181	54	418,941	77	437,186	250
TX	1,928,234	216	1,881,883	278	1,883,124	950
UT	249,572	35	227,951	37	221,090	101
VT	34,654	0-9*	37,637	0-9*	46,012	15
VA	511,849	61	511,246	46	550,965	244
WA	429,877	46	438,233	53	462,128	180
WV	106,016	16	109,045	18	120,092	70
WI	368,617	47	375,927	51	399,209	194
WY	37,213	0-9*	35,955	10	38,142	24
DC	26,147	68	25,041	45	39,919	33

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 5a: Infant Deaths Due to Ill-Defined Causes and SIDS; 2000

State	Deaths Under 1 Year	All Unknown Causes of Death Under 1 Year	% of Unknown Causes of Death Under 1 Year	SIDS Deaths Under 1 Year	% of Unknown Causes of Death Ruled as SIDS
AL	596	88	14.77%	52	59.09%
AK	68	0-9*	Unreliable	0-9*	Unreliable
AZ	573	51	8.90%	37	72.55%
AR	316	59	18.67%	31	52.54%
CA	2,894	389	13.44%	172	44.22%
CO	404	64	15.84%	56	87.50%
CT	282	26	9.22%	19	73.08%
DE	102	0-9*	Unreliable	0-9*	Unreliable
FL	1,425	186	13.05%	94	50.54%
GA	1,126	130	11.55%	116	89.23%
HI	142	10	7.04%	0-9*	Unreliable
ID	153	12	7.84%	12	100.00%
IL	1,568	170	10.84%	109	64.12%
IN	685	65	9.49%	58	89.23%
IA	247	35	14.17%	33	94.29%
KS	268	50	18.66%	40	80.00%
KY	401	62	15.46%	39	62.90%
LA	608	63	10.36%	55	87.30%
ME	66	0-9*	Unreliable	0-9*	Unreliable
MD	562	54	9.61%	49	90.74%
MA	376	35	9.31%	18	51.43%
MI	1,119	107	9.56%	100	93.46%
MN	378	38	10.05%	32	84.21%
MS	470	68	14.47%	64	94.12%
MO	547	86	15.72%	65	75.58%
MT	67	12	17.91%	11	91.67%
NE	180	28	15.56%	26	92.86%
NV	201	18	8.96%	16	88.89%
NH	84	12	14.29%	0-9*	Unreliable
NJ	733	89	12.14%	62	69.66%
NM	180	14	7.78%	12	85.71%
NY	1,656	193	11.65%	69	35.75%
NC	1,038	117	11.27%	92	78.63%
ND	62	0-9*	Unreliable	0-9*	Unreliable
OH	1,187	175	14.74%	113	64.57%
OK	425	65	15.29%	55	84.62%

OR	255	58	22.75%	47	81.03%
PA	1,039	112	10.78%	102	91.07%
RI	79	0-9*	Unreliable	0-9*	Unreliable
SC	488	53	10.86%	36	67.92%
SD	57	10	17.54%	0-9*	Unreliable
TN	724	109	15.06%	98	89.91%
TX	2,065	323	15.64%	228	70.59%
UT	248	27	10.89%	17	62.96%
VT	39	0-9*	Unreliable	0-9*	Unreliable
VA	682	78	11.44%	63	80.77%
WA	421	81	19.24%	77	95.06%
WV	158	27	17.09%	21	77.78%
WI	457	64	14.00%	59	92.19%
WY	42	0-9*	Unreliable	0-9*	Unreliable
DC	92	14	15.22%	0-9*	Unreliable

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 5b: Infant Deaths Due to Ill-Defined Causes and SIDS; 2005

State	Deaths Under 1 Year	All Unknown Causes of Death Under 1 Year	% of Unknown Causes of Death Under 1 Year	SIDS Deaths Under 1 Year	% of Unknown Causes of Death Ruled as SIDS
AL	568	81	14.26%	22	27.16%
AK	62	0-9*	Unreliable	0-9*	Unreliable
AZ	662	65	9.82%	38	58.46%
AR	309	65	21.04%	42	64.62%
CA	2,930	283	9.66%	153	54.06%
CO	444	44	9.91%	35	79.55%
CT	243	25	10.29%	13	52.00%
DE	105	11	10.48%	0-9*	Unreliable
FL	1,629	178	10.93%	89	50.00%
GA	1,159	148	12.77%	134	90.54%
HI	116	15	12.93%	0-9*	Unreliable
ID	141	17	12.06%	12	70.59%
IL	1,328	142	10.69%	92	64.79%
IN	698	56	8.02%	50	89.29%
IA	210	31	14.76%	24	77.42%
KS	294	46	15.65%	44	95.65%
KY	375	79	21.07%	60	75.95%
LA	613	125	20.39%	78	62.40%
ME	97	10	10.31%	0-9*	Unreliable
MD	547	63	11.52%	59	93.65%
MA	396	40	10.10%	23	57.50%
MI	1,012	57	5.63%	47	82.46%
MN	362	45	12.43%	44	97.78%
MS	481	97	20.17%	91	93.81%
MO	590	76	12.88%	52	68.42%
MT	81	17	20.99%	10	58.82%
NE	147	32	21.77%	30	93.75%
NV	215	28	13.02%	17	60.71%
NH	76	0-9*	Unreliable	0-9*	Unreliable
NJ	595	69	11.60%	46	66.67%
NM	177	19	10.73%	14	73.68%
NY	1,431	159	11.11%	19	11.95%
NC	1,083	123	11.36%	105	85.37%
ND	50	10	20.00%	0-9*	Unreliable
OH	1,225	159	12.98%	82	51.57%
OK	417	66	15.83%	28	42.42%

OR	269	36	13.38%	31	86.11%
PA	1,061	115	10.84%	61	53.04%
RI	82	0-9*	Unreliable	0-9*	Unreliable
SC	543	66	12.15%	47	71.21%
SD	83	13	15.66%	0-9*	Unreliable
TN	724	110	15.19%	83	75.45%
TX	2,537	386	15.21%	216	55.96%
UT	230	22	9.57%	17	77.27%
VT	42	10	23.81%	0-9*	Unreliable
VA	781	95	12.16%	79	83.16%
WA	421	53	12.59%	42	79.25%
WV	169	50	29.59%	10	20.00%
WI	469	41	8.74%	37	90.24%
WY	49	0-9*	Unreliable	0-9*	Unreliable
DC	112	19	16.96%	0-9*	Unreliable

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 5c: Infant Deaths Due to Ill-Defined Causes and SIDS; 2010

State	Deaths Under 1 Year	All Unknown Causes of Death Under 1 Year	% of Unknown Causes of Death Under 1 Year	SIDS Deaths Under 1 Year	% of Unknown Causes of Death Ruled as SIDS
AL	523	75	14.34%	46	61.33%
AK	43	12	27.91%	11	91.67%
AZ	522	65	12.45%	36	55.38%
AR	282	65	23.05%	61	93.85%
CA	2,420	245	10.12%	184	75.10%
CO	392	38	9.69%	26	68.42%
CT	199	17	8.54%	17	100.00%
DE	87	12	13.79%	12	100.00%
FL	1,403	131	9.34%	66	50.38%
GA	860	149	17.33%	125	83.89%
HI	117	15	12.82%	0-9*	Unreliable
ID	112	21	18.75%	20	95.24%
IL	1,118	100	8.94%	63	63.00%
IN	640	40	6.25%	36	90.00%
IA	189	37	19.58%	33	89.19%
KS	253	34	13.44%	25	73.53%
KY	379	81	21.37%	62	76.54%
LA	474	74	15.61%	55	74.32%
ME	70	10	14.29%	0-9*	Unreliable
MD	498	48	9.64%	45	93.75%
MA	323	41	12.69%	33	80.49%
MI	817	51	6.24%	44	86.27%
MN	308	30	9.74%	28	93.33%
MS	387	73	18.86%	44	60.27%
MO	507	48	9.47%	35	72.92%
MT	71	15	21.13%	0-9*	Unreliable
NE	136	15	11.03%	15	100.00%
NV	201	13	6.47%	0-9*	Unreliable
NH	51	11	21.57%	0-9*	Unreliable
NJ	514	46	8.95%	38	82.61%
NM	157	13	8.28%	0-9*	Unreliable
NY	1,243	98	7.88%	47	47.96%
NC	858	103	12.00%	50	48.54%
ND	62	0-9*	Unreliable	0-9*	Unreliable
OH	1,072	138	12.87%	109	78.99%
OK	404	90	22.28%	31	34.44%

OR	225	33	14.67%	32	96.97%
PA	1,039	114	10.97%	73	64.04%
RI	79	10	12.66%	0-9*	Unreliable
SC	430	56	13.02%	49	87.50%
SD	82	0-9*	Unreliable	0-9*	Unreliable
TN	630	103	16.35%	35	33.98%
TX	2,368	324	13.68%	225	69.44%
UT	254	18	7.09%	14	77.78%
VT	26	0-9*	Unreliable	0-9*	Unreliable
VA	700	95	13.57%	56	58.95%
WA	389	62	15.94%	52	83.87%
WV	149	35	23.49%	25	71.43%
WI	400	46	11.50%	36	78.26%
WY	51	0-9*	Unreliable	0-9*	Unreliable
DC	72	0-9*	Unreliable	0-9*	Unreliable

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

Appendix 6a: Autopsy Rates By State; 2005

	Age Group Under 1			Age Group 1-4			Age Group 15-19		
State	**Yes**	**No**	**Un-Known**	**Yes**	**No**	**Un-Known**	**Yes**	**No**	**Un-Known**
AL	149	262	157	42	38		113	145	26
AK	26	35		0-9*	0-9*		18	29	
AZ	194	465		81	50		238	122	
AR	103	180	26	30	40		55	126	
CA	853	2,050	27	311	250		1,031	538	14
CO	148	294		45	37		129	64	
CT	80	146	17	14	15		58	47	
DE	38	64		0-9*	0-9*		14	16	
FL	549	1,036	44	211	101		728	140	
GA	322	829		104	76		223	234	
HI	32	17	67	0-9*	0-9*		23	0-9*	
ID	43	98		13	19		18	43	
IL	506	778	44	96	87		336	213	10
IN	138	277	283	56	35	41	89	127	72
IA	97	111		24	15		96	42	
KS	109	145	40	26	16		83	40	10
KY	145	178	52	42	40		113	111	11
LA	183	370	60	61	63		207	127	15
ME	28	67		0-9*	0-9*		16	43	
MD	166	368	13	43	20		203	58	
MA	154	237		23	22		123	51	
MI	315	686	11	98	75		267	160	
MN	156	204		28	14		117	65	
MS	156	170	155	32	35	10	84	126	
MO	216	342	32	53	38		146	191	14
MT	36	44		0-9*	10		20	40	
NE	69	77		12	12		48	36	
NV	75	139		31	24		65	56	
NH	19	39	18	0-9*	0-9*		22	30	
NJ	161	312	122	38	32	16	167	81	24
NM**	----	----	159	----	----	43	----	----	116
NY	535	751	145	126	88	12	404	164	22
NC	314	602	167	74	59		147	237	30
ND	19	29		0-9*	0-9*		17	19	
OH	467	715	43	97	64		349	149	
OK	128	279	10	42	32		66	159	
OR	91	176		19	28		36	90	

PA**	----	----	1,023	----	----	164	----	----	550
RI	46	28		0-9*	0-9*		20	0-9*	
SC	176	358		41	32		113	135	
SD	28	54		0-9*	10		18	39	
TN	225	234	265	52	36	18	137	141	43
TX	871	1,651	15	285	157		756	358	
UT	73	153		12	41		42	64	
VT	23	13		0-9*	0-9*		24	0-9*	
VA	198	294	289	51	46	12	147	138	18
WA	167	250		53	24		151	85	
WV	69	89	11	12	15		36	61	
WI	169	300		42	28		133	126	
WY	19	29		0-9*	0-9*		16	23	
DC	47	61		0-9*	0-9*		41	0-9*	

* Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d)). In the "Unknown" columns, any value less than 10 was simply omitted.

**Pennsylvania and New Mexico values for "Yes" and "No" columns were omitted since they consisted values of less than 10, only data in the "Unknown" column were added for this state.

Appendix 6b: Autopsy Rates By State; 2010

	Age Group Under 1			Age Group 1-4			Age Group 15-19		
State	**Yes**	**No**	**Un-Known**	**Yes**	**No**	**Un-Known**	**Yes**	**No**	**Un-Known**
AL	153	232	138	37	31	12	99	111	17
AK	22	21		11	0-9*		14	28	
AZ	156	366		71	53		142	86	
AR	99	168	15	21	41		45	78	
CA	711	1,709		238	201		774	365	
CO	136	256		56	32		124	36	
CT	45	146		12	12		68	22	
DE	30	50		0-9*	0-9*		18	15	
FL	422	947	34	174	102		447	146	
GA	276	540	44	98	87		206	154	17
HI	42	58	17	0-9*	0-9*		27	0-9*	
ID	38	73		10	22		20	44	
IL	415	667	36	110	67		292	188	
IN	183	454		50	43		124	149	
IA	80	108		19	11		78	31	
KS	93	127	33	42	18		81	41	
KY	171	197	11	45	26		79	98	
LA	172	300		35	53		141	101	
ME	21	47		0-9*	0-9*		12	40	
MD	142	350		21	33		145	44	
MA	130	186		32	17		85	58	
MI	274	539		71	42		281	116	
MN	113	188		46	24		119	56	
MS	129	117	141	40	30		57	82	18
MO	211	287		46	33		147	135	
MT	26	45		0-9*	14		18	39	
NE	44	91		20	0-9*		34	26	
NV	60	141		21	17		53	41	
NH	23	27		0-9*	0-9*		13	21	
NJ	105	289	120	36	22	18	126	61	24
NM	60	90		23	23		81	40	
NY	444	704	95	91	83		379	128	10
NC	220	491	147	73	67	14	133	186	39
ND	18	43		0-9*	0-9*		26	11	
OH	378	676	18	119	62		246	116	
OK	127	271		47	37		71	105	
OR	78	146		18	24		35	70	

PA**	----	----	1011	----	----	122	----	----	443
RI	36	41		0-9*	0-9*		14	0-9*	
SC	156	265		41	32		105	92	
SD	27	48		0-9*	0-9*		15	34	
TN	222	208	200	56	36	17	120	105	25
TX	807	1,551	10	274	163		635	311	
UT	63	188		17	26		44	57	
VT	14	11		0-9*	0-9*		0-9*	0-9*	
VA	174	262	264	41	31	15	131	97	16
WA	146	234		39	34		129	51	
WV	63	75	11	20	13		27	40	
WI	144	253		36	23		107	87	
WY	21	29		0-9*	0-9*		0-9*	16	
DC	33	39		0-9*	0-9*		29	0-9*	

* Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d)). In the "Unknown" columns, any value less than 10 was simply omitted.

**Pennsylvania values for "Yes" and "No" columns were omitted since they consisted values of less than 10, only data in the "Unknown" column were added for this state.

Appendix 7: Infant Mortality Statistics; 2010

State	Under 1 Population	Under 1 Deaths	<1 Day	1-6 Days	7-27 Days	28-364 Days
AL	60,056	523	172	67	87	197
AK	10,828	43	0-9*	0-9*	0-9*	21
AZ	87,557	522	197	72	63	190
AR	38,402	282	91	29	40	122
CA	494,058	2,420	1,051	320	311	738
CO	66,594	392	179	62	46	105
CT	38,012	199	104	23	23	49
DE	10,858	87	40	0-9*	0-9*	29
FL	208,724	1,403	579	159	196	469
GA	133,178	860	285	98	140	337
HI	17,764	117	51	21	0-9*	41
ID	23,610	112	38	13	12	49
IL	162,506	1,118	462	159	148	349
IN	84,277	640	256	80	81	223
IA	39,155	189	59	20	24	86
KS	40,786	253	119	24	31	79
KY	55,189	379	100	37	48	194
LA	61,882	474	165	39	61	209
ME	13,180	70	32	0-9*	10	21
MD	71,523	498	249	45	56	148
MA	71,434	323	169	34	38	82
MI	114,751	817	390	85	75	267
MN	69,009	308	117	50	42	99
MS	40,260	387	125	42	53	167
MO	76,119	507	206	47	65	189
MT	12,157	71	25	0-9*	0-9*	29
NE	26,082	136	60	20	16	40
NV	36,505	201	65	25	36	75
NH	12,994	51	13	0-9*	0-9*	24
NJ	104,986	514	209	82	78	145
NM	28,179	157	47	27	21	62
NY	231,872	1,243	520	179	167	377
NC	123,336	858	397	88	118	255
ND	8,931	62	26	11	0-9*	16
OH	139,042	1,072	492	122	114	344
OK	51,949	404	134	36	57	177
OR	46,042	225	97	22	34	72

PA	141,550	1,039	478	112	146	303
RI	10,959	79	39	0-9*	12	20
SC	58,999	430	151	50	65	164
SD	11,650	82	40	0-9*	0-9*	27
TN	79,016	630	219	57	91	263
TX	379,846	2,368	894	279	335	860
UT	52,675	254	98	41	37	78
VT	5,968	26	0-9*	0-9*	0-9*	12
VA	100,078	700	312	66	97	225
WA	87,016	389	171	39	56	123
WV	20,221	149	41	11	29	68
WI	69,446	400	149	61	53	137
WY	7,786	51	14	0-9*	0-9*	20
DC	7,156	72	23	15	12	22
Total	**3,944,153**	**24,586**	**9,967**	**2,926**	**3,295**	**8,398**

*****Demographic data containing values of less than 10 must be omitted from the table due to The Public Health Service Act (42 U.S.C. 242m(d))

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EDUCATION

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WESTERN NEW ENGLAND UNIVERSITY Springfield, MA
Bachelors of Science, Forensic Chemistry
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Course work concentration in Biochemistry, Toxicology, Analytical Chemistry, and Instrumental Analysis

SAINT JOHN'S HIGH SCHOOL Shrewsbury, MA
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WORK EXPERIENCE

June 2009: **MASSACHUSETTS STATE POLICE FORENSIC & TECHNOLOGY CENTER**, Maynard, MA

Completed a 4-week internship at the CODIS Collection & Investigative Unit, performed various tasks which included scanning convicted offender blood and information cards. Hours worked: 160.

2005 - Present: **CVS/CAREMARK PHARMACY, CERTIFIED PHARMACY TECHNICIAN**, Worcester, MA, Boston, MA, Shrewsbury, MA

Perform all activities related to the processing of prescription medications under the supervision of a licensed pharmacist including receipt of prescription from patient, data entry, insurance confirmation, retrieval of drug product and filling of prescription for pharmacist review and approval.

Verification of patient insurance eligibility and prescription benefit coverage. Educate Medicare patients regarding deductibles, co-payments and coverage gaps in their prescriptions drug plans. Contacting physicians as required, perform inventory management and general pharmacy clerical duties.

OTHER EXPERIENCE & CONTINUED EDUCATION

Summer Semester 2012:

Participated in a Trace Evidence Analysis laboratory course. Experience with the Polarizing Light Microscope, and the Fourier Transform Infrared (FTIR) Spectrophotometer. Obtained graduate college credits for completion of this course.

Fall Semester 2011:

Attended the Northeastern Association of Forensic Scientists' annual conference meeting in Newport RI from November 3rd to November 5th

Spring Semester 2011:

Participated in a DNA laboratory course, working with Chelex extractions, Qiagen extractions, and PCR. Experience with the ABI Quantifiler, the 9700 Thermal Cycler, the ABI Prism 3130 Capillary Electrophoresis, and the GeneMapperID Software. Obtained graduate college credits for completion of this course.

Spring Semester 2009:

Provided tutoring for freshman chemistry students three nights per week at the Western New England University Science Center.

Attended supervised custodial visits at the YWCA in Northampton, MA as part of a Domestic Violence course.

Fall Semester 2009:

Assisted the West Springfield Police Department with security at the Eastern States Big Expedition fair during the month of September.

Provided assistance to the criminal justice professors at Western New England College with the development of a mock crime scene for an Introduction to Forensic Science Course.