
Louisiana Autopsy Patterns 1999-2006

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This report presents autopsy trends in Louisiana for 1999-2006 data and provides some comparison with national data for 2003. Mortality data for Louisiana was collected from the field 'autopsy' on the Certificate of Death from 1999-2006 and compared with national data for the year 2003. The overall autopsy rate was 9.3% in Louisiana versus 7.7% in the United States (US) in 2003. Autopsy rates were higher than those of the US in almost all categories of personal factors (gender, race and age group). Louisiana's autopsy levels were generally greater for both natural disease (3.7% versus 3.5% for the US) and the high autopsy rate group (61.1% versus 54.3% for the US).

INTRODUCTION

Autopsies are considered to provide important information for medical education and medical research. Autopsies provide definite evidence for the processes that have caused patient morbidity and mortality. A high proportion of errors in clinical diagnosis or omissions of unsuspected complications of the disease or of treatment become evident after autopsies.^{1,2} In spite of the progress in diagnostic methods, errors and omissions in medical diagnosis have only slightly decreased. In 1980 in the United States (US), diagnostic errors that may have affected patient outcome ("Class I errors") were detected in 10.2% (6.7%-15.3% at the 95% confidence interval) of autopsies. The prevalence of other "major errors" (related to the principal diagnosis or underlying cause of death) was 25.2% (95% CI: 20.8%-31.2%). These error rates showed modest decreases with time, "Class I errors" still occur in 3.8%-7.9% of cases and "major errors" in 8.0%-22.8%.¹

On the other hand, the rates of autopsies have decreased over time in the US and other industrialized nations. In 2003, the last year for which national data are available, autopsy rates for non-forensic deaths decreased to less than 6% compared with average rates of 30% to 40% in the 1960s.³ This report presents autopsy trends in Louisiana for 1999-2006 data and provides some comparison with national data for 2003.

POPULATION AND METHODS

Mortality Data

Mortality data for Louisiana was collected from the field 'autopsy' on the Certificate of Death from 1999-2006.

Physicians, medical examiners, and coroners are responsible for completing the medical portion of the death certificate. Funeral directors are responsible for completing

legal and demographic information on death certificates and ensuring that the death certificates are filed with local or state governments.

The data collected for Louisiana's autopsy analyses in this report are compiled from data provided by the Louisiana Office of Public Health Vital Records Section. The autopsy data presented in this report are based on the items on the death certificate that ask "Was an autopsy performed?", and "Disease or condition directly leading to death." The categories chosen as leading causes and causes associated with autopsy (Table 2) were based on the leading causes of death already in place from the National Vital Health Stats 2003 data.

Louisiana Vital Records mortality data provides demographic information and cause of death in the form of the International Classification of Disease, Tenth Revision (ICD-10). Death population for this report was chosen from persons who died in Louisiana from 1999 to 2006 (all years included) and had a Louisiana parish listed for residence on the death certificate. This information was analyzed using SAS version 9.1.3. A Cochran-Armitage test was performed on these data to assess whether there were any trends in autopsies performed from the years 1999-2006.

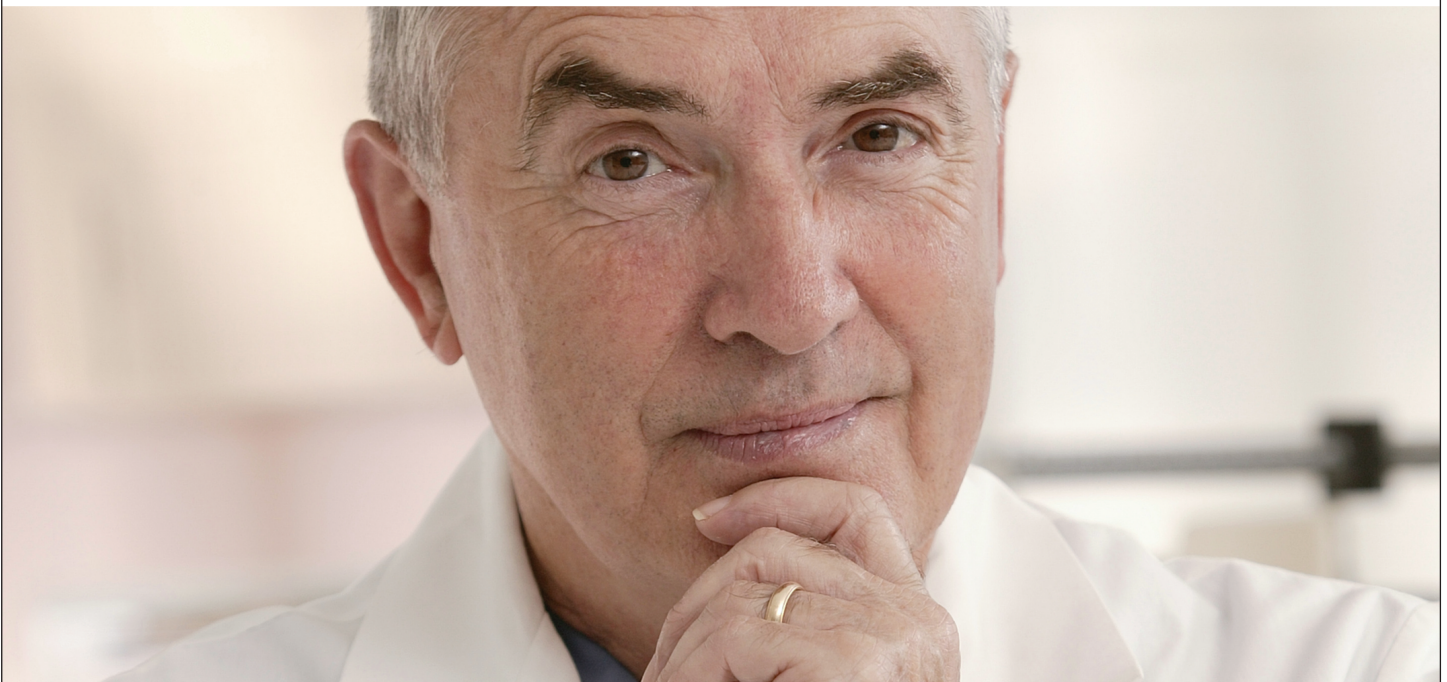
Data from the Center for Disease Control (CDC) and Prevention's National Center for Health Statistics (NCHS) was the source of information on the use of autopsy for 2003.^{4,5}

RESULTS

Louisiana Mortality Data

The number of deaths reported from 1999 to 2006 ranges from 36,000 to 43,000 deaths per year with autopsies performed on 3,000 to 4,000 decedents per year. Information was missing only on 0.7% of certificates. The proportion of autopsy (referred to as autopsy rate in the following) varied from 8.5% to 10.2%, with an overall average of 9.3%.

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Group		Number autopsied	Number Not autopsied	Total	% autopsied in Louisiana	% autopsied in USA 2003	Odds ratio	Confidence interval	
Gender	M	21,664	144,728	166,392	13.0	10.6	1.0	2.46	2.59
	F	9,201	155,388	164,589	5.6	4.8	2.53	Reference	
Race	White	16,603	206,798	223,401	7.4	6.8	1.0	Reference	
	African American	12,654	87,011	206,798	12.7	12.8	1.81	1.77	1.86
	American Indian	91	438	529	17.2	15.1	2.59	2.05	3.26
	Asian	220	1,039	1,259	17.6	9.6	2.64	2.27	3.06
	Missing data	20	107	127					
	Other = All non White	12,965	88,488	101,453	12.8	12.8	1.82	1.78	1.87
Age group	≤ 1	1,534	3,236	4,770	32.2	30.6	4.72	4.40	5.06
	1-4	482	461	943	51.1	50.0	10.41	9.10	11.91
	5-14	571	684	1,255	45.5	40.3	8.31	7.39	9.35
	15-24	3,856	2,513	6,369	60.5	54.9	15.28	14.37	16.24
	25-34	4,135	3,668	7,803	53.0	49.6	11.22	10.61	11.88
	35-44	5,156	9,376	14,532	35.5	36.3	5.48	5.22	5.75
	45-54	5,634	21,947	27,581	20.4	21.5	2.56	2.44	2.67
	55-64	3,633	36,171	39,804	9.1	9.5	1.0	Reference	
	65-74	2,194	57,560	59,754	3.7	4.1	0.38	0.36	0.42
	75-84	1,677	85,390	87,067	1.9	2.0	0.21	0.20	0.22
	85 +	681	74,339	75,020	0.9	0.9	0.10	0.09	0.11
Total		30,865	300,116	330,981	9.3	7.7	--	--	--

A Cochran Armitage trend test showed no statistically significant trend ($z = 0.99$; p -value 0.32) from year to year. Analysis for other variables did not show any significant trends either, so the analysis was carried on the combined year period (1999-2006) autopsy data, a total of about 331,000 deaths and about 31,000 autopsies.

Details on autopsy rates are presented in Table 1. Autopsy rates on males were about twice the rates among females (13.0% of male decedents were autopsied versus 5.6% of female decedents (Odds ratio OR = 2.53, confidence interval CI = 2.46-2.59).

Among races, minority decedents were autopsied more often: autopsy rates were 7.4% for whites, 12.7% for African Americans, 17.2% for American Indians, and 17.5% for Asians. The odds ratio of all minority groups combined to be autopsied versus whites was 1.82, confidence interval 1.78 to 1.87.

The autopsy rate distribution by age group shows large variations. Younger decedents had notably higher percentages of autopsy with a peak of 60.5% in the age group of 15-24 years. As age increased the percentages of autopsy decreased (Figure). Odds ratios show that these differences were probably not the result of random variations.

The autopsy rate is influenced by the cause of death (see Table 2). Autopsy rates are low for natural diseases (average 3.7%, range from 0.5% to 13.7%) and much higher for

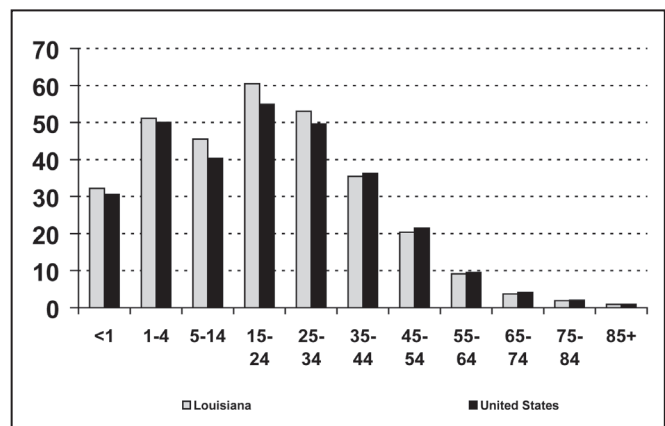


Figure. Percentages of decedents autopsied by age group in Louisiana and the United States.

accidents, assaults, and suicide (average 65.3%, range 50.0% to 95.8%). The odds ratio between high and low autopsy rate is 49 with a confidence interval of 47.51 to 50.54.

A multiple logistic regression analysis was carried out to determine which variables were significant determinants of having an autopsy. The outcome variable was having an autopsy completed, and the final model consisted of seven predictor variables (age, gender, race, and four death cause categories: Intentional, Accidents, Cancer, and Unknown/

Table 2. Number of deaths and percentages autopsied for selected causes: Louisiana, 1999-2006.

Cause of death (based on the International Classification of Diseases, Tenth Revision, 1992)	Autopsied	Not autopsied	Total	% Autopsied	US % (*)
All Causes	29,588	313,393	342,981	8.6	7.7
Low autopsy rates					
Diseases of heart(I00–I09,I11,I13,I20–I51)	5,912	78,491	84,403	7.0	6.2
Malignant neoplasms(C00–C97)	705	69,693	70,398	1.0	1.3
Cerebrovascular diseases(I60–I69)	423	18,501	18,924	2.2	2.0
Chronic lower respiratory diseases (J40–J47)	323	12,558	12,881	2.5	2.0
Diabetes mellitus (E10–E14)	333	12,500	12,833	2.6	2.7
Influenza and pneumonia (J10–J18)	292	6,757	7,049	4.1	4.2
Alzheimer's disease (G30)	37	8,097	8,134	0.5	0.8
Nephritis, nephrotic syndrome and nephrosis(N00–07, N17–N19, N25–N27)	81	7,630	7,711	1.1	1.7
Septicemia(A40–A41)	164	5,737	5,901	2.8	4.1
Chronic liver disease and cirrhosis (K70, K73–K74)	366	2,312	2,678	13.7	7.4
Essential hypertension and hypertensive renal disease (I10–I12)	47	2,353	2,400	2.0	1.6
Parkinson's disease (G20–G21)	9	1,871	1,880	0.5	1.1
Subtotal	8,692	226,500	235,192	3.7	3.5
High autopsy rates					
Assault (homicide) (X85–Y09, Y87.1)	3,999	174	4,173	95.8	91.8
Intentional self-harm (suicide) (X60–X84, Y87.0)	2,209	1,486	3,695	59.8	51.8
Intentional self-harm (suicide) by other & unspecified means (X60–X71, X75–X84, Y87.0)	701	382	1,083	64.7	55.2
Accidents (unintentional injuries) (V01–X59, Y85–Y86)	8,160	8,173	16,333	50.0	43.7
Accidental poisoning and exposure to noxious substances(X40–X49)	1,779	675	2,454	72.5	72.5
Accidental drowning and submersion (W65–W74)	466	194	660	70.6	63.7
Accidental discharge of firearms (W32–W34)	173	108	281	61.6	60.7
Accidental exposure to smoke, fire and flames (X00–X09)	412	291	703	58.6	59.3
Water, air /space, & other transport accidents and their sequelae (V90–V99, Y85)	253	171	424	59.7	54.6
Legal Intervention (Y35, Y89.0)	31	3	34	91.2	81.7
Events of undetermined intent (Y10–Y34, Y87.2, Y89.9)	455	197	652	69.8	76.7
Pregnancy, childbirth and the puerperium (O00–O99)	37	29	66	56.1	60.3
Subtotal	22,674	12,057	34,731	65.3	54.3

[The asterisk (*) preceding the category of 2003 National percent indicates that the National percents were calculated using 47 states and the District of Columbia, 2003]

Undetermined Causes & Others).

- Age was categorized into four categories: Ages 14 and below, Ages 15-34, Ages 35-54, and Ages 55 and over. This was seen as children, young adults, middle-age, and seniors. The seniors' category was used as the reference.
- Race was categorized as White, Black, and Other with White being the reference category. The "Other" race category is comprised of American Indian (AI) and Asian-Pacific Islanders (API). The chi-square analysis

between autopsied AI and API was non-significant (p-value= .89).

- Gender was coded for Male and Female with the females being the reference category.
- The Death cause categories were all binarily coded. The death cause category "Intentional" is comprised of all homicides and suicides, "Accidents" are all accidents, "Cancer" are all malignant neoplasms and "Unknown/ Undetermined Causes & Others" is comprised of Alzheimer's, Nephritis, nephrotic syndrome, and

Table 3. Effects of various predictors on autopsy performance from the logistic regression analysis.						
Effect	Reference	Variable	OR	Low CI	High CI	p-value
Gender	F	M	1.529	1.253	1.865	<0.0001
Race	W	Non W	1.302	1.075	1.576	0.0070
Age	Seniors	Children	10.219	6.889	15.157	<0.0001
		Young Adults	8.869	6.433	12.228	<0.0001
		Middle Age	6.907	5.523	8.636	0.0002
Cause of Death	Not intentional	Intentional deaths	18.057	11.722	27.817	<0.0001
	Not accidental	Accidental deaths	5.979	6.145	4.439	<0.0001
	Not cancer	Cancer deaths	0.141	0.084	0.236	<0.0001
	Not unknown	Unknown / Other	0.918	0.717	1.175	0.4969

OR=Odds ratio, CI=Confidence interval

Children = Ages 14 and below; Young adults = ages 15-34; Middle age = Ages 35-54; Seniors = Ages 55 and older

nephrosis, Septicemia, Parkinson's, Legal Intervention, Events of Undetermined intent, Pregnancy, childbirth and the puerperium, Influenza and Pneumonia, Diabetes mellitus, Chronic Liver Disease and Cirrhosis, Chronic Lower Respiratory Disease, Heart Disease and Cardiovascular Disease.

The multivariate analysis was done using SAS 9.1. The model has been controlled for overdispersion by using the Deviance method. Without adjusting for the overdispersion, the standard errors are likely to be underestimated causing the Wald test to be oversensitive. This model was completed using 324,854 observations with α at the 5% level.

The following point estimates are odds ratios significant at their 95% confidence intervals (Table 3). Thus, the odds of having an autopsy completed for males compared to females are 1.53 (CI 1.253, 1.865), that is males have a 52.9% higher chance of having an autopsy compared to a female. Non-whites have a 30.2% higher chance of having an autopsy compared to whites (OR 1.3; CI 1.08, 1.6). The age group with the highest chances of having an autopsy completed compared to seniors (Ages 55 and older and here the reference group for this data) was for children (Ages 14 and below) with an OR of 10.22 (CI 6.89, 15.16), in other words children were approximately nine times as likely as seniors to have had an autopsy done. Young adults (Ages 15-34) were approximately eight times as likely to have had an autopsy done compared to seniors (OR 8.86; CI 6.43, 12.23), and middle aged (Ages 35-54) were approximately six times as likely compared to seniors to have had an autopsy done with an OR of 6.91 (CI 5.52, 8.64). Those who died "Intentional" deaths were 17 times as likely to have had an autopsy done compared to those who did not die intentionally (OR 18.06; CI 11.72, 27.82). Those who died as the result of an "Accident" were approximately five times as likely to have received an autopsy compared to those who had not died as the result of an "Accident" (OR 5.98; CI 4.44, 8.05). The odds-ratio of having an autopsy completed for

those who died a death attributable to "Cancer" compared to those who died of other cancers was 0.141 (CI 0.08, 0.24). This meant that those who died of cancer had an 85.9% less chance of having an autopsy done as opposed to those whose death was not attributable to cancer.

Comparison with 2003 National Data

The overall autopsy rate was 9.3% in Louisiana versus 7.7% in the US in 2003. Autopsy rates were higher than those of the US in almost all categories of personal factors (gender, race, and age group). Louisiana's autopsy levels were generally greater for both natural disease (3.7% versus 3.5% for the US; odds ratio 1.09, Confidence interval 1.07-1.11) and the high autopsy rate group (61.1% versus 54.3% for the US; odds ratio 1.31, confidence interval 1.28 to 1.34).

DISCUSSION

There are numerous reasons for the decline in autopsy rates: reimbursement issues, attitudes of clinicians regarding the utility of autopsies in view of the advances in diagnostic methods, ignorance on how to request autopsies, and a reluctance by pathologists whose higher priorities are patient-care services.

The main determinants for having an autopsy performed were age group (the younger the age group, the more likely an autopsy) and intentional or accidental death. Other determinants such as male gender and non-white race played minor roles. These results were expected and demonstrate that autopsies are still used to determine the cause of death for unusual circumstances. It also shows that autopsies are seldom performed for the elderly and diagnosed diseases.

Comparisons of autopsy rates in Louisiana versus the entire US showed slightly higher rates in Louisiana. This held true when looking at personal characteristics (age,

gender, race) and at type of disease.

REFERENCES

1. Burton EC, Troxclair DA, Newman WP. Autopsy diagnoses of malignant neoplasms—how often are clinical diagnoses incorrect. *JAMA* 1998;280:1245-1248.
2. Shojania K, Burton E, McDonald K, et al. The autopsy as an outcome and performance measure. Evidence Report/Technology Assessment No. 58 (Prepared by the University of California at San Francisco-Stanford Evidence-based Practice Center under Contract No. 290-97-0013) 2002; AHRQ Publication No. 03-E002. Rockville, MD: Agency for Healthcare Research and Quality.
3. Shojania K, Burton E, McDonald K, et al. Changes in rates of

autopsy detected diagnostic errors over time: A systematic review. *JAMA* 2003;289:2849-2858.

4. Hoyert DL, Kung HC, Xu J. Autopsy patterns in 2003. National Center for Health Statistics. *Vital Health Statistics* 2007;20:(need page numbers here).
5. Hoyert DL, Kung HC, Smith BL. Deaths: Preliminary data for 2003. National vital statistics reports 2005; vol 53 no 15. Hyattsville, Maryland: National Center for Health Statistics.

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