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Autopsies in the United States in 2020

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Abstract

Objectives—This report presents information on autopsy data by age, cause, place of death, and year.

Methods—Data presented in this report are based on information from death certificates filed in states and the District of Columbia and subsequently compiled into the National Vital Statistics System. This report presents the number of deaths, number of autopsies, and autopsy rate (number of autopsies per the number of deaths multiplied by 100). Trends in the autopsy rate were evaluated for years 1972–1994 and 2003–2020, and differences in the 2020 rate by age, place of death, and cause of death were examined.

Results—In 2020, the autopsy rate reached a low of 7.4%. The autopsy rate varied by age, cause, and place of death. The autopsy rate for those aged 15–24 years was 62.6%, and then decreased with increasing age. Deaths occurring in settings such as hospital inpatient, hospice facility, and nursing home or long-term care were least likely to be autopsied compared with other locations. External causes such as assault (homicide) (98.7%) were among the most frequently autopsied causes of death. Changes in the autopsy rate over time have changed the profile of those autopsied. In 1972, 79% of autopsies were performed for deaths due to diseases and 19% for deaths due to external causes. By 2020, 37% of autopsies were performed for deaths due to diseases and 60% due to external causes.

Keywords: autopsy rate • cause of death • National Vital Statistics System

Introduction

An autopsy, a medical examination of a deceased person, may be performed under different circumstances and may confirm clinical findings, provide more complete information to describe cause of death, or uncover conditions not recognized clinically before death (1–3). Variation in autopsy rates between groups, by cause of death, and over time has implications for

which deaths may have a more complete and conclusive causeof-death determination. The autopsy rate, or percentage of deaths that received this final assessment, was stable from the 1950s until the beginning of the 1970s, when the autopsy rate began to decline (4).

The ability to track autopsy trends was hampered by the removal of the autopsy item from National Center for Health Statistics (NCHS) data in 1995 in response to budgetary restrictions (5-8). This capacity was restored with the reinstatement of reporting the autopsy item in 2003 to NCHS under a new agreement with the jurisdictions (8). Previous analyses (4.5) examined data from the early 2000s for years when jurisdictions again reported the autopsy item. However, due to variations in systems used by the states to report data to NCHS, and other data processing-related issues, not all 50 states and the District of Columbia provided complete data consistently for each year throughout the next 2 decades. Now that reporting has been complete for all 50 states and the District of Columbia since 2016, this report revisits some of the previous analyses (4,5), while focusing on age, cause, and place of death using mortality data from the National Vital Statistics System (NVSS) for 2020. It also presents autopsy rate trends in the United States to provide nearly 50 years of context for the 2020 analyses.

Methods

Data presented in this report are based on information from death certificates filed in states and the District of Columbia and subsequently compiled into national data, also known as NVSS, by NCHS (9). While two autopsy types are performed in the United States: a) hospital or clinical autopsies, which family or doctors request to clarify cause of death or assess care, and b) medicolegal autopsies, which legal officials order to further investigate the circumstances surrounding a death (10,11), autopsy type is not distinguishable in vital statistics data. The autopsy data presented in this report are based on the item on the death certificate that asked, "Was an autopsy performed?"





The instructions to the person completing the item on the death certificate were to respond "yes" if a partial or complete autopsy was performed. Otherwise, they were instructed to answer "no."

Characteristics presented in this report were selected based on the differences they showed for autopsy rates in previous analyses (4.5). This report includes data for years 1972-1994 and 2003-2020, although, as described previously, not all states reported for each year between 2003 and 2015. Autopsy data were not available in the national data for 1995-2002 because, as agreed to by NCHS and the jurisdictions due to budgetary reasons, the item was not among those that the states provided to NCHS for those years. The item was restored as part of national data in 2003 (8), but not all 50 states and the District of Columbia provided complete data to NCHS every year for 2003-2015. As of 2016, all states and the District of Columbia provide data on autopsy. The states excluded for selected years in Figure 1 and Table 1 were Florida (2003–2004), Minnesota (2003–2004), New Mexico (2003-2005), Pennsylvania (2003-2011), and Tennessee (2015). These states accounted for about 14% of all deaths in the United States for 2003-2004, 5%-6% for 2005-2011, and 3% in 2015. Additional analyses (not shown) were done for the United States and for a subnational grouping that excluded these five states for 2012-2014 and 2016-2020. For these years, the autopsy rate for the entire United States and the rate excluding the five states never differed by more than 0.1 (12).

The autopsy rate was also examined with respect to the final cause of death: whether death was due to a disease such as heart disease or cancer; an external cause such as unintentional injury, which includes drug overdose, homicide, or suicide; or due to an ill-defined condition such as unknown cause or sudden infant death syndrome. Cause-of-death groupings were identified using underlying cause of death and applicable *International Classification of Diseases* (ICD) codes:

Diseases

- ICD-10 codes A00-Q99, U04, and U07
- ICD-9 codes 001-779
- ICDA-8 codes 000-779

III-defined conditions

- ICD-10 codes R00-R99
- ICD-9 codes 780-799
- ICDA–8 codes 780–796

External causes

- ICD-10 codes *U01-*U03 and V01-Y98
- ICD-9 codes E800-E999
- ICDA-8 codes E800-E999

This report also revisits the cause-of-death distribution of autopsied deaths (5) at three points during the period: 1972, 1994, and 2020. Previous analyses (5) showed a change over time. For this report, 3 years were selected to give more insight than the end points would provide but avoid years when not all 50 states and the District of Columbia provided complete data. The year 1994 was selected as the third year because no data

were available for the midpoint of the time period (1996) and 1994 was the closest year to 1996 with complete data.

This report presents the number of deaths, number of autopsies, and autopsy rate (number of autopsies per the number of deaths multiplied by 100). Comparisons made in the text among percentages, unless otherwise specified, are statistically significant at the 0.05 level. Lack of comment in the text about any two percentages does not mean that the difference was tested and found not to be significant at this level. Trends in the autopsy rate were evaluated using the Joinpoint Regression Program (13) using the default settings. Differences between percentages were evaluated using two-sided significance tests at the 0.05 level. See Technical Notes for further details.

Results

Autopsy rate

Trend

The autopsy rate was 19.1% in 1972 and decreased through 1994 to 9.4% (Figure 1 and Table 1). This was followed by a period (1995–2002) when national data were not compiled (see Methods). After 2003, once these data began to be reported again, the autopsy rate fluctuated; however, only the decrease between 2006 (8.7%) and 2013 (7.7%) was statistically significant. During the COVID-19 pandemic year of 2020, 7.4% of deaths were autopsied, which was the lowest percentage seen in the 1972–2020 period.

Age

In 2020, although the number of deaths increased with age after 1 year of age (Table 2), autopsy rates declined with age for decedents aged 15–24 years and over (Figure 2). The autopsy rate was 31.6% for those under 1 year, 55.4% for those aged 1–4, and 46.8% for those aged 5–14. The autopsy rate was highest for those aged 15–24 (62.6%), falling to 56.1% for those aged 25–34 and decreasing further with each successively older age group. The largest drop was observed from 35–44 to 45–54 (41.0% and 22.1%, respectively). For those aged 65–74, the autopsy rate was 3.9% and by 85 and over was 0.6%. The difference between the autopsy rate for those aged 1–4 and 25–34 was not statistically significant.

Place of death

The autopsy rate could also be examined with respect to the place where death was pronounced (Figure 3 and Table 3). The autopsy rate was highest for decedents where place of death was recorded as dead on arrival at hospital (30.5%), followed by other place (for example, highway, public building, or prison ward) (28.9%), and unknown place (25.9%). The autopsy rate at hospital outpatient or emergency room was 20.9%. Place of residence, hospital inpatient, hospice facility, and nursing home or long-term care facility were the locations with the lowest autopsy rates (9.2%, 3.1%, 0.5%, 0.4%, respectively).

Figure 1. Trend in the autopsy rate: United States, 1972-2020

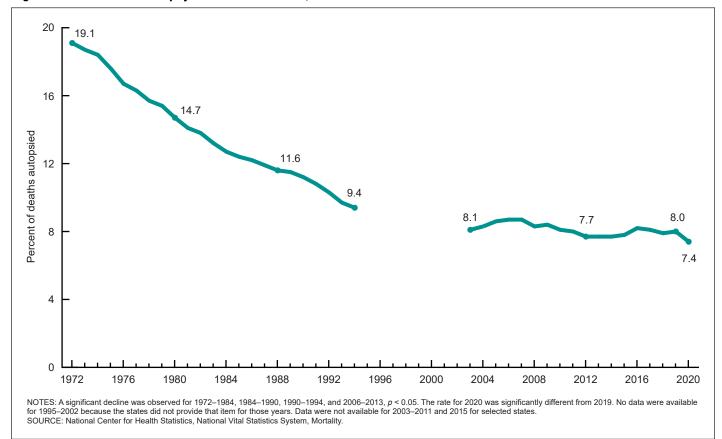
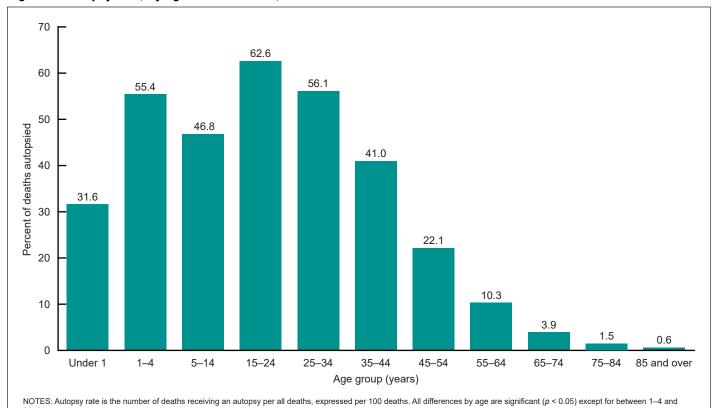


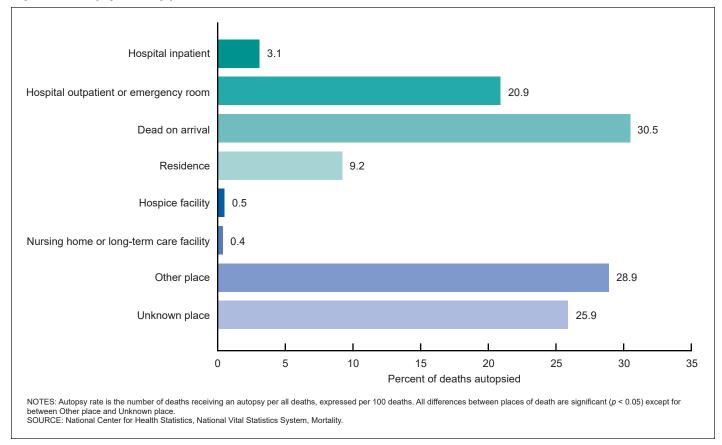
Figure 2. Autopsy rate, by age: United States, 2020

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.



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Figure 3. Autopsy rate, by place of death: United States, 2020



Cause-of-death grouping

While 91% of deaths in the United States were due to disease in 2020 (Table 4), the autopsy rate for deaths due to diseases (3.0%) was lower than for deaths due to external causes (52.4%) or ill-defined conditions (22.7%) (Figure 4). Among external causes, the autopsy rate for unintentional injuries, homicide, and suicide was 47.5%, 98.7%, and 49.3%, respectively. Among diseases, the autopsy rate for the leading causes of death—heart disease, cancer, and COVID-19—was 6.5%, 0.8%, and 0.9%, respectively.

Cause-of-death distribution of autopsied deaths

Figure 1 shows changes in the autopsy rate over 48 years. This report also explores the cause-of-death distribution of autopsied deaths during the period. Three years when autopsy information was available for the entire United States (1972, 1994, and 2020) (see Methods) are shown. For all 3 years examined, about 90%–92% of all deaths were due to diseases, 7%–8% due to external causes, and 1% due to ill-defined conditions (Table 5). The percentage of autopsied deaths that were deaths caused by diseases decreased from 79% in 1972 to 54% in 1994 and to 37% in 2020 (Figure 5). The percentage of autopsied deaths caused by external causes increased from 19% in 1972 to 41% in 1994 and to 60% in 2020. Ill-defined conditions accounted for 2%, 5%, and 3% of autopsied deaths in 1972, 1994, and 2020, respectively.

Summary

This report presents autopsy rates between 1972 and 2020. Overall, the rate decreased from 19.1% to 7.4%, with the most consistent decreasing pattern before 1994. In 2020, the autopsy rate differed by characteristics such as age, cause, and place of death. This is consistent with previous analyses (4,5) done before data were complete for all 50 states and the District of Columbia again.

The autopsy rate had several potential influences over the period from 1972 to 2020. In 1971, the Joint Commission on Accreditation of Hospitals dropped a hospital accreditation standard requiring a 20%-25% autopsy rate for deaths occurring in hospitals (2,14). This relaxation of previous hospital accreditation standards regarding autopsy had a downward influence on the autopsy rate. Protocols that address autopsy practices for investigating sudden and unexplained infant deaths were developed after 1972 (2-4,7,11,14,15). This had an upward influence on the autopsy rate. Findings that indicated an increasing percentage of autopsies composed of external-cause deaths between 1972 and 2020 were consistent with declining trends in hospital autopsies and stable or increasing trends for medicolegal autopsies (11). While the overall pattern was of decline, the rate fluctuated more after the autopsy item was restored in 2003. The COVID-19 pandemic introduced a large number of deaths with a low autopsy rate, which may account for the significant decline in 2020.

Figure 4. Autopsy rate, by cause-of-death groupings: United States, 2020

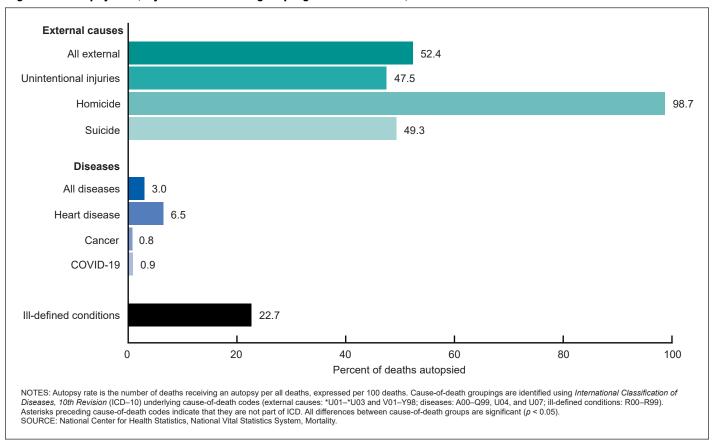
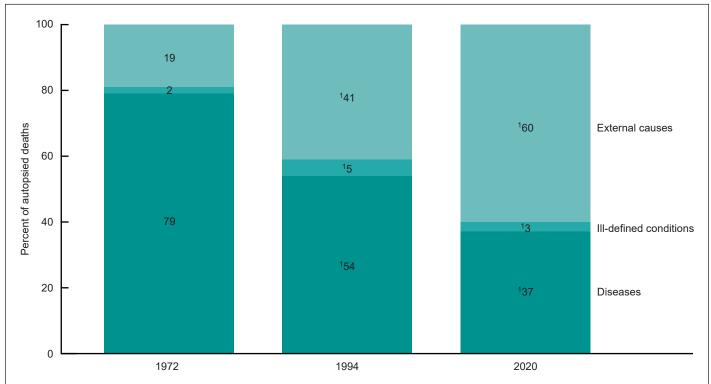


Figure 5. Distribution of cause of death for autopsied deaths: United States, 1972, 1994, and 2020



¹Significantly different from previous year shown.
NOTES: Percentage of autopsied deaths is the number of deaths due to noted cause receiving an autopsy per all autopsied deaths, expressed per 100. Cause-of-death groupings are identified using the applicable International Classification of Diseases underlying cause-of-death codes SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Most of this report focuses on 2020. However, 2020 was also the first year of the COVID-19 pandemic, which changed the environment in which people were living and dying. Aside from introducing a large number of deaths from a new cause of death that was infrequently autopsied, the findings in this report are consistent with previous findings. This report has some limitations. First, the report presents information on trends between 1972 and 2020 but cannot provide the national autopsy pattern for 1995-2002 because the data item was not reported by all states. Second, for 2003-2011 and 2015, selected states were excluded, mainly because of delays in resuming autopsy data submission after it was restored in the national data. While this limited being able to definitively document the trend for the United States for all years, additional analyses showed little difference from the United States in the years when data were available for the entire United States (see Methods). Third, the cause-of-death distribution of autopsied deaths is only presented for 3 years that had complete data. This demonstrates change in the profile of autopsied deaths at three selected points in the broad time period covered by this report but does not address every year.

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Table 1. Number of total deaths, deaths for which autopsies were reported, and autopsy rate: United States, 1972-2020

[Autopsy rate is the number of deaths receiving an autopsy per all deaths, expressed per 100 deaths]

expressed per 100 deaths]			
		Number of	Autopsy
Year	All deaths	autopsies	rate
1972	1,963,944	375,820	19.1
1973	1,973,003	369,655	18.7
1974	1,934,388	355,515	18.4
1975	1,892,879	333,068	17.6
1976	1,909,440	318,830	16.7
1977	1,899,597	309,259	16.3
1978	1,927,788	303,134	15.7
1979	1,913,841	294,182	15.4
1980	1,989,841	291,702	14.7
1981	1,977,981	279,656	14.1
1982	1,974,797	272,431	13.8
1983	2,019,201	266,362	13.2
1984	2,039,369	259,187	12.7
1985	2,086,440	258,596	12.4
1986	2,105,361	257,890	12.2
1987	2,123,323	253,023	11.9
1988	2,167,999	251,095	11.6
1989	2,150,466	247,251	11.5
1990	2,148,463	239,591	11.2
1991	2,169,518	233,707	10.8
1992	2,175,613	224,071	10.3
1993	2,268,553	220,620	9.7
1994	2,278,994	213,879	9.4
1995	2,312,132		
1996	2,314,690		
1997	2,314,245		
1998	2,337,256		
1999	2,391,399		
2000	2,403,351 2,416,425		
2002	2,410,423		
2003 ¹	2,443,367		8.1
2004 ¹	2,097,437	170,022 169,405	8.3
2005 ²		•	8.6
2006 ³	2,303,502 2,300,725	197,823 199,999	8.7
2007 ³	2,298,608	199,154	8.7
2008 ³	2,344,522	195,614	8.3
2009 ³	2,344,322	194,633	8.4
2010 ³	2,343,839	189,435	8.1
2011 ³	2,387,221	190,535	8.0
2012	2,543,279	196,698	7.7
2013	2,545,273	200,357	7.7
2014	2,626,418	200,337	7.7
20154	2,646,060	205,741	7.8
2016	2,744,248	224,488	8.2
2017	2,813,503	227,197	8.1
2018	2,839,205	223,115	7.9
2019	2,854,838	229,011	8.0
2020	3,383,729	249,337	7.4

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

⁻⁻⁻ Data not available.

¹Autopsy data exclude Florida, Minnesota, New Mexico, and Pennsylvania.

²Autopsy data exclude New Mexico and Pennsylvania.

³Autopsy data exclude Pennsylvania.

⁴Autopsy data exclude Tennessee.

Table 2. Number of total deaths, deaths for which autopsies were reported, and autopsy rate, by age: United States, 2020

[Autopsy rate is the number of deaths receiving an autopsy per all deaths, expressed per 100 deaths]

Age group (years)	All deaths	Number of autopsies	Autopsy rate
All ages	3,383,729	249,337	7.4
Under 1	19,582	6,196	31.6
1–4	3,529	1,956	55.4
5–14	5,623	2,630	46.8
15–24	35,816	22,406	62.6
25–34	73,486	41,232	56.1
35–44	104,490	42,791	41.0
45–54	191,142	42,216	22.1
55–64	440,549	45,391	10.3
65–74	674,507	25,985	3.9
75–84	822,084	12,290	1.5
85 and over	1,012,805	6,188	0.6

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 3. Number of total deaths, deaths for which autopsies were reported, and autopsy rate, by place of death: United States, 2020

[Autopsy rate is the number of deaths receiving an autopsy per all deaths, expressed per 100 deaths] $\begin{tabular}{ll} \hline \end{tabular}$

Place of death	All deaths	Number of autopsies	Autopsy rate
Hospital inpatient	3,383,729	249,337	7.4
	1,023,837	31,603	3.1
	202,468	42,331	20.9
	9,673	2,949	30.5
	1,127,967	103,219	9.2
	204,671	1,106	0.5
	587,986	2,486	0.4
	226,479	65,475	28.9
	648	168	25.9

 $SOURCE: National\ Center\ for\ Health\ Statistics,\ National\ Vital\ Statistics\ System,\ Mortality.$

Table 4. Number of total deaths, deaths for which autopsies were reported, and autopsy rate, by cause-of-death grouping: United States, 2020

[Autopsy rate is the number of deaths receiving an autopsy per all deaths, expressed per 100 deaths. Cause-of-death groupings are identified using underlying cause of death classified according to the *International Classification of Diseases*, 10th Revision (ICD-10). Asterisks preceding cause-of-death codes indicate that they are not part of ICD-10]

Cause of death and code	All deaths	Number of autopsies	Autopsy rate
External causes	283,706	148,610	52.4
Unintentional injuries	200,955	95,526	47.5
Homicide*U01–*U02, X85–Y09, Y87.1	24,576	24,249	98.7
Suicide	45,979	22,666	49.3
III-defined conditions	34,098	7,730	22.7
Diseases	3,065,925	92,997	3.0
Heart disease	696,962	44,971	6.5
Cancer	602,350	4,844	0.8
COVID-19	350,831	3,303	0.9

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table 5. Number of total deaths, deaths for which autopsies were reported, and percentage of autopsied deaths: United States, 1972, 1994, and 2020

[Percentage of autopsied deaths is the number of deaths due to noted cause receiving an autopsy per all autopsied deaths, expressed per 100. Cause-of-death groupings are identified using underlying cause of death classified according to applicable *International Classification of Diseases* (ICD) codes. Asterisks preceding cause-of-death codes indicate that they are not part of ICD-10]

Cause of death	All deaths	Number of autopsies	Autopsy rate	Percent of autopsied deaths
1972				
All causes	1,963,944	375,820	19.1	100
Diseases	1,771,280	296,858	16.8	79
III-defined conditions	27,500	6,408	23.3	2
External causes	165,164	72,554	43.9	19
1994				
All causes	2,278,994	213,879	9.4	100
Diseases	2,102,809	114,622	5.5	54
III-defined conditions	25,245	10,777	42.7	5
External causes	150,940	88,480	58.6	41
2020				
All causes	3,383,729	249,337	7.4	100
Diseases	3,065,925	92,997	3.0	37
III-defined conditions	34,098	7,730	22.7	3
External causes	283,706	148,610	52.4	60

NOTE: Cause-of-death groupings are identified using ICDA-8 in 1972, ICD-9 in 1994, and ICD-10 in 2020.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Technical Notes

Nature and sources of data

Data presented in this report are based on information from all death certificates filed in the 50 states and the District of Columbia and subsequently compiled into national data. Death certificates were completed by funeral directors, attending physicians, medical examiners, coroners, or other people legally authorized to certify death. Additional details on mortality data are documented in the Technical Notes section of annual mortality publications (16).

Data for the autopsy item were not complete for all years. Production of this report was delayed until information was complete for multiple years. Figure 1 and Table 1 do not include data for Florida for 2003-2004, Minnesota for 2003-2004, New Mexico for 2003-2005, Pennsylvania for 2003-2011, and Tennessee for 2015. For 2003, the information sent to the National Center for Health Statistics was missing for the autopsy item for 71% of Florida records, while it was missing for 100% of the records for the other states for the years excluded. Additional analyses (not shown) examined the trend using a constant reporting area that excluded these states for all years and found this to be consistent with the data as shown in the report (12). The other figures and tables shown are based on years with complete data for autopsy. Figure 5 and Table 5 span the time period included in Figure 1 and Table 1 but use selected years that were complete. Additional analyses (not shown) included all available years and found the selected years shown in Figure 5 to be representative of the change in distribution over time. With just 3 years, differences between percentages were evaluated using two-sided significance tests rather than a trend analysis using Joinpoint.

Cause-of-death classification

The mortality statistics presented in this report were compiled according to with World Health Organization regulations, which specify that member countries classify and code causes of death according to the *International Classification of Diseases* (ICD). The classifications are periodically revised, and the causes shown in this report were classified according to the revisions then in use (16).

Random variation

The mortality data presented in this report were not subject to sampling error. Mortality data, even based on complete counts, may be affected by random variation (16). Trends in the autopsy rate were evaluated using the Joinpoint Regression Program (11) using the default settings. Differences between percentages were evaluated using two-sided significance tests at the 0.05 level (4).

Definitions

Autopsy—An examination after death for medical, legal, or scientific reasons, such as to establish medical conditions and the reason for death occurring when it did (1,10).

Autopsy rate—Number of deaths receiving an autopsy per all deaths, expressed per 100 deaths.

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