State Differences in the Reporting of Diabetes-Related Incorrect Cause-of-Death Causal Sequences on Death Certificates

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OBJECTIVE—To examine state differences in the reporting of diabetes-related incorrect cause-of-death (COD) causal sequences on death certificates in the U.S.

RESEARCH DESIGN AND METHODS—We conducted a cross-sectional descriptive study to determine the prevalence of two types of incorrect COD causal sequences with data from the Multiple Cause Mortality File of the year 2004.

RESULTS—Among deaths in which diabetes was reported as the first diagnosis on line a, b, c, or d in Part I of the death certificate in the U.S., 21% had below diabetes placement error (ranged from 30% in Maryland to 7% in Hawaii) and 11% had above diabetes placement error (ranged from 18% in Kentucky to 5% in California). The net effects of the two types of error ranged from −0.7% in Nevada to 19.6% in the District of Columbia.

CONCLUSIONS—Because the rates of incorrect reporting of diabetes-related COD causal sequence varied across states, the comparability of the diabetes death rate between states may have been compromised.

Diabetes Care 35:1572–1574, 2012

Mortality from diabetes is one of the important indicators in the state diabetes surveillance system initiated by the Centers for Disease Control and Prevention, Division of Diabetes Translation (1). If, however, certifying physicians in different states were found to have different practices in reporting cause-of-death (COD) causal sequences in Part I of the death certificate, the comparability of diabetes death rates across states would be in doubt (2). A recent study indicated an increase in the reporting of diabetes-related incorrect COD causal sequences in the U.S. (3). Little is known, however, regarding the prevalence of this COD certification problem at the state level. We aimed in this study to examine state differences in the reporting of diabetes-related incorrect COD causal sequences and to evaluate the possible effects on the reported diabetes death rate at the state level in the U.S.

RESEARCH DESIGN AND METHODS

We extracted all diabetes-related deaths occurring in the year 2004 from the Multiple-Cause Mortality File compiled by the National Center for Health Statistics of the National Centers for Disease Control and Prevention (4). All cases in which diabetes was mentioned anywhere on the death certificate were included for analysis. ICD-10 codes E10–E14 were used to identify diabetes-related death (5).

We determined two types of errors in the reporting of an incorrect COD causal sequence, the "below diabetes error" and the "above diabetes error," according to the algorithm developed by Lu et al. (3). A below diabetes error occurred when diagnoses were incorrectly reported as the cause of diabetes (on the line below) in Part I of the death certificate. For example, see the following report:

a) Acute myocardial infarction
b) Diabetes mellitus
c) Hypertension

In this example, hypertension was incorrectly reported (on the line below) as a cause of diabetes mellitus. In contrast, an above diabetes error occurred when diagnoses were incorrectly reported as a consequence of diabetes (on the line above). In the following example, lung cancer was incorrectly reported as a consequence of diabetes mellitus (on the line above):

a) Respiratory failure
b) Lung cancer
c) Diabetes mellitus

With regard to the analysis, we first calculated the proportions of the two types of errors in reporting of incorrect COD causal sequences among deaths in which diabetes was reported as the first diagnosis on line a, b, c, or d in Part I of the death certificate in each state. We did not include cases in which diabetes was reported in Part II of the death certificate, because diabetes was very unlikely to be selected as the underlying COD in these cases according to the International Selection Rules set by ICD-10. All percentages were age adjusted according to the age structure of the U.S. as a whole. To estimate the possible effects of incorrect reporting on the state diabetes death rates, we calculated the net effect of the two types of error for each state.

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Received 6 November 2011 and accepted 22 February 2012.
DOI: 10.2337/dc11-2156

Table 1—*Age-adjusted diabetes death rate (deaths per 100,000 population) and numbers and percentages of reporting of incorrect COD causal sequences on the death certificate by medical certifiers in each state in the U.S., 2004*

	Diabetes death rate	Diabetes reported as first diagnosis on either line in Part I of death certificate	Reporting of incorrect COD causal sequence			Below diabetes error*		Above diabetes error*		Net effect of both error types (%)*
			Deaths	%	95% CI	Deaths	%	Deaths	%	
U.S.	24.4	77,708	25,241	32	32–33	16,364	21	8,874	11	10
Alabama[H]	30.2	1,526	616	41	37–45	421	28	195	13	15
Alaska	21.4	103	28	34	20–48	18	17	10	10	8
Arizona[L]	20.6	1,236	227	19	16–21	146	12	81	7	5
Arkansas	27.9	913	324	35	31–40	205	22	119	13	9
California[L]	22.0	7,133	1,186	17	16–18	841	12	345	5	7
Colorado[L]	17.9	699	143	21	17–24	96	14	47	7	7
Connecticut	19.0	773	290	37	32–42	192	25	98	13	12
Delaware[H]	23.9	239	108	45	35–55	68	28	40	17	12
DC	40.2	219	63	29	21–37	53	24	10	5	20
Florida[H]	21.5	5,331	2,028	38	36–40	1,334	25	694	13	12
Georgia[L]	22.0	1,574	374	24	22–27	256	16	118	7	9
Hawaii[L]	13.5	164	21	13	7–19	11	7	10	6	1
Idaho[L]	26.1	356	83	23	18–29	50	14	33	9	5
Illinois	24.1	3,237	1,008	31	29–33	663	20	345	11	10
Indiana[H]	26.2	1,867	718	38	35–41	455	24	263	14	10
Iowa[L]	19.5	702	161	23	19–27	108	15	53	8	8
Kansas	23.3	736	252	34	29–39	165	22	87	12	11
Kentucky[H]	28.3	1,415	562	40	36–44	306	22	256	18	4
Louisiana	39.2	1,929	674	35	32–38	436	23	238	12	10
Maine	24.3	402	128	31	25–37	85	21	43	11	10
Maryland[H]	26.3	1,574	680	43	39–47	466	30	214	14	16
Massachusetts	18.5	1,342	434	32	29–36	292	22	142	11	11
Michigan[H]	28.2	3,351	1,362	40	38–43	872	26	490	15	11
Minnesota[H]	21.6	1,082	486	44	40–49	302	28	184	17	11
Mississippi[L]	23.2	655	155	24	20–28	90	14	65	10	4
Missouri[H]	23.4	1,616	606	38	34–41	379	23	227	14	9
Montana	22.7	245	72	29	21–37	39	16	33	13	2
Nebraska[L]	20.5	363	69	19	14–24	38	10	31	9	2
Nevada	13.8	300	80	27	20–34	39	13	41	14	0
New Hampshire	23.3	337	114	34	27–41	72	21	42	12	9
New Jersey[H]	27.6	2,983	1,215	40	38–43	733	25	482	16	8
New Mexico	31.3	647	228	35	30–41	156	24	72	11	13
New York[L]	18.9	3,929	674	17	16–19	448	11	226	6	6
North Carolina	26.7	2,344	843	36	33–39	555	24	288	12	11
North Dakota	26.8	228	73	32	23–40	47	21	26	11	9
Ohio	28.7	3,914	1,397	35	33–38	874	22	523	13	9
Oklahoma	30.6	1,281	458	36	32–40	290	23	168	13	10
Oregon[L]	27.8	1,005	238	24	20–27	149	15	89	9	6
Pennsylvania[H]	23.1	3,900	1,570	40	38–42	978	25	592	15	10
Rhode Island	22.1	287	76	26	20–33	55	19	21	7	12
South Carolina	27.4	1,202	413	35	31–38	286	24	127	11	13
South Dakota[L]	25.4	240	52	20	14–26	29	12	23	10	3
Tennessee	31.3	2,026	701	34	31–37	446	22	255	13	9
Texas[H]	28.9	5,857	2,096	36	34–38	1,404	24	692	12	12
Utah	27.5	503	161	32	26–37	116	23	45	9	14
Vermont	22.0	154	52	33	23–43	38	25	14	9	16
Virginia	22.4	1,643	490	30	27–33	316	19	174	11	9
Washington	25.0	1,588	485	30	27–34	331	21	154	10	11
West Virginia[H]	37.8	910	380	42	37–47	254	28	126	14	14
Wisconsin	21.8	1,455	541	37	33–40	330	23	211	15	8
Wyoming	21.7	114	27	24	14–34	15	13	12	11	3

*Below diabetes error denotes that some diagnoses are incorrectly reported as the cause of diabetes (on the line below), above diabetes error denotes that some diagnoses are incorrectly reported as a consequence of diabetes (on the line above), and the net effect of both types of error together represents the difference in percentage between the two types of error. [H]The percentage in the state was significantly higher than the percentage in the U.S. as a whole. [L]The percentage in the state was significantly lower than the percentage in the U.S. as a whole. DC, District of Columbia.

RESULTS—Among deaths in which diabetes was reported as the first diagnosis on either line a, b, c, or d in Part I of the death certificate in the U.S., 32% had an incorrect COD causal sequence reported. There were 13 states with a percentage of improper COD statement significantly higher than the U.S. average (32%) and 12 states with a percentage lower than the U.S. average (Table 1).

For below diabetes error, the percentage ranged from 30% in Maryland to 7% in Hawaii. For above diabetes error, the percentage ranged from 18% in Kentucky to 5% in California. For the net effect of the two types of error, the percentage ranged from −0.7% in Nevada and 0.6% in Hawaii to 19.6% (24.2% − 4.6%) in the District of Columbia. We found a significant positive correlation ($r = 0.53$, $P < 0.001$) between the net effect of the two types of error in each state and the state diabetes death rate.

CONCLUSIONS—The findings of this study indicate a more than threefold interstate difference in the reporting of diabetes-related incorrect COD causal sequences across states. In most states, the proportion of below diabetes error was larger than the proportion of above diabetes error. The net effect of these two types of incorrect reporting therefore resulted in overreporting of the state diabetes death rate.

There are three possible explanations for large variations in rates of incorrect reporting across states. The first is that states with a higher percentage of specialists (cardiologists, endocrinologists, and nephrologists) would have a greater likelihood of valid COD assignment, as suggested by Murray et al. (2) and Lu et al. (6). The second is that the states with more aggressive practices in querying certifiers to clarify the incorrect COD causal sequence statements would have a lower percentage of improper COD statements (7). The third is that the states with more diabetic patients with cardiovascular complications or comorbidities would have a higher percentage of improper COD statements, because a previous study has indicated higher error rates among decedents with both diabetes and cardiovascular diseases (3).

In conclusion, the rates of incorrect reporting of diabetes-related COD causal sequence vary across states. Thus the comparability of the diabetes death rate between states is in question. Efforts (such as education, training, and querying certifying physicians for improper COD statements) are needed to improve the comparability. Further studies are needed to verify the possible explanations of large variation in rates of improper COD statements across states and to compare multiple-year error rates, especially in some states with high error rates.

Acknowledgments—This work was partially supported by the National Science Council of Taiwan Grant NSC98-2314-B-006-015-MY2 and the Department of Health of Taiwan Grant 99Z4001. T.-H.L. from the Department of Public Health, National Cheng Kung University, Tainan, Taiwan, was supported by the Fulbright Scholar Program as a visiting scholar in the Department of Society, Human Development, and Health, Harvard University School of Public Health, Boston, MA.

No potential conflicts of interest relevant to this article were reported.

T.-J.C. and T.-H.L. researched the data and wrote the manuscript. I.K. reviewed and edited the manuscript and contributed to the discussion. T.-H.L. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

The authors thank Research Assistant Bai-Huan Lin from the Department of Public Health, National Cheng Kung University, for her analyses of the data.

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