

Supplementary Table 1. ICD-10 diagnostic coding for gastrointestinal cancers

Cancer Type	ICD-10 Diagnostic Codes
Esophageal cancer	C15.0 cervical part of esophagus – malignant neoplasms C15.1 thoracic part of esophagus – malignant neoplasms C15.2 abdominal part of esophagus – malignant neoplasms C15.3 upper third of esophagus – malignant neoplasms C15.4 middle third of esophagus – malignant neoplasms C15.5 lower third of esophagus – malignant neoplasms C15.8 overlapping lesion of esophagus – malignant neoplasms C15.9 esophagus unspecified – malignant neoplasms
Stomach cancer	C16.0 cardia – malignant neoplasms C16.1 fundus of stomach – malignant neoplasms C16.2 body of stomach – malignant neoplasms C16.3 pyloric antrum – malignant neoplasms C16.4 pylorus – malignant neoplasms C16.5 lesser curvature of stomach, unspecified – malignant neoplasms C16.6 greater curvature of stomach, unspecified – malignant neoplasms C16.8 overlapping lesion of stomach – malignant neoplasms C16.9 stomach unspecified – malignant neoplasms
Colorectal cancer	C18.0 cecum – malignant neoplasms C18.1 appendix – malignant neoplasms C18.2 ascending colon – malignant neoplasms C18.3 hepatic flexure – malignant neoplasms C18.4 transverse colon – malignant neoplasms C18.5 splenic flexure – malignant neoplasms C18.6 descending colon – malignant neoplasms C18.7 sigmoid colon – malignant neoplasms C18.8 overlapping lesion of colon – malignant neoplasms C18.9 colon unspecified – malignant neoplasms C19 malignant neoplasm of rectosigmoid junction C20 malignant neoplasm of rectum
Pancreas cancer	C25.0 head of pancreas – malignant neoplasms C25.1 body of pancreas – malignant neoplasms C25.2 tail of pancreas – malignant neoplasms C25.3 pancreatic duct – malignant neoplasms C25.4 endocrine pancreas – malignant neoplasms C25.7 other parts of pancreas – malignant neoplasms C25.8 overlapping lesion of pancreas – malignant neoplasms C25.9 pancreas unspecified – malignant neoplasms

Supplementary Table 2. Total deaths from gastrointestinal cancers (2010-2019)

Cancer type	Counties included*	Deaths in adults aged 25-84 years; 2010-2019	Deaths captured by included counties, N (% total)
Esophageal	1,315	150,533	145,668 (96.7)
Gastric	826	112,036	105,487 (94.2)
Pancreas	2,174	411,531	409,358 (99.4)
Colorectal	2,449	516,517	515,126 (99.7)

*Excludes counties with fewer than 20 gastrointestinal cancer-related deaths as age-adjusted rates are unreliable

Supplementary Table 3. County-level differences in age-standardized mortality for gastrointestinal cancers, by time-period

Cancer Type	County-Level Age-Adjusted Mortality Rate (Per 100,000)					90 th minus 10 th percentile (deaths/100,000 population)	90 th /10 th percentile Ratio
	Minimum	10 th Percentile	Median	90 th Percentile	Maximum		
Esophagus							
<i>2010-2014</i>	1.9	3.3	4.6	6.3	10.6	3.0	1.9
<i>2015-2019</i>	1.7	3.0	4.3	6.2	9.5	3.2	2.0
Stomach							
<i>2010-2014</i>	1.6	2.3	3.2	4.5	10.3	2.2	2.0
<i>2015-2019</i>	1.3	2.0	2.8	4.2	8.7	2.2	2.1
Pancreas							
<i>2010-2014</i>	5.9	9.0	11.2	14.2	27.5	5.2	1.6
<i>2015-2019</i>	6.4	9.3	11.5	14.6	30.7	5.3	1.6
Colorectal							
<i>2010-2014</i>	6.3	12.0	15.9	21.8	46.4	9.8	1.8
<i>2015-2019</i>	5.8	11.2	14.9	20.7	49.2	9.5	1.9

Supplementary Table 4. Within state variability in gastrointestinal cancer-related mortality, expressed as the ratio between the highest vs. lowest mortality county

Esophageal Cancer		Gastric Cancer		Pancreatic Cancer		Colorectal Cancer	
State	Ratio	State	Ratio	State	Ratio	State	Ratio
Nebraska	1.24	Oklahoma	1.28	South Dakota	1.09	New Hampshire	1.32
Oklahoma	1.30	Louisiana	1.28	New Hampshire	1.10	Massachusetts	1.38
Arkansas	1.32	Massachusetts	1.37	Nebraska	1.11	Oklahoma	1.39
New Hampshire	1.32	Kentucky	1.47	Massachusetts	1.13	Idaho	1.46
Massachusetts	1.36	Wisconsin	1.49	Montana	1.13	Arizona	1.48
Alabama	1.37	Illinois	1.50	Oklahoma	1.13	Minnesota	1.53
South Carolina	1.39	Arizona	1.51	North Dakota	1.16	Louisiana	1.55
Mississippi	1.42	Arkansas	1.51	Minnesota	1.16	Pennsylvania	1.55
Maine	1.43	Oregon	1.54	Vermont	1.16	Wisconsin	1.55
Kansas	1.43	Pennsylvania	1.55	Louisiana	1.17	South Dakota	1.55
Minnesota	1.44	Mississippi	1.56	Maine	1.17	Nebraska	1.55
West Virginia	1.45	Georgia	1.58	Idaho	1.17	Vermont	1.58
Ohio	1.46	Florida	1.61	Washington	1.18	Maine	1.59
Kentucky	1.46	Ohio	1.61	Wyoming	1.18	Oregon	1.62
Vermont	1.47	New Jersey	1.63	Arizona	1.19	New Jersey	1.63
Missouri	1.49	Washington	1.64	Wisconsin	1.19	Kentucky	1.64
Tennessee	1.51	Indiana	1.65	Ohio	1.19	Washington	1.64
Arizona	1.54	Alabama	1.66	New York	1.19	Kansas	1.65
Louisiana	1.57	Texas	1.67	Kansas	1.19	Arkansas	1.65
Wisconsin	1.57	South Carolina	1.69	Kentucky	1.19	Ohio	1.65
Iowa	1.57	New York	1.70	Oregon	1.20	Wyoming	1.65
Pennsylvania	1.61	Michigan	1.70	Utah	1.20	New York	1.65
Illinois	1.62	Tennessee	1.70	Illinois	1.20	Illinois	1.66
Oregon	1.65	Minnesota	1.71	New Jersey	1.20	North Dakota	1.67
Washington	1.65	Missouri	1.72	Iowa	1.21	West Virginia	1.67
Indiana	1.69	New Mexico	1.75	Indiana	1.22	Iowa	1.68
Colorado	1.73	Maryland	1.76	Pennsylvania	1.22	Alabama	1.69
North Carolina	1.78	California	1.82	West Virginia	1.22	Florida	1.69
New Jersey	1.81	Virginia	1.98	Colorado	1.24	Mississippi	1.69
Michigan	1.82	North Carolina	2.25	Michigan	1.25	Missouri	1.73
New Mexico	1.95			New Mexico	1.26	Texas	1.75
Georgia	2.00			Missouri	1.26	South Carolina	1.77
Virginia	2.04			California	1.27	New Mexico	1.78
Texas	2.08			Mississippi	1.30	Michigan	1.78
California	2.37			Tennessee	1.31	Maryland	1.79
Maryland	2.44			South Carolina	1.32	Utah	1.79
New York	2.60			Maryland	1.33	Indiana	1.81
Florida	2.93			Alabama	1.34	Montana	1.81
				Arkansas	1.34	Tennessee	1.88
				Georgia	1.35	Georgia	1.94
				Texas	1.36	California	1.96
				Florida	1.36	Colorado	1.98
				North Carolina	1.44	North Carolina	2.09
				Virginia	1.44	Virginia	2.26

Supplementary Table 5. Models evaluating factors associated with statewide variability in esophageal cancer mortality

Variable	2011	2012	2013	2014	2015	2016	2017	2018	2019
% uninsured	0.01	-0.06	-0.01	0.006	0.01	-0.04	-0.07	-0.02	-0.03
Racial composition									
% Non-Hispanic white	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Hispanic white	-0.08	-0.03	-0.03	-0.07	-0.05	-0.06	-0.06	-0.05	-0.05
% Non-Hispanic Black	-0.06	-0.03	-0.02	-0.08	-0.04	-0.07	-0.07	-0.08	-0.06
% Hispanic Black	0.49	-0.25	0.11	0.34	0.07	0.46	-0.17	0.05	0.13
% Asian	-0.01	-0.04	-0.04	-0.04	-0.03	-0.04	-0.05	-0.03	-0.03
% Native American	0.01	-0.01	-0.04	-0.05	0.01	0.10	0.03	0.02	0.06
% with obesity	0.04	-0.04	0.10	0.01	0.05	0.11	-0.04	0.07	0.13
% with diabetes	0.01	0.31	-0.09	0.14	-0.19	-0.04	0.16	-0.01	0.04
% cigarette use	0.067	0.04	0.04	0.09	0.13	0.17	0.07	0.04	0.04
% heavy alcohol use	0.03	0.27	0.17	0.35	0.38	0.30	0.30	0.10	0.34
Rural/urban status									
% Large metropolitan	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Small/medium metropolitan	-0.005	-0.006	-0.004	-0.002	-0.006	0.002	-0.004	-0.001	-0.01
% Rural	-0.0007	-0.003	-0.005	-0.01	-0.0001	-0.04	-0.01	-0.02	-0.01
Overall Model R ²	0.36	0.56	0.41	0.47	0.62	0.53	0.49	0.53	0.45

Beta coefficients with a positive value associated with increased county-level cancer-related mortality. Selected variables that were significantly associated in primary county-level models

Supplementary Table 6. Models evaluating factors associated with statewide variability in gastric cancer mortality

Variable	2011	2012	2013	2014	2015	2016	2017	2018	2019
% uninsured	-0.11	-0.04	0.10	-0.02	-0.07	0.005	-0.09	-0.10	-0.06
Racial composition									
% Non-Hispanic white	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Hispanic white	0.07	0.03	0.17	0.02	0.02	0.003	0.04	0.06	0.03
% Non-Hispanic Black	0.07	0.05	0.06	0.04	0.07	0.03	0.05	0.08	0.05
% Hispanic Black	0.05	0.61	0.53	0.33	0.32	0.55	0.38	-0.05	0.22
% Asian	0.06	0.05	0.07	0.06	0.05	0.05	0.02	0.02	0.04
% Native American	0.06	0.12	0.17	0.13	0.16	0.16	0.11	0.16	0.06
% with obesity	-0.05	0.003	-0.02	0.03	0.06	0.06	0.006	0.02	0.03
% with diabetes	0.17	0.17	0.05	0.27	0.14	0.05	0.16	0.11	0.09
% cigarette use	0.09	0.05	0.11	-0.03	-0.05	-0.007	-0.03	-0.03	-0.03
% heavy alcohol use	0.03	0.10	0.12	0.10	0.27	0.13	0.07	0.10	0.12
Rural/urban status									
% Large metropolitan	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Small/medium metropolitan	0.005	0.005	0.002	0.007	0.005	0.007	0.007	-0.004	-0.006
% Rural	0.01	0.004	0.003	-0.009	-0.001	-0.02	0.003	0.006	0.01
Overall Model R ²	0.64	0.51	0.46	0.69	0.75	0.62	0.59	0.75	0.64

Beta coefficients with a positive value associated with increased county-level cancer-related mortality. Selected variables that were significantly associated in primary county-level models

Supplementary Table 7. Models evaluating factors associated with statewide variability in pancreatic cancer mortality

Variable	2011	2012	2013	2014	2015	2016	2017	2018	2019
% uninsured	-0.11	-0.15	-0.05	-0.006	-0.09	-0.11	-0.13	-0.08	-0.11
Racial composition									
% Non-Hispanic white	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Hispanic white	-0.03	-0.07	0.03	-0.07	-0.06	-0.03	-0.04	-0.04	-0.02
% Non-Hispanic Black	0.02	0.03	0.07	0.03	0.03	0.06	0.02	0.02	0.01
% Hispanic Black	0.35	0.27	0.37	0.22	0.10	0.82	0.13	0.32	0.001
% Asian	0.01	0.009	0.004	0.03	0.01	0.008	-0.008	-0.02	-0.001
% Native American	0.05	0.07	0.04	-0.08	0.04	0.12	-0.05	-0.13	-0.08
% with obesity	0.10	0.15	0.21	0.17	0.17	0.27	0.10	0.10	0.07
% with diabetes	0.22	0.83	-0.032	-0.07	0.40	-0.26	0.41	-0.02	0.05
% cigarette use	0.06	-0.23	-0.06	0.04	-0.14	0.007	-0.08	0.09	0.11
% heavy alcohol use	0.34	0.37	-0.03	0.09	0.52	0.20	0.51	0.01	0.22
Rural/urban status									
% Large metropolitan	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Small/medium metropolitan	0.006	0.009	-0.004	-0.008	-0.004	0.008	-0.004	-0.008	-0.02
% Rural	-0.02	0.02	0.01	0.02	0.001	-0.01	0.003	-0.005	0.003
Overall Model R ²	0.33	0.47	0.15	0.42	0.44	0.36	0.35	0.51	0.30

Beta coefficients with a positive value associated with increased county-level cancer-related mortality. Selected variables that were significantly associated in primary county-level models

Supplementary Table 8. Models evaluating factors associated with statewide variability in colorectal cancer mortality

Variable	2011	2012	2013	2014	2015	2016	2017	2018	2019
% uninsured	0.06	0.13	-0.06	-0.03	0.01	0.04	-0.03	0.10	0.07
Racial composition									
% Non-Hispanic white	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Hispanic white	0.05	-0.01	0.02	-0.03	-0.02	-0.02	0.02	-0.008	-0.05
% Non-Hispanic Black	-0.01	0.02	0.0004	0.05	0.02	0.004	0.04	0.003	0.19
% Hispanic Black	0.67	1.11	0.23	-0.03	0.07	-0.12	-0.36	-0.03	-0.36
% Asian	0.07	0.08	0.10	0.06	-0.002	0.04	0.03	0.02	0.05
% Native American	-0.31	0.05	0.15	0.22	0.08	0.05	0.14	0.90	0.10
% with obesity	0.47	0.36	0.46	0.34	0.13	0.20	0.13	0.36	0.19
% with diabetes	-0.35	-0.03	0.36	0.39	0.44	0.37	0.28	0.21	0.55
% cigarette use	0.47	0.33	0.40	0.21	0.28	0.24	0.40	0.21	0.14
% heavy alcohol use	-0.12	0.02	0.22	-0.004	-0.31	-0.17	-0.03	0.008	0.08
Rural/urban status									
% Large metropolitan	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
% Small/medium metropolitan	0.002	-0.03	-0.014	-0.01	-0.02	-0.03	-0.03	-0.03	-0.018
% Rural	0.02	0.04	0.003	0.02	0.03	0.04	0.0007	0.02	0.02
Overall Model R ²	0.68	0.67	0.70	0.55	0.69	0.57	0.51	0.68	0.72

Beta coefficients with a positive value associated with increased county-level cancer-related mortality. Selected variables that were significantly associated in primary county-level models