

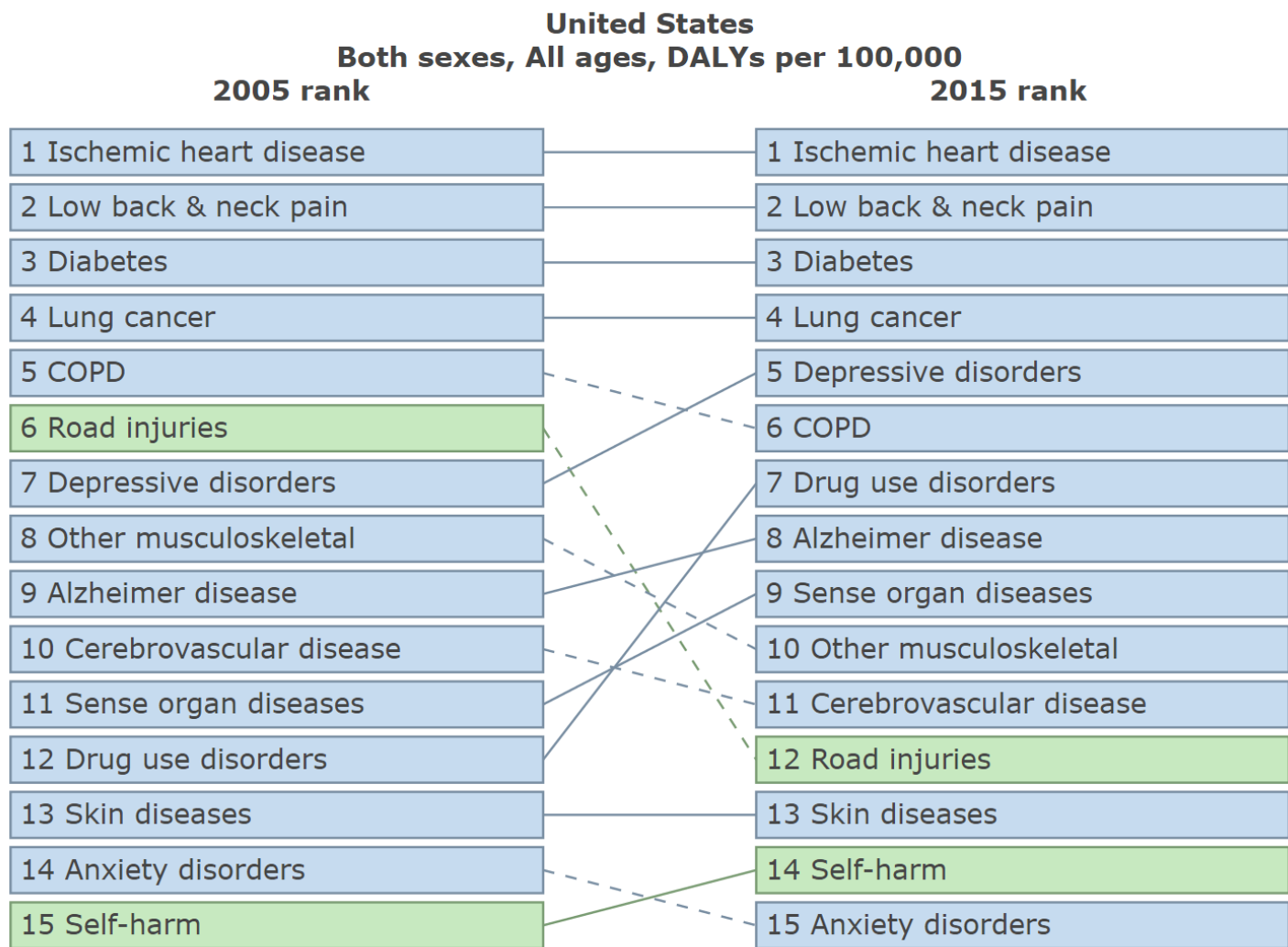
Outline

- 1) **US Burden by State**
- 2) County analysis

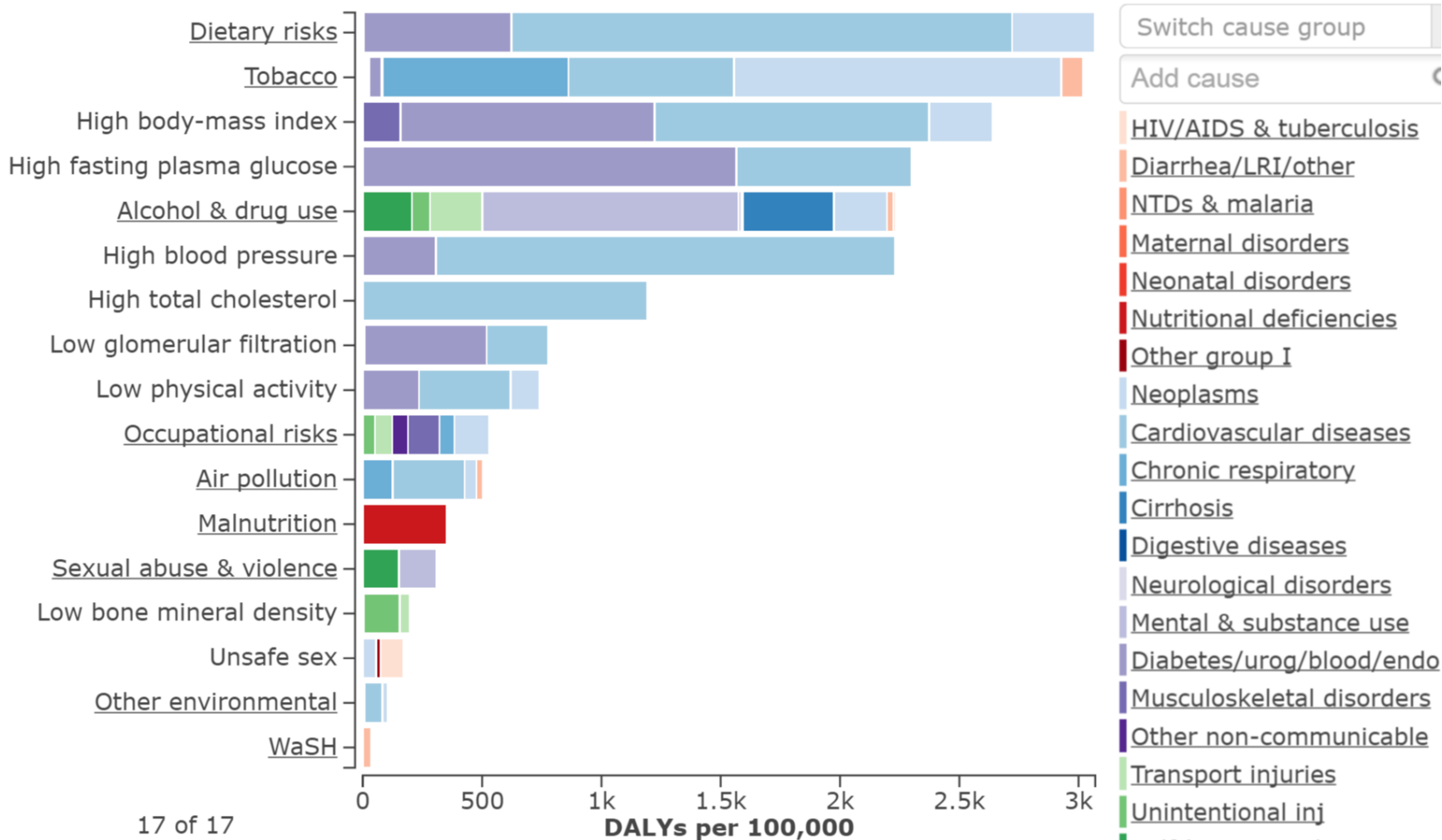
GBD 2015 analysis by state

- Vital registration data by state
- Hospitalization data by state
- Claims data (private and public insurers) by state
- BRFSS by state (and county)
- Wide variety of risk and disease specific studies

Leading causes of US disease burden



United States, Both sexes, All ages, 2015



Rank order by states of leading causes of DALYs

Both sexes, Age-standardized, 2015, DALYs per 100,000



	Alabama	Alaska	Arizona	Arkansas	California	Colorado	Connecticut	Delaware	Florida	Georgia	Hawaii	Idaho	Illinois	Indiana	Iowa	Kansas	Kentucky	Louisiana	Maine	Maryland	Massachusetts	Michigan	Minnesota	Mississippi	Missouri	Montana	Nebraska	Nevada	New Hampshire	New Jersey	New Mexico	New York	N Dakota	Ohio	Oklahoma	Oregon	Pennsylvania	Rhode Island	S Carolina	S Dakota	Tennessee	Texas	Utah	Vermont	Washington	W Virginia	Wisconsin	Wyoming				
Ischemic heart disease	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Low back & neck pain	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
Diabetes	3	7	4	5	4	11	5	3	7	3	3	4	4	5	3	5	4	6	3	5	3	6	3	4	5	4	9	4	6	4	3	4	4	3	6	4	4	5	4	6	3	6	4	3	4	5	3	5	4	5	8	
Road injuries	4	12	6	4	11	9	13	7	26	7	7	12	6	13	8	8	7	7	5	9	11	15	12	11	2	8	3	7	10	13	14	5	15	7	4	10	6	12	11	16	4	3	6	5	11	11	12	14	7	8	3	
Lung cancer	5	6	10	3	9	14	7	5	6	6	4	9	10	6	4	4	5	3	4	3	5	5	6	5	4	3	8	6	7	6	7	12	8	4	7	5	5	6	7	5	5	8	3	7	18	4	5	7	5	6	10	
COPD	6	8	9	6	10	7	11	9	22	8	6	18	7	8	5	6	6	5	8	8	12	11	8	10	6	7	6	5	5	8	11	9	10	8	8	7	7	9	10	9	8	7	8	8	9	7	9	9	6	10	4	
Depressive disorders	7	5	5	7	3	3	3	6	3	5	5	3	3	3	6	3	3	8	7	4	4	3	5	3	7	6	5	3	4	3	4	6	3	6	5	6	8	4	5	3	6	4	7	4	5	3	4	3	8	3	5	
Drug use disorders	8	3	3	10	5	4	4	4	5	4	8	6	9	4	7	12	8	4	6	7	15	4	4	8	9	5	10	14	3	5	5	3	6	5	16	3	3	3	3	4	7	14	5	6	6	6	6	4	3	4	7	
Cerebrovascular disease	9	14	17	9	14	18	17	18	18	17	9	15	16	14	14	15	14	15	10	15	16	17	16	17	8	15	16	16	15	18	15	19	17	12	15	14	11	15	17	20	9	16	9	14	14	19	13	17	12	16	16	
Other musculoskeletal	10	9	7	12	7	6	8	8	9	10	11	8	8	7	9	7	9	9	12	6	7	7	7	6	15	9	7	8	9	7	8	8	7	9	3	8	10	7	8	7	10	5	11	9	7	8	7	6	10	7	9	
Self-harm	11	4	8	8	18	5	16	12	31	12	16	10	5	17	10	10	10	10	14	11	8	13	11	12	12	10	4	12	8	12	19	7	18	15	9	13	9	8	14	14	14	9	10	16	3	10	15	11	9	11	6	
Sense organ diseases	12	11	11	11	8	8	9	10	10	11	12	7	11	9	12	9	11	14	13	10	9	9	10	7	11	11	11	9	11	9	9	10	9	10	10	11	14	11	12	10	12	10	13	11	8	9	10	10	11	9	11	
Skin diseases	13	15	12	14	6	12	6	11	8	9	10	5	12	10	13	11	12	13	11	13	6	8	9	9	17	14	13	10	13	11	6	13	5	11	13	9	15	10	9	8	11	12	14	10	10	13	8	8	13	12	15	
Interpersonal violence	14	24	19	18	20	30	29	24	4	19	19	31	40	16	22	48	27	25	9	49	14	33	17	38	14	18	31	29	22	47	22	20	24	21	43	23	21	34	23	36	19	34	18	20	38	38	25	30	25	30	31	
Congenital anomalies	15	10	16	13	16	10	15	13	15	14	15	13	14	15	13	16	12	16	18	21	16	13	15	10	12	14	11	12	17	13	15	13	13	11	15	12	16	18	15	16	11	12	13	13	16	11	12	13	14	16	15	12
Alzheimer disease	16	13	15	15	12	13	10	15	12	15	13	11	13	11	11	16	13	11	18	12	10	10	14	16	13	12	15	16	10	12	11	11	14	12	12	13	13	15	11	13	15	15	12	16	12	11	13	14	13	14		
Migraine	17	19	13	19	17	16	14	17	25	16	18	16	17	20	17	17	18	16	21	17	17	14	18	19	22	17	19	19	17	15	16	16	14	16	17	17	17	14	13	13	18	19	17	17	15	17	17	16	15	17	18	
Chronic kidney disease	18	22	20	17	19	20	20	19	17	20	17	20	20	18	18	21	19	18	15	19	20	18	21	20	13	20	21	20	18	20	18	21	20	17	20	18	18	20	19	21	17	21	19	18	20	21	18	20	18	20	22	
Anxiety disorders	19	16	14	16	13	15	12	14	13	13	14	14	15	12	16	14	15	17	17	14	13	12	15	13	18	16	15	13	14	14	10	14	12	18	14	16	16	18	16	12	15	13	16	15	12	15	14	12	17	14	13	
Neonatal preterm birth	20	32	29	26	28	28	22	16	11	21	22	21	27	21	21	27	22	24	19	21	18	25	20	26	21	23	28	27	30	24	27	28	27	19	22	20	24	29	20	19	21	22	23	25	29	29	20	29	23	21	28	
Colorectal cancer	21	20	22	21	23	23	23	21	21	22	23	22	21	22	20	20	21	19	20	20	24	21	22	22	19	22	20	21	21	21	20	22	22	23	21	21	19	21	21	22	22	20	20	21	24	20	23	22	19	22	20	
Lower respiratory infect	22	30	28	20	27	29	26	26	24	28	20	25	26	23	23	25	23	21	22	28	22	24	26	29	20	24	26	26	20	29	23	27	21	22	27	25	23	30	25	26	23	25	22	22	23	30	21	28	22	27	23	
Iron-deficiency anemia	23	18	18	22	15	17	18	20	23	18	21	17	18	19	19	18	17	20	25	16	19	19	19	18	23	19	18	17	19	16	17	35	16	20	18	19	22	17	6	17	20	18	21	19	17	18	19	18	21	18	17	
Breast cancer	24	28	26	23	22	24	25	23	19	24	25	27	23	24	25	23	24	23	23	24	23	24	23	23	24	24	25	24	23	24	23	21	26	23	24	24	24	25	23	24	24	24	24	25	24	22	23	24	23	24	24	26
Other cardiovascular	25	26	31	25	30	27	28	29	30	31	28	29	24	29	26	26	26	27	28	27	29	28	29	23	27	27	25	24	31	27	29	33	30	28	30	28	28	26	27	28	26	28	28	28	27	25	27	25	28	26	25	

Outline

- 1) **US Burden by State**
- 2) County analysis

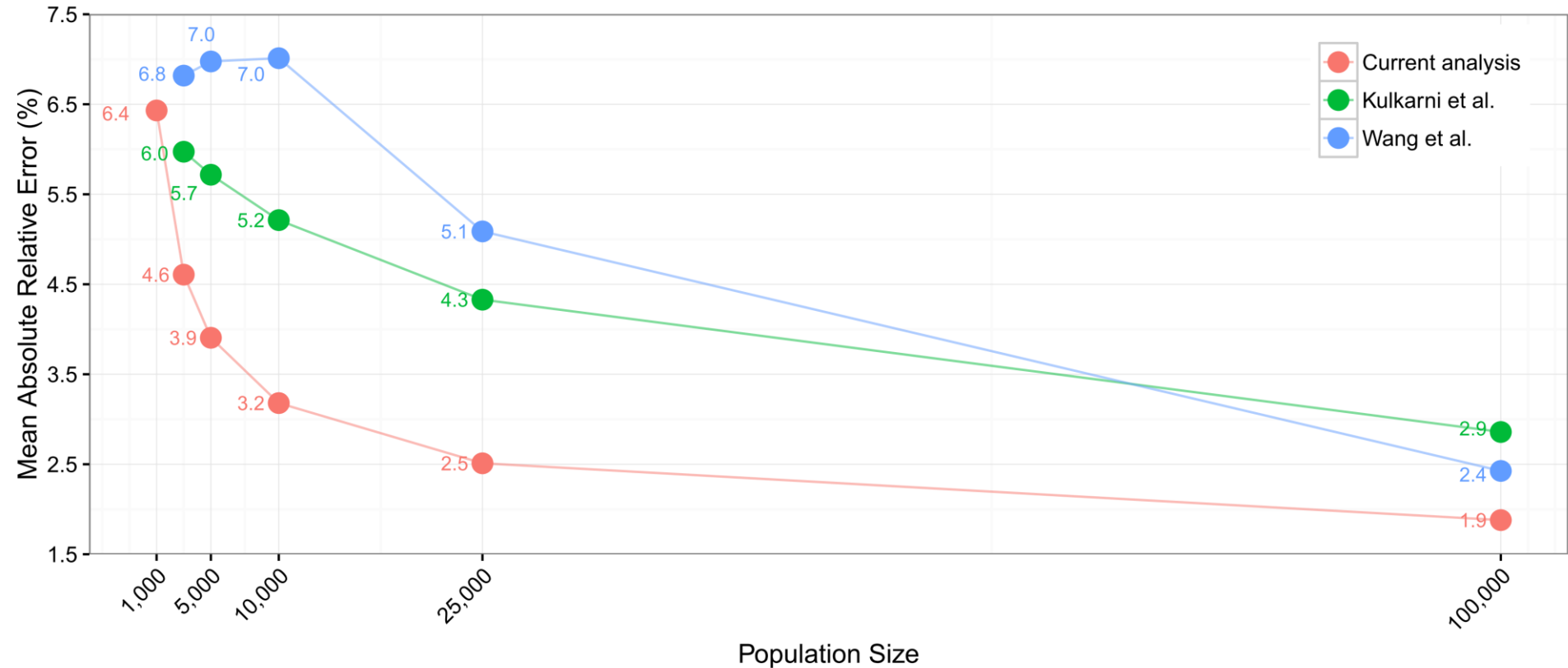
Mortality analysis by county: methodological advancements

- In previous iterations of county-level life expectancy estimation, we had to fit separate models by age and year due to computational limitations
- With new software (TMB) we are now able to fit much more complex models on data for all years and ages combined
- This allows us to capitalize on temporal patterns and age patterns in addition to spatial patterns
- Objective validation tests show these models give more accurate estimates (and confidence intervals with better coverage)
- This has allowed us to expand beyond analyzing all-cause mortality to cause-specific mortality for 213 causes

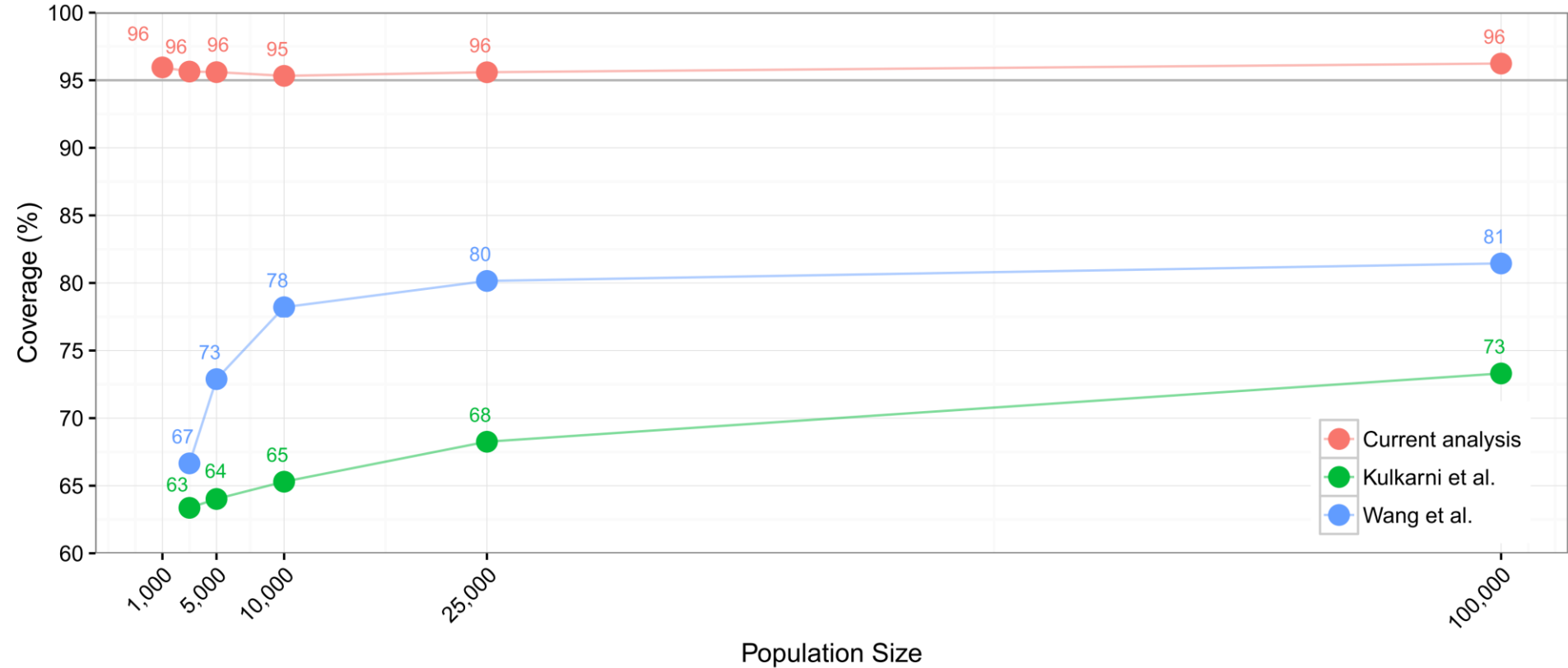
Validation framework

- 1) Identify a **validation set**
- 2) Calculate the **gold standard**
- 3) Create **validation datasets**
- 4) **Fit the model** to each validation dataset and **generate predictions** for the validation set
- 5) Compare these predictions to the gold standard and calculate **summary error metrics**
 - *Bias (mean error, mean relative error).*
 - *Precision (mean absolute error, mean absolute relative error, RMSE).*
 - *Accuracy of the uncertainty intervals (coverage).*

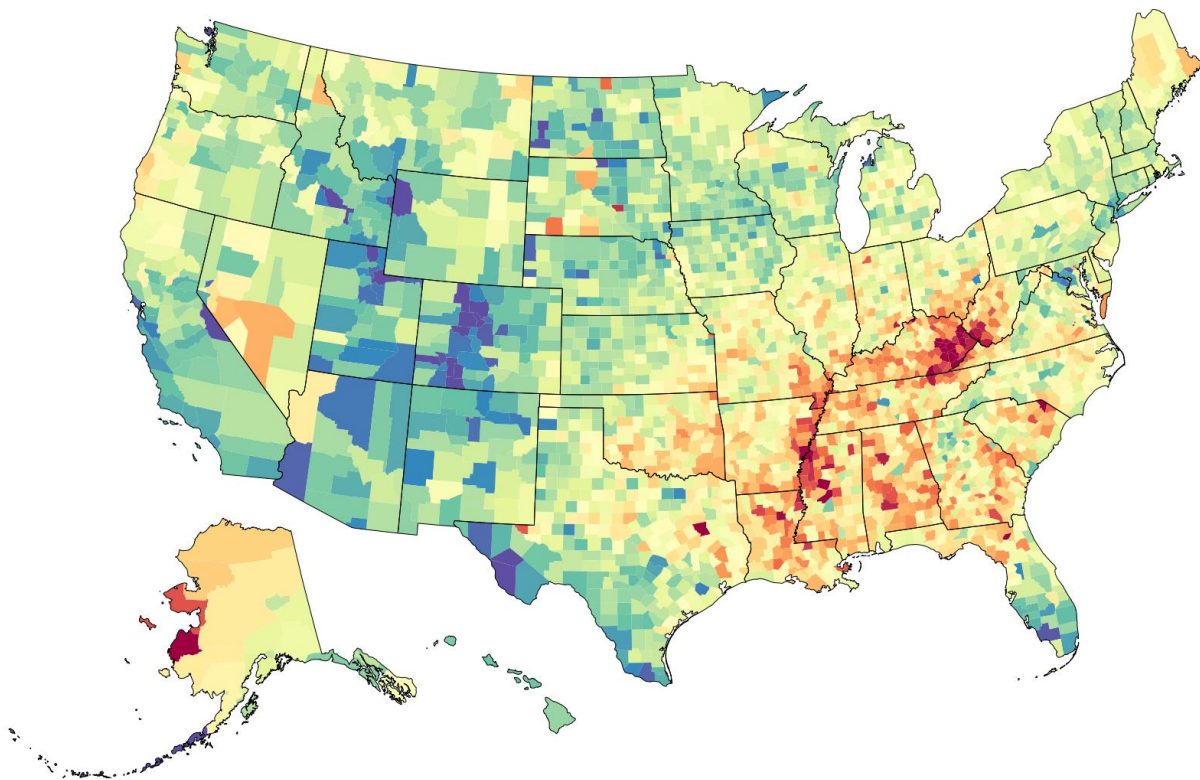
Validation results: precision



Validation results: coverage

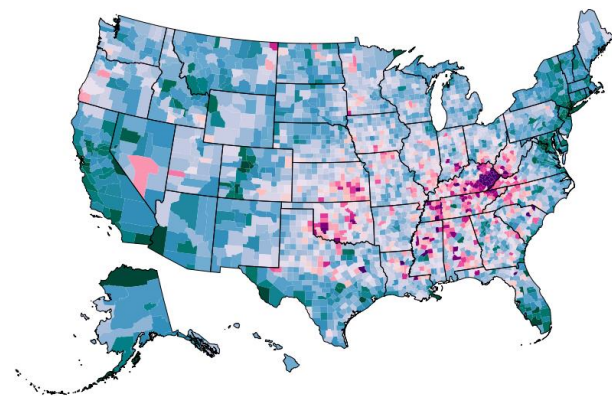


Neoplasms



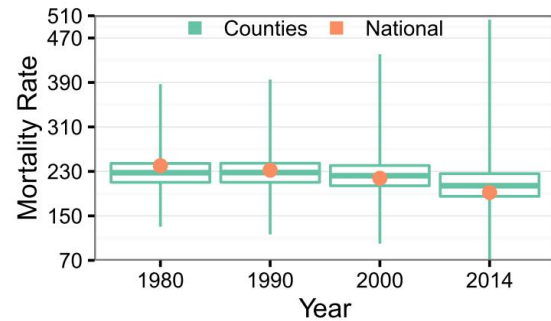
Age-standardized mortality rate, 2014 (deaths per 100,000 population):

<130 160 190 220 250 280 >300

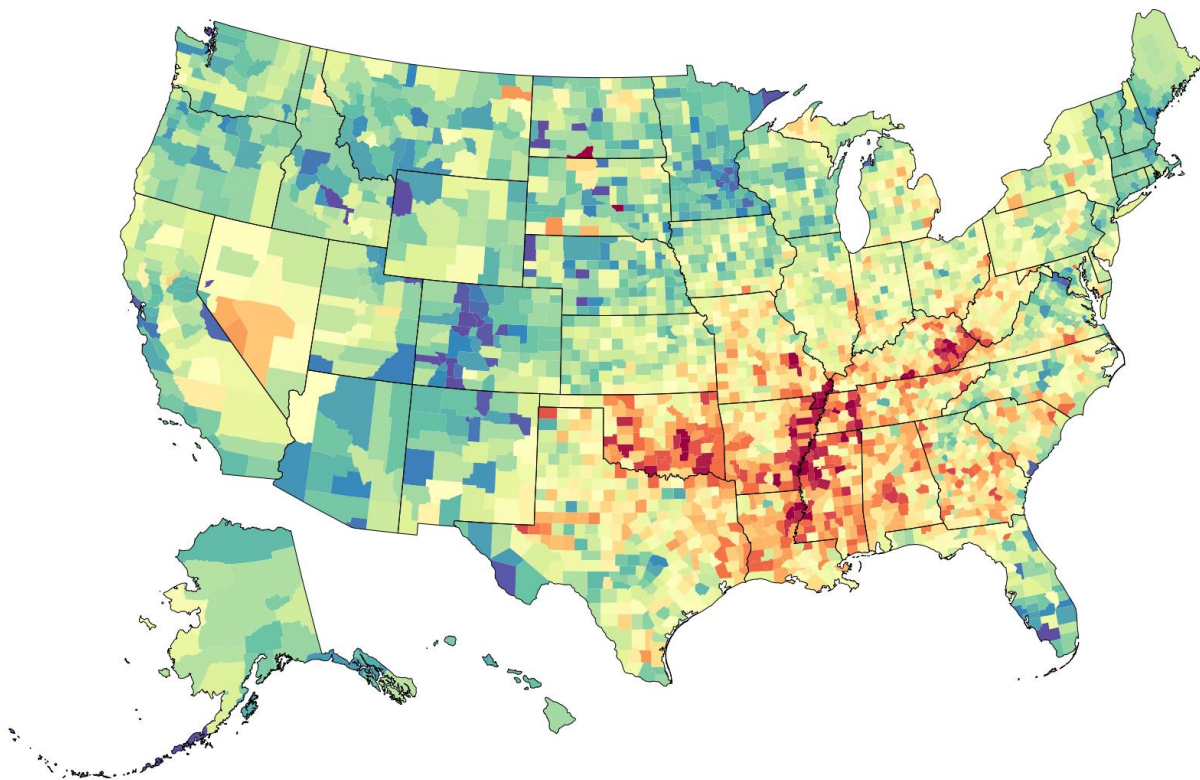


Change in mortality rate, 1980–2014 (%):

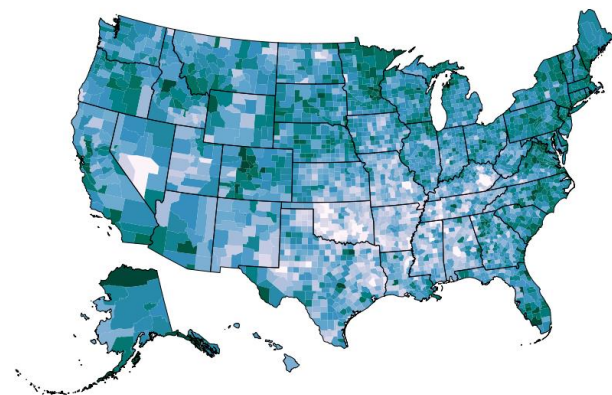
<-36% -22% -8% 6% >20%



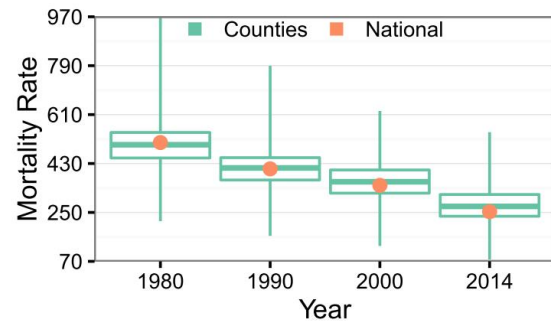
Cardiovascular diseases



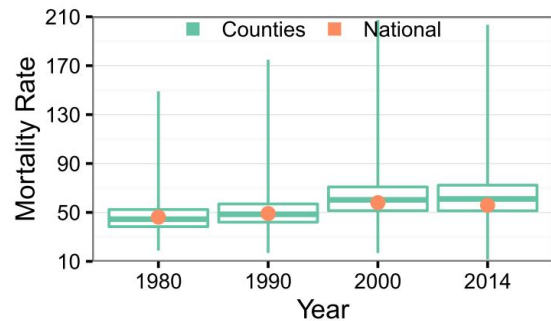
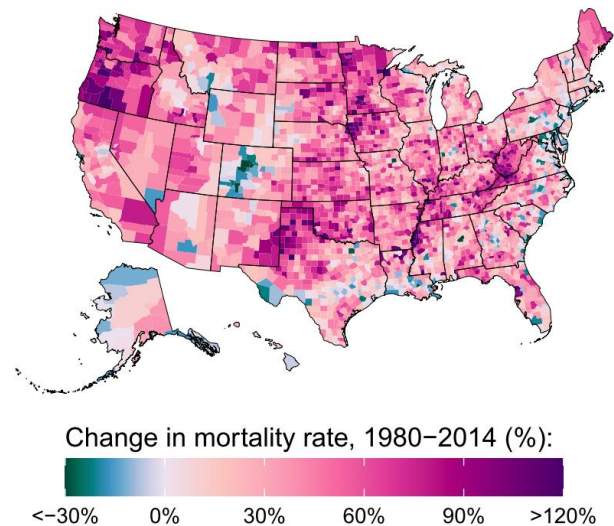
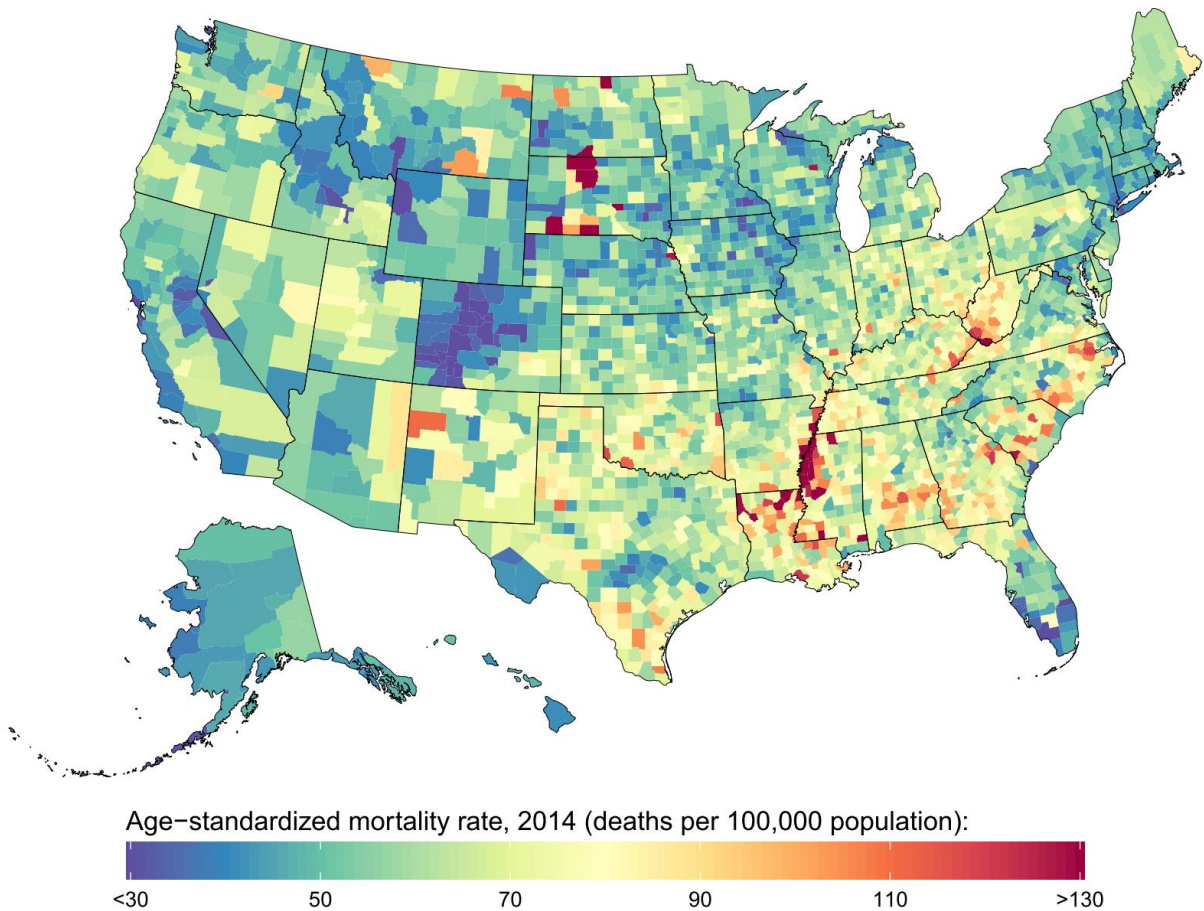
Age-standardized mortality rate, 2014 (deaths per 100,000 population):



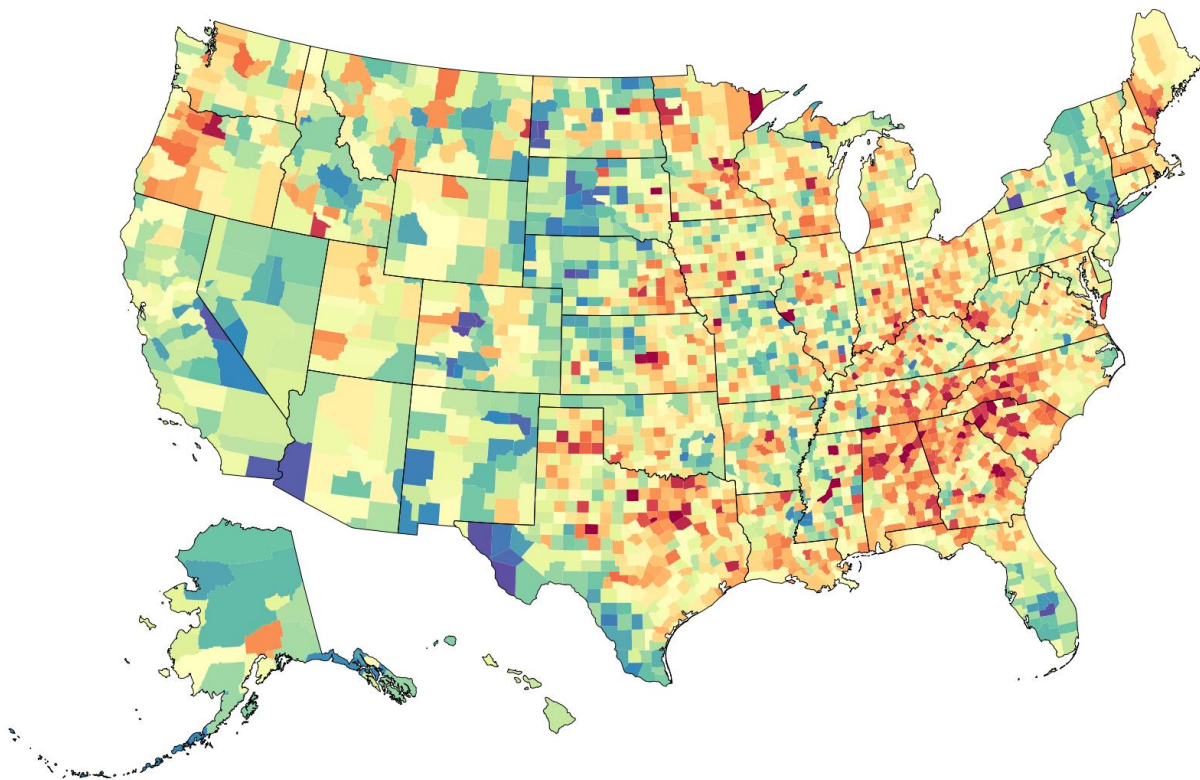
Change in mortality rate, 1980–2014 (%):



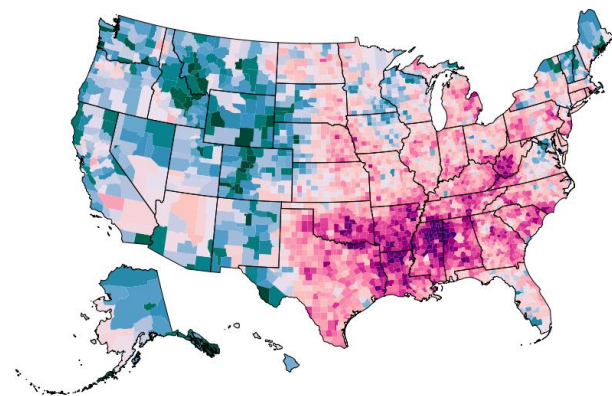
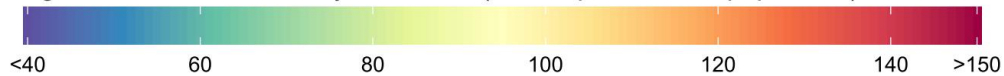
Diabetes, urogenital, blood, and endocrine disorders



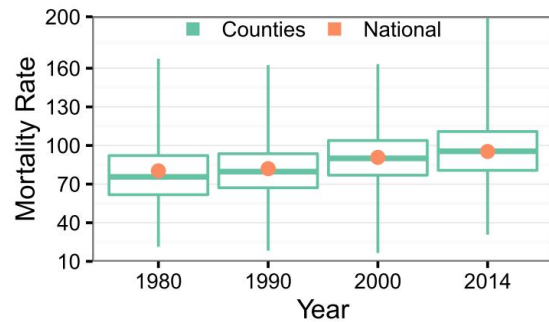
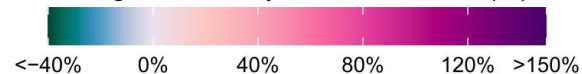
Neurological disorders



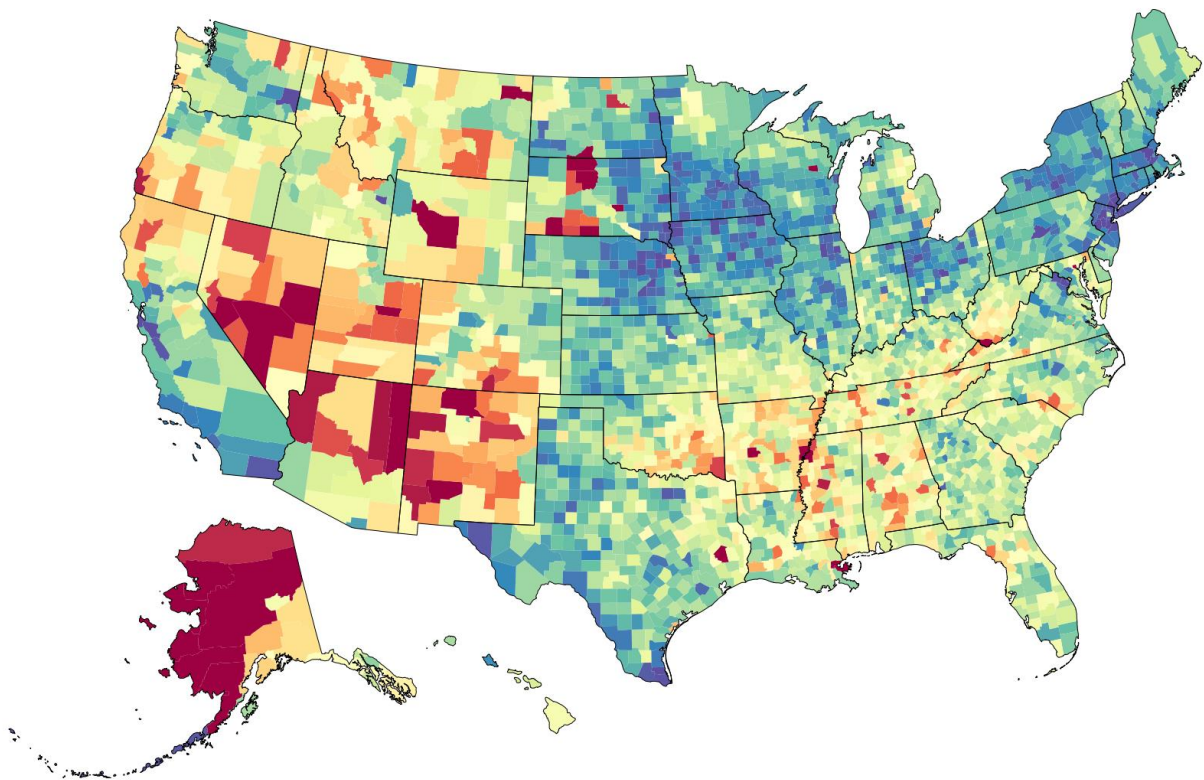
Age-standardized mortality rate, 2014 (deaths per 100,000 population):



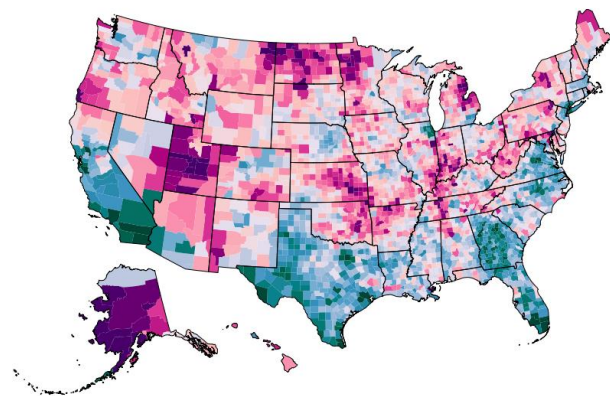
Change in mortality rate, 1980–2014 (%):



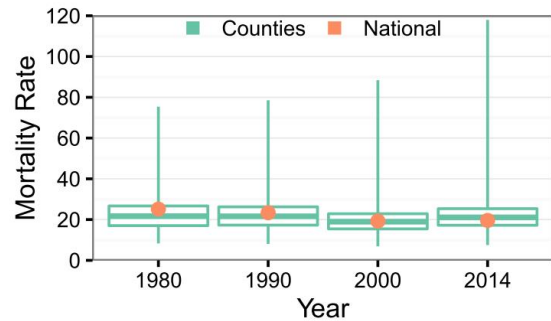
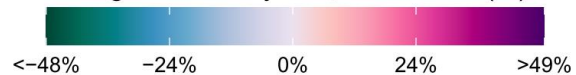
Self-harm and interpersonal violence



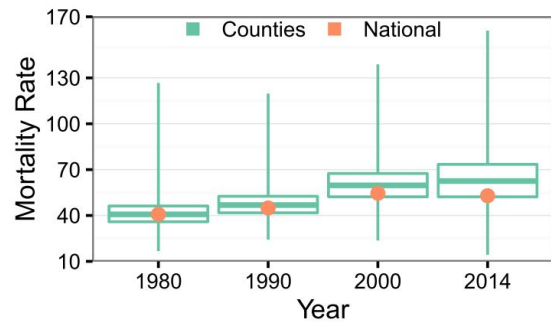
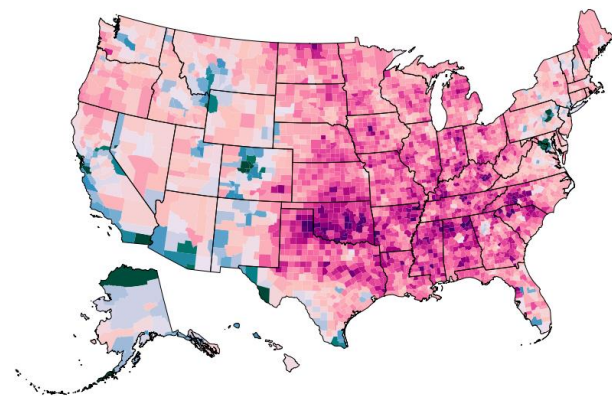
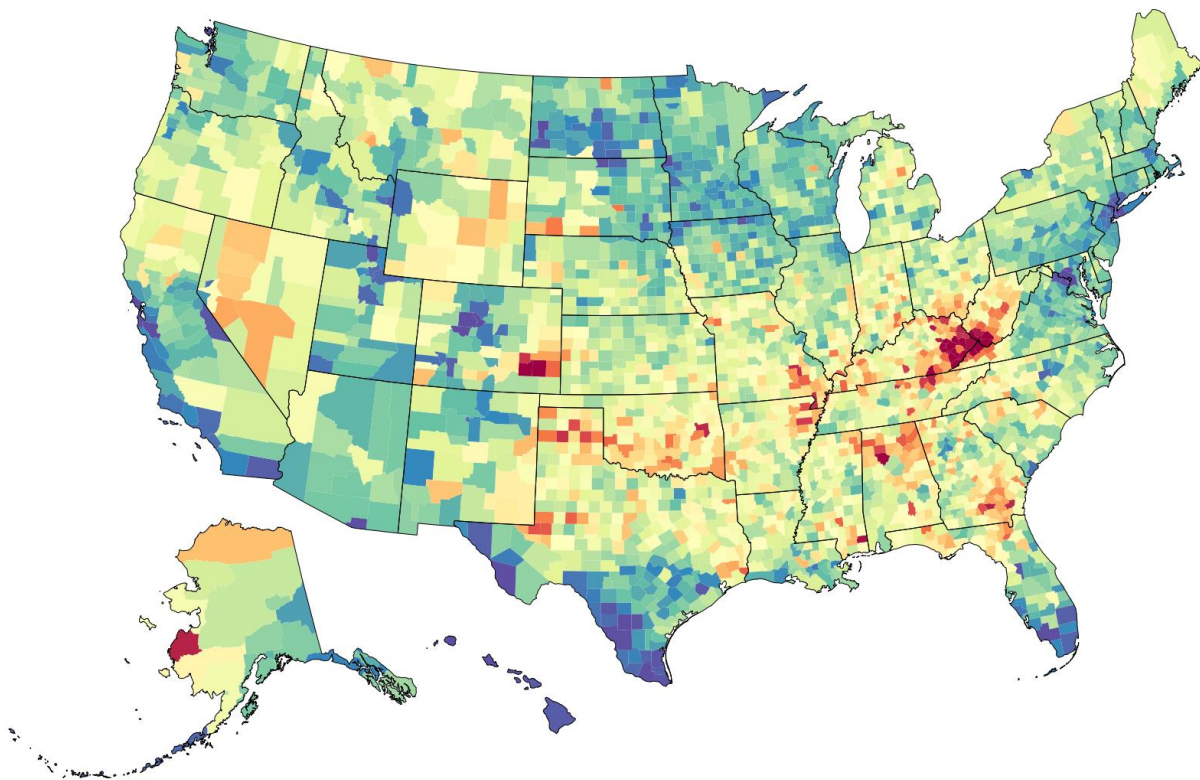
Age-standardized mortality rate, 2014 (deaths per 100,000 population):



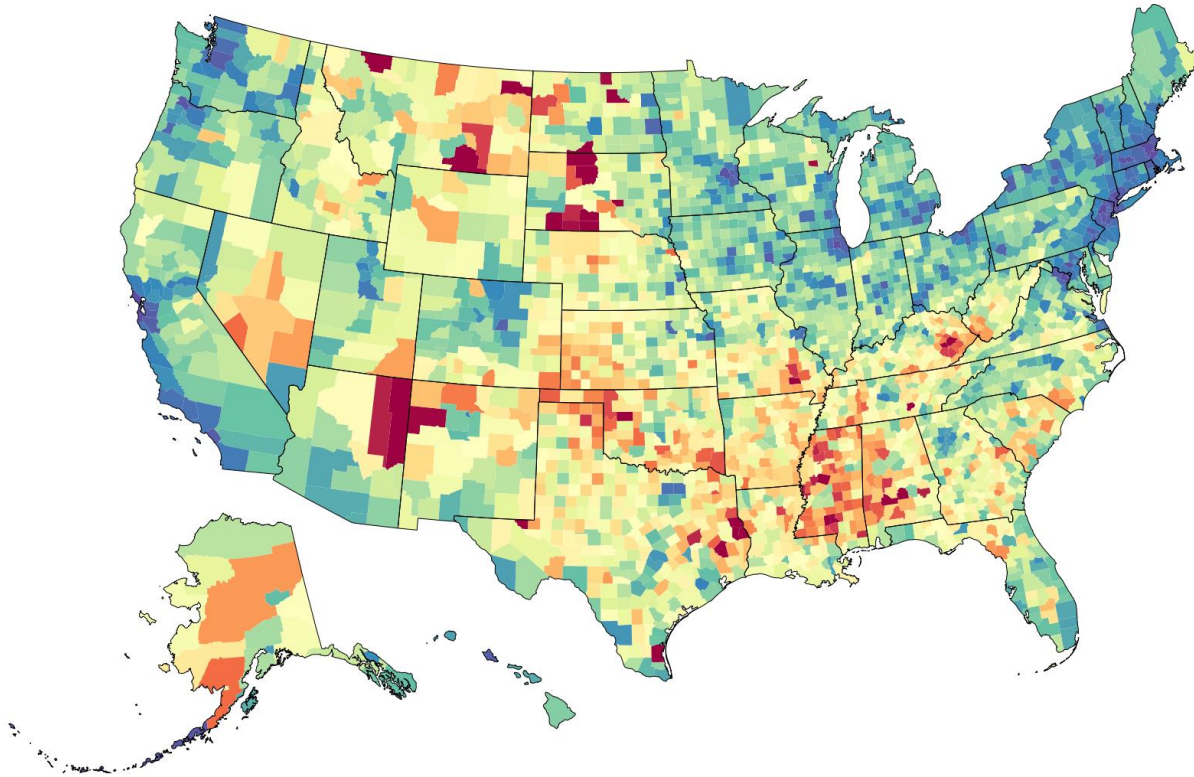
Change in mortality rate, 1980–2014 (%):



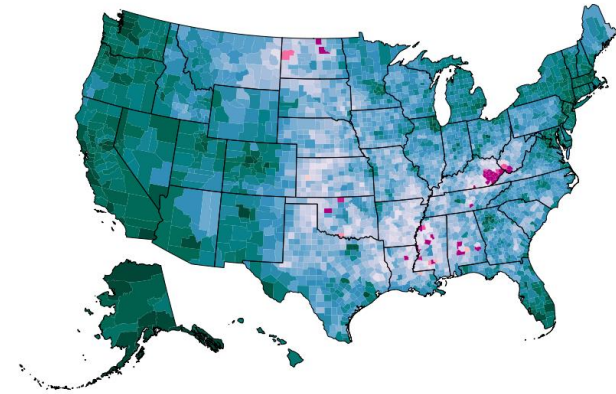
Chronic respiratory diseases



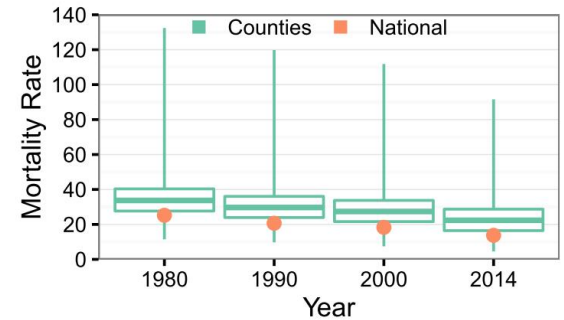
Transport Injuries



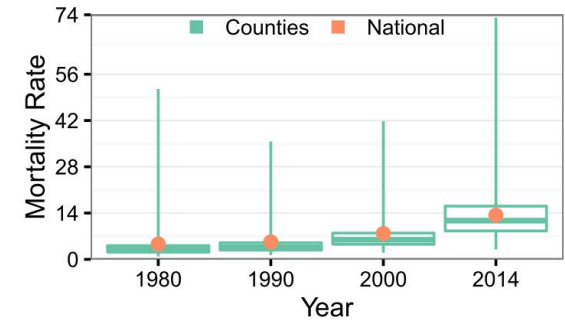
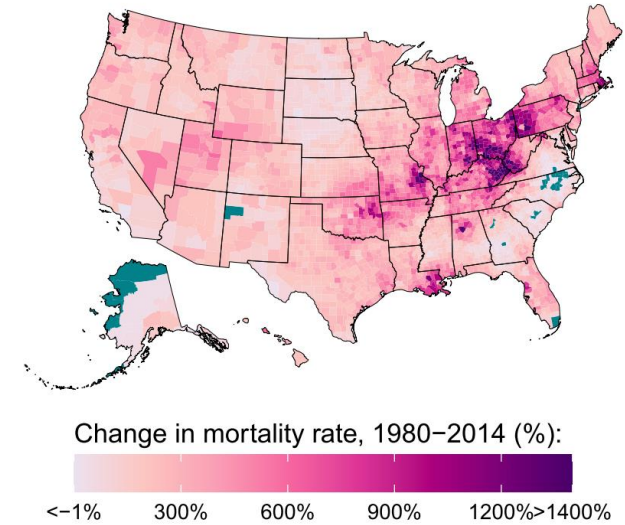
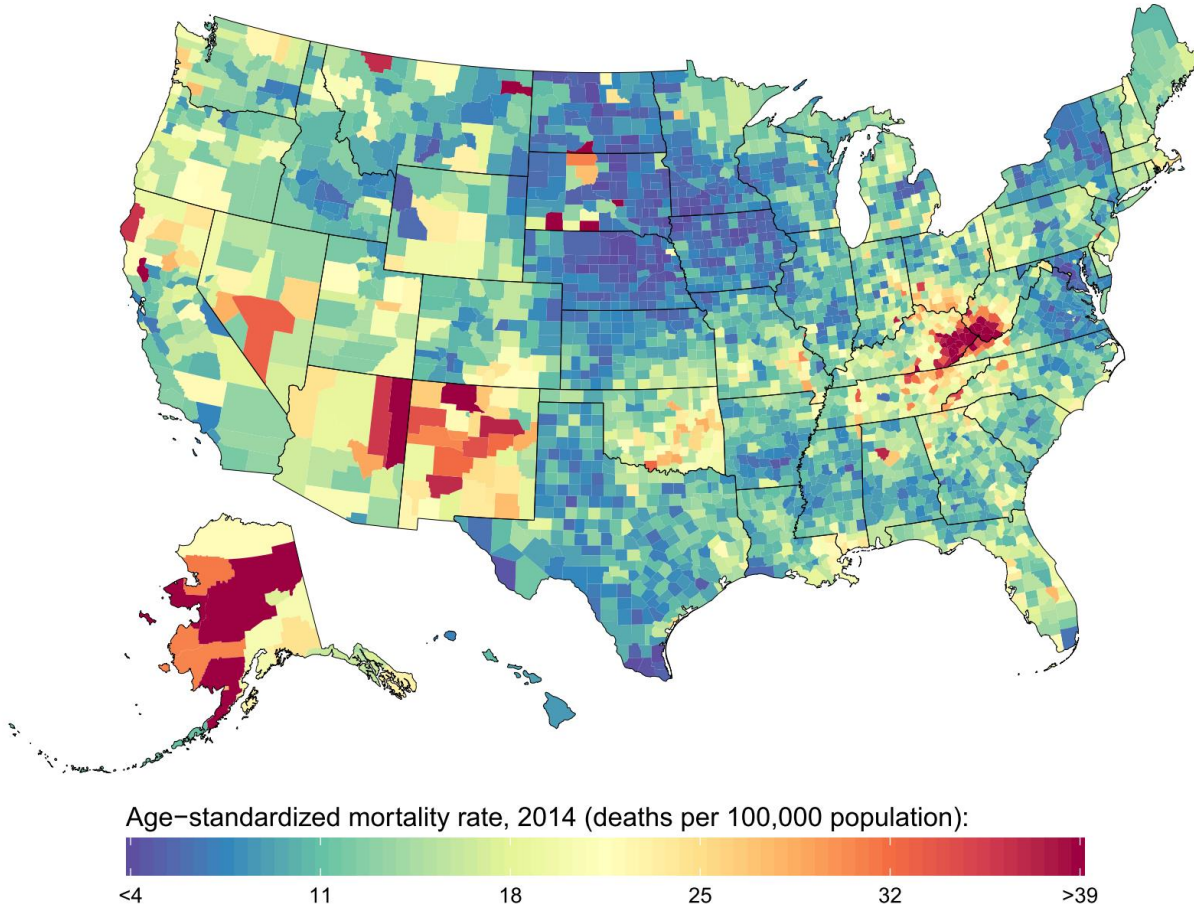
Age-standardized mortality rate, 2014 (deaths per 100,000 population):



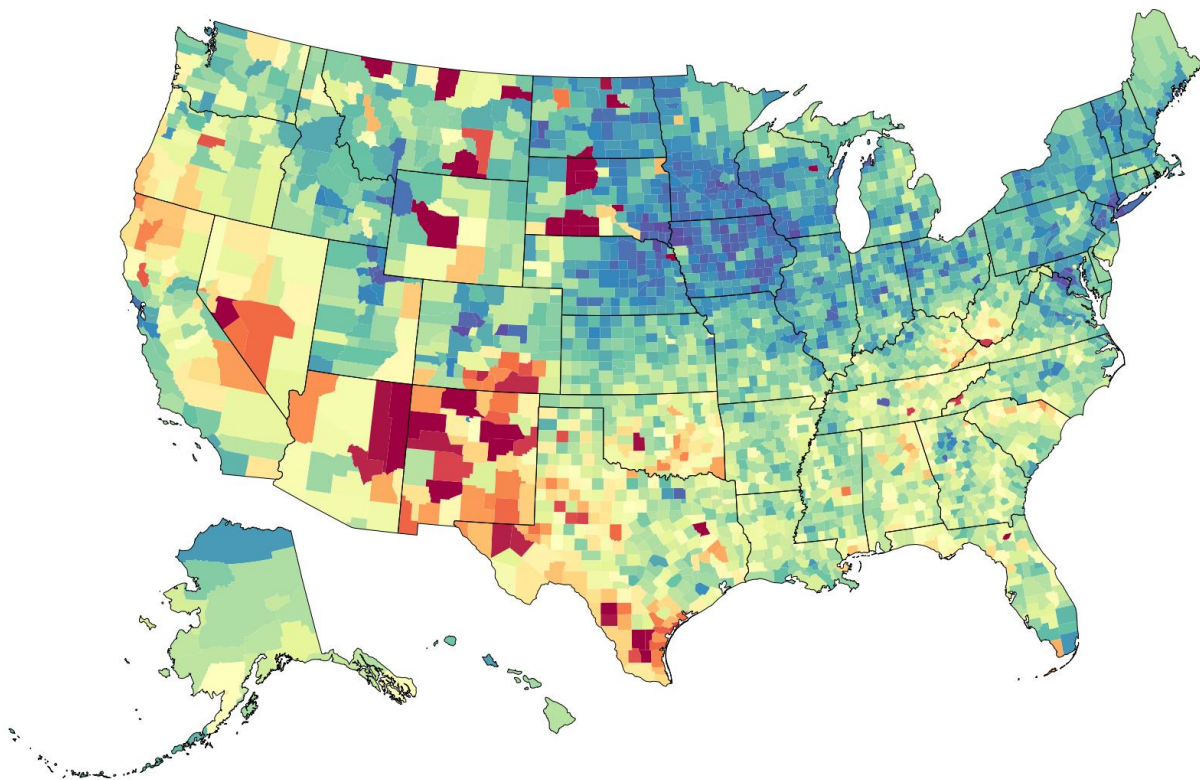
Change in mortality rate, 1980–2014 (%):



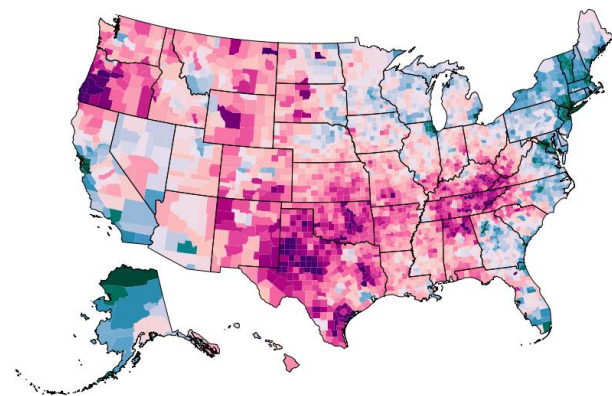
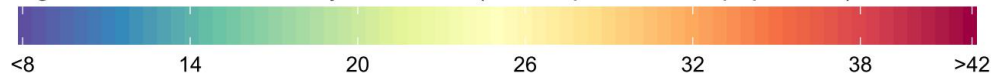
Mental and substance use disorders



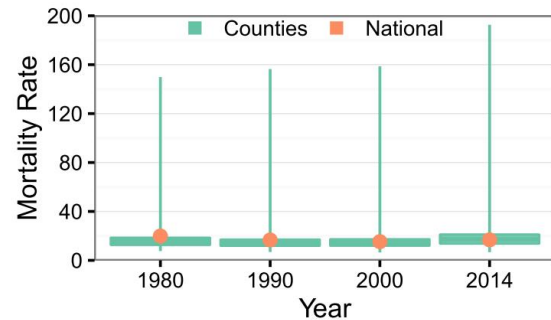
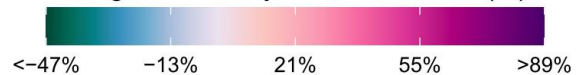
Cirrhosis and other chronic liver diseases



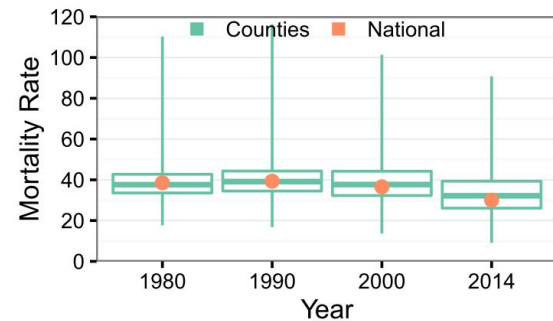
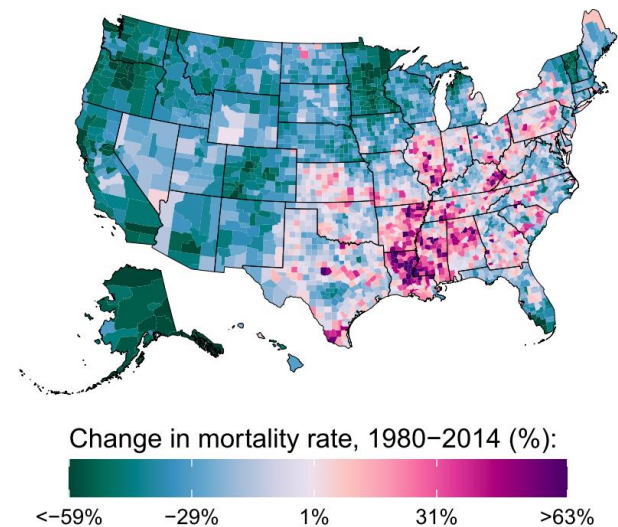
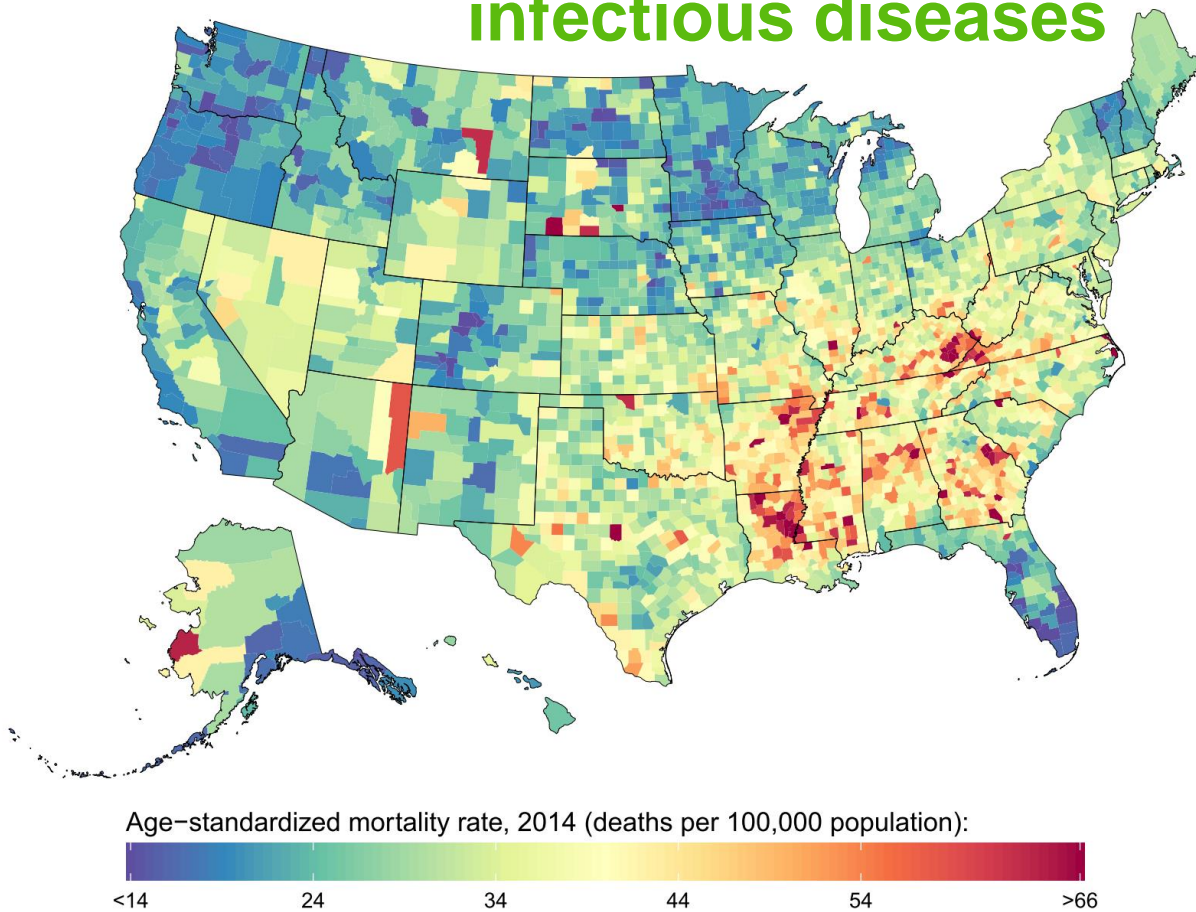
Age-standardized mortality rate, 2014 (deaths per 100,000 population):



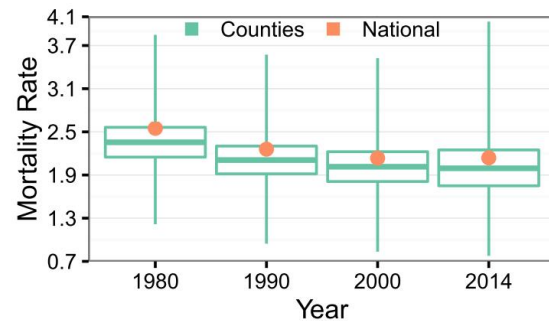
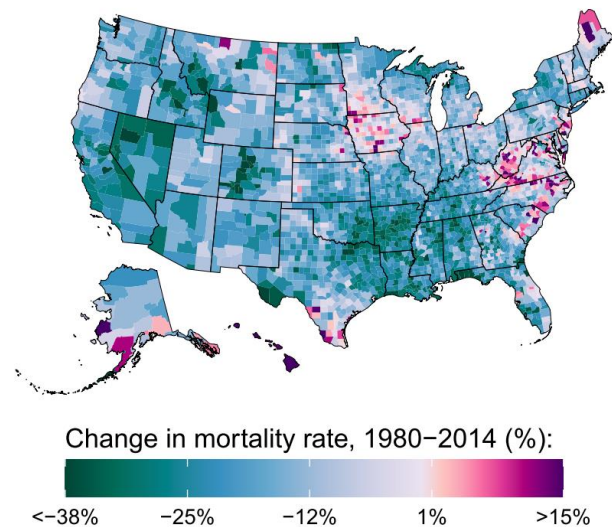
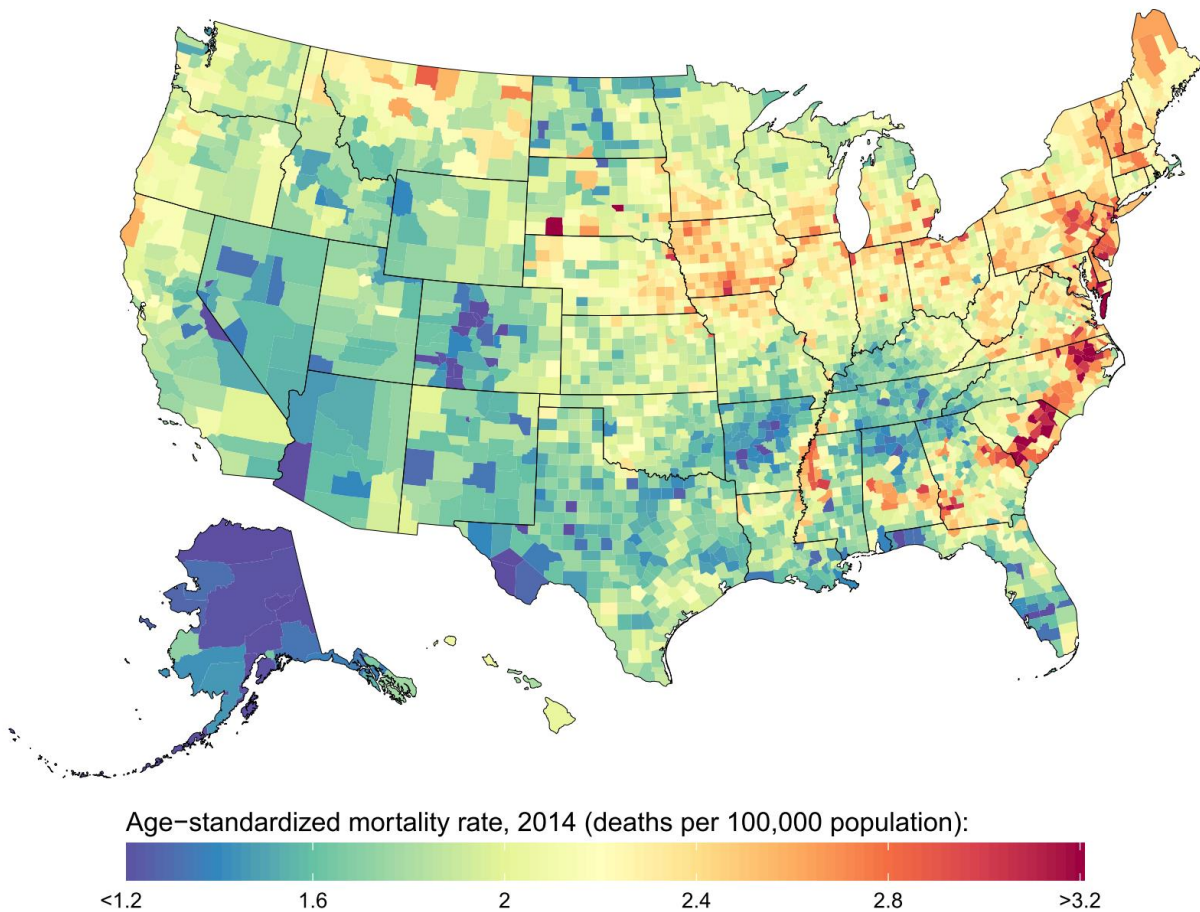
Change in mortality rate, 1980–2014 (%):



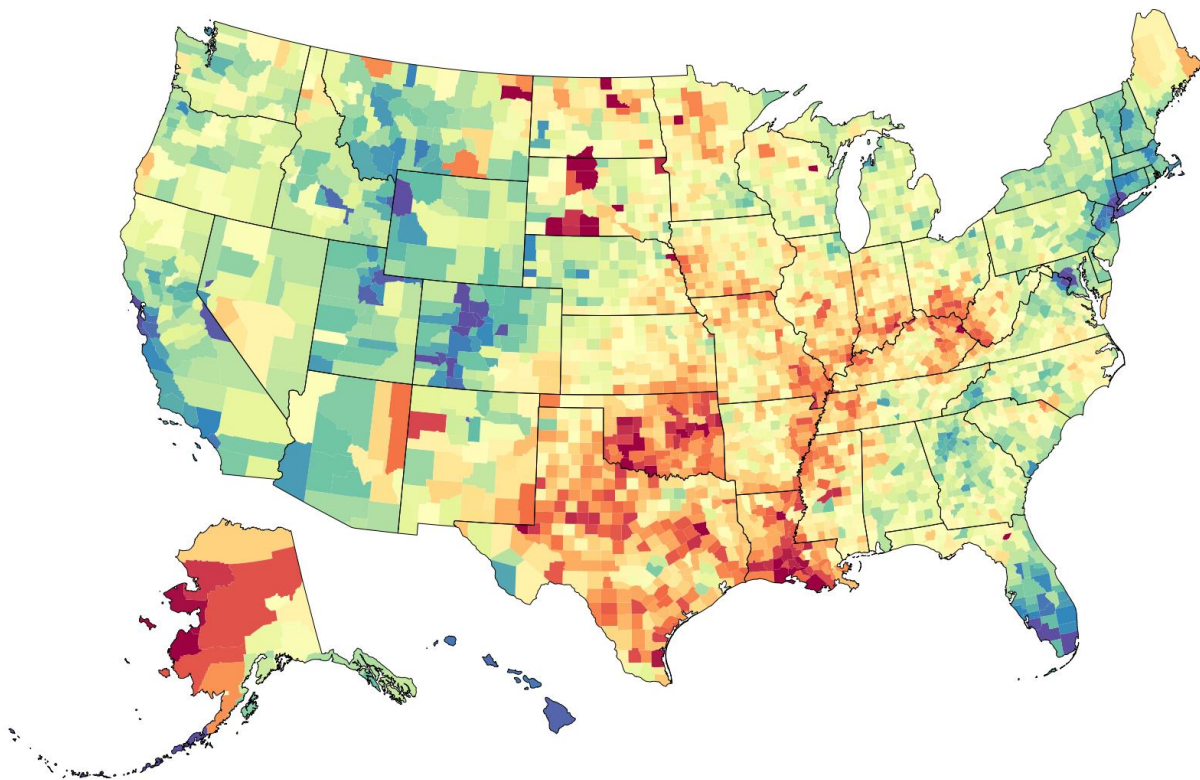
Diarrhea, lower respiratory, and other common infectious diseases



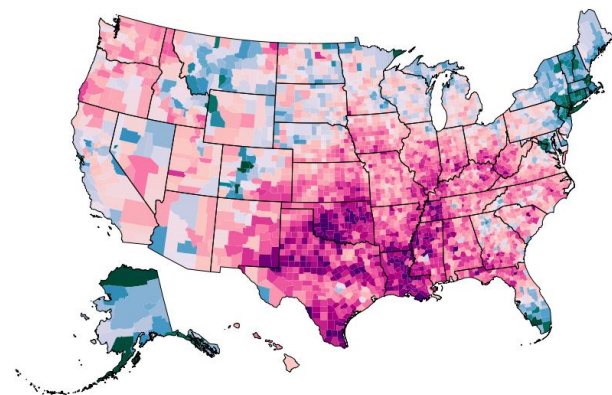
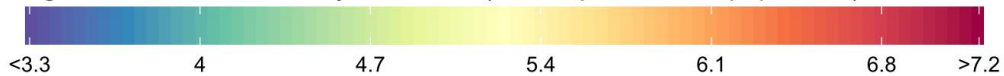
Uterine cancer



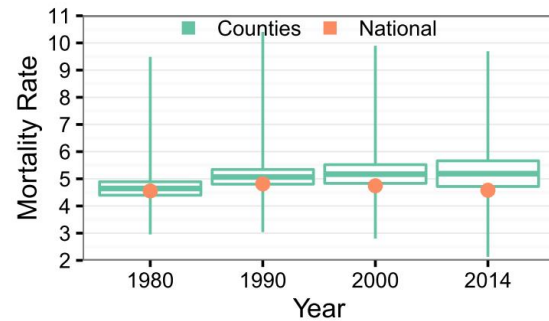
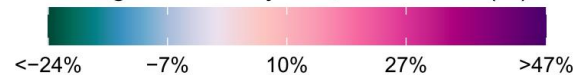
Kidney cancer



Age-standardized mortality rate, 2014 (deaths per 100,000 population):



Change in mortality rate, 1980–2014 (%):



Liver cancer

