

Title: State-Level Hypertension Prevalence and Control Among Adults in the U.S.

Authors: Siran He, Soyoun Park, Yui Fujii, Samantha Lange Pierce, Emily M. Kraus, Hilary K. Wall, Nicole L Therrien, Sandra L. Jackson

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APPENDIX MATERIAL

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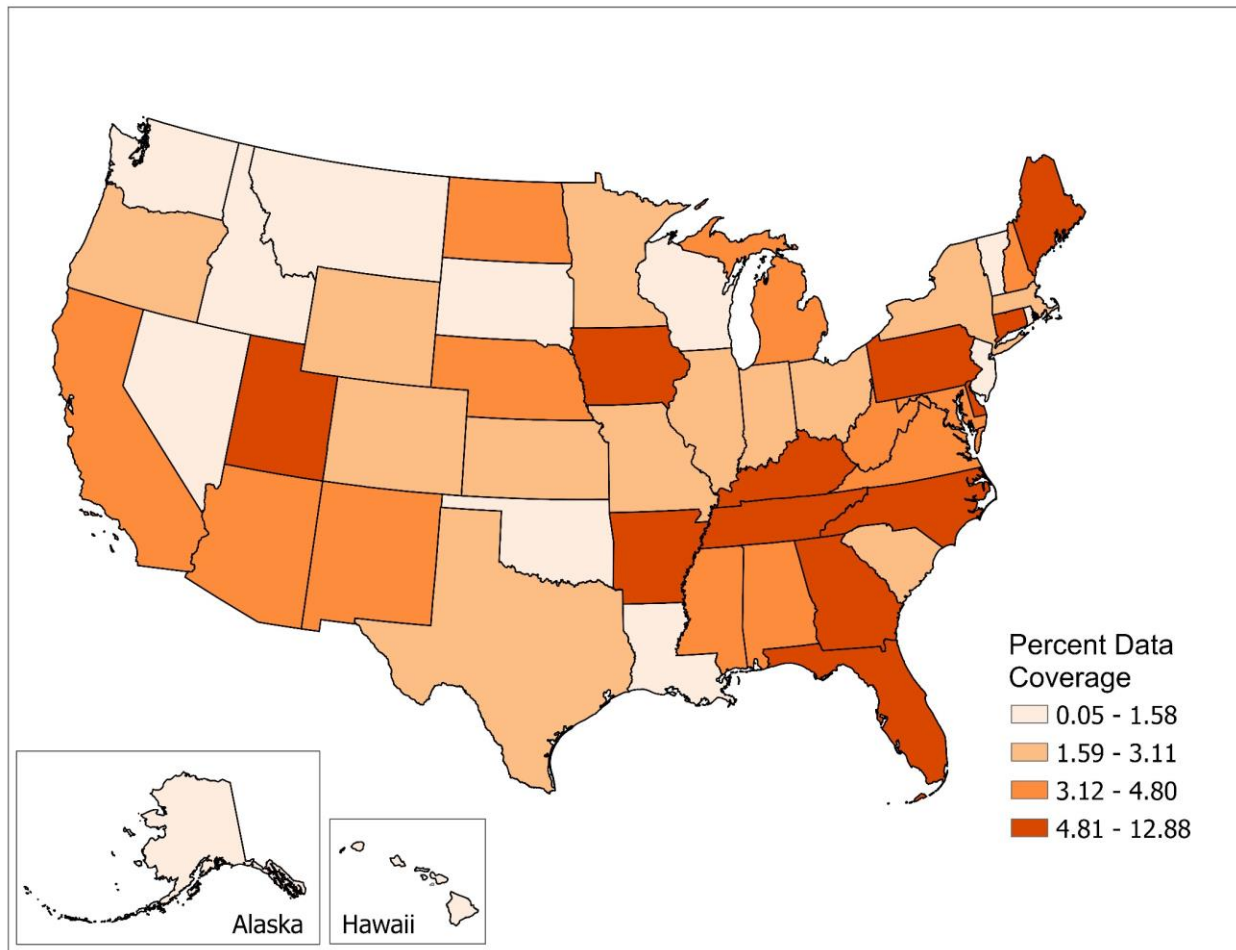
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Appendix Table 1. Summary of the electronic health record-based hypertension e-phenotype

Data type	Electronic health records (EHR) data in the Observational Medical Outcomes Partnership (OMOP) common data model <ul style="list-style-type: none"> • Example: IQVIA Ambulatory EMR-US dataset
Measurement period	12 months <ul style="list-style-type: none"> • Example: January 1, 2019 to December 31, 2019
Denominator:	
Exclusion criteria	Following the electronic clinical quality measurement (CMS165v10) specifications, over a one-year measurement period, exclude: <ul style="list-style-type: none"> • Pregnant women aged 18-44 years • Patients who had end-stage renal disease • Patients aged > 65 years who received long-term care • Patients in hospice care or palliative care
Inclusion criteria	Over a one-year measurement period, include: <ul style="list-style-type: none"> • Patients aged 18 years and above, AND • Patients who have at least 1 blood pressure (BP) measurement in the past 24 months: <ul style="list-style-type: none"> ○ BP measurement refers to 1 systolic BP and 1 diastolic BP recorded on the same day ○ Example: If 2019 is the main measurement period, then January 01, 2018 to December 31, 2019 is considered to be the past 24 months
Numerator:	
Case identification (“suspected hypertension”)	Over a one-year measurement period, hypertension cases can be defined as patients who had: <ul style="list-style-type: none"> • At least 1 diagnosis code for hypertension, OR • At least 2 high BP measurements on two or more separate days (at either $\geq 140/90$mmHg or $\geq 130/80$mmHg thresholds, depending on research needs), OR • At least 1 prescription of antihypertensive medication

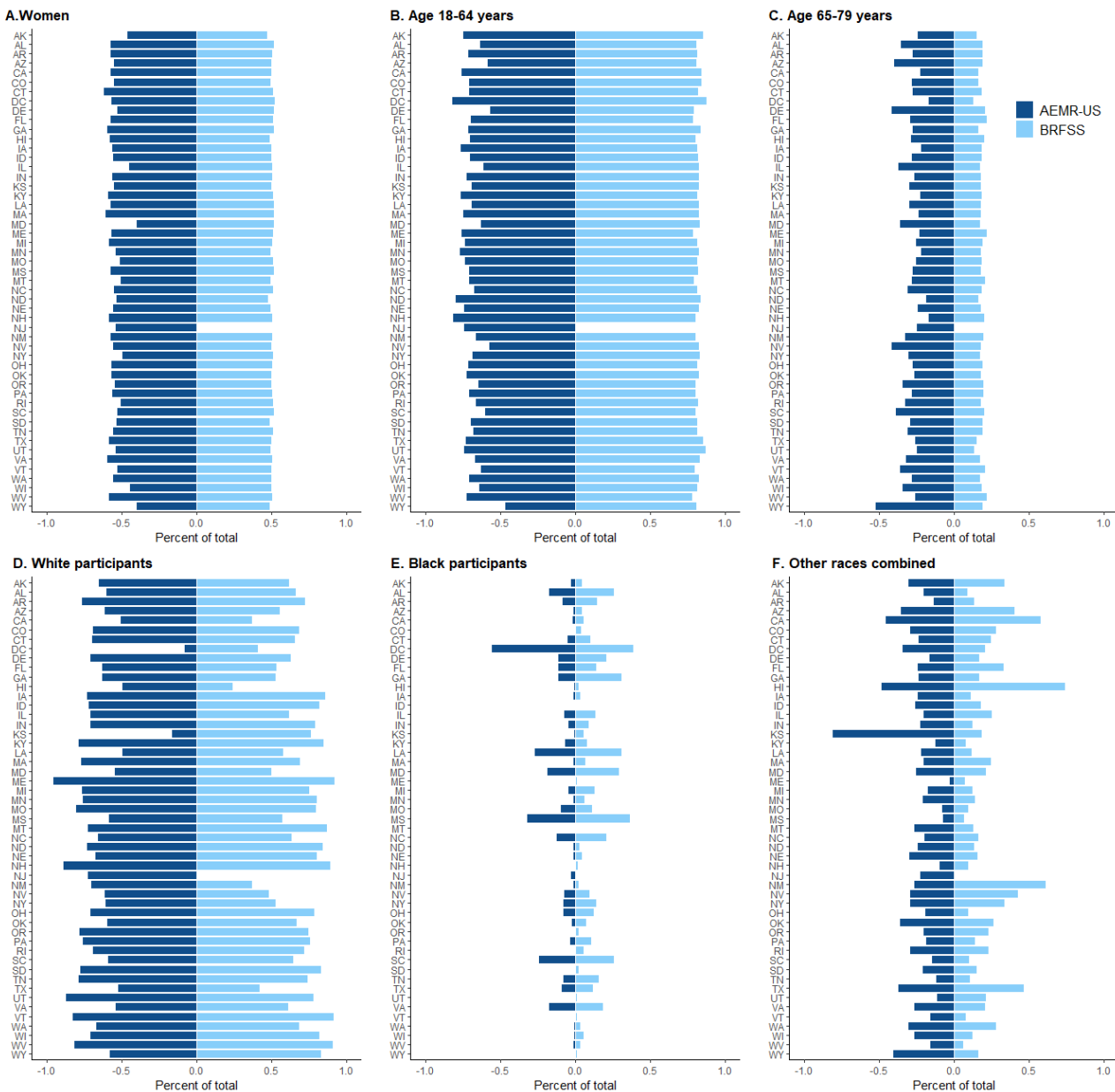
Note: All standard code lists for the criteria are available upon reasonable request to the corresponding author

Appendix Figure 1. Data coverage by state in AEMR-US 2019



Note: The cut points were based on the quartiles of data coverage. Data coverage was defined as state-level unique patient count as a proportion of the population in the corresponding state based on 2010 US census. States with data coverage < 1% included Alaska, Hawaii, Idaho, Montana, Oklahoma, Rhode Island, Vermont, Washington, and Wisconsin. Abbreviations: AEMR-US, IQVIA Ambulatory Electronic Medical Record-US.

Appendix Figure 2. Comparison of population characteristics by state in AEMR-US 2019 and BRFSS 2019



Note: Data unavailable for New Jersey in BRFSS 2019. “Other” category in this panel C contains patients with Hispanic ethnicity, Asians, multi-racial identification, other races, and unknown. Abbreviations: AEMR-US, IQVIA Ambulatory Electronic Medical Record-US; BRFSS, the Behavioral Risk Factor Surveillance System

Appendix Table 2. Differences in the estimates of age-standardized hypertension prevalence by state between IQVIA AEMR-US 2019 and BRFSS 2019

State	AEMR-US estimates (%)	BRFSS Estimates (%)	Difference in estimates (%)
Wyoming	53.7	27.7	26.0
Alabama	51.0	39.1	11.9
Mississippi	50.8	41.0	9.8
South Carolina	48.0	34.3	13.7
Louisiana	42.8	37.4	5.4
West Virginia	42.5	38.9	3.7
Kentucky	42.5	37.5	5.0
Oklahoma	42.3	35.2	7.2
Arkansas	41.0	37.9	3.1
Delaware	41.0	32.3	8.7
Missouri	40.2	27.4	12.8
Tennessee	40.0	36.0	4.0
Indiana	39.8	32.0	7.9
Ohio	39.3	31.2	8.1
Virginia	38.7	30.8	7.9
North Carolina	38.5	31.9	6.6
Maryland	37.7	31.1	6.6
Florida	36.5	28.5	7.9
Nevada	36.4	30.6	5.8
Georgia	36.3	32.8	3.5
Texas	35.3	30.6	4.7
Arizona	34.1	29.4	4.8
Kansas	34.0	31.1	2.9
Oregon	33.9	27.4	6.5
South Dakota	33.9	27.7	6.2
Michigan	33.4	31.5	1.9
New Mexico	33.1	28.4	4.7
Pennsylvania	33.0	28.9	4.1
Utah	32.9	26.2	6.7
North Dakota	32.5	27.5	5.0
Nebraska	32.1	28.3	3.8
Montana	31.8	25.4	6.4
Rhode Island	31.3	29.7	1.6
Wisconsin	31.2	27.2	4.0
Washington	31.0	28.1	3.0
District of Columbia	31.0	29.0	1.9
Iowa	30.9	28.5	2.4
New Hampshire	30.5	27.2	3.3
Idaho	30.3	28.1	2.2
Colorado	30.2	24.0	6.2

Alaska	29.9	32.2	-2.3
New Jersey	29.8	--	--
Connecticut	29.6	26.7	2.9
California	28.7	25.9	2.8
New York	28.7	26.6	2.1
Maine	28.4	30.9	-2.6
Minnesota	27.4	25.8	1.6
Massachusetts	26.2	24.8	1.5
Vermont	23.5	25.8	-2.2
Illinois	23.5	29.2	-5.8
Hawaii	21.7	27.5	-5.9

Note: States were ordered based on the highest age-standardized hypertension prevalence (53.7%) to the lowest (21.7%) in AEMR-US. The difference column represents direct subtraction: AEMR-US hypertension estimates minus BRFSS hypertension estimates. Bold and italic numbers showed differences > 10%. Abbreviations: AEMR-US, IQVIA Ambulatory Electronic Medical Record-US; BRFSS, the Behavioral Risk Factor Surveillance System

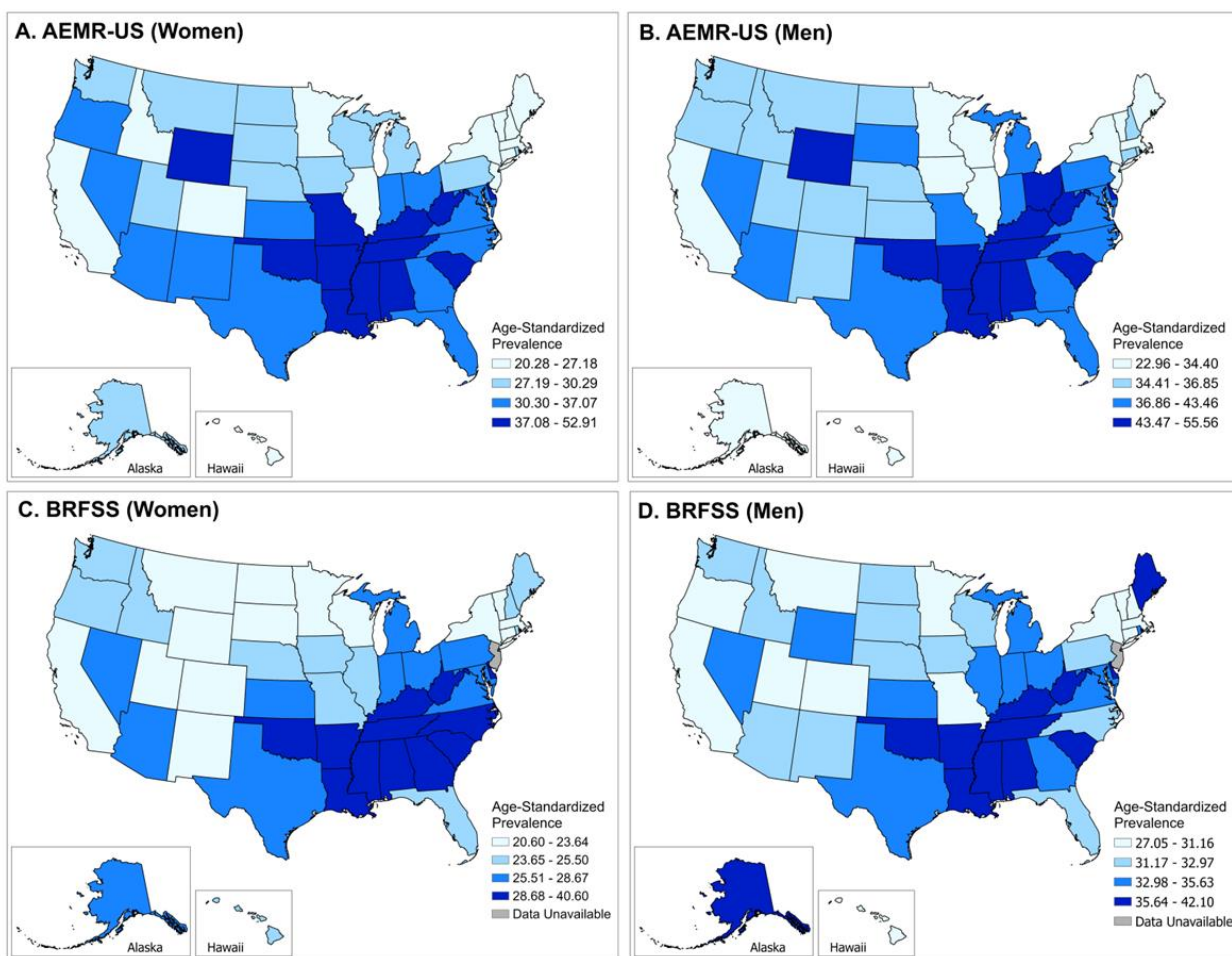
Appendix Table 3. State-level crude hypertension prevalence by sociodemographic characteristics in AEMR-US 2019 and BRFSS 2019

AEMR-US	Total	Sex		Age group (year)			Race			
		Female	Male	18-44	45-64	65-79	Black	White	Asian	Other
ALL	44.0	40.0	49.2	16.8	48.2	68.6	55.2	44.7	32.2	39.2
WY	73.6	71.1	75.2	32.7	71.6	84.7	82.1	77.9	72.7	67.2
AL	63.5	59.6	68.7	31.7	67.3	80.5	73.5	64.9	48.6	50.7
MS	60.7	57.5	65.0	28.3	70.4	83.0	63.7	60.8	42.1	48.3
SC	60.6	59.1	62.4	28.7	65.3	74.4	71.8	55.5	53.7	63.2
DE	57.8	52.7	63.5	20.2	57.2	76.3	73.4	56.9	47.7	51.0
LA	52.6	50.1	56.0	23.7	58.5	72.9	60.2	49.6	33.6	50.6
MD	52.0	46.2	55.9	18.0	52.1	73.6	58.6	51.6	43.1	48.8
TN	51.5	47.5	56.6	20.4	54.6	75.5	68.8	50.9	31.8	43.8
NV	50.9	48.3	54.2	20.5	47.9	65.6	55.7	51.6	48.0	48.1
OK	50.4	47.9	53.7	25.2	55.9	70.9	62.0	52.3	34.0	46.4
WV	50.0	46.2	55.4	24.5	57.3	71.2	56.0	50.6	24.1	46.3
VA	49.9	46.7	54.8	20.2	52.3	72.4	58.3	50.2	38.8	44.3
NC	49.7	46.2	54.0	19.3	53.0	72.2	60.8	48.1	33.8	48.4
OH	49.1	44.9	54.8	18.8	54.7	75.5	55.0	51.4	33.0	38.5
KY	49.0	45.0	54.8	23.4	57.5	74.6	54.7	49.9	27.4	41.4
AR	48.8	45.4	53.4	22.9	55.6	70.8	58.9	48.8	32.4	42.7
IN	48.6	45.4	52.8	19.7	55.3	74.5	59.0	51.6	32.3	37.1
MO	47.8	46.3	49.5	19.7	56.1	75.8	32.9	50.7	37.3	38.5
AZ	47.7	43.9	52.5	17.4	46.2	65.1	56.3	48.6	39.7	46.0
FL	46.4	41.7	52.8	17.7	50.5	70.0	53.5	46.7	34.8	42.7
GA	46.2	43.1	51.0	18.7	48.4	70.9	57.5	47.3	25.9	39.3
RI	44.1	39.4	49.1	13.2	42.8	69.7	40.7	45.3	35.5	41.7
SD	43.0	37.7	49.1	16.0	46.6	67.7	28.6	42.5	28.3	45.7
KS	42.9	40.5	46.0	16.4	46.7	66.7	65.3	46.4	31.3	42.0
OR	42.9	40.3	46.2	19.3	44.8	59.7	41.9	44.9	37.2	35.6
NM	42.7	39.5	47.1	16.2	45.7	63.2	53.4	42.9	34.4	41.6
PA	42.6	38.3	48.2	14.9	45.8	67.4	47.2	43.4	28.2	39.2
TX	42.4	38.7	47.7	17.1	49.2	66.8	48.1	44.8	28.9	38.0
MI	41.8	37.2	48.5	14.2	46.7	70.7	46.2	42.7	27.0	37.8
WI	41.4	36.6	45.4	15.5	42.8	60.1	37.5	44.3	35.7	34.1
MT	39.6	35.1	44.3	14.2	46.7	58.1	40.0	40.0	20.0	38.7
CT	39.3	33.4	49.1	13.4	39.8	64.2	47.7	38.0	30.0	42.3
NJ	39.2	34.9	44.4	10.5	42.8	68.4	55.9	38.9	31.0	38.6
NE	38.6	35.2	43.0	14.5	45.1	64.1	26.6	38.2	28.2	40.7
WA	38.4	33.8	44.2	14.6	42.7	61.9	43.7	39.7	34.7	35.4
NY	38.3	32.5	44.1	12.6	39.6	60.4	47.7	37.9	31.7	36.9
CO	38.1	33.3	44.1	13.8	41.1	63.7	44.2	38.3	30.3	37.6
UT	37.4	34.1	41.4	16.8	43.6	65.4	30.6	37.7	29.1	36.2
IA	36.2	33.1	40.2	13.2	43.4	64.4	37.7	37.6	25.0	32.1
ID	36.0	32.0	41.2	12.4	44.9	59.3	30.0	37.6	28.6	32.1
ND	35.8	31.8	40.7	14.6	45.6	65.1	31.0	38.0	23.6	29.9
NH	35.5	30.1	43.1	12.4	41.6	69.3	29.4	36.4	24.0	28.0
AK	35.2	32.6	37.6	10.4	44.5	65.0	21.6	40.6	31.6	24.3
CA	34.7	30.8	40.0	11.5	39.8	64.6	42.9	35.9	33.1	32.9
DC	34.0	32.4	36.1	13.6	44.3	61.3	40.5	21.1	27.2	26.7
VT	33.2	29.5	37.4	12.4	30.7	46.7	47.1	32.1	16.7	39.0
MA	32.9	27.9	40.8	10.6	36.0	59.7	35.9	33.2	18.5	33.1
ME	32.6	29.6	36.6	15.5	37.6	52.6	28.6	32.9	19.5	24.9
IL	32.4	26.5	37.2	11.9	31.6	45.9	23.2	34.4	26.1	29.3
MN	32.1	29.4	35.4	12.3	37.7	57.2	24.4	33.8	24.0	27.0
HI	28.3	26.1	31.3	7.5	30.6	51.4	37.5	31.5	30.4	23.6

BRFSS	Total	Sex		Age group (year)			Race			
		Female	Male	18-44	45-64	65-79	Black	White	Asian	Other
ALL	31.3	28.9	33.8	14.3	40.4	59.3	40.2	32.9	18.9	25.2
WY	29.7	24.6	34.5	13.7	36.4	57.7	19.6	30.8	12.3	25.2
AL	41.5	39.7	43.4	20.9	53.7	69.0	46.9	41.3	11.8	28.8
MS	42.7	43.1	42.2	23.0	54.9	72.0	45.9	41.9	18.7	32.8
SC	37.0	34.7	39.5	16.9	47.3	65.5	43.5	36.9	13.7	22.3
DE	35.2	32.7	37.9	16.3	44.6	60.1	39.9	37.7	20.5	19.9
LA	38.7	37.7	39.8	19.0	52.2	67.6	42.8	37.8	13.9	34.6
MD	32.9	31.0	35.0	15.6	40.9	63.5	39.7	33.7	18.7	23.3
TN	38.1	35.3	41.0	18.6	49.7	64.8	45.8	37.8	16.6	30.5
NV	32.1	29.3	34.9	16.0	40.4	59.5	31.8	35.8	37.4	25.7
OK	36.5	33.5	39.4	16.8	49.3	66.8	43.2	37.7	28.3	31.9
WV	42.8	40.4	45.2	21.3	52.7	68.0	39.2	43.0	1.9	44.1
VA	32.3	30.1	34.5	14.8	42.1	61.2	44.3	32.8	13.6	23.2
NC	34.1	33.9	34.4	15.6	43.4	63.2	45.0	34.2	12.1	20.6
OH	33.3	29.9	36.8	15.8	43.3	57.1	42.7	33.1	10.8	27.1
KY	39.7	38.1	41.4	21.1	49.8	67.0	45.3	40.5	8.9	27.0
AR	39.7	37.5	42.0	20.0	53.3	64.6	48.3	40.6	2.2	28.0
IN	33.7	31.2	36.2	16.0	43.3	62.1	44.4	33.7	20.1	26.4
MO	29.3	28.0	30.6	13.0	37.6	54.6	33.8	29.3	8.8	25.9
AZ	30.9	28.3	33.5	14.1	41.2	55.9	48.4	34.1	17.0	25.4
FL	32.0	29.3	34.8	13.1	39.5	57.9	34.7	36.3	16.8	24.7
GA	33.9	32.9	35.0	15.3	45.7	64.6	41.4	33.9	8.9	22.8
RI	31.7	28.0	35.5	15.4	38.8	60.0	35.5	32.5	15.5	30.1
SD	29.6	25.3	33.7	12.7	38.0	56.9	6.2	30.1	39.2	29.5
KS	32.4	29.0	35.7	16.1	41.6	59.8	47.4	33.4	22.9	23.9
OR	29.5	26.7	32.4	13.9	35.8	56.1	37.2	31.1	21.9	23.9
NM	30.4	26.8	34.0	14.2	37.6	57.1	42.5	33.5	31.3	28.1
PA	31.8	29.5	34.1	13.7	39.1	59.5	42.4	32.4	15.6	21.4
TX	30.5	27.9	33.1	13.5	43.3	61.4	39.0	33.6	18.2	26.5
MI	33.9	30.8	37.1	14.9	44.6	59.3	42.3	33.7	15.4	29.5
WI	29.6	25.9	33.2	12.5	36.4	58.5	35.8	30.6	12.5	21.1
MT	28.1	23.8	32.2	12.2	33.5	53.8	17.8	27.9	21.4	30.2
CT	29.1	26.8	31.5	12.5	36.2	55.4	42.0	29.6	15.4	24.3
NJ	--	--	--	--	--	--	--	--	--	--
NE	29.6	27.1	32.0	13.3	38.6	58.0	34.0	31.0	18.0	21.7
WA	29.4	25.7	33.0	14.0	37.3	56.6	34.0	31.4	21.7	25.0
NY	28.1	25.3	31.1	11.9	36.4	56.4	35.5	28.3	20.0	26.6
CO	24.7	22.2	27.1	11.7	31.4	50.9	36.5	24.8	13.0	23.9
UT	24.9	20.3	29.5	13.4	33.9	54.5	24.9	25.8	15.1	22.4
IA	30.3	27.5	33.0	14.0	38.6	56.9	38.3	31.3	12.6	22.1
ID	29.6	27.1	32.1	14.8	36.7	55.9	42.4	30.3	15.6	26.6
ND	28.0	24.6	31.1	13.4	35.5	59.9	18.5	28.6	9.8	28.8
NH	30.3	27.3	33.3	14.9	34.2	55.5	18.5	30.8	19.9	28.8
AK	32.4	27.0	37.1	19.1	40.6	59.9	41.1	32.6	20.6	32.5
CA	26.6	25.0	28.2	12.6	34.3	54.4	37.8	30.9	20.3	23.8
DC	26.2	24.5	28.1	11.9	40.9	62.3	40.8	17.7	9.1	17.2
VT	28.7	24.1	33.3	12.2	35.6	50.9	23.7	28.8	14.8	30.6
MA	26.6	23.6	29.8	11.5	32.3	55.2	29.3	28.2	12.4	25.2
ME	34.9	30.1	39.8	16.9	40.7	58.1	17.2	34.9	30.8	36.4
IL	31.0	28.2	33.9	13.0	39.7	63.1	36.8	33.4	15.5	24.3
MN	27.4	24.0	30.7	11.9	34.6	55.0	24.6	28.8	14.9	24.0
HI	29.6	26.6	32.4	13.5	37.3	54.6	26.0	25.0	34.1	28.2

Note: The color scale is based on hypertension prevalence (not age-standardized). Red, higher prevalence; white, median prevalence (42.7% in AEMR-US and 31.7% in BRFSS); blue, lower prevalence; gray, data unavailable. The order of states is based on hypertension prevalence in the “Total” column of AEMR-US. Abbreviations: AEMR-US, IQVIA Ambulatory Electronic Medical Record-US. BRFSS, the Behavioral Risk Factor Surveillance System.

Appendix Figure 4. Age-standardized hypertension prevalence by state in IQVIA AEMR-US 2019 and BRFSS 2019, by sex



Note: The cut points were based on the quartiles of prevalence in the two datasets, respectively. Age standardization was based on 2010 US census age groups of 18-44, 45-64, and 65-79 years. Abbreviations: AEMR-US, IQVIA Ambulatory Electronic Medical Record-US; BRFSS, the Behavioral Risk Factor Surveillance System.

Appendix Table 4. State-level crude hypertension control prevalence by sociodemographic characteristics in AEMR-US 2019

AEMR-US	Total	Sex		Age group (year)			Race			
		Female	Male	18-44	45-64	65-79	Black	White	Asian	Other
ALL	64.5	66.4	62.5	63.9	63.9	65.3	56.9	66.0	67.8	63.0
KS	73.7	76.0	71.1	73.5	72.9	74.4	59.4	64.7	75.7	76.1
IA	72.7	75.4	69.7	71.7	71.4	74.4	66.6	73.5	77.6	69.8
NJ	72.6	74.2	71.0	72.3	71.9	73.3	62.5	73.3	68.4	72.9
AK	72.3	69.7	74.2	71.4	73.1	71.7	68.0	72.9	67.4	71.2
MI	70.3	71.7	68.8	69.2	69.6	71.3	59.2	71.7	70.9	67.0
TN	70.1	72.5	67.4	70.8	70.1	69.8	61.2	71.8	72.1	66.3
DE	70.0	70.8	69.3	68.7	68.6	71.1	63.2	73.0	72.2	61.7
RI	69.2	71.2	67.5	65.8	69.6	69.5	83.3	68.1	59.3	72.1
CO	69.1	70.9	67.3	69.8	67.2	70.5	68.3	69.2	75.8	68.4
OH	68.8	70.0	67.5	65.8	67.8	70.7	61.5	70.5	70.8	64.8
NM	67.7	70.4	64.6	65.9	64.6	70.6	64.3	68.9	69.5	64.6
MA	67.6	69.5	65.6	68.8	66.8	68.1	64.1	67.6	68.5	68.0
SD	67.5	70.7	64.6	69.8	67.3	67.1	64.3	69.8	86.7	59.3
PA	67.5	69.5	65.3	67.8	66.9	67.9	63.2	67.9	73.8	66.4
MJ	67.1	69.6	65.2	67.7	66.2	67.8	59.9	68.5	68.1	66.6
UT	66.6	69.1	64.2	64.8	63.5	70.0	55.7	66.8	68.0	65.3
WY	66.4	71.7	63.0	71.8	64.6	66.9	62.5	68.8	37.5	62.8
AZ	65.9	67.2	64.4	63.9	63.8	67.5	63.1	69.4	71.3	59.1
MN	65.2	68.2	62.2	66.2	62.7	67.6	59.6	64.9	67.9	67.3
HI	64.9	69.2	60.0	82.4	75.0	54.8	100	57.7	57.1	76.7
NE	64.8	67.9	61.6	62.8	63.8	66.5	52.7	65.9	59.0	62.9
NC	64.6	66.7	62.3	63.7	63.8	65.5	58.8	66.6	67.4	62.6
NH	64.5	68.0	61.0	66.2	64.0	64.6	57.1	64.4	71.7	64.6
CT	64.2	66.3	61.9	64.3	63.9	64.6	58.0	64.2	68.5	65.9
GA	64.0	65.5	62.2	62.1	63.4	65.2	58.5	66.4	72.3	59.4
FL	64.0	65.5	62.3	61.9	63.2	65.4	57.5	65.6	66.9	63.2
WA	63.7	67.4	60.1	69.3	62.1	63.5	58.8	64.8	66.7	60.9
ND	63.4	66.5	60.5	60.3	62.9	65.6	48.5	64.9	55.9	58.8
VT	63.3	65.0	61.7	72.0	65.2	60.6	75.0	63.0	66.7	64.2
KY	63.2	65.8	59.9	63.8	62.8	63.3	55.7	63.9	64.1	63.1
CA	62.4	63.8	61.0	61.8	61.4	63.6	55.4	62.2	67.7	62.2
WV	62.3	65.2	58.9	65.6	62.5	60.7	59.1	62.9	64.6	59.9
MO	61.9	64.6	59.2	62.8	61.5	62.0	51.9	62.9	59.5	59.8
ID	61.7	61.5	62.0	65.4	60.3	61.9	33.3	62.6	75.0	59.2
VA	61.6	62.7	60.3	61.5	61.3	61.9	54.5	64.1	69.1	61.8
OR	61.5	64.0	58.7	67.0	60.2	61.1	68.2	62.0	70.8	58.4
SC	61.2	63.2	59.1	59.2	60.7	62.1	58.5	61.5	65.4	65.0
IL	60.8	64.7	58.5	62.6	61.1	60.3	54.6	62.0	66.3	56.9
ME	60.3	61.6	58.9	60.3	59.2	61.6	59.8	60.3	70.5	57.5
LA	60.3	61.5	58.7	62.1	60.6	59.4	55.6	64.6	59.0	57.5
AR	60.2	62.0	58.0	61.3	60.4	59.5	55.4	61.4	61.4	56.5
AL	59.7	60.3	59.0	58.9	59.8	59.7	54.1	61.4	64.3	60.2
IN	58.6	60.6	56.4	58.0	57.7	59.9	49.4	59.8	61.1	56.9
TX	58.6	60.5	56.3	57.8	59.2	58.2	51.3	60.1	59.3	58.4
MD	58.3	62.0	56.2	57.8	59.7	57.3	54.7	58.8	63.7	59.9
NV	57.5	57.5	57.4	47.0	53.0	61.9	44.4	56.8	62.2	63.1
MS	55.6	56.3	54.8	54.6	55.8	55.9	49.9	58.9	59.9	56.1
OK	54.3	57.3	50.7	54.5	54.1	54.6	52.1	55.7	60.2	51.9
MT	54.0	56.4	51.9	60.6	51.9	54.5	0	53.6	0	55.7
DC	52.3	53.2	51.3	51.8	51.8	53.5	50.8	66.7	60.2	52.9
WI	44.4	50.4	40.5	39.9	43.7	45.9	56.7	44.6	40.0	43.4

Note: The color scale is based on hypertension control prevalence (not age-standardized). Red, worse (lower) hypertension control; white, median (63.5%) prevalence; blue, better (higher) hypertension control; gray, insufficient data (<10 patients). Abbreviations: AEMR-US, IQVIA Ambulatory Electronic Medical Record-US.