Interpretation of data used for BSN maps

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This memo is intended to address questions about state-level data on the percentage of registered nurses (RNs) who have a bachelor's degree in nursing or higher degree in any field.

The source of data used for the Campaign for Action Dashboard Indicator related to educational attainment is the American Community Survey (ACS), which is a product of the U.S. Census Bureau. The metric is derived from the ACS question:

What is the highest degree or level of school this person has completed?

If the respondents report they have a bachelor's or higher degree, they are asked to identify the major field of study for their bachelor's degree. For the Dashboard metric, we count the number of RNs who report having earned a bachelor's in nursing or a master's or doctoral degree in any field. The ACS does not provide information on the field of study for graduate degrees. This metric will be abbreviated "BSN+" in this memo.

The ACS is a sample survey and estimates of the numbers and percentages of RNs with BSN+ education are based on individual respondents in the survey. For the Dashboard metric, we include all respondents whose occupation is reported as RN, nurse practitioner, nurse midwife, or nurse anesthetist. Clinical nurse specialists are part of the same occupation category as RNs. In 2017, there were 34,840 survey respondents in the ACS dataset who indicated they were employed as an RN. The number of respondents per state ranged from a high of 3,347 in California to a low of 29 in the District of Columbia.

Because the Dashboard metric is derived from sample data, each estimate has an associated margin of error. A common frame of reference when talking about margins of error is the 95% confidence interval. When we refer to a 95% confidence interval, what we mean is that we are 95% confident that the estimate of any given parameter (e.g. the *percentage of employed nurses with BSN+ education*) falls within a specific range of values (i.e. the margin of error).

Table 1 below demonstrates this concept. It presents the number of sample observations used to estimate the percentage of employed RNs with BSN+ education in 2017, the estimated percentage and the 95% confidence interval associated with the estimate (referred to as "lower bound" and "upper bound"), as well as the range (in percentage points) of this confidence interval. Looking at the first row of the table as an example, in California the estimated percentage of employed RNs with BSN+ was 60.4%, with a lower bound estimate of 58.4% and an upper bound estimate of 62.3%. This means that we can state with 95% confidence that, in 2017, the true percentage of employed RNs with BSN+ is somewhere in the range from 58.4% to 62.3% - a range of 3.9 percentage points. There is a 2.5% chance that the true value is above 62.3% and a 2.5% chance that the true value is below 58.4%. As the number of sample observations in the state becomes smaller, the range of the confidence interval becomes larger. Note that the most likely "true" value is the reported estimate. The likelihood of the true value being the highest or lowest values in the confidence interval is comparatively small – in most datasets, you can think of the data as being normally distributed with the probability of values in the "tails" of the distribution being smaller than the probability of values near the center of the distribution.

The large confidence intervals for some states are a cause for concern. There is no generally-accepted rule regarding the minimum number of observations that should be required to publicly report data; the decision depends on your willingness to tolerate potential error in the estimates.

Table 1. Estimated percentage of employed nurses with BSN+ education for selected states, 2017

State	Number of observations	Estimate	Lower bound	Upper bound	Range (percentage points)
CA	3,347	60.4%	58.4%	62.3%	3.9
TX	2,622	53.7%	51.2%	56.2%	5.0
OH	1,575	52.2%	49.1%	55.2%	6.1
GA	944	58.2%	54.2%	62.1%	7.9
AZ	611	58.9%	54.2%	63.5%	9.3
UT	252	51.1%	43.7%	58.5%	14.8
HI	132	72.0%	62.4%	80.0%	17.6
ND	102	66.4%	53.0%	77.7%	24.7
VT	83	42.5%	29.4%	56.7%	27.3
AK	64	61.7%	42.9%	77.5%	34.6
WY	62	51.5%	36.4%	66.2%	29.8
DC	29	60.3%	38.6%	78.6%	40.0

Source: American Community Survey, Public Use Microdata Sample (series)

The confidence intervals associated with estimates derived from the ACS affect the certainty with which we can say that a state has had a change in the percentage of employed RNs with BSN+ education. A standard approach to assessing whether the difference between two values is likely to be a "true" difference, rather than the result of potential errors in the estimates, is to use a statistical test to measure the confidence level associated with the estimated difference. The result of the test is typically presented as a p-value, which is the probability that the difference between two estimates is the result of chance. A small p-value indicates a greater degree of confidence that the difference between two estimates is a real difference. A widely-accepted standard is to consider an observed difference to be statistically significant if the p-value is 0.05 or smaller.

Table 2 presents the estimated percentages of RNs with BSN+ education for each state in 2010 and 2017, the estimated change, and the p-value associated with the estimated change. States with statistically significant increases in the percent of RNs with BSN+ education are Arizona, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Kentucky, Louisiana, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Washington, West Virginia, and Wisconsin, as well as the District of Columbia. Note, however, that the amount of change may be somewhat smaller or larger than presented because the estimates have an associated margin of error. (The estimates for each state and their 95% confidence intervals are provided in Table 3.)

Table 2. Estimated percentage of employed nurses with BSN+ education and p-value for estimated change, 2010 and 2017 (* indicates statistically significant change with p<=0.05)

	2010 Percent BSN+	2017 Percent BSN+	P-value from Wald Test		2010 Percent BSN+	2017 Percent BSN+	P-value from Wald Test
Alabama	43.3%	49.4%	0.130	Montana	46.1%	59.5%	0.088
Alaska	60.4%	61.7%	0.912	Nebraska	49.1%	56.8%	0.188
Arizona*	49.5%	58.9%	0.006	Nevada	58.8%	58.6%	0.960
Arkansas	44.0%	43.8%	0.968	New Hampshire	40.3%	50.3%	0.111
California*	53.8%	60.4%	<0.001	New Jersey*	53.3%	59.7%	0.019
Colorado*	57.0%	66.6%	0.008	New Mexico	45.8%	55.5%	0.152
Connecticut*	49.2%	58.7%	0.017	New York*	53.3%	57.4%	0.028
Delaware*	42.1%	62.8%	0.009	North Carolina*	43.1%	51.9%	0.001
DC*	26.1%	60.3%	0.024	North Dakota	60.0%	66.4%	0.505
Florida*	46.4%	50.2%	0.048	Ohio*	41.8%	52.2%	<0.001
Georgia*	52.1%	58.2%	0.032	Oklahoma	39.8%	49.1%	0.064
Hawaii	59.3%	72.0%	0.082	Oregon*	50.5%	63.7%	0.002
Idaho	45.4%	54.4%	0.271	Pennsylvania*	45.9%	57.5%	<0.001
Illinois*	49.3%	61.6%	<0.001	Rhode Island	57.0%	58.3%	0.866
Indiana	49.4%	53.3%	0.226	South Carolina	48.0%	54.5%	0.096
Iowa	36.5%	41.5%	0.259	South Dakota	53.4%	60.0%	0.419
Kansas	53.9%	54.8%	0.850	Tennessee	50.2%	55.1%	0.135
Kentucky*	43.8%	54.6%	0.006	Texas*	47.9%	53.7%	0.001
Louisiana*	50.4%	63.7%	0.001	Utah	42.9%	51.1%	0.140
Maine	45.6%	57.2%	0.120	Vermont	57.3%	42.5%	0.149
Maryland	55.4%	60.2%	0.129	Virginia	51.1%	51.7%	0.847
Massachusetts	57.4%	61.2%	0.160	Washington*	50.3%	59.5%	0.005
Michigan	44.8%	50.1%	0.052	West Virginia*	37.4%	50.1%	0.038
Minnesota	47.5%	51.5%	0.255	Wisconsin*	51.2%	59.5%	0.016
Mississippi	33.8%	40.5%	0.164	Wyoming	34.4%	51.5%	0.135
Missouri*	45.5%	60.5%	<0.001				

Table 3. Estimated percentage of employed nurses with BSN+ education and 95% confidence intervals, 2010 and 2017

	2010		2017			2010		2017	
	Percent BSN+	Confidence Interval	Percent BSN+	Confidence Interval		Percent BSN+	Confidence Interval	Percent BSN+	Confidence Interval
Alabama	43.3%	38.06-48.72%	49.4%	43.61-55.28%	Montana	46.1%	35.51-57.11%	59.5%	48.45-69.71%
Alaska	60.4%	43.96-74.72%	61.7%	42.93-77.53%	Nebraska	49.1%	41.44-56.71%	56.8%	48.03-65.21%
Arizona*	49.5%	44.58-54.35%	58.9%	54.16-63.54%	Nevada	58.8%	50.41-66.79%	58.6%	50.55-66.13%
Arkansas	44.0%	37.33-50.96%	43.8%	37.11-50.79%	New Hampshire	40.3%	32.29-48.95%	50.3%	41.49-59.05%
California*	53.8%	51.64-55.89%	60.4%	58.39-62.33%	New Jersey*	53.3%	49.44-57.07%	59.7%	55.87-63.40%
Colorado*	57.0%	51.71-62.16%	66.6%	61.61-71.25%	New Mexico	45.8%	36.65-55.27%	55.5%	46.09-64.47%
Connecticut*	49.2%	43.63-54.73%	58.7%	53.11-64.09%	New York*	53.3%	50.63-55.86%	57.4%	54.77-59.92%
Delaware*	42.1%	32.01-52.9%	62.8%	51.05-73.17%	North Carolina*	43.1%	39.5-46.85%	51.9%	48.24-55.45%
DC*	26.1%	10.97-50.34%	60.3%	38.55-78.57%	North Dakota	60.0%	45.37-73.06%	66.4%	53.00-77.66%
Florida*	46.4%	43.68-49.07%	50.2%	47.52-52.91%	Ohio*	41.8%	38.67-45.02%	52.2%	49.13-55.16%
Georgia*	52.1%	48.07-56.04%	58.2%	54.21-62.13%	Oklahoma	39.8%	33.04-47.01%	49.1%	42.34-55.82%
Hawaii	59.3%	47.72-69.9%	72.0%	62.38-79.97%	Oregon*	50.5%	43.93-57.14%	63.7%	58.38-68.71%
Idaho	45.4%	34.64-56.63%	54.4%	42.80-65.61%	Pennsylvania*	45.9%	42.85-49.07%	57.5%	54.38-60.49%
Illinois*	49.3%	45.98-52.65%	61.6%	58.35-64.69%	Rhode Island	57.0%	47.46-66.05%	58.3%	46.45-69.24%
Indiana	49.4%	45.05-53.83%	53.3%	48.88-57.63%	South Carolina	48.0%	42.74-53.34%	54.5%	49.01-59.79%
Iowa	36.5%	30.33-43.09%	41.5%	35.66-47.69%	South Dakota	53.4%	42.03-64.47%	60.0%	48.59-70.36%
Kansas	53.9%	47.37-60.29%	54.8%	47.87-61.55%	Tennessee	50.2%	45.72-54.75%	55.1%	50.58-59.56%
Kentucky*	43.8%	38.29-49.44%	54.6%	49.27-59.77%	Texas*	47.9%	45.27-50.44%	53.7%	51.24-56.22%
Louisiana*	50.4%	44.67-56.12%	63.7%	57.77-69.15%	Utah	42.9%	35.09-51.02%	51.1%	43.68-58.53%
Maine	45.6%	36.33-55.17%	57.2%	45.93-67.77%	Vermont	57.3%	42.56-70.91%	42.5%	29.39-56.71%
Maryland	55.4%	50.91-59.75%	60.2%	55.74-64.53%	Virginia	51.1%	46.77-55.36%	51.7%	47.39-55.92%
Massachusetts	57.4%	53.62-61.13%	61.2%	57.47-64.77%	Washington*	50.3%	45.58-55.09%	59.5%	55.24-63.52%
Michigan	44.8%	41.05-48.7%	50.1%	46.45-53.78%	West Virginia*	37.4%	29.5-46.08%	50.1%	41.62-58.63%
Minnesota	47.5%	42.49-52.5%	51.5%	46.64-56.42%	Wisconsin*	51.2%	46.44-55.84%	59.5%	54.57-64.24%
Mississippi	33.8%	27.05-41.18%	40.5%	34.39-46.90%	Wyoming	34.4%	20.38-51.88%	51.5%	36.42-66.23%
Missouri*	45.5%	40.68-50.46%	60.5%	56.18-64.75%					