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Forecasts of the Registered Nurse Workforce in California

Prepared for the California Board of Registered Nursing

by

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Executive Summary

This report presents supply and demand forecasts for the Registered Nurse (RN) workforce in California from 2017 through 2035. These new forecasts are based on data from the 2016 California Board of Registered Nursing (BRN) Survey of Registered Nurses, the 2015-2016 BRN Annual Schools Report, data extracted from the BRN license records, and other state and national data sources. The 2017 forecasts indicate that supply of and demand for RNs are fairly well-balanced over the next 10 years if current enrollment and state-to-state migration patterns are stable.

The forecasts of RN supply take into account the aging of the RN workforce, new graduates (including those from out-of-state and international nursing programs), interstate flows of RNs, and changes in license status. These new forecasts of supply incorporate new data for these factors.

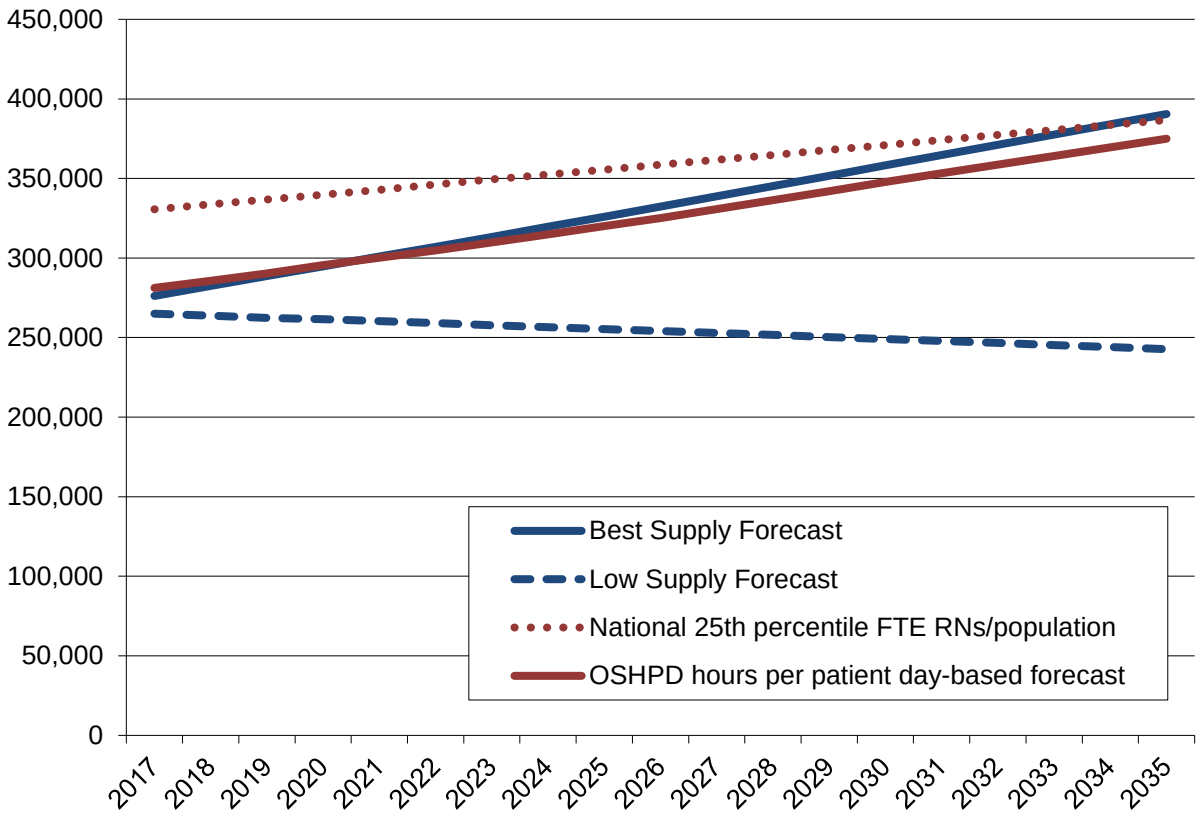
The demand forecasts are based on national numbers of RNs per 100,000 population. An alternate forecast of demand was developed that estimates future hospital utilization in California and current data on RN employment in hospitals. The forecasts are compared with other published forecasts including those from the U.S. Bureau of Health Workforce and California Employment Development Department. Together, the demand estimates provide a range of possible scenarios for the future.

The Executive Summary Exhibit indicates that whether California experiences a shortage of RNs in the future depends on the measure of demand selected for comparison with supply as well as whether supply variables change. The forecasting model produces a range of supply forecasts; the "Best Supply Forecast" is based on the midpoint of most of the parameters in the model; the Exhibit presents both the "Best" and "Low" forecasts. In the figure, the supply forecasts are compared with two different estimates of demand: (1) the 2015 national 25th percentile of full-time equivalent RNs per population; and (2) a forecast of demand based on current hospital utilization by age group. In 2017, the statewide RN labor supply is slightly lower than the utilization-based forecast and 17 percent lower than the national 25th percentile of full-time equivalent (FTE) RNs per capita. Overall, California's RN supply is forecasted to reach the national 25th percentile by 2034 if the number of RN graduates remains stable and state-to-state migration patterns do not change substantially; it will remain close to the utilization-based demand forecast

throughout this period. However, if supply variables shift so that the low forecast prevails, California could face a severe shortage of RNs.

Policymakers should be cautioned that the 2017 BRN forecasts represent an 18-year period and are not intended to reflect rapidly changing economic and labor market conditions. The forecasts also do not measure variations across regions of California; it is possible that some regions of the state will experience shortages even while others have a surplus of RNs. Finally, the factors that affect RN supply and demand are unlikely to remain static. The most important possible changes include: (1) the number of graduates from RN education programs; (2) inter-state migration; and (3) employment rates of older RNs. California leaders should observe closely retirement patterns that are opening positions for which clinical experience is desired. It will be important for employers to invest in training newly-graduated RNs to fill these positions. Finally, the availability of faculty should be monitored to ensure that there are sufficient numbers of qualified faculty to educate the needed number of graduates from the RN education programs.

Executive Summary Exhibit: Projected full-time equivalent supply of and demand for RNs, 2017-2035



Forecasts of the Registered Nurse Workforce in California

The labor market for registered nurses (RNs) has been characterized by cycles of shortage and surplus since World War II. The most recent period of shortage began in the late 1990s (Buerhaus 1998), and persisted through 2007. After 2008, survey data indicated that California's long-standing RN shortage ended, at least temporarily (Bates, Keane, & Spetz 2011). This change in the labor market was attributed to several trends. First, nursing school enrollments expanded substantially in California, more than doubling between 2001 and 2010 (Waneka, Keane, & Spetz 2012). This expansion of RN supply would have alleviated the shortage in many regions on its own. The economic recession that started in late 2007 further mitigated the shortage by increasing the workforce participation of RNs who otherwise might have retired or reduced their hours of work. It has been estimated that nearly all the hospital employment increase in the past decade can be attributed to growth in RN supply during economic recessions (Buerhaus & Auerbach 2011). The recession also reportedly dampened demand for newly-graduated nurses. In late 2010, a survey of Chief Nursing Officers found that there were fewer than 6,500 full-time equivalent vacant positions for RNs statewide (Bates, Keane, & Spetz 2011) while the 2010 BRN Survey of Registered Nurses indicated that nearly 7,700 RNs were seeking employment (Spetz, Keane, & Herrera 2011).

More recent data suggest the labor market may be shifting again. The Fall 2016 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 90 percent of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2017). Hospital vacancy rates have been rising since 2013, reaching 5.9 percent in 2016. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, rising from 59 percent in 2013 to 84 percent in 2016 (HealthImpact 2017). These data are consistent with the expectation that the economic recovery would lead nurses who had delayed retirement, re-entered the labor force, or increased their hours of work due to the economic recession to retire or reduce their employment as the economy recovers (Buerhaus & Auerbach 2011).

At the same time, the implementation of the most significant components of the Affordable Care Act (ACA) – an expansion of Medi-Cal and the implementation of the Covered California health insurance exchange to facilitate insurance enrollment – reduced the share of nonelderly Californians without health insurance from 16.2 percent in 2011 (Charles 2015) to 8.1 percent in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand greater health care services,

although the types of services needed are likely to change. In addition, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively (Spetz 2014). These changes have increased demand for RNs.

This report updates forecasts of RN supply and demand in California, which were first developed for the California Board of Registered Nursing (BRN) in 2005 and subsequently updated every two years (Spetz & Dyer 2005; Spetz 2007; Spetz 2009; Spetz 2011; Spetz 2013; Spetz 2015). New data from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2017), and BRN license records were used to update the model of RN supply. The supply forecast is compared with several benchmarks of demand, including national numbers of RNs per 100,000 population, estimates of future hospital utilization in California, and forecasts published by the U.S. Bureau of Health Workforce and California Employment Development Department (BHW 2014; EDD 2016).

The Supply of RNs

As of April 6, 2017, there were 415,798 RNs with current, active licenses in California, of whom 353,051 resided in California. For the purposes of these forecasts, the California-resident population is defined as the supply of nurses; the role of nurses who travel to work in California from other states is discussed later in the report.

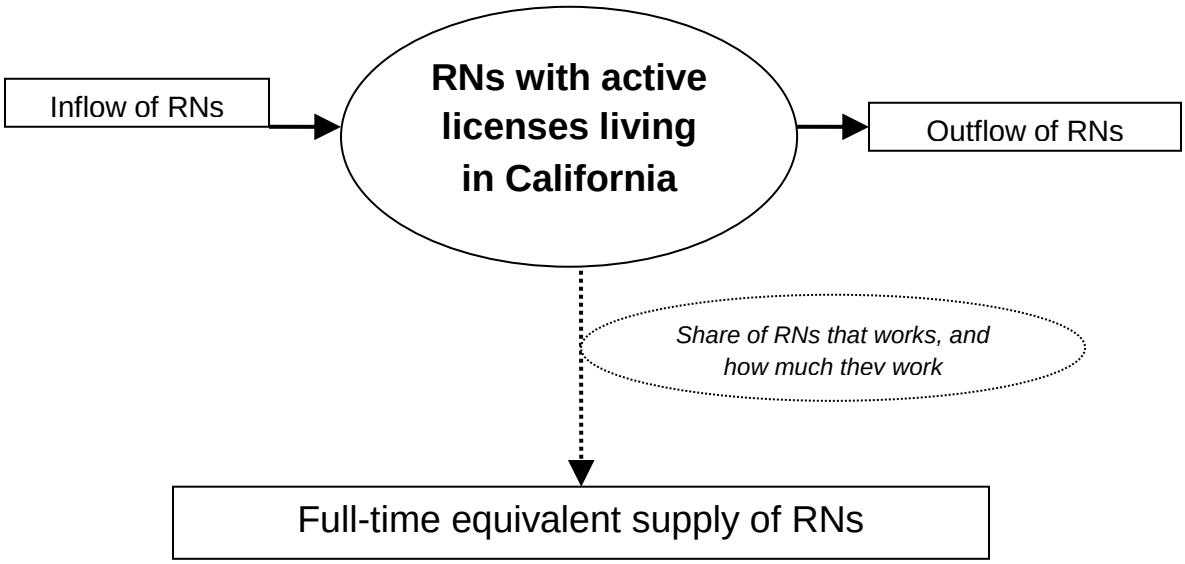
The RN workforce constantly changes with the entrance of newly graduated nurses, migration of nurses from other states and countries, retirements, temporary departures from nursing work, and fluctuations in the number of hours that nurses choose to work. These factors can be grouped into three categories:

- Inflows of nurses: Additions to the number of RNs in California
  - Graduates from California nursing programs
  - Graduates of nursing programs in other states who obtain their first RN license in California
  - Internationally-educated nurses who immigrate to California and obtain their RN license
  - Interstate migration of RNs to California
  - Changes from inactive to active license status
  - Changes from delinquent to active license status

- Outflows of nurses: The departure of RNs from the California population
  - Migration out of California (to another state or country)
  - Movements from active to inactive or lapsed license status
- Labor force participation factors: Decisions to work, and how much to work
  - Share of RNs with active licenses and California residence that work in nursing
  - Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in California with active licenses, which is called the "stock" of nurses available to work, and the outflows are subtracted from the stock. Estimates of the labor supply of RNs are derived from the stock of RNs potentially available to work and how much they choose to work in nursing. This number is expressed as full-time equivalent (FTE) employment in order to account for differences in the work commitments of those employed full-time and part-time. Exhibit 1 illustrates this model of the supply of RNs in California, commonly called a "stock-and-flow model."

Figure 1. A model of the supply of RNs



Method of Calculating RN Supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. At first glance, it seems clear that as long as the inflow of RNs is greater than the outflow, the RN workforce will grow over time. However, such a comparison between total inflow and outflow does not take into account the aging of the RN workforce. The age distributions of the stock of RNs and each inflow and outflow component affect supply. Thus, the model "ages" each age cohort to capture the impact of age on the supply forecast.

In the supply model, the number of RNs with active licenses who reside in California is divided into 13 age categories: under 25, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, and 80 and older. One-fifth of RNs in each age category moves into the next (older) age category in the subsequent year, until they reach the oldest age category.[1] The inflow estimates are added to each age group of RNs and the outflow estimates are subtracted from each age group of RNs. The result is a forecast of the new stock of RNs for the next year. Finally, employment rates and hours worked per week in nursing are applied to the estimated stock of RNs in each age group to obtain estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of California's RN supply.

For some factors in the supply model, differing estimates are available, with no indication of which estimate is most reliable. For other factors, there is uncertainty as to whether current data are applicable to what might happen in the future. For example, in 2010 and 2012, a greater share of nurses over age 60 was employed as compared with prior years. This increase was likely the result of older nurses delaying retirement due to declines in the value of their retirement savings (Buerhaus & Auerbach 2011). More recent data indicate that employment of nurses in this age group has returned to lower pre-recession levels (Spetz et al. in press). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and higher rates of employment in older age groups will reemerge. For variables with such uncertainty, a range of estimates is offered representing the highest and lowest values. In the final models, the "best estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

[1] All but one age group spans 5 years, so if nurses are evenly distributed across those five years, 20% - or 1 in 5 – would move to the next age group each year. The youngest age group spans 7 years, but there were few RNs under 20 years old in 2017; thus, the 20% assumption seems reasonable for this group as well.

Estimates of Supply Model Factors

Stock of RNs in 2017

Data describing the number of RNs with active licenses on April 6, 2017, were obtained from the BRN. At that time, 353,051 RNs had active licenses and a California address. The 62,747 RNs with addresses outside California were not included in the stock of RNs because California's border regions are generally rural and thus few nurses commute regularly from out of state. Some nurses might intermittently come to California as traveling nurses, thus supplanting the state's supply; this is discussed in more detail below.

The number of RNs with active licenses and California addresses was divided into 13 age groups. Three RNs who resided in California did not have age data recorded in the licensing file and are excluded from the analysis; the models are thus based on 353,048 RNs. The same age groups are used throughout the model. Table 1 compares the 2017 and 2015 data. The total number of licensed RNs living in California grew by 12,263 (3.6%) between 2015 and 2017, which is nearly the same as the 3.8% rate of growth between 2013 and 2015.

Table 1. Counts of actively-licensed RNs living in California, by age group, April 6, 2017, and April 9, 2015

	April 6, 2017		April 9, 2015	
Age Group	Count	% of Total	Count	% of Total
Under 25	4,424	1.25%	4,178	1.23%
25-29	28,319	8.02%	27,363	8.03%
30-34	42,917	12.16%	38,173	11.20%
35-39	40,382	11.44%	36,880	10.82%
40-44	42,122	11.93%	43,292	12.70%
45-49	41,270	11.69%	36,080	10.59%
50-54	34,918	9.89%	36,750	10.78%
55-59	39,496	11.19%	43,848	12.87%
60-64	41,187	11.67%	39,071	11.46%
65-69	23,582	6.68%	21,453	6.30%
70-74	9,605	2.72%	9,044	2.65%
75-79	3,495	0.99%	3,373	0.99%
80+	1,331	0.38%	1,280	0.38%
Total	353,048	100.00%	340,785	100.00%

Source: California Board of Registered Nursing license records, April 2017.

Graduates from California nursing programs

According to the 2015-2016 BRN Annual Schools Report, there were 11,191 new graduates from California nursing programs in the 2015-2016 academic year (Blash & Spetz 2017). Table 2 presents the numbers of enrollments and graduates from the past ten Annual Schools Reports. Growth in RN new student enrollments leads to growth in graduates in future years. Associate Degree (AD) programs are designed so that students can complete the nursing component of the degree in two years. In most Baccalaureate of Science Nursing Degree (BSN) programs, students are formally enrolled in nursing major courses during the last 2.5 to 3 years of the pre-licensure BSN degree program, unless the program is an accelerated BSN program. Thus, student enrollment changes translate to changes in the number of graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments for each year of the Annual Schools Report were compared with the number of graduates two years later. From 2010-2011 through 2015-2016, graduates averaged 80.8 percent of the number of student enrollments two years prior (a small decrease from the 81.9 percent "productivity rate" used in the 2015 forecasts). This is the rate used to estimate the number of future graduates; thus, the forecasted number of graduates in 2017-2018 is 80.8 percent of the known student enrollments from 2015-2016.

Table 2. New student enrollments and number of graduates from RN education programs, 2006-2007 through 2015-2016

Survey year	Number of new student enrollments	Growth in new student enrollments	Number of graduates	Growth in graduates
2006-2007	12,709	14.2%	8,317	10.5%
2007-2008	12,961	2.0%	9,580	15.2%
2008-2009	13,988	7.9%	10,570	10.3%
2009-2010	14,228	1.7%	11,512	8.9%
2010-2011	13,939	-2.0%	10,666	-7.4%
2011-2012	13,677	-1.9%	10,814	1.4%
2012-2013	13,181	-3.6%	11,292	4.4%
2013-2014	13,226	0.3%	11,291	-0.01%
2014-2015	13,318	0.7%	11,119	-1.5%
2015-2016	13,152	-1.2%	11,191	0.6%

Source: Blash, L, Spetz, J. 2017. 2015-2016 Annual School Report: Data Summary and Historical Trend Analysis. Sacramento, CA: California Board of Registered Nursing.

Forecasting the number of graduates beyond the 2017-2018 academic year is difficult because total new student enrollments after 2015-2016 are not yet known. As part of the BRN Annual School Survey, schools are asked to estimate future new student enrollment. For example, in the 2015-2016 survey, schools were asked to report expected student enrollment totals for the 2016-2017 and 2017-2018 academic years. Schools estimated that 2016-2017 new student enrollments would be 13,862 (5.4% higher than the previous year), and that 2017-2018 new student enrollments would be 14,219. These estimates were multiplied by 80.8 percent to obtain the forecasted number of graduates for 2018-2019 and 2019-2020. The forecasts assume that nursing student enrollments will be stable after the 2019-2020 academic year. In the forecasting model, the low estimate of growth in RN education after 2017-2018 is -1%, the high estimate is 1%, and the best estimate is 0%. Actual and predicted number of graduates from 2012-2013 through 2019-2020 are presented in Table 3.

Table 3. Predicted number of graduates based on new student enrollments

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	13,181*	11,292*
2013-2014	13,226*	11,291*
2014-2015	13,318*	11,119*
2015-2016	13,152*	11,191*
2016-2017	13,862	10,761
2017-2018	14,219	10,627
2018-2019		11,200
2019-2020		11,489

* Actual number of student enrollments and graduates based on Annual Schools Report.
Note: Forecasts of student enrollments are provided by RN programs in the Annual Schools Survey. The forecasted number of graduates is 80.8 percent of enrollments two years prior.
Source: Blash, L, Spetz, J. 2017. 2015-2016 Annual School Report: Data Summary and Historical Trend Analysis. Sacramento, CA: California Board of Registered Nursing.

Graduates from nursing programs in other states who obtain their first license in California

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 493 out-of-state graduates obtained their first license from California; this is the high estimate of out-of-state graduates who move to California. BRN records also indicate that 429 of these nurses are living in California; this is the low estimate. The best estimate for the

inflow of new licensees from other states is the average of the high and low estimates: 461 nurses. This estimate is higher than that from the 2015 forecasts, which was 291.

Immigration of internationally-educated nurses

In 2016, the BRN reported that 703 internationally-educated nurses passed the National Council Licensure Examination for RNs (NCLEX-RN) and received initial licensure as an RN in California, 503 of whom also had a California residence; the remainder lived in other states or countries. In the supply model, we use the total number of 2016 international graduates receiving initial licensure in California as the high estimate of the number of immigrants; we use the number that lives in California as the low estimate. The best estimate is the average of the high and low estimates: 603 internationally-educated RNs immigrate to California each year. This number is similar to the 2015 estimate of 209. However, these figures are much lower than the prior decade when the number of first licenses issued to internationally-educated nurses ranged between 1,145 and 4,107 annually. The lower numbers in recent years are consistent with other reports that international recruitment of nurses slowed significantly after 2008 (Chu, Bates, & Spetz 2017).

Age distributions of new graduates

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual Schools Report uses an uneven set of age groups for new California graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To create consistent groups of graduates in the forecasting model, we allocated the graduates into five-year groups. Table 4 shows how new graduates from California nursing programs were distributed by age group. RN graduates from nursing programs in other states seeking initial licensure as an RN in California are assumed to have the same age distribution as California graduates.

BRN records of internationally-educated nurses who receive initial U.S. licensure in California include the birth years of these nurses. The age distribution of internationally-educated RNs who lived in California and obtained licenses in 2016 is presented in the last column of Table 4; these data are used to forecast the age distribution for all internationally-educated RNs receiving first licenses in California.

Table 4. Estimated age distribution of new graduates from California RN programs

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25*	28.3%	8.2%
26-29*	30.7%	35.6%
30-34	16.0%	27.2%
35-39	12.5%	13.7%
40-44	5.9%	6.8%
45-49	4.3%	4.4%
50-54	1.5%	2.4%
55-59	0.8%	1.0%
60-64	0.3%	0.6%
65+	0.0%	0.2%

* The age groups for internationally-educated RNs are "Under 25" and 25-29.
Sources: Blash, L, Spetz, J. 2017. 2015-2016 Annual School Report: Data Summary and Historical Trend Analysis. Sacramento, CA: California Board of Registered Nursing; California BRN licensing records, 2016.

Interstate migration of RNs to California

Estimates of interstate migration to California were developed in two ways. The low estimate of interstate migration was computed from BRN records of nurses requesting license endorsement from another state into California. Table 5 presents the number of RNs requesting endorsement to California in 2016 who have permanent addresses in California, and the number requesting endorsement with permanent addresses anywhere. The rate of movement into California is based on the ratio of the number who requested endorsement in 2016 divided by the total number of licensed RNs residing in California in 2017 (from BRN licensing records). The low forecast estimate was the rate of endorsement requests only for those with California addresses, and the high estimate was the rate for all endorsement requests regardless of California residence. The best estimate is the average of the high and low estimates. Prior research found that 49 percent of RNs requesting endorsement to California intended to live and work in the state (Waneka, Spetz, & Chan 2008). That statistic was reported during a period when California had a deep shortage of RNs and many RNs obtained California licenses to work as travelers. Thus, it is likely that more than half of those requesting endorsement will move to California.

Table 5. Requests for license endorsement into California, 2016

Age Category	Residing in California: Number requesting endorsement	Residing in California: Endorsements as a percentage of RNs living in California	Residing anywhere: Number requesting endorsement	Residing anywhere: Endorsements as a percentage of RNs living in California	**Best Estimate**
Under 25	228	5.2%	613	13.9%	9.5%
25-29	875	3.1%	4,222	14.9%	9.0%
30-34	712	1.7%	2,932	6.8%	4.2%
35-39	440	1.1%	1,726	4.3%	2.7%
40-44	272	0.7%	1,381	3.3%	2.0%
45-49	203	0.5%	1,218	3.0%	1.7%
50-54	150	0.4%	932	2.7%	1.5%
55-59	121	0.3%	730	1.8%	1.1%
60-64	82	0.2%	503	1.2%	0.7%
Over 64	35	0.1%	124	0.5%	0.3%

Sources: California Board of Registered Nursing license records, 2016 & 2017

Movements from inactive to active license status

We obtained data from the BRN, by age category, on the number of RNs with California addresses changing from inactive to active license status for 2016. The total has ranged from a low of 189 nurses in 2002-2003 to a high of 932 nurses in 2016. The 2016 data are used to estimate the number and age distribution of RNs changing from inactive to active license status (Table 6).

Table 6. Number and age distribution of RNs changing status from inactive to active license status, 2016

Age Category	Number	Percent	Age Category	Number	Percent
<30	29	3.1%	55-59	100	10.7%
30-34	102	10.9%	60-64	109	11.7%
35-39	102	10.9%	65-69	117	12.6%
40-44	88	9.4%	70-74	57	6.1%
45-49	103	11.1%	75+	34	3.6%
50-54	91	9.8%	Total	932	100.0%

Source: California Board of Registered Nursing license records, 2016.

Movements from lapsed to active license status

The BRN provided data on the number and age distribution of RNs whose licenses were lapsed and later were reactivated. In 2016, 5,489 RNs living in California reactivated their licenses. The rate of reactivation was computed by dividing the number of RNs reactivating their licenses in each age group by the total number of actively licensed RNs in the age group. These data are presented in Table 7. Note that the number reactivating in 2013-2014 was only 392; the rate increased substantially over the past 2 years.

Table 7. Number and rate of RNs reactivating lapsed licenses, 2016

Age Category	Number	Percent	Age Category	Number	Percent
<30	101	0.3%	55-59	681	1.7%
30-34	310	0.7%	60-64	858	2.1%
35-39	360	0.9%	65-69	779	3.3%
40-44	383	0.9%	70-74	492	5.1%
45-49	564	1.4%	75+	363	7.5%
50-54	598	1.7%	Total	5,489	100.0%

Source: California Board of Registered Nursing license records, 2016.

Migration out of California (to another state or country)

Data were obtained from BRN records on applications for outgoing endorsements in 2016, by age group. Some of these people requesting outgoing endorsement had in-state addresses at the time of the request, and others had out-of-state addresses. Both of these numbers were divided by the numbers of RNs in each age group in 2017 to obtain estimates of the rate of migration out of California. Table 8 presents the rates used in the model. The best estimate is the average of the two estimated out-migration rates.

Movements from active to inactive or lapsed license status

Estimates of the rate at which actively-licensed RNs allow their licenses to lapse were computed from California BRN license records and the NSSRN. These estimates are very important to the model because they measure the loss of nurses due to relocation, change in employment plans, retirement, and death. The model does not distinguish among these reasons for allowing a license to lapse.

Table 8. Estimated annual rates of RNs migrating out of California

Age Category	BRN estimate: CA addresses	BRN estimate: all addresses	Best estimate 2017	Best estimate 2015
Under 25	1.7%	2.4%	2.0%	3.7%
25-29	2.2%	4.6%	3.4%	3.8%
30-34	1.9%	4.2%	3.1%	3.5%
35-39	1.6%	3.5%	2.6%	2.8%
40-44	1.1%	2.7%	1.9%	2.0%
45-49	1.1%	2.6%	1.9%	1.8%
50-54	1.1%	2.7%	1.9%	1.7%
55-59	0.9%	2.3%	1.6%	1.4%
60-64	0.7%	1.9%	1.3%	1.2%
65-69	0.5%	1.5%	1.0%	1.1%
70-74	0.3%	0.9%	0.6%	0.6%
75-79	0.2%	0.5%	0.4%	0.2%
80+	0.0%	0.0%	0.0%	0.0%

Source: California Board of Registered Nursing license records, 2016.

The BRN provided data on the number of RNs with California addresses who changed their license status to inactive or allowed their license to lapse in 2016. These data were provided in age groups up through "80 and older"; we assumed this rate applies to all age groups over 75 years. Estimates of the rate at which nurses leave the pool of actively licensed RNs were calculated as the number of RNs with a non-active license divided by the number of current active RNs. Table 9 presents the rates used in the supply model.

Supply Forecasts of California's RN workforce

To create a forecast of the total number of RNs with active licenses in California, the model assumes that one-fifth of RNs in each age category moves into the next age category every year after 2017. In this manner, the workforce is "aged." For the age group 80 years and older, 20% of those 75 to 79 years older in the previous year enter, and people leave this age group (and other) based on the estimated outflows described above. For each age category, the basic formula is:

Forecasted Supply of CA RNs next year =
Current supply of RNs in current year
+ Estimated total inflows – Estimated total outflows.

Table 9. Estimated annual rates of RNs changing from active to inactive or lapsed license status, by age category

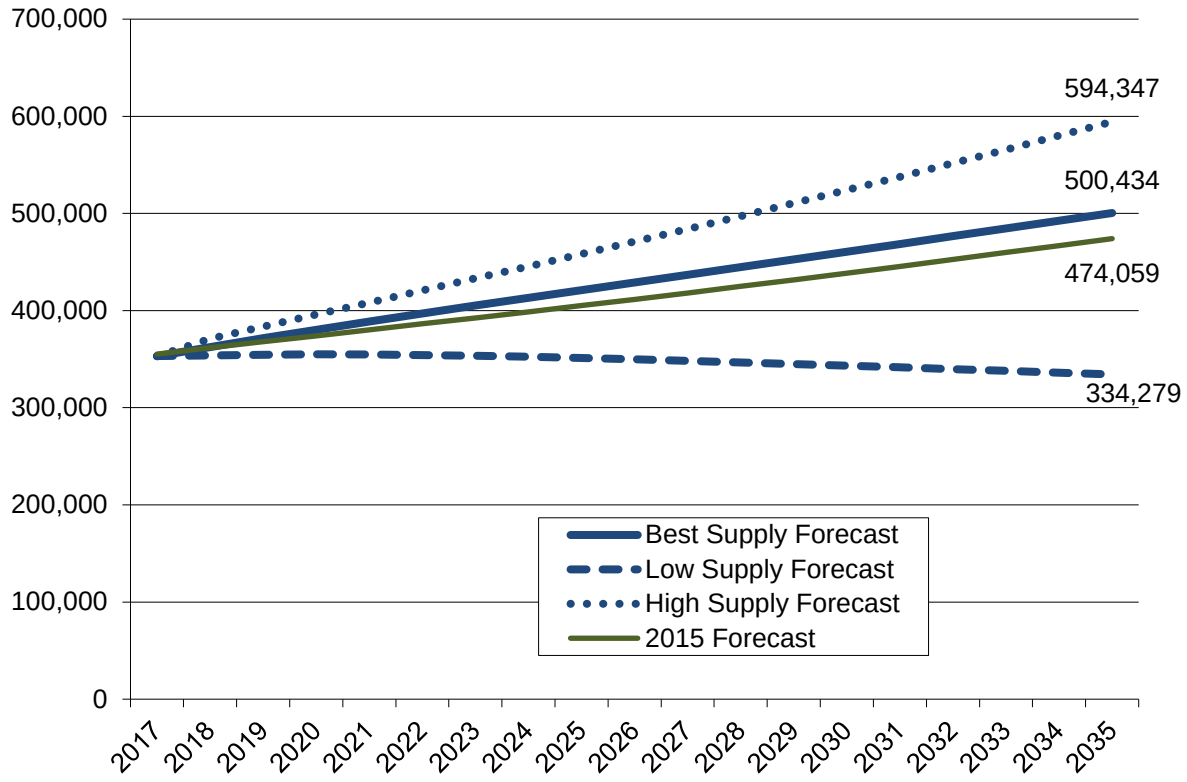
Age Category	BRN Data (Best Estimate) 2017	Best Estimate 2015
<30	0.0%	1.0%
30-34	0.9%	1.7%
35-39	1.5%	1.6%
40-44	1.4%	1.2%
45-49	1.2%	1.6%
50-54	1.3%	1.6%
55-59	1.5%	2.1%
60-64	1.8%	3.9%
65-69	3.4%	10.0%
70-74	9.7%	15.8%
75-79	17.6%	23.3%
80+	25.9%	23.3%

Sources: California Board of Registered Nursing license records, 2016.

This formula is used to produce a forecast of the total active RN population residing in California through 2035. We estimate that California will have 500,434 active resident RNs by 2035, as shown in Figure 2. This is 5.6% larger compared to the 2015 forecast of 474,059 RNs by 2035. This difference is largely due to increases in the numbers of RNs reactivating their licenses and lower rates of nurses migrating out of California; small adjustments in estimated numbers of license reactivations and rates of inter-state migration change the forecasts significantly.

As noted above, there was a range of plausible estimates for several of the inflow and outflow parameters in the model. Different sources of data provided different estimates of migration to California, migration from California, changes from active to inactive license status, and the projected number of new nursing graduates. Figure 2 presents the range of supply estimates that result when the highest and lowest possible supply forecasts are calculated. The rapid growth of the RN workforce in the high forecast is largely driven by a high rate of migration to California from other states, and the slow growth in the low forecast results from a low rate of migration to California from other states. These alternate forecasts are useful to provide a sense of the range of possible supply outcomes that could occur as a result of changes in any of the variables identified above.

Figure 2. Forecasted number of RNs with active licenses residing in California, 2017-2035



The forecasted number of RNs with active licenses does not account for the variation in hours worked by RNs and the fact that some RNs with active licenses do not work in nursing. Data from the 2016 BRN Survey of RNs were used to estimate the proportion of RNs living in California with active licenses that are employed in nursing, by age category (Spetz, Chu, & Jura 2017). The estimated employment rates range from a high of 97.4% for RNs 25 years and younger to a low of 10% for RNs 80 years and older. Employment rates by age groups have varied since 2008, likely due to the economic recession that began in late 2007. During the recession, younger nurses were employed at lower rates, and older nurses were employed at higher rates. The low estimate of the employment rate for each age group is the lowest of five most recent employment rates measured in biennial BRN Surveys. The high estimate is the highest of these five rates. The best estimate is the average of the low and high rates and is presented in Table 10.

Table 10. Employment rates for RNs residing in California, 2016, and average rates used in forecasts

Age Category	Share Employed, 2016	Low Estimate	High Estimate	Best Estimate
Under 25	97.4%	89.6%	100.0%	94.8%
25-29	93.4%	93.4%	97.4%	95.4%
30-34	92.3%	92.1%	95.5%	93.8%
35-39	93.5%	92.3%	95.2%	93.8%
40-44	95.6%	89.7%	95.6%	92.6%
45-49	94.7%	92.1%	94.7%	93.4%
50-54	91.1%	89.8%	91.1%	90.4%
55-59	89.3%	85.3%	89.3%	87.3%
60-64	76.9%	75.5%	78.5%	77.0%
65-69	53.3%	53.3%	65.2%	59.2%
70-74	46.2%	40.5%	46.2%	43.3%
75-79	25.9%	25.9%	36.0%	31.0%
80+	10.0%	10.0%	24.2%	17.1%

Source: Spetz, J, Chu, L, Jura, M. 2017. 2016 Survey of Registered Nurses. Sacramento, CA: California Board of Registered Nursing.

In the supply model, the 2016 BRN Survey of RNs was used to estimate the average usual hours worked per week in all nursing jobs for each age category by active RNs who resided in California and were employed in nursing (Spetz, Chu, & Jura 2017). This is to account for variation in hours worked by RNs. These estimated hours per week are divided by 40 to obtain the average full-time equivalent employment (FTE) for each age category. The data used for this calculation are presented in Table 11. As with the estimates of the employment rate, the high estimate is the highest of the number of hours worked in the past five surveys and the low estimate is the lowest of these five. The best estimate is the average of the high and low estimates.

Figure 3 presents projected high, low, and best estimates of FTE supply based on the best estimates of the future count of RNs. The 2017 forecast is slightly higher than that of 2015, reflecting the increase in the forecasted total number of RNs discussed above. In the chart, these forecasts are compared with the FTE supply forecasted published by the U.S. Bureau of Health Workforce (BHW 2014). The BHW forecast is notably higher than the forecasts developed in the model described here.

Table 11. Average hours worked per week by RNs residing in California, 2016, and average hours used in forecasts

Age Category	Hours Worked per Week, 2016	Low Estimate	High Estimate	Best Estimate
Under 25	37.8	37.8	47.1	42.4
25-29	37.0	35.8	37.0	36.4
30-34	37.3	35.8	37.3	36.5
35-39	35.3	35.3	36.2	35.8
40-44	36.6	36.4	37.0	36.7
45-49	38.1	36.7	38.1	37.4
50-54	38.0	36.9	38.0	37.5
55-59	38.1	36.6	38.1	37.4
60-64	35.4	35.3	35.5	35.4
65-69	33.6	32.0	33.6	32.8
70-74	25.4	24.0	26.0	25.0
75-79	26.4	18.8	26.4	22.6
80+	22.8	22.8	31.1	26.9

Source: Spetz, J, Chu, L, Jura, M. 2017. 2016 Survey of Registered Nurses. Sacramento, CA: California Board of Registered Nursing.

The supply forecasts and California Department of Finance (2013) projections of total population in the state can be used to calculate the number of employed RNs per 100,000 people in the population for the years 2017 through 2035 (Figure 4). We compared these projections to the number of employed RNs per 100,000 population in 2015, as computed from the American Community Survey (U.S. Bureau of the Census, 2016). In 2015, there was an average of 1,038 employed RNs per 100,000 U.S. residents, which is an increase from 936 per 100,000 in 2013. The 25th percentile across all states was 916 employed RNs per 100,000 residents. By 2035, California's ratio is expected to approach the national 25th percentile.

Figure 3. Forecasted full-time equivalent supply of RNs, 2017-2035

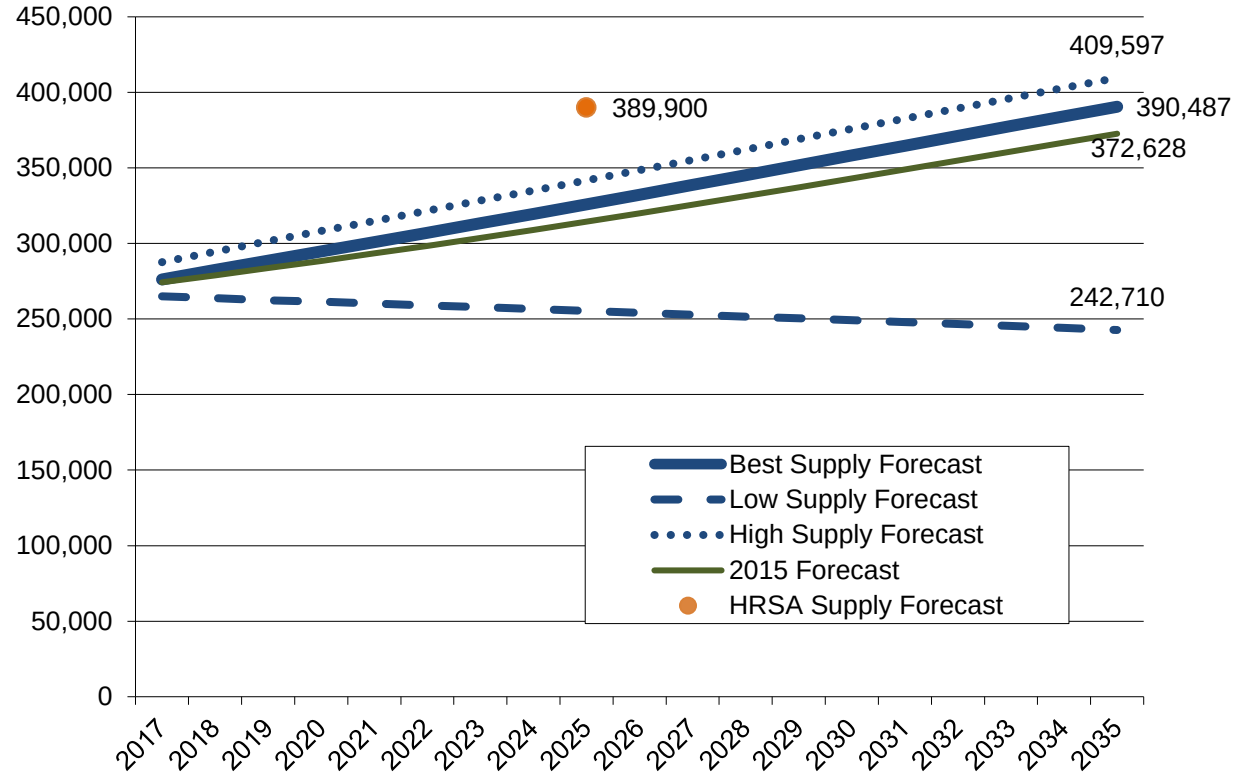
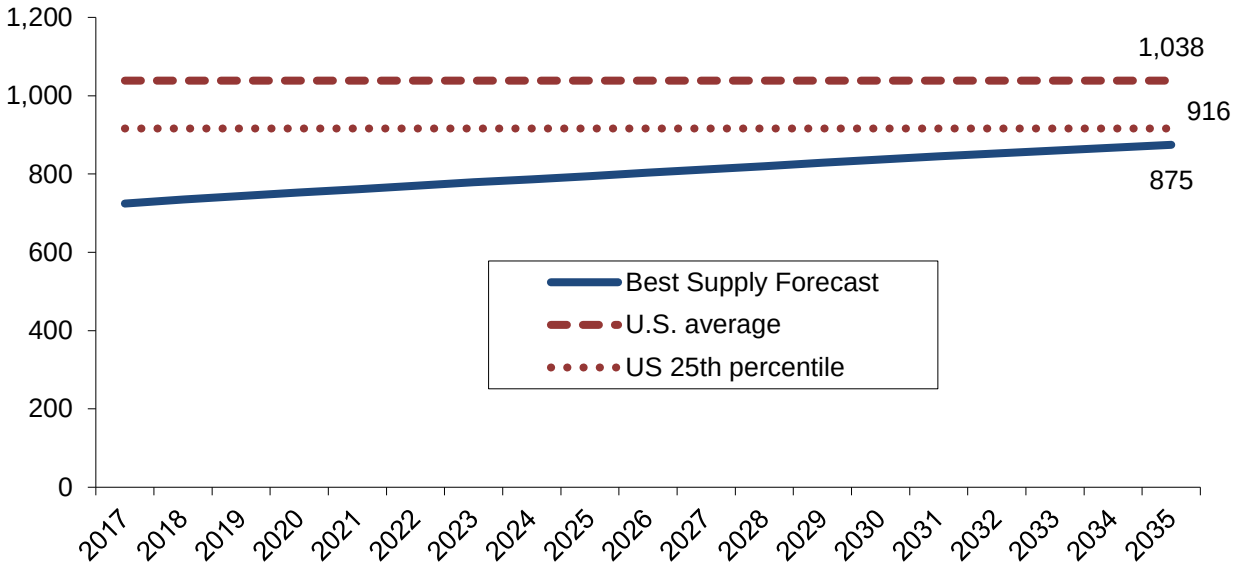


Figure 4. Forecasted number of employed RNs per 100,000 population, 2017-2035



The Demand for RNs

The demand for RNs can be measured and forecasted in many ways, reflecting disparate notions of what demand is or should be. Many policymakers and health planners consider population needs as the primary factor that should dictate the need for health care workers. For example, the World Health Organization has established a goal of countries needing a minimum of 2.28 health care professionals per 1,000 population in order to achieve the goal of 80 percent of deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, policymakers could target a stable number of nurses per capita, a level developed by an expert panel, or a goal based on comparisons with other U.S. states.

It is important to recognize, however, that population need is not the same thing as economic demand. Nurses and other health professionals are not free, and the cost of employing them must be weighed against other uses of resources. A nurse employer might want to hire more nurses but may not have sufficient income from its patient care services to afford more nurses. An employer might have resources that could be used to hire more nurses, but might think that investment in an electronic medical record will produce more value to patients. The demand for nurses is essentially derived from economic forces, which may not be aligned with population needs.

For this report, several different measures of demand (or need) are considered in order to develop a range of plausible estimates of future demand for RNs. The approaches used are:

- Fixed benchmarks based on current RN-to-population ratios in California
- Fixed benchmarks based on U.S. RN-to-population ratios
- Demand forecasts based on 2015 hospital patient days, employment in hospitals, and future population growth and aging
- An employment forecast for 2024 published by the California Employment Development Department (EDD 2016)
- A demand forecast for 2025 published by the U.S. Bureau of Health Workforce (BHW 2014)

These approaches are informed by surveys of RN employers conducted from fall 2010 through 2014 and by other recent analyses of the effect of health insurance expansion in California.

Forecasts based on RNs per capita

One frequently-used benchmark of the need for RNs is the number of employed RNs per 100,000 population (California Institute for Nursing and Health Care,

2006). For decades, California has had one of the lowest ratios of employed RNs-per-100,000 population in the United States. Table 12 presents 2015 ratios of working RNs per 100,000 population for the states with the 10 lowest and 10 highest ratios, based on data from the American Community Survey (U.S. Bureau of the Census, 2016). California had the 5th lowest ratio. Many policy advocates have supported efforts to move California's full-time equivalent employment of RNs toward the current 25th percentile nationwide (916 RNs per 100,000) or even the national average (1,038 RNs per 100,000). These benchmarks were compared with the current and forecasted population of California (California Department of Finance, 2013) to project need for RNs to remain at current RN-to-population ratios in order to reach the 25th percentile ratio and to attain the national average ratio.

Table 12. Working RNs per 100,000, 2015

State with the lowest ratios	RNs per 100,000	States with the highest ratios	RNs per 100,000
Wyoming	584	Ohio	1,226
Nevada	678	South Dakota	1,275
Utah	771	Mississippi	1,288
New Mexico	774	Wisconsin	1,294
California	809	Massachusetts	1,295
Alaska	836	West Virginia	1,306
Oklahoma	840	Delaware	1,324
Texas	854	Minnesota	1,350
Arizona	856	Maine	1,463
Washington	877	New Hampshire	1,640

Source: U.S. Bureau of the Census. 2016. American Community Survey, Summary File, 2015. Washington DC: U.S. Bureau of the Census. Note: States with small sample sizes have greater margin of error in the estimated RN-to-population ratio.

Forecasts based on hospital staffing of RNs per patient day

The main shortcoming of targeting a fixed number of RNs per population is that the target is arbitrarily defined. The current number of nurses per capita may not be a large enough number to deliver health care needs, and if there is a shortage of nurses, the number may not be as large as economic demand. Likewise, a target number based on a national average or other source might not reflect the unique population and health care system of California. An additional shortcoming is that

fixed nurse-to-population ratios do not account for increases in the demand for health care services associated with population aging.

A second approach to forecasting demand for RNs uses current hospital utilization and staffing patterns to estimate future demand. First, the 2015 total number of hospital patient discharges, per ten-year age group, at short-term acute-care hospitals was obtained (California OSHPD 2016).[2] In order to estimate the total number of patient days per age group, these data were then multiplied by the average length of stay per age group, as reported from the 2014 Hospital National Inpatient Statistics (AHRQ 2014).

To calculate the rate of hospital utilization per age group, the total number of patient days per age group was divided by the estimated population of each age group. Age-specific population estimates and forecasts were gathered from the California Department of Finance (2013). Dividing patient days by population provides the number of patient days per population, per age group. These rates of patient days were then applied to the population projections to get projections of total patient days by age category.

To produce forecasts of hospital demand for RNs, RN hours per patient day were calculated using OSHPD's Hospital Annual Financial Data (Office of Statewide Health Planning and Development, 2016). In 2015, a total of 225,000,204 productive RN hours were reported. The number of RN hours per discharge was calculated by dividing these hours by the number of patient days in 2015, resulting in 12.51 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasts of the total number of patient days produces a forecast of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours are divided by 1,768 (average annual productive hours per FTE).

The calculations described above provide demand forecasts for only one type of care setting (hospitals), and only for a subset of hospitals (long-term hospitals and federal hospitals are not included in the calculations based on OSHPD data). The OSHPD data estimate that there were 127,263 FTE hospital positions in 2015. Calculations based on the 2016 BRN Survey of Registered Nurses find that total FTE employment was 272,522 (Spetz et al., 2015). Together, these figures indicate that 46.7 percent of jobs were in the types of hospitals included in the OSHPD data. The hospital-based projections of future RN demand were thus augmented to maintain this 46.7 percent ratio in future years. The projections indicate there will be a need for 175,096 FTE RNs in hospitals and 374,954 FTE RNs statewide in 2035. Projected

[2] The age groups are under 1, 1-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80 and older.

RN FTEs in hospitals are 4.3 percent larger and projected statewide RN FTEs are 2.7 percent larger than the forecasts developed in 2015 (167,930 and 365,214 respectively), reflecting increases in hospital utilization and higher RN hours per patient day reported by OSHPD in 2015 as compared with 2014.

Employment Development Department forecasts

The most recent projection by the EDD indicates that there will be 300,300 registered nurse jobs in California by 2024 (California Employment Development Department, 2016). The EDD projection does not distinguish between full-time and part-time jobs. To estimate the FTE employment implied by the EDD projection, we use the adjustment of 0.906, which is the average number of hours worked per week by California RNs in 2016 (36.24), divided by 40 (Spetz, Chu, and Jura 2017). The FTE projection for 2024 is thus 272,072, which is slightly higher than the EDD's projection of 271,378 jobs in 2022.

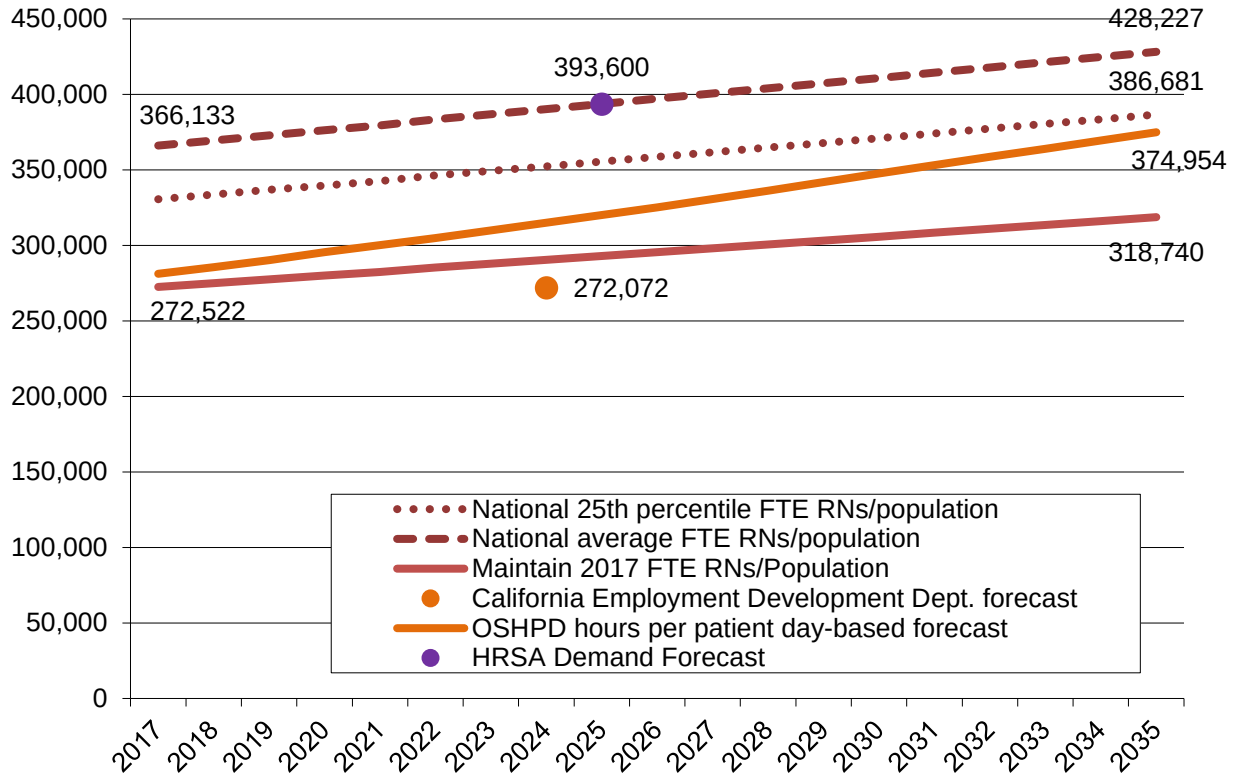
Bureau of Health Workforce forecasts

The U.S. Bureau of Health Workforce developed forecasts of supply and demand for RNs nationally and for states (BHW 2014). These forecasts are based on a multi-step model that first projects demand for different types of health services and then projects demand for health care workers based on estimated service demand. They project that supply in California in 2025 will be 389,900 FTE RNs, and demand will be 393,600 FTE RNs.

Comparing the demand forecasts

Figure 5 compares alternative demand forecasts of full-time equivalent RNs. The forecasts estimate that the FTE demand for RNs in 2017 ranged from 272,522 to 366,133. Demand in 2035 is forecasted to be between 318,740 and 428,227. These lower figures are not likely to accurately represent total future demand because they do not account for additional demand caused by future population growth and aging. The EDD forecast for 2024 is lower than that produced by maintaining the current RN-to-population ratio. The BHW forecast for 2025 is slightly higher than the projection based on attaining the national average RN-to-population ratio.

Figure 5. Forecasted full-time equivalent demand for RNs, 2017-2035.



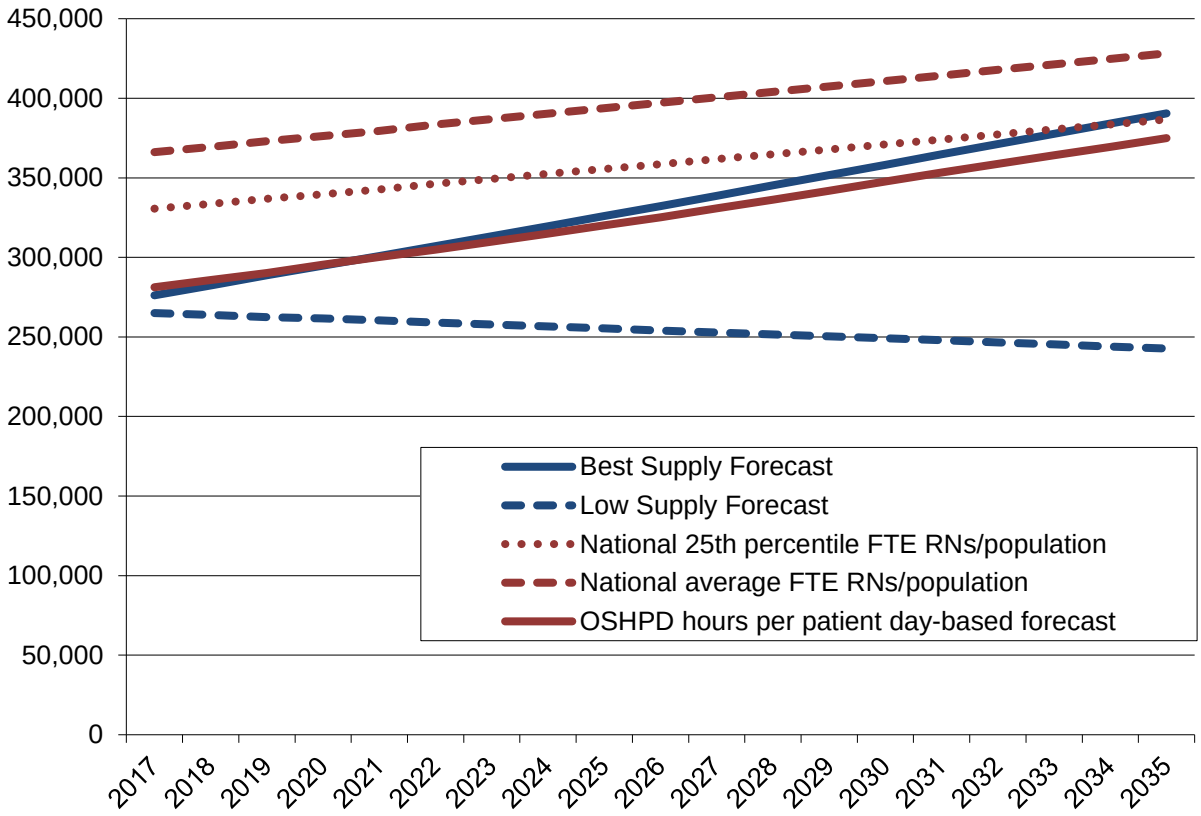
Comparing Supply and Demand for RNs

Through most of the 2000s, there was a widespread perception that California faced a significant long-term shortage of RNs, and forecasts published by the BRN in 2005 and 2007 were consistent with this perception. However, after the number of RN graduations more than doubled in California in the 2000s, the forecasts published in 2011 indicated that California had closed the gap between RN supply and demand. The rapid onset of the economic recession that began in December 2007 led to concerns that RN supply was exceeding demand, although in the long-term another RN shortage could emerge. The 2015 forecasts indeed suggested there may have been a small surplus of RNs, but that RN supply and demand would be well-balanced through 2035.

Figure 6 presents the new 2017 best supply forecast and low supply forecast, along with three alternate demand forecasts based on: (1) striving to reach the national 25th percentile, (2) attaining the national average, and (3) forecasted growth in hospital patient days. All forecasts are for full-time equivalent employment. The best supply estimate is that in 2017, there were 276,161 FTE RNs available to work, and the patient days-based demand estimate is 281,232 FTE positions to be

filled. This suggests a small shortage of RNs in 2017. This is consistent with employer survey data that California employers perceive an overall shortage of experienced RNs and a surplus of recently-graduated RNs (Chu, Bates, & Spetz, 2017).

Figure 6. Forecasted full-time equivalent supply of and demand for RNs, 2017-2035.



In the long-term, the best supply forecast predicts that nurse supply will rise more rapidly than California's population as a whole, and RN supply will reach the national 25th percentile of FTE RNs per 100,000 by 2034. The demand forecast based on hospital utilization is nearly perfectly aligned with projected supply. However, there is uncertainty regarding what future demand for RNs will be. The California EDD forecasts demand in 2024 to be 272,072 FTEs, which is lower than forecasted supply of 319,588.

In contrast, the U.S. BHW forecasts demand in 2025 to be 393,600, which is much higher than the BRN model's demand forecast. Note that the BHW's supply forecast is 389,900 and thus the BHW model projects California to have a small shortage in 2025. The national model relies upon a national data source, the American Community Survey; it has less detailed information than the BRN Survey of

Registered Nurses, which may account for some of the difference between the BRN and national projections.

The low projection of supply indicates that it is possible that California will enter another period of RN shortage that could persist for decades. Which scenario prevails will depend on a number of factors:

- Whether the number of RN graduates is sustained at the current level or declines
- Whether inter-state migration leads to fewer nurses entering California than leaving
- Whether older RNs work at higher rates than in the past
- Whether expanded health insurance coverage continues, supporting higher demand for primary care services
- How organizations utilize RNs to meet population health goals and leverage value-based health insurance payment

Educational and public policies at the state and federal level will play roles in determining whether California's RN workforce stays in balance or tips toward shortage.

Comparison of the 2017 Forecasts with Previous Forecasts

The forecasts presented here use a similar methodology to that used in prior BRN forecasts. The magnitude of the projected shortage changed dramatically over time. In 2005, California had a substantial shortage of RNs, ranging between 6,872 and 21,161 RN FTEs. This shortage grew by 2007, reaching at least 10,294 RN FTEs. However, due to growth in the number of new RN student enrollments, the 2007 forecasts predicted that the shortage would be reduced over time and that California would surpass the national average of RN FTEs per 100,000 population (825) by 2022. The 2009 forecasts were similar to those of 2007.

The 2011 forecasts indicated that supply would rise more rapidly than had been previously estimated, in part due to continued growth in new student enrollments in RN education programs and in part due to greater employment of nurses during the economic recession. The forecasts suggested that it was possible that a surplus of RNs would emerge in the late 2020s. However, the 2015 forecasts did not project a future surplus of RNs, largely due to the flattening of student enrollments in RN education programs. Supply was anticipated to grow at a rate roughly equivalent to demand growth. The 2017 forecasts are similar to those from 2015, with supply and demand in close alignment and a surplus unlikely to emerge.

The year in which California might reach the national 25th percentile or national average of RNs-per-population has moved later in each forecast. This is in part because the number of RNs-per-population has risen nationwide from 825 in 2007 to 1,038 in 2015. Thus, one should not interpret the later year of attainment of these benchmarks as a sign that California's RN workforce is not growing adequately.

Policy Implications

Periods of nursing shortage generate significant challenges because patient outcomes are impacted by the level of nurse staffing in hospitals and other care facilities (Kane & Shamliyan, 2007; Institute of Medicine, 2011; Penoyer, 2010). In addition, shortages drive up the cost of health care as wages rise (Spetz and Given, 2003). Thus, it is essential that these forecasts of RN supply and demand guide policies to prevent RN shortages.

The 2005 forecast report advised that "The only plausible solution to the RN shortage, based on our preliminary analyses, appears to be continued efforts to increase the numbers of graduates from California nursing programs." This recommendation was acted upon by state leaders. Significant increases in state funding for nursing programs, increased funding for equipment, use of updated instructional technologies, and other educational investments had a favorable impact on addressing the RN shortage in California. Between the academic years 2004-2005 and 2009-2010, the number of nursing graduates increased 72 percent, exceeding 11,500 new RN graduates in 2009-2010 (Waneka, Keane, & Spetz 2012). The total number of graduates has stabilized since then, ranging from 10,666 and 11,292 since 2010-2011. The number of graduates is projected to remain above 10,000 per year through 2019-2020, thus leading to a stable workforce. If future numbers of student enrollments and graduates decline, a shortage could re-emerge.

Changes in the demand for RNs also could lead to a future shortage or surplus. If emerging care delivery models, such as accountable care organizations and patient-centered medical homes, lead to greater use of RNs in care management roles, demand for RNs could rise above the projections presented in this report. A recent report (Oberlin et al. 2015) found that if health care organizations increase employment of RNs by 10 percent to serve in care management roles, overall demand would increase by about 22,000 jobs in California (which may include some part-time jobs). This would be a relatively small change in demand, which would likely emerge slowly enough over time that nursing education programs could respond by increasing student enrollment.

Policymakers should be cautioned that the 2017 BRN forecasts represent the state as a whole and do not reflect the fact that one region of California may experience a shortage while another may face a surplus of RNs. Both statewide and regionally, the most important changes that could lead to shortages include: (1) the number of graduates from RN education programs; (2) inter-state migration; and (3) employment rates of older RNs. These factors and any other potential influences on California's nursing shortage, such as the limited pool of faculty, limited availability of clinical education placements, and faculty salaries that are not competitive with clinical practice positions, should be monitored continuously.

California leaders should track the employment paths of recent nursing graduates as they develop specialized skills to fill the roles of experienced nurses who will retire in the near future. Moreover, they should watch new student enrollments in nursing programs, as well as monitor local labor market conditions, which could warrant local action. California will need to maintain the present number of nursing graduates in order to meet long-term health care needs.

Acronyms

ACA – Affordable Care Act of 2010

AD – Associate Degree

BHW – Bureau of Health Workforce, Health Resources and Services Administration, U.S. Department of Health and Human Services

BRN – California Board of Registered Nursing

BSN – Bachelors (or Baccalaureate) of Science in Nursing

EDD – California Employment Development Department

FTE – Full-time Equivalent

NCLEX-RN – National Council Licensure Examination – Registered Nurses (NCLEX is a registered trademark and/or servicemark of the National Council of State Boards of Nursing, Inc.)

NSSRN – National Sample Survey of Registered Nurses (last conducted in 2008)

OSHPD – California Office of Statewide Health Planning and Development

RN – Registered Nurse

UCSF – University of California San Francisco

WHO – World Health Organization

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