Regional Forecasts of the Registered Nurse Workforce in California

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Abstract / Overview

Statewide forecasts of the supply and demand for registered nurses (RNs) project a balanced RN labor market, but regional forecasts reveal large differences across regions. Substantial shortages are projected for the San Francisco, Central Valley, and Central Coast regions, while surpluses may emerge in the Sacramento and Los Angeles regions. The forecasts account for population growth, population aging, and anticipated changes in the numbers of new RN graduates.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of RN supply and demand for each of the eight regions of California, based on a statewide projection model developed for the California Board of Registered Nursing (BRN).

The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition of the Regions

The eight regions of California are composed of counties that have interconnected economies and labor markets:

- Northern Counties: Butte, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Nevada, Plumas, Shasta, Sierra, Siskiyou, Tehama, Trinity
- Sacramento: El Dorado, Placer, Sacramento, Sutter, Yolo, Yuba
- San Francisco Bay Area: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma
- Central Valley & Sierra: Alpine, Amador, Calaveras, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, Tuolumne
- Central Coast: Monterey, San Benito, Santa Barbara, San Luis Obispo
- Los Angeles: Los Angeles, Orange, Ventura
- Southern Border: Imperial, San Diego

Modeling the Supply of RNs

The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
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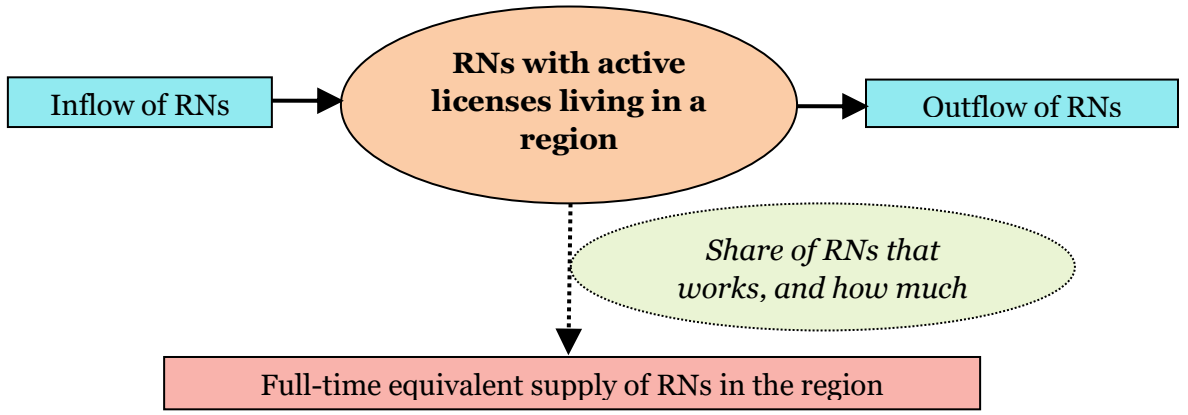
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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

Figure 1. A model of the supply of RNs



account for differences in the work commitments of those employed full-time and part-time. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of each region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in each region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age

group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

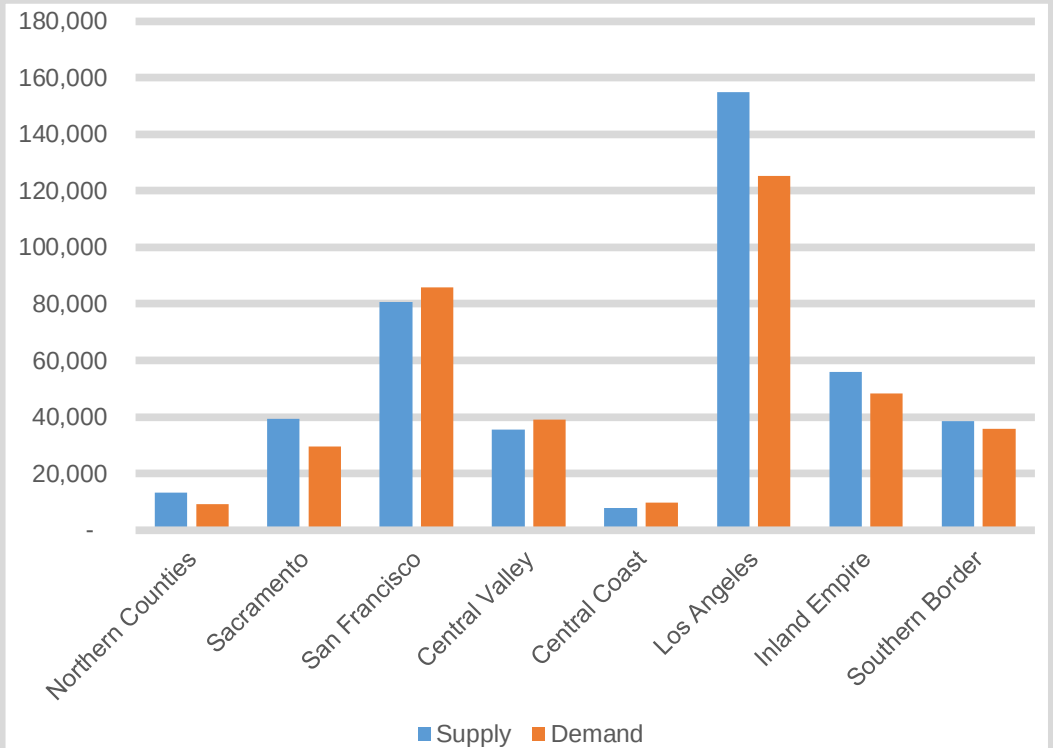
To produce forecasts of hospital demand for RNs, RN hours per patient day were calculated using OSHPD's Hospital Annual Financial Data (Office of Statewide Health Planning and Development 2017). The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate 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). The 2016 BRN Survey of Registered Nurses report provides data on total FTE employment in each region (Spetz et al. 2017). This was divided by estimated FTE employment in hospitals to obtain the total-to-hospital ratio. To forecast total demand for RNs in future years, projected hospital demand was multiplied by the total-to-hospital ratio.

Comparing Supply and Demand for RNs

Figure 2 presents the baseline forecasts of FTE RN supply and the forecasts of FTE RN demand based on hospital patient days (OSHPD data) for each region of California. These projections indicate that the RN labor markets in the Northern Counties and Southern Border will be fairly well-balanced, surpluses may emerge in the Sacramento, Los

Figure 2. Forecasted full-time equivalent supply and demand for RNs, 2035



Angeles, and Inland Empire regions, and that shortages may develop in the San Francisco, Central Valley, and Central Coast regions.

Additional factors that affect regional RN shortages

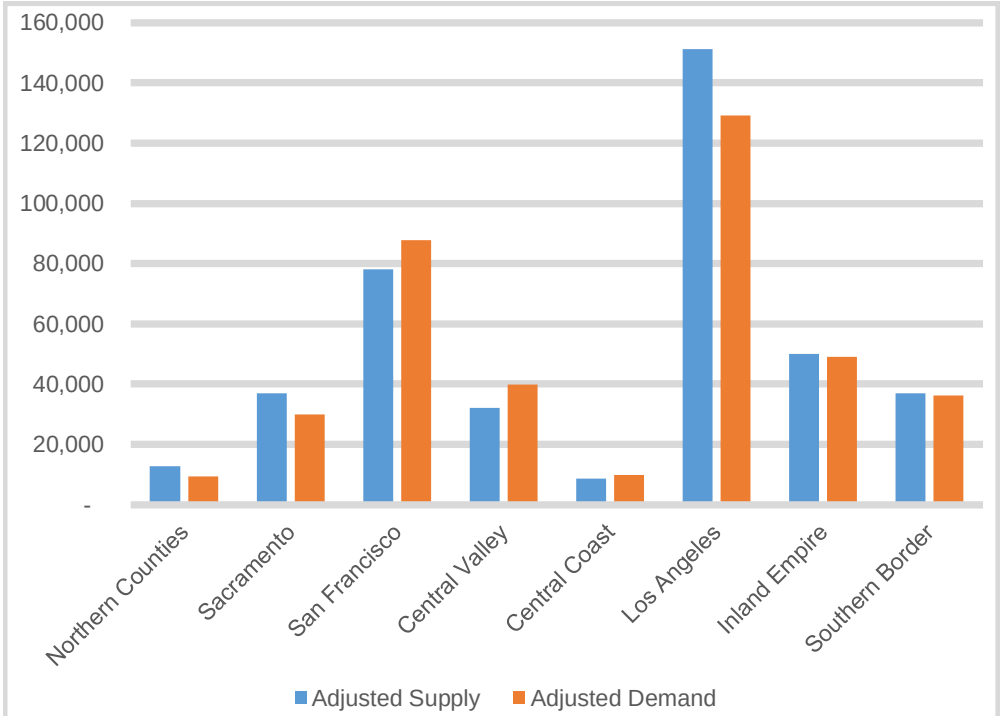
Some RNs travel across regions for work, which could result in fewer or more nurses working in each region. Data from the 2016 BRN Survey of RNs were used to estimate the numbers of RNs commuting across regions.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. Data from the 2016 Board of Registered Nursing Survey of RNs were used to estimate the number of RNs in each region that might work in advanced practice roles. Some APRNs work in RN positions, so these figures are likely an overestimate.

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The data indicated that the average share of regional hospital RN hours provided by contract staff ranges from 3.5% to 8.6%.

Figure 3 presents adjusted projected FTE supply and demand for RNs. The supply numbers are adjusted for inter-region commuting and the possibility that APRNs do not work as RNs. The demand numbers are increased by the estimated number of contract personnel employed in hospitals in 2017. These adjustments are total numbers rather than FTEs and thus likely overstate the changes in true supply and demand caused by these factors.

Figure 3. Forecasted full-time equivalent supply and demand for RNs, after adjustments to supply and demand for inter-region commuting, advanced practice, and contract personnel, 2035



After adjustments, the projected surpluses of RNs are smaller, and disappears entirely for the Inland Empire region. The projected shortages in San Francisco and the Central Valley are larger. The projected shortage in the Central Coast becomes slightly smaller.

Comparisons across regions in RNs per population

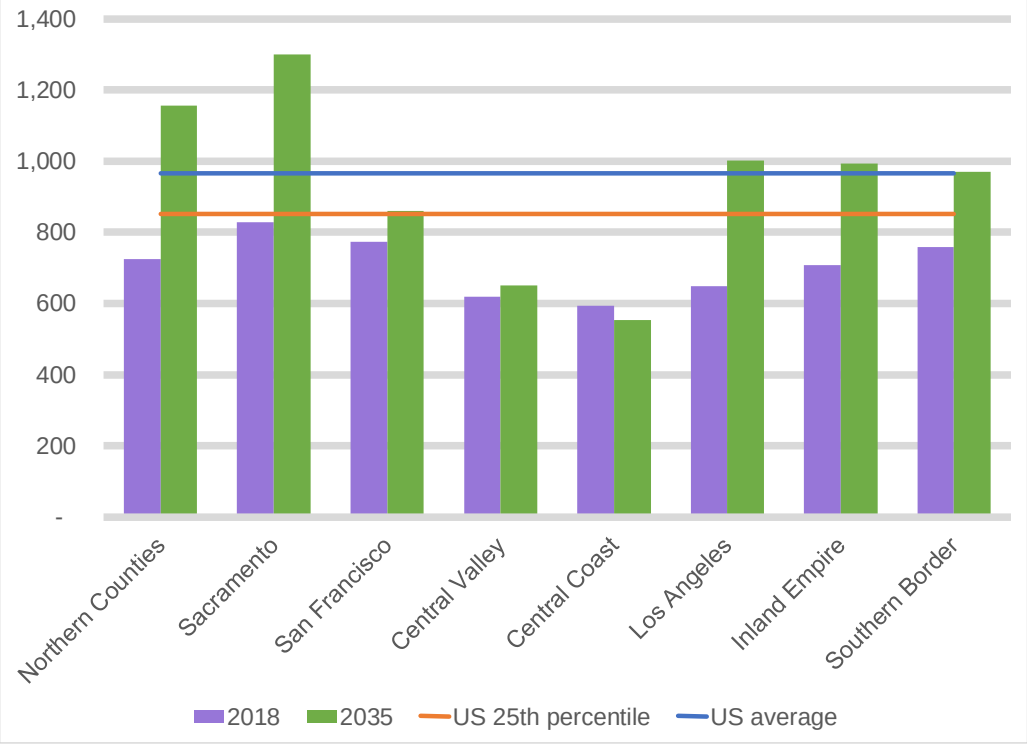
The demand forecasting model is based on current employment levels of RNs. However, current RN employment levels reflect both demand and supply, since employers cannot employ RNs who do not exist. It is possible that current employment levels are not adequate to meet population needs and do not indicate the number of RNs employers would hire if supply were adequate. A comparison of the current and projected number of RNs per 100,000 population in each region provides another perspective of the potential demand in each region. Figure 4 presents FTE RNs per 100,000 for 2018 and projected for 2035, and compares these ratios to the national 25th percentile and national average.

All regions of California now have FTE RN-per-100,000 ratios below the national 25th percentile, but there is notable variation across regions. The lowest RN-to-population ratios in 2018 are in the Central Coast, Central Valley, and Los Angeles regions, while the highest ratios are in the Sacramento, San Francisco, and Southern Border regions. By 2035, several regions are projected to have RN-to-population ratios that exceed the current national average: Northern Counties, Sacramento, Los Angeles, and Inland Empire; the ratio in the Southern Border region will nearly equal the national average and the ratio in the San Francisco region will reach the current national 25th percentile by 2035. However, the Central Valley and Central Coast will remain far below the national 25th percentile, and the RN-per-100,000 ratio is projected to decrease in the Central Coast region between 2018 and 2035.

Policy Implications

Statewide forecasts have projected a balanced RN labor market on average through 2035. However, regional forecasts reveal large differences across regions of the state. Some regions now have much lower supplies of RNs than other regions – notably

Figure 4. Full-time equivalent RNs per 100,000 population, 2018 and 2035



the Central Valley, Central Coast, and Los Angeles. These regions, as well as the Inland Empire, Sacramento, and Southern Border region, appear to have a shortage in 2018. In 2035, the Central Valley and Central Coast regions will continue to have shortages of RNs and a shortage will emerge in the San Francisco Bay Area region. Other regions that now have shortages – the Inland Empire, Sacramento, Los Angeles, and Southern Border regions – will experience substantial increases in the supply of RNs between 2018 and 2035, largely due to growth in RN education programs in their regions, thus mitigating the shortages that now exist. In these regions, the growth of RN supply will give health care systems the opportunity to employ nurses in a wide variety of roles that fully utilize their skills in direct patient care, care management, patient education, home health, and ambulatory care.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors, and any other potential influences on regional nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine whether and the extent to which local RN education programs should expand.

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Forecasts of the Registered Nurse Workforce in the San Francisco Bay Area of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The San Francisco Bay region of California, which consists of ten counties, is projected to have growth in the supply of registered nurses (RNs) but supply will not keep up with growth in demand. Projections of supply and demand through 2035 indicate that an RN shortage may exist now and will worsen due to population growth, aging of the population, and rising shares of RNs who enter advanced practice.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the San Francisco Bay Area of California, based on a statewide projection model developed for the California Board of Registered

Nursing (BRN). The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the San Francisco Bay Area

The San Francisco Bay Area region is defined as a 10-county area that includes counties in the U.S. Census Bureau core-based statistical areas of San Francisco-Oakland-Berkeley, San Jose-Sunnyvale-Santa Clara, Santa Cruz-Watsonville, Santa Rosa-Petaluma, and Napa: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma. This region corresponds to the combined Employment Development Department regions of Oakland, San Rafael, and San Francisco metropolitan divisions (MDs), and Napa, San Jose, Santa Cruz, Vallejo, and Santa Rosa metropolitan statistical areas (MSAs). There are 79 short-term general, children's, and specialty hospitals in the region, as well as 18 associate degree (AD), eight bachelor's degree (BSN), and four entry-level master's (ELM) RN education programs.

The Supply of RNs

In February 2018, there were 81,595 RNs with current, active licenses living in the San Francisco Bay Area region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

1) Inflows of nurses: Additions to the number of RNs in the region
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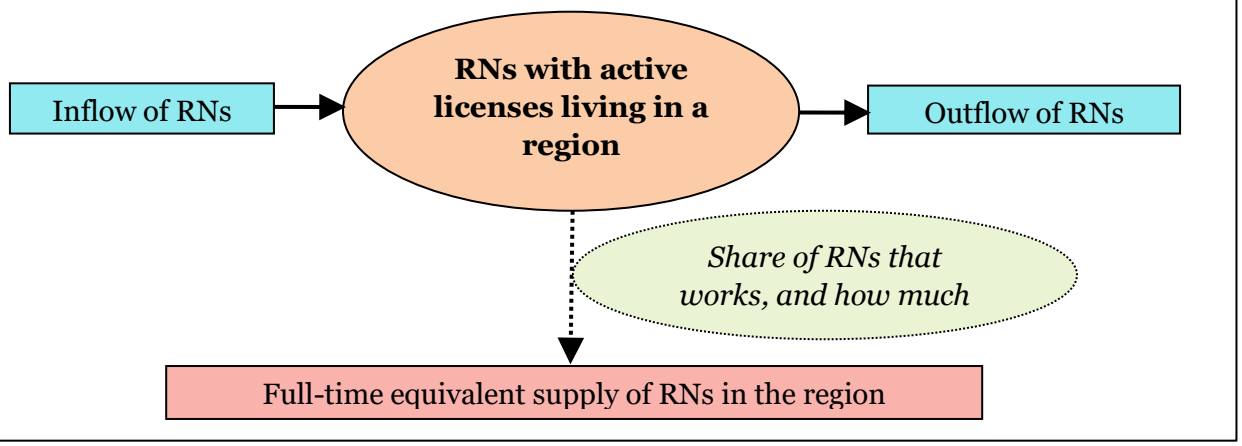

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Forecasted Supply of RNs next year
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Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 81,595 RNs had active licenses and an address in the San Francisco Bay Area region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the San Francisco Bay Area region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	933	1.1%
25-29	5,757	7.1%
30-34	9,900	12.1%
35-39	9,815	12.0%
40-44	9,716	11.9%
45-49	9,837	12.1%
50-54	7,848	9.6%
55-59	8,605	10.5%
60-64	9,499	11.6%
65-69	6,089	7.5%
70-74	2,477	3.0%
75-79	847	1.0%
80+	272	0.3%
Total	**81,595**	**100.0%**

Graduates from RN education programs

RN education programs in the San Francisco Bay Area region produced 2,213 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the San Francisco Bay Area region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 88.8% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 2,562 and that 2018-2019 new student enrollments would be 2,618. These estimates were multiplied by 88.8% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. From these totals, 205 projected graduates who attended satellite campuses in other regions were subtracted. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	2,411*	2,257*
2013-2014	2,361*	2,193*
2014-2015	2,525*	2,472*
2015-2016	2,349*	2,054*
2016-2017	2,581*	2,213*
2017-2018	2,325	1,880
2018-2019	2,382	2,086
2019-2020		2,069
2020-2021		2,119

* Actual enrollments/graduates, which include satellite campuses located in other regions.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 76 such out-of-state graduates had an address in the San Francisco Bay Area region. Additionally, 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, 160 of whom had an address in the San Francisco Bay Area region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the San Francisco Bay Area region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the San Francisco Bay Area region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the San Francisco Bay Area region in 2018, and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a San Francisco region address. The region's in-migration rate was as the sum of RNs who migrated to the San Francisco Bay Area region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	37.5%	9.4%
26-29	27.9%	33.8%
30-34	12.9%	30.0%
35-39	12.9%	15.0%
40-44	3.6%	4.4%
45-49	3.6%	4.4%
50-54	0.8%	1.9%
55-59	0.8%	0.6%
60-64	0.0%	0.6%
65+	0.0%	0.0%

Table 4. Movement of RNs into San Francisco Bay Area region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	47	35	8.7%
25-29	338	204	9.4%
30-34	365	162	5.3%
35-39	214	97	3.2%
40-44	155	43	2.0%
45-49	143	38	1.8%
50-54	105	27	1.7%
55-59	105	27	1.5%
60-64	73	26	1.0%
Over 64	31	4	0.4%
Total	**1,576**	**663**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, San Francisco Bay Area region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	28	2.0%
30-34	88	6.4%
35-39	102	7.4%
40-44	95	6.9%
45-49	125	9.1%
50-54	136	9.9%
55-59	159	11.5%
60-64	208	15.1%
65-69	199	14.4%
70-74	134	9.7%
75+	104	7.5%
Total	**1,378**	**100.0%**

Migration out of the region

Estimates of migration out of the San Francisco Bay Area region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the San Francisco Bay Area region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the San Francisco Bay Area region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the San Francisco Bay Area region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Total as a share of RNs living in region
Under 25	39	4.2%
25-29	218	3.8%
30-34	285	2.9%
35-39	219.5	2.2%
40-44	182	1.9%
45-49	130.5	1.3%
50-54	132.5	1.7%
55-59	164.5	1.9%
60-64	144	1.5%
65-69	84	1.4%
70-74	23	0.9%
75+	0	0.0%
Total	**1,622**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the San Francisco Bay Area region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

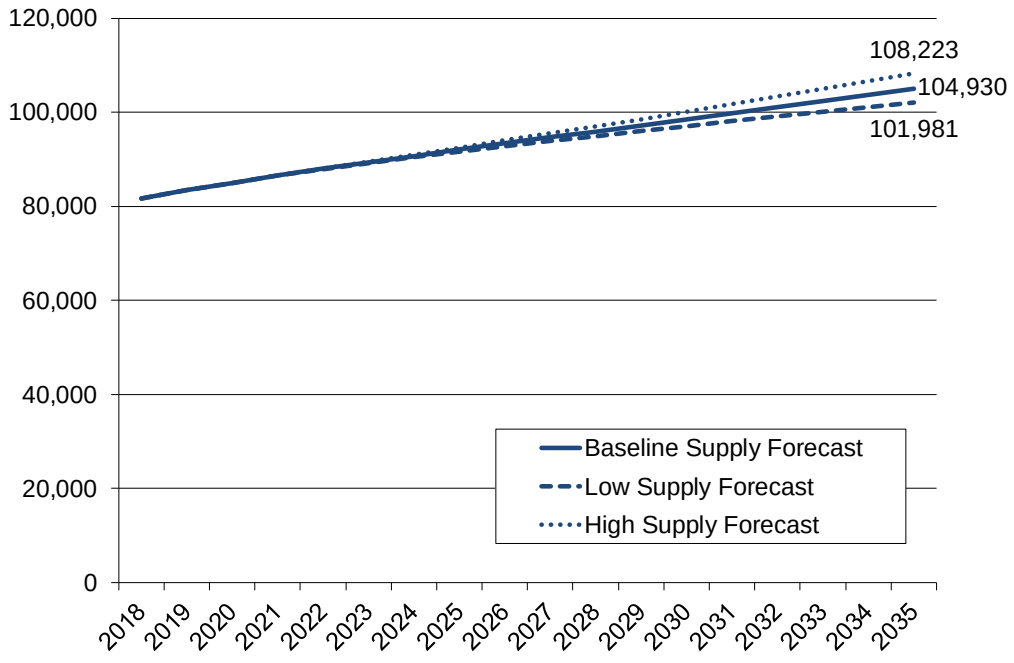
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	16	1.7%
25-29	87	1.5%
30-34	146.5	1.5%
35-39	127	1.3%
40-44	99	1.0%
45-49	98.5	1.0%
50-54	124.5	1.6%
55-59	207	2.4%
60-64	509.5	5.4%
65-69	595.5	9.8%
70-74	486.5	13.5%
Total	**2,497**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the San Francisco Bay Area region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the San Francisco Bay Area region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the San Francisco Bay Area region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	92.0%	92.0%	97.4%	94.7%
30-34	92.4%	92.1%	95.5%	93.8%
35-39	94.8%	92.3%	95.2%	93.8%
40-44	97.7%	89.7%	97.7%	93.7%
45-49	89.7%	89.7%	93.4%	91.6%
50-54	90.1%	89.8%	90.8%	90.3%
55-59	89.2%	85.3%	89.2%	87.3%
60-64	74.4%	74.4%	78.5%	76.4%
65-69	47.3%	47.3%	65.2%	56.2%
70-74	46.2%	40.5%	46.2%	43.3%
75-79	58.4%	32.0%	58.4%	45.2%
80+	0.0%	0.0%	24.2%	12.1%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the San Francisco Bay Area region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

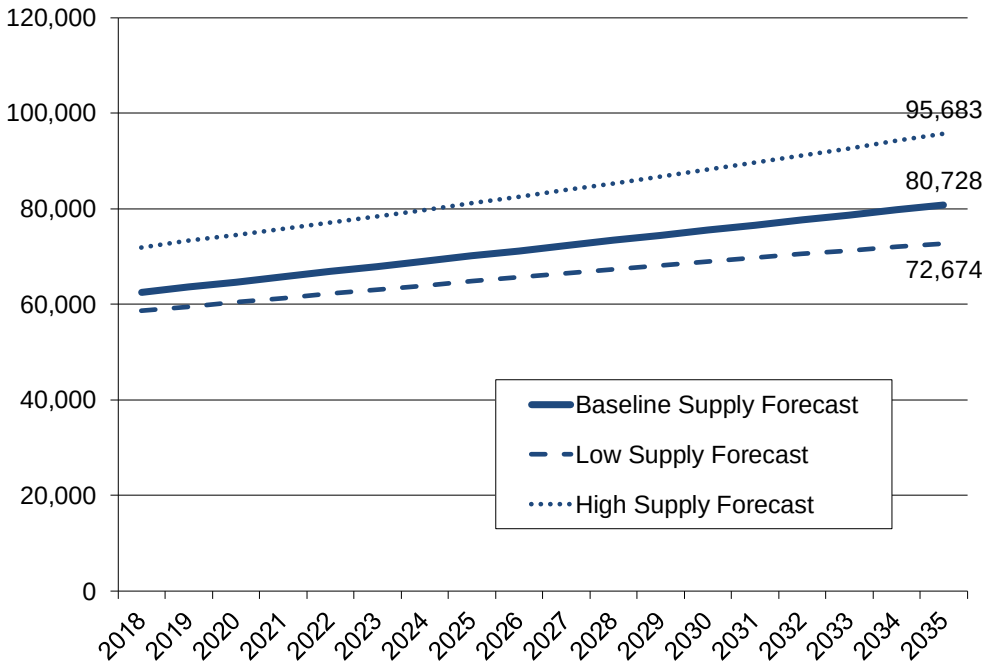
Table 9. Hours worked per week by employed RNs in the San Francisco Bay Area region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	34.9	34.9	47.1	41.0
25-29	41.4	35.8	41.4	38.6
30-34	34.6	34.6	36.6	35.6
35-39	34.1	34.1	36.2	35.2
40-44	34.6	34.6	37.0	35.8
45-49	34.4	34.4	37.4	35.9
50-54	36.1	36.1	37.6	36.9
55-59	36.6	36.6	37.4	37.0
60-64	35.6	35.3	35.6	35.4
65-69	34.5	32.0	34.5	33.3
70-74	31.5	24.0	31.5	27.7
75-79	29.2	18.8	29.2	24.0
80+	7.0	7.0	31.1	19.1

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the San Francisco Bay Area region. These estimates in 2035 range from 72,674 to 95,683 in 2035, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the San Francisco Bay Area region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the San Francisco Bay Area region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 43,855,081 productive RN hours were reported by hospitals in the San Francisco Bay Area region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 13.03 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 24,805 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the San Francisco Bay Area region was 61,107 (Spetz et al. 2017); thus, total RN employment was 2.46 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 2.46 times greater than hospital RN demand in future years. The projections indicate there will be a need for 34,807 FTE RNs in hospitals and 85,747 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 67,610 RN jobs in the San Francisco Bay Area region in 2024 (California Employment Development Department 2018). The

EDD projection does not distinguish between full-time and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.872 was used, which is the average number of hours worked per week by RNs in the region in 2016 (34.87), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 58,945 FTE jobs across the region in 2024.

Comparing the demand forecasts

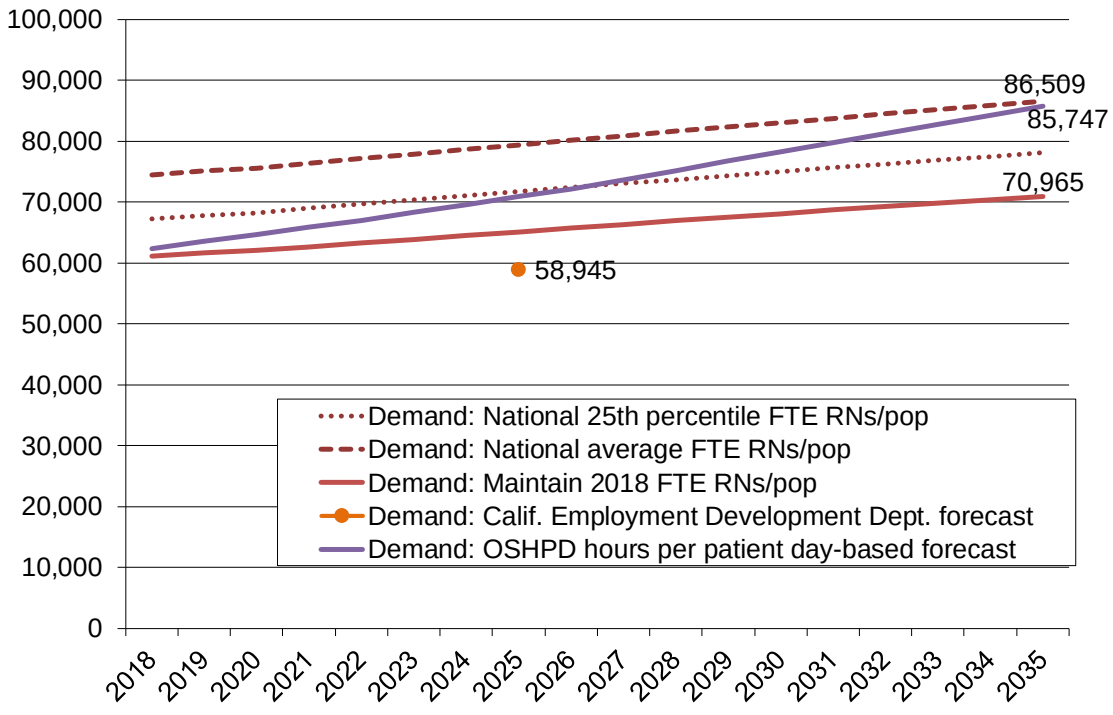
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the San Francisco Bay Area region, 8,050 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 70,965 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 86,509 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is notably lower than any of the other demand projections.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 62,507 FTE RNs available to work; the low supply forecast estimates there were 58,586 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 62,325 RNs that year, suggesting the market was fairly well-balanced. It is worth noting that RN supply in 2018 was 7.1% lower than demand based on the national per capita ratio at the 25th percentile. In the long term, the baseline supply forecast predicts that nurse supply will increase more slowly than projected demand based on OSHPD

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



data. Thus, the labor market is projected to have a 5.8% shortage of RNs compared with the demand forecast based on hours per patient day by 2035.

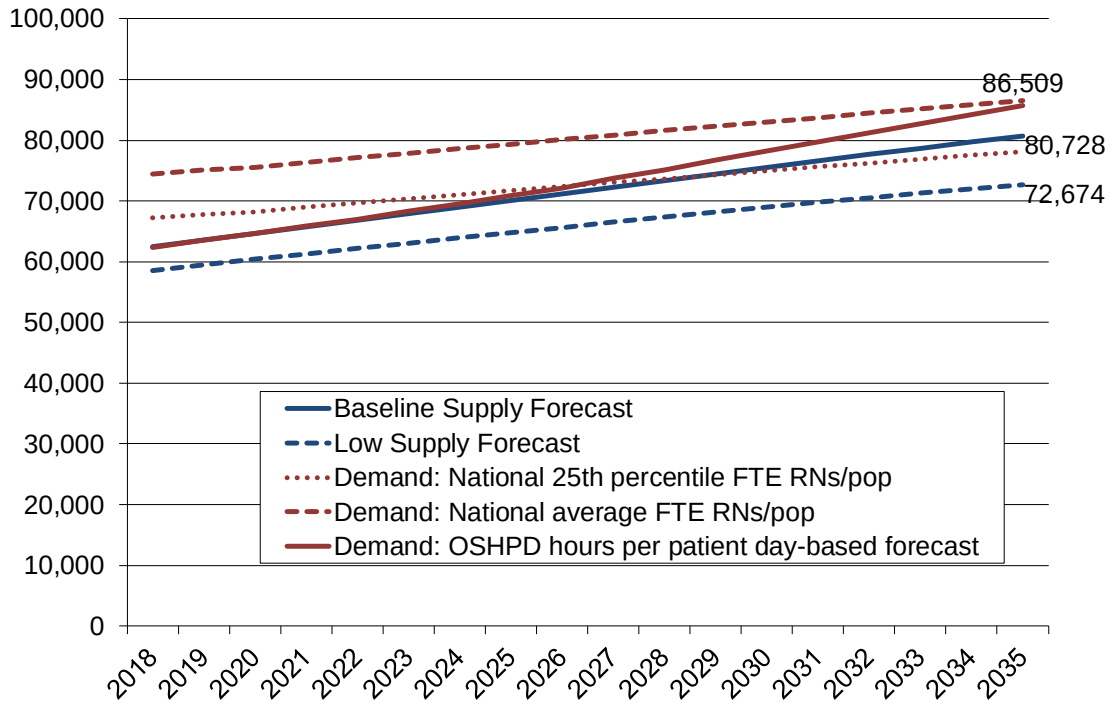
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the San Francisco Bay Area region. Data from the 2016 BRN Survey of RNs indicate that 98.5% of employed RNs who lived in the San Francisco Bay Area region also worked in the region. Approximately 1000 RNs with San Francisco Bay Area addresses worked in other regions, with most of those working in the Central Coast or Sacramento areas. Conversely, some nurses living in other regions worked in the Northern region: approximately 907 from Sacramento, 1,064 from the Central Valley, and 328 from Northern counties. In sum, in 2016 the San Francisco Bay Area region had an estimated 1,500 more RNs crossing regional boundaries to work in the area versus to work outside the area.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the San Francisco Bay Area region, 4.9% of RNs are NPs, 0.5% are CNMs, and 0.6% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 6% (4,050 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average share of hospital RN hours provided by contract staff

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



in the San Francisco Bay Area region was 6.2%, equivalent to a total of 1,953 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the San Francisco Bay Area region might be 2,500 fewer than the model calculation, and demand might be approximately 2,000 greater in 2018. The baseline supply and demand forecasts estimate that the region has balanced RN supply and demand, but the addition of inter-region commuting and use of contract RNs suggests that the San Francisco Bay Area region may have a shortage of more than 4,000 FTE RNs (6.4%) in 2018. In the long-term, the demand for RNs will grow more rapidly than supply in the San Francisco Bay Area, leading to a shortage of 10% or more.

Policy Implications

The San Francisco Bay Area region of California may have a small shortage of RNs in 2018, and projected growth in supply will not keep pace with projected growth in demand for RNs. If the number of RN graduations declines in this region – even a small amount – a shortage is likely.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the San Francisco Bay Area region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine the extent to which local RN education programs should expand.

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Forecasts of the Registered Nurse Workforce in the Central Valley Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The Central Valley region of California, which consists of the counties in the San Joaquin Valley, Gold Country, and Eastern Sierra, has a shortage of registered nurses (RNs). Projections of supply and demand through 2035 indicate that the RN shortage will worsen in coming years, because educational capacity and migration of RNs to the region are not large enough to keep up with population growth.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Central Valley region of California, based on a statewide projection model developed for the California Board of Registered

Nursing (BRN). The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Central Valley Region

The Central Valley region of California is defined by the counties of the San Joaquin Valley, Gold Country, and eastern Sierra: Alpine, Amador, Calaveras, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne. This region corresponds to the combined Employment Development Department regions of Eastern Sierra and Mother Lode and the metropolitan statistical areas of Bakersfield-Kern, Fresno, Hanford-Corcoran, Madera, Merced, Modesto, Stockton-Lodi, and Visalia-Porterville. There are 56 short-term general, children's, and specialty hospitals in the region, as well as ten associate degree (AD) and four bachelor's degree (BSN) RN education programs. There also is a satellite campus of National University in the region.

The Supply of RNs

In February 2018, there were 34,536 RNs with current, active licenses living in the Central Valley region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

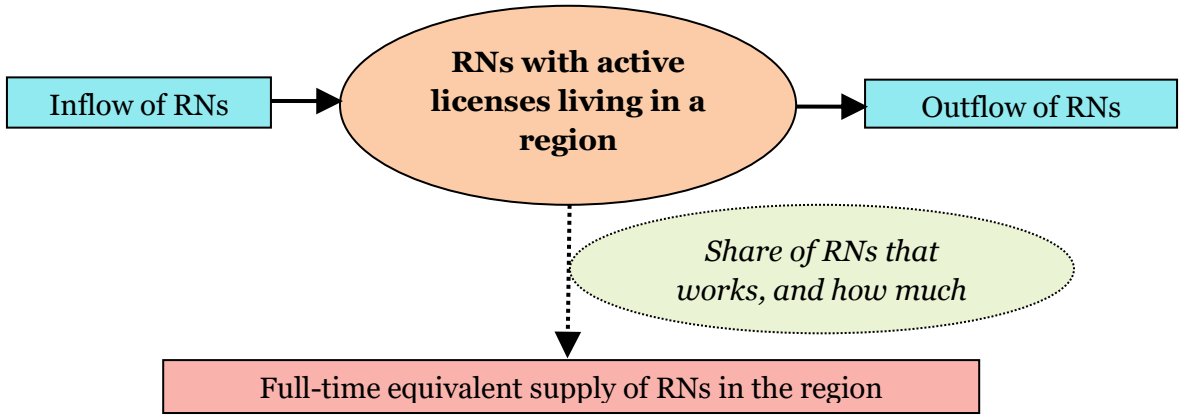
1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the

Figure 1. A model of the supply of RNs



age distribution of the stock of RNs, as well as of each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 34,536 RNs had active licenses and an address in the Central Valley region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Central Valley region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	396	1.1%
25-29	2,854	8.3%
30-34	4,364	12.6%
35-39	4,232	12.3%
40-44	4,163	12.1%
45-49	4,350	12.6%
50-54	3,375	9.8%
55-59	3,771	10.9%
60-64	3,658	10.6%
65-69	2,111	6.1%
70-74	885	2.6%
75-79	283	0.8%
80+	94	0.3%
Total	**34,536**	**100.0%**

Graduates from RN education programs

RN education programs in the Central Valley region produced 1,161 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Central Valley region from 2012-2013 through 2016-2017, on average, the number of graduates totaled 86.1% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 1,208 and that 2018-2019 new student enrollments would be 1,244. These estimates were multiplied by 86.1% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. From these totals, seven projected graduates who attended satellite campuses in other regions were subtracted. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	1,515*	1,467*
2013-2014	1,398*	1,402*
2014-2015	1,283*	1,112*
2015-2016	1,276*	1,097*
2016-2017	1,305*	1,161*
2017-2018	1,180	1,092
2018-2019	1,216	1,117
2019-2020		1,033
2020-2021		1,064

* Actual enrollments/graduates, which do not include satellite campuses.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 28 such out-of-state graduates had an address in the Central Valley region. Additionally, 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, 51 of whom had an address in the Central Valley region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Central Valley region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the Central Valley region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Central Valley region in 2018, and dividing the number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a Central Valley region address.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	29.9%	0.0%
26-29	26.9%	52.9%
30-34	15.7%	21.6%
35-39	15.7%	19.6%
40-44	4.7%	3.9%
45-49	4.7%	2.0%
50-54	0.8%	0.0%
55-59	0.8%	0.0%
60-64	0.9%	0.0%
65+	0.0%	0.0%

The region's in-migration was computed as the sum of RNs who migrated to the Central Valley region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 4. Movement of RNs into Central Valley region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	12	13	6.3%
25-29	116	53	5.9%
30-34	117	44	3.7%
35-39	96	32	3.0%
40-44	105	20	3.0%
45-49	70	11	1.9%
50-54	65	13	2.3%
55-59	66	11	2.0%
60-64	59	6	1.8%
Over 64	32	1	1.0%
Total	**738**	**204**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Central Valley region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	12	2.2%
30-34	36	6.5%
35-39	24	4.4%
40-44	38	6.9%
45-49	67	12.2%
50-54	62	11.3%
55-59	68	12.3%
60-64	85	15.4%
65-69	86	15.6%
70-74	40	7.3%
75+	33	6.0%
Total	**551**	**100.0%**

Migration out of the region

Estimates of migration out of the Central Valley region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Central Vallye region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Central Valley region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Central Valley region

Source: California BRN licensing records.

Age group	Average annual number moving out of region 2016-18	Total as a share of RNs living in region
Under 25	24.5	6.2%
25-29	128.5	4.5%
30-34	136.5	3.1%
35-39	97.5	2.3%
40-44	82.5	2.0%
45-49	70.5	1.6%
50-54	71	2.1%
55-59	71	1.9%
60-64	60.5	1.7%
65-69	29	1.4%
70-74	5	0.6%
75+	0	0.0%
Total	**776.5**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Central Valley region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

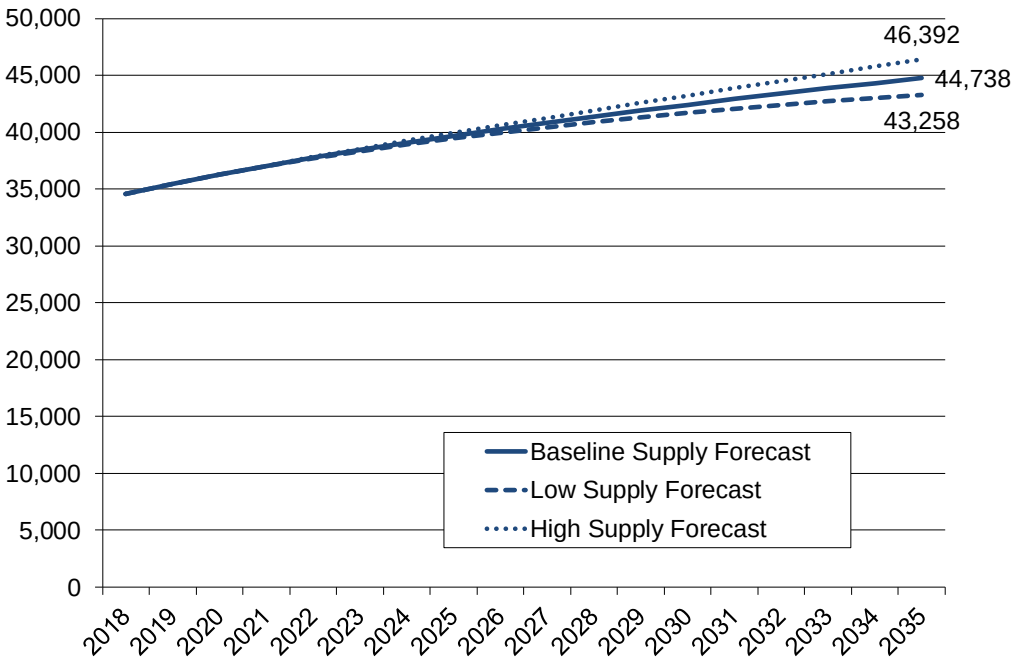
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	2.5	0.6%
25-29	32	1.1%
30-34	54.5	1.2%
35-39	45	1.1%
40-44	49.5	1.2%
45-49	45.5	1.0%
50-54	60	1.8%
55-59	100.5	2.7%
60-64	201	5.5%
65-69	197	9.3%
70-74	175.5	13.9%
Total	**963**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Central Valley region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Central Valley region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Central Valley region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	96.2%	93.5%	97.4%	95.4%
30-34	95.1%	92.1%	95.5%	93.8%
35-39	97.4%	92.3%	97.4%	94.9%
40-44	96.7%	89.7%	96.7%	93.2%
45-49	97.9%	92.1%	97.9%	95.0%
50-54	91.0%	89.8%	91.0%	90.4%
55-59	86.0%	85.3%	87.5%	86.4%
60-64	62.4%	62.4%	78.5%	70.4%
65-69	57.9%	57.5%	65.2%	61.3%
70-74	38.5%	38.5%	43.0%	40.7%
75-79	0.0%	0.0%	36.0%	18.0%
80+	50.0%	23.3%	50.0%	36.7%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Central Valley region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

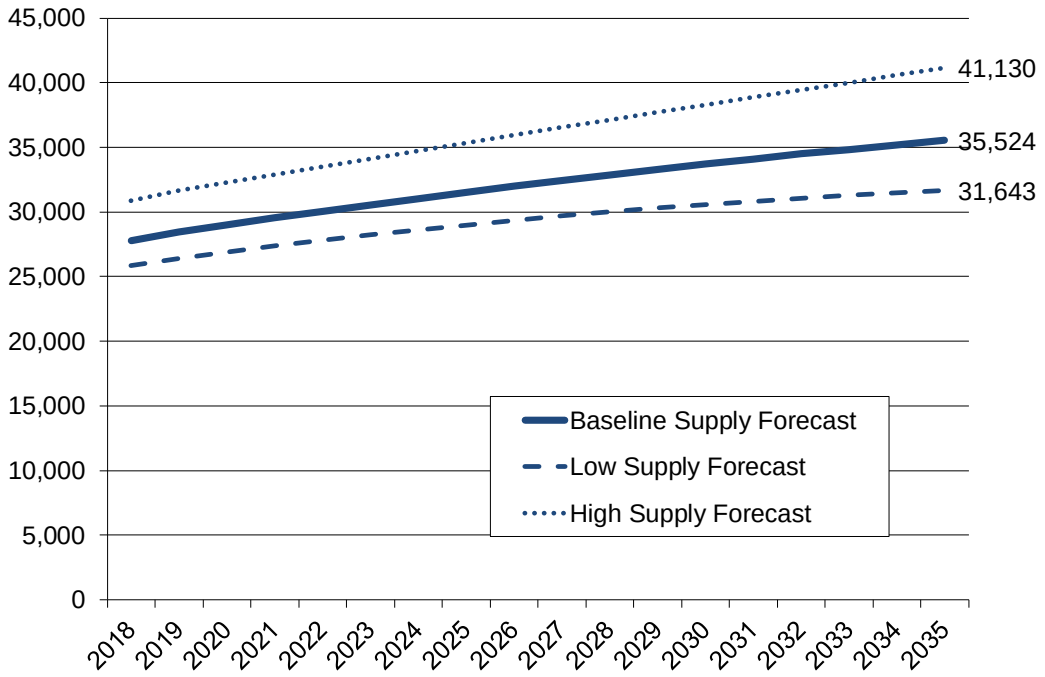
Table 9. Hours worked per week by employed RNs in the Central Valley region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	37.9	37.9	47.1	42.5
25-29	40.0	35.8	40.0	37.9
30-34	39.3	35.8	39.3	37.5
35-39	36.0	35.8	36.2	36.0
40-44	38.5	36.4	38.5	37.5
45-49	36.8	36.7	37.4	37.1
50-54	42.9	36.9	42.9	39.9
55-59	38.5	36.6	38.5	37.6
60-64	38.4	35.3	38.4	36.9
65-69	36.4	32.0	36.4	34.2
70-74	29.2	24.0	29.2	26.6
75-79	34.8	18.8	34.8	26.8
80+	12.0	12.0	31.1	21.6

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Central Valley region. The estimates for 2035 range from 31,643 to 41,130, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Central Valley region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Central Valley region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 23,655,585 productive RN hours were reported by hospitals in the Central Valley region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 13.38 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 13,380 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the Central Valley region was 28,437 (Spetz et al. 2017); thus, total RN employment was 2.13 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 2.13 times greater than hospital RN demand in future years. The projections indicate there will be a need for 18,427 FTE RNs in hospitals and 39,164 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 20,790 RN jobs in the Central Valley region in 2024 (California Employment Development Department 2018), excluding Madera county for which EDD did not

provide a projection. The EDD projection does not distinguish between full-time and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment of 0.949 was used, which is the average number of hours worked per week by RNs in the region in 2016 (37.95), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 19,722 FTE jobs across the region in 2024.

Comparing the demand forecasts

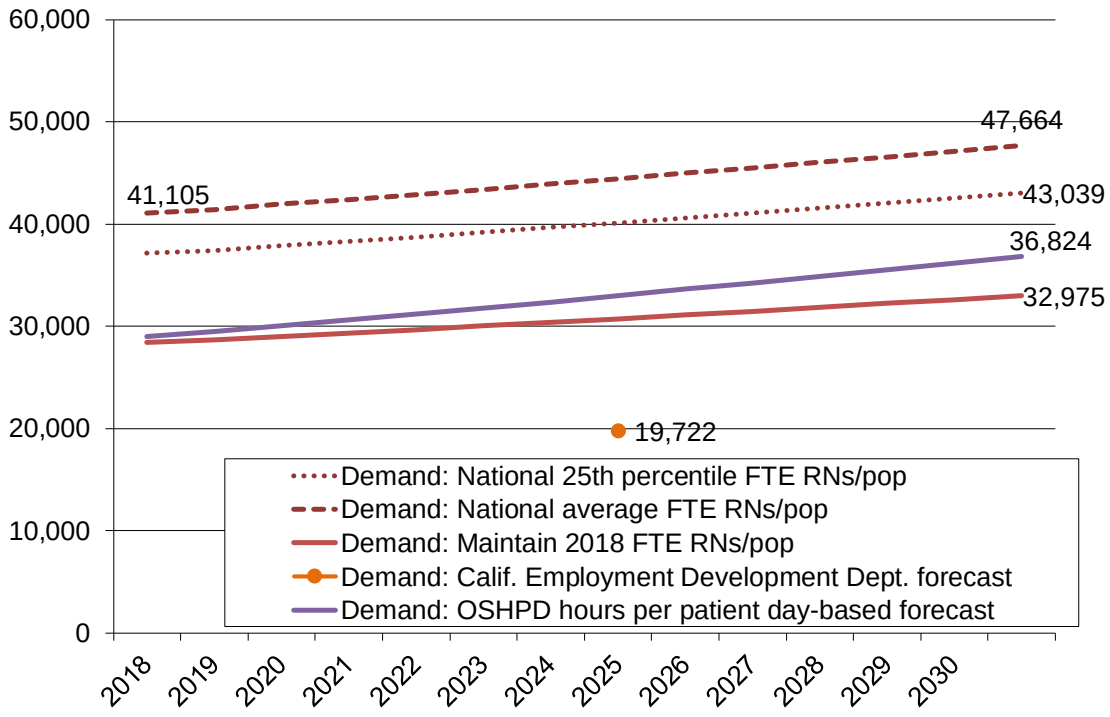
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Central Valley region, 32,975 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 36,824 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 47,664 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is far below the other projections.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 27,771 FTE RNs available to work; the low supply forecast estimates there were 25,821 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 28,954 RNs that year, suggesting the market was in shortage. It is worth noting that RN supply in 2018 was 25.2% lower than demand based on the national per capita ratio at the 25th percentile, which is consistent with the estimate that the region now has an RN shortage. In the long term, the baseline supply forecast predicts that nurse supply

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



will increase more slowly than the Central Valley region's population as a whole, and RN supply will not keep up with rising demand.

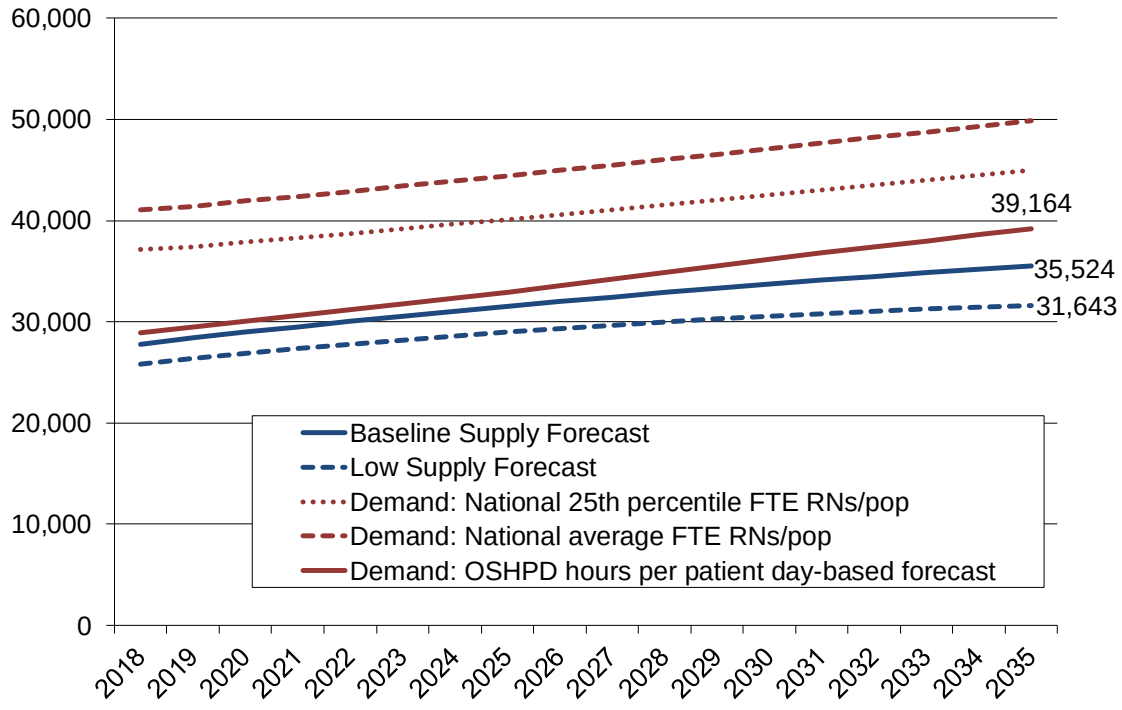
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Central Valley region. Data from the 2016 BRN Survey of RNs indicate that 91.8% of employed RNs who lived in the Central Valley region also worked in the region. Approximately 1,064 RNs worked in the San Francisco Bay Area region (3.9%), 509 worked in the Sacramento region (1.9%), 495 worked in the Los Angeles area (1.8%), and small numbers worked in the Central Coast and Inland Empire regions. Conversely, some nurses living in other regions worked in the Northern region: approximately 648 from Sacramento, and 16 from the Central Coast. In sum, in 2016 the Central Valley region had an estimated 1,500 more RNs crossing regional boundaries to work outside the region versus to work within the region.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Central Valley region, 5.4% of RNs are NPs, 0.5% are CNMs, and 0.5% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 6.4% (1,820 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization,

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average share of hospital RN hours provided by contract staff in the Central Valley region was 7.1%, which was equivalent to a total of 793 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Central Valley region might be 3,300 fewer than the model calculation, and demand might be approximately 800 greater in 2018. The baseline supply and demand forecasts estimate that the region has a shortage of more than 1,000 FTE RNs, and addition of inter-region commuting and the use of contract RNs suggests that the total shortage may be more than 5,000 FTE RNs (17.3%) in 2018. Moreover, the forecasts indicate that this shortage will worsen in the future in the Central Valley.

Policy Implications

The Central Valley region of California appears to have an RN shortage in 2018, which will worsen in coming years unless actions are taken to increase the supply of RNs in the region. Educational capacity in the Central Valley is not large enough to maintain the RN workforce as the population grows, and there is not enough migration of RNs to the Central Valley to fill the gap.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Central Valley region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine the extent to which local RN education programs should expand.

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Forecasts of the Registered Nurse Workforce in the Central Coast Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

Projections of registered nurse (RN) supply and demand through 2035 indicate that the Central Coast region of California, which consists of four counties between the Los Angeles and San Francisco Bay regions, is likely to face a large shortage of RNs as a result of population growth, population aging, and inadequate numbers of new RN graduates.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Central Coast region of California, based on a statewide projection model developed for the California Board of Registered

Nursing (BRN). The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Central Coast Region

The Central Coast region of California is defined by the counties of Monterey, San Benito, Santa Barbara, and San Luis Obispo counties. This region corresponds to the combined Employment Development Department Metropolitan Statistical Areas (MSA) of Salinas, Santa Maria-Santa Barbara, and San Luis Obispo-Paso Robles. There are 14 short-term general, children's, and specialty hospitals in the region, as well as five associate degree (AD) RN education programs. There also is a satellite campus of California State University Channel Islands in the region.

The Supply of RNs

In February 2018, there were 9,977 RNs with current, active licenses living in the Central Coast region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

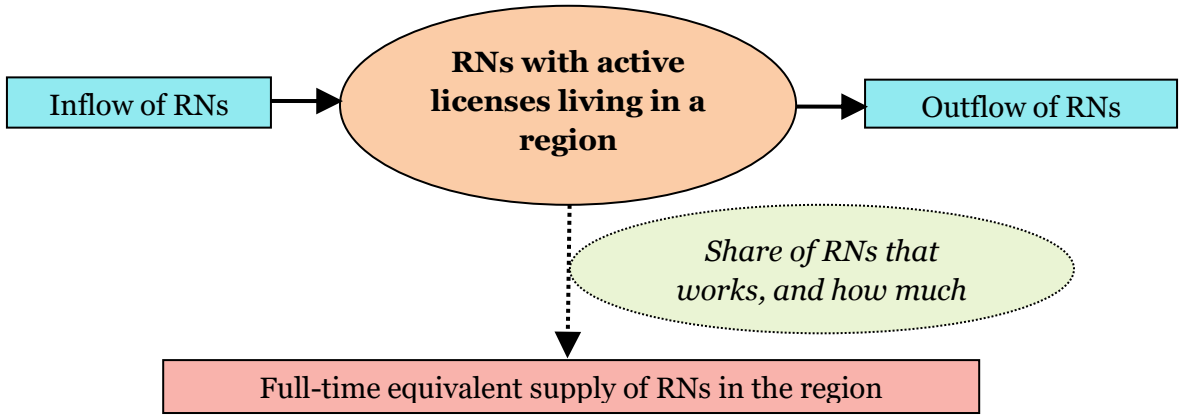
1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of

Figure 1. A model of the supply of RNs



each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 9,977 RNs had active licenses and an address in the Central Coast region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Central Coast region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	80	0.8%
25-29	558	5.6%
30-34	1,081	10.8%
35-39	1,107	11.1%
40-44	937	9.4%
45-49	1,025	10.3%
50-54	981	9.8%
55-59	1,248	12.5%
60-64	1,460	14.6%
65-69	967	9.7%
70-74	362	3.6%
75-79	124	1.2%
80+	47	0.5%
Total	**9,977**	**100.0%**

Graduates from RN education programs

RN education programs in the Central Coast region produced 230 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Central Coast region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 82.3% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 228 and that 2018-2019 new student enrollments would be 234. These estimates were multiplied by 82.3% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. To these totals were added 20 projected graduates from satellite campuses located in the region. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	246*	183*
2013-2014	242*	199*
2014-2015	226*	188*
2015-2016	226*	184*
2016-2017	230*	214*
2017-2018	240	206
2018-2019	256	209
2019-2020		208
2020-2021		213

* Actual enrollments/graduates, which do not include satellite campuses.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 14 such out-of-state graduates had an address in the Central Coast region. Additionally, 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, four of whom had an address in the Central Coast region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Central Coast region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the Central Coast region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Central Coast region in 2018, and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a Central Coast region address.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	10.3%	0.0%
26-29	35.5%	25.0%
30-34	19.4%	25.0%
35-39	19.4%	50.0%
40-44	6.3%	0.0%
45-49	6.3%	0.0%
50-54	1.4%	0.0%
55-59	1.4%	0.0%
60-64	0.0%	0.0%
65+	0.0%	0.0%

The region's in-migration rate was computed as the sum of RNs who migrated to the Central Coast region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 4. Movement of RNs into Central Coast region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	8	4	15.0%
25-29	50	27	13.7%
30-34	55	19	6.8%
35-39	42	6	4.3%
40-44	33	7	4.3%
45-49	27	5	3.1%
50-54	46	2	4.9%
55-59	40	5	3.6%
60-64	38	3	2.8%
Over 64	17	2	1.3%
Total	**356**	**80**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Central Coast region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	3	1.3%
30-34	11	4.8%
35-39	15	6.5%
40-44	9	3.9%
45-49	18	7.8%
50-54	27	11.7%
55-59	35	15.2%
60-64	38	16.5%
65-69	38	16.5%
70-74	22	9.5%
75+	15	6.5%
Total	**231**	**100.00%**

Migration out of the region

Estimates of migration out of the Central Coast region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Central Coast region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Central Coast region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Central Coast region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Total as a share of RNs living in region
Under 25	7	8.8%
25-29	40.5	7.3%
30-34	56.5	5.2%
35-39	31	2.8%
40-44	17	1.8%
45-49	26	2.5%
50-54	24.5	2.5%
55-59	32	2.6%
60-64	29.5	2.0%
65-69	15.5	1.6%
70-74	6	1.7%
75+	0	0.0%
Total	**285.5**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Central Coast region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

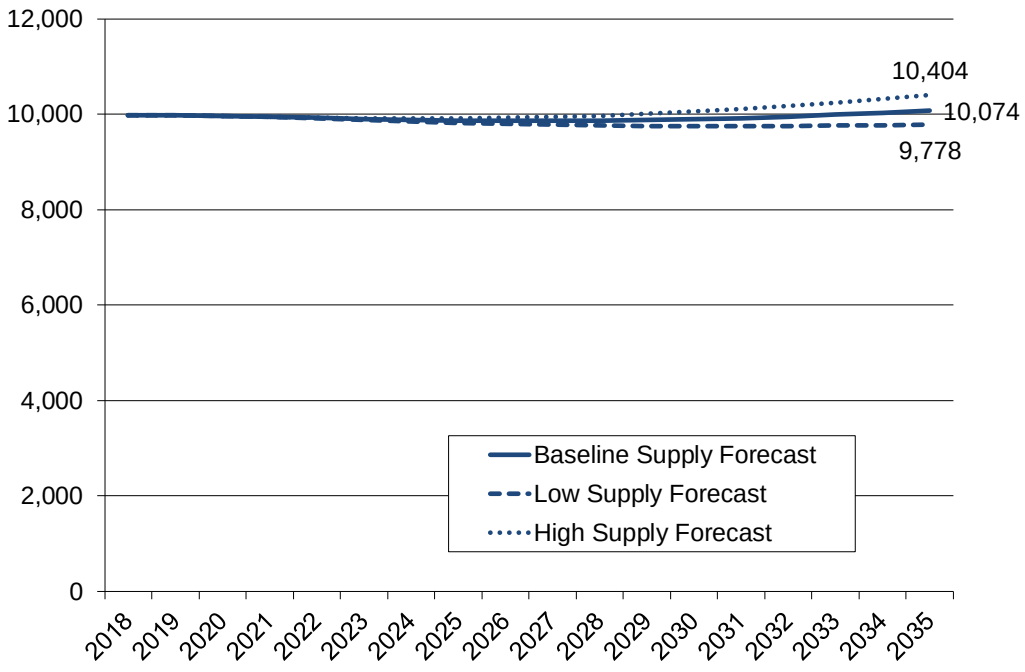
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	1.5	1.9%
25-29	10	1.8%
30-34	22	2.0%
35-39	17.5	1.6%
40-44	8.5	0.9%
45-49	13.5	1.3%
50-54	27	2.8%
55-59	41.5	3.3%
60-64	88	6.0%
65-69	94	9.7%
70-74	67.5	12.7%
Total	**391**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Central Coast region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Central Coast region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Central Coast region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	100.0%	93.5%	100.0%	96.7%
30-34	93.6%	92.1%	95.5%	93.8%
35-39	84.3%	84.3%	95.2%	89.7%
40-44	90.6%	89.7%	91.1%	90.4%
45-49	92.3%	92.1%	93.4%	92.7%
50-54	84.3%	84.3%	90.8%	87.6%
55-59	87.7%	85.3%	87.7%	86.5%
60-64	58.9%	58.9%	78.5%	68.7%
65-69	45.5%	45.5%	65.2%	55.3%
70-74	63.2%	40.5%	63.2%	51.8%
75-79	40.0%	32.0%	40.0%	36.0%
80+	0.0%	0.0%	24.2%	12.1%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Central Coast region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

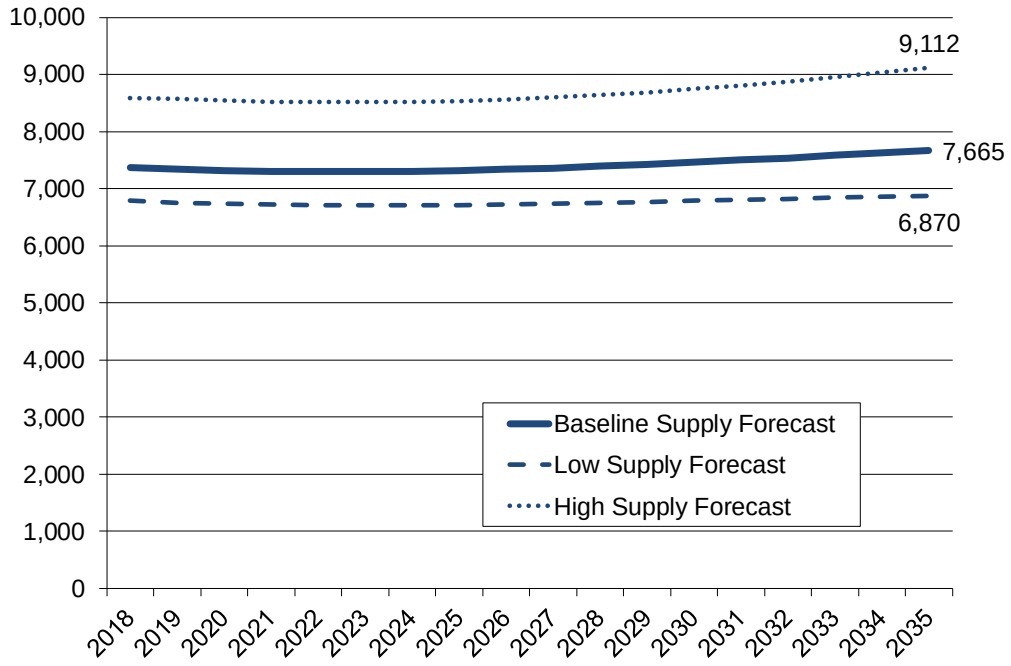
Table 9. Hours worked per week by employed RNs in the Central Coast region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	36.0	36.0	47.1	41.5
25-29	38.0	35.8	38.0	36.9
30-34	35.6	35.6	36.6	36.1
35-39	35.2	35.2	36.2	35.7
40-44	38.1	36.4	38.1	37.3
45-49	40.9	36.7	40.9	38.8
50-54	35.1	35.1	37.6	36.3
55-59	37.2	36.6	37.4	37.0
60-64	36.9	35.3	36.9	36.1
65-69	33.9	32.0	33.9	33.0
70-74	30.5	24.0	30.5	27.2
75-79	26.2	18.8	26.2	22.5
80+	21.0	21.0	31.1	26.1

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Central Coast region. The estimates for 2035 range from 6,870 to 9,112, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Central Coast region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Central Coast region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 6,491,678 productive RN hours were reported by hospitals in the Central Coast region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 13.73 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 3,672 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses report indicates that total FTE employment in the Central Coast region was 7,130 (Spetz et al. 2017); thus, total RN employment was 1.94 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 1.94 times greater than hospital RN demand in future years. The projections indicate there will be a need for 4,919 FTE RNs in hospitals and 9,552 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 7,800 RN jobs in the Central Coast region in 2024 (California Employment Development Department 2018). The EDD projection does not distinguish between full-

time and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.899 was used, which is the average number of hours worked per week by RNs in the region in 2016 (35.96), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 7,011 FTE jobs across the region in 2024.

Comparing the demand forecasts

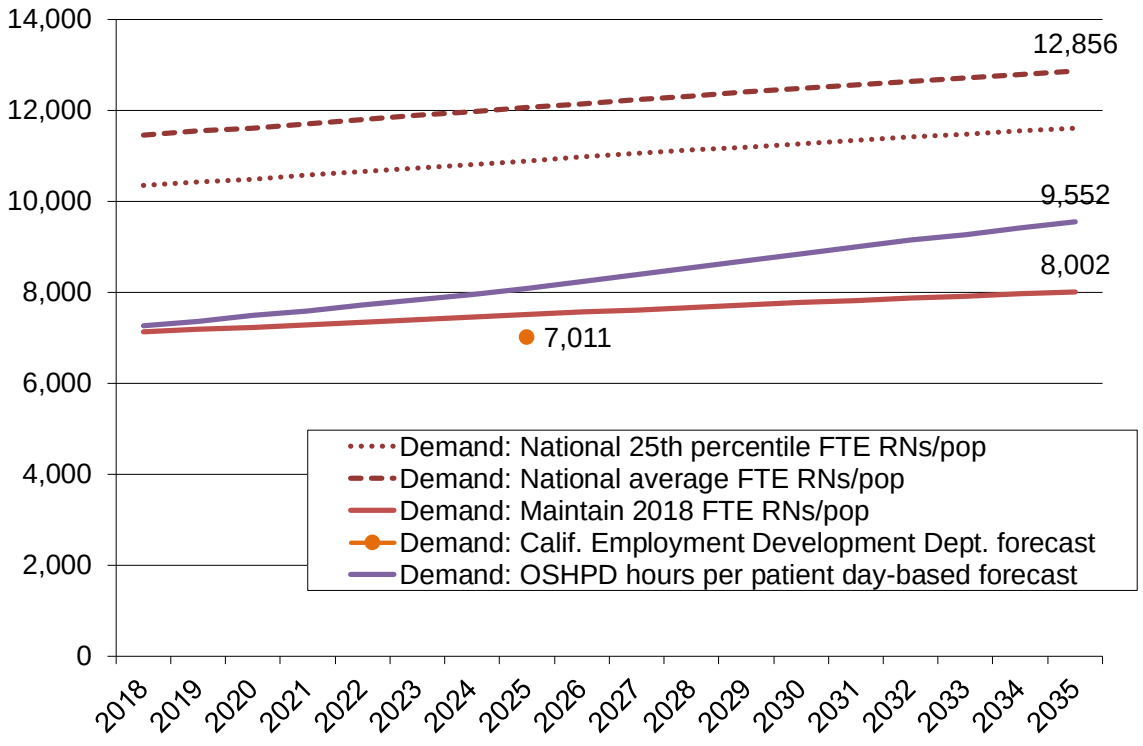
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Central Coast region, 8,002 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 9,552 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 12,856 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is slightly below the trajectory of demand based on maintaining the region's current RN-to-population ratio.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 7,371 FTE RNs available to work; the low supply forecast estimates there were 6,788 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 7,261 RNs that year, suggesting the market was fairly balanced. However, it is worth noting that RN supply in 2018 was 28.7% lower than demand based on the national per capita ratio at the 25th percentile, which may indicate that current demand for RNs is lower than optimal. In the long term, the baseline supply forecast predicts that nurse

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



supply will increase very little while RN demand will increase as a result of population growth and aging. The Central Coast region is facing a shortage of RNs, which will become severe if RN education programs contract or the employment rate of licensed nurses falls.

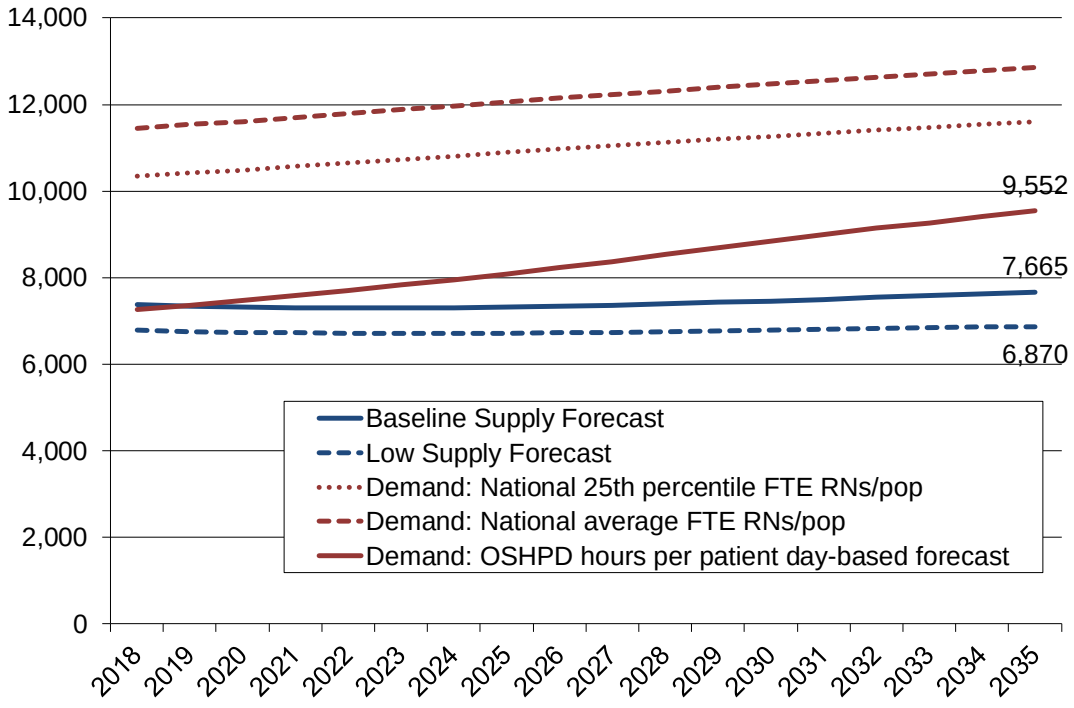
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Central Coast region. Data from the 2016 BRN Survey of RNs indicates that 95.7% of employed RNs who lived in the Central Coast region also worked in the region. Approximately 203 RNs worked in the San Francisco Bay Area region (2.8%), 66 worked in the Los Angeles region (0.9%), and 38 worked in the Central Valley or Sacramento regions. Conversely, some nurses living in other regions worked in the Central Coast region: approximately 559 from the San Francisco Bay Area, 1,001 from the Los Angeles region, 221 from the Inland Empire, and 45 from the Central Valley. In sum, in 2016 the Central Coast region had an estimated 1,500 more RNs crossing regional boundaries to work in the area versus to work outside the area.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Central Coast region, 6.2% of RNs are NPs, 0.6% are CNMs, and 0.3% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 7.1% (524 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average share of hospital RN hours provided by contract staff in the Central Coast region was 7.1%, which was the second-highest regional rate across the state and equivalent to a total of 184 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Central Coast region might be 1,000 more than the model calculation, and demand might be approximately 190 greater in 2018. The relatively large number of RNs commuting to the region suggests that the local supply of RNs is inadequate and employers rely on commuters to meet demand. The situation is projected to worsen in the Central Coast region due to the projected demand for RNs in the region increasing more rapidly than supply. The shortage is likely to become severe by 2035 if there are not increases in local RN graduations or concerted efforts to increase migration and/or commuting to the Central Coast region.

Policy Implications

The Central Coast region of California appears to have an RN labor market that is balanced largely due to reliance on inter-regional commuting into the area. A severe shortage is likely to emerge because the region is projected to have increasing demand for RNs but has relatively small numbers of RN program graduations. As a result, there will be up to 25% fewer RNs than needed in 2035.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Central Coast region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine the extent to which local RN education programs should expand.

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Forecasts of the Registered Nurse Workforce in the Los Angeles Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The Los Angeles region of California, which consists of Los Angeles, Orange, and Ventura counties, has a growing supply of registered nurses (RNs) due to expansion of local RN education programs and satellite campuses. Projections of supply and demand through 2035 indicate that an RN shortage may exist now, but is likely to dissipate due to rapid supply growth. A surplus of RNs is possible in the future.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Los Angeles region of California, based on a statewide projection model developed for the California Board of Registered Nursing (BRN).

The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Los Angeles Region

The Los Angeles region of California is defined by the counties of Los Angeles, Orange, and Ventura, which are three of the five counties in the Census Bureau Consolidated Statistical Area of Los Angeles-Long Beach. This region corresponds to the combined Employment Development Department Metropolitan Divisions of Anaheim-Santa Ana-Irvine and Los Angeles-Long Beach-Glendale, and the Oxnard-Thousand Oaks-Ventura Metropolitan Statistical Area. There are 134 short-term general, children's, and specialty hospitals in the region, as well as 33 associate degree (AD), 14 bachelor's degree (BSN), and six entry-level master's (ELM) RN education programs. There also are two RN education programs based outside the region that have satellite campuses in the region: National University and University of San Francisco.

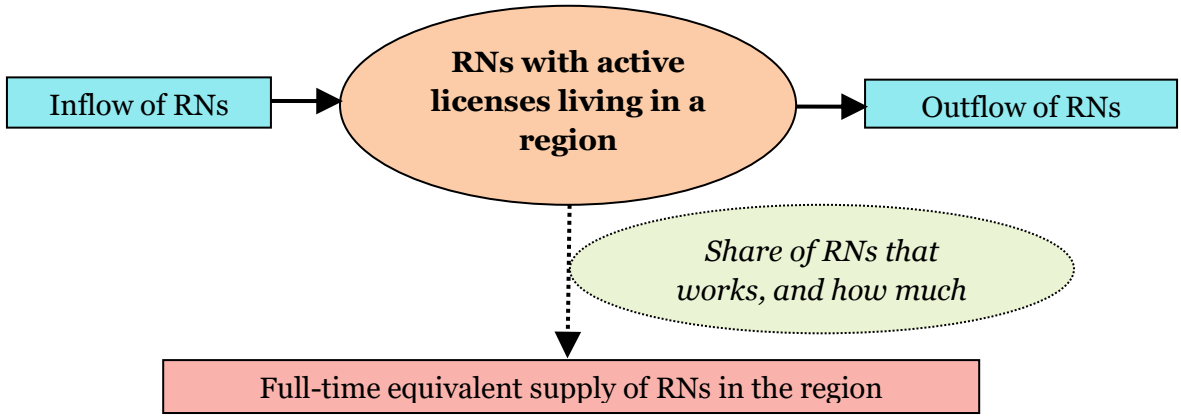
The Supply of RNs

In February 2018, there were 119,643 RNs with current, active licenses living in the Los Angeles region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, 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. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 119,643 RNs had active licenses and an address in the Los Angeles region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Los Angeles region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	1,779	1.5%
25-29	10,715	9.0%
30-34	15,310	12.8%
35-39	13,733	11.5%
40-44	13,645	11.4%
45-49	14,650	12.2%
50-54	11,308	9.5%
55-59	12,039	10.1%
60-64	13,296	11.1%
65-69	7,930	6.6%
70-74	3,314	2.8%
75-79	1,365	1.1%
80+	559	0.5%
Total	**119,643**	**100.0%**

Graduates from RN education programs

RN education programs in the Los Angeles region produced 4,821 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Los Angeles region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 83.2% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 6,619 and that 2018-2019 new student enrollments would be 6,780. These estimates were multiplied by 83.2% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. From these totals, 548 projected graduates who attended satellite campuses in other regions were subtracted. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	5,166*	4,063*
2013-2014	5,224*	4,244*
2014-2015	5,964*	4,442*
2015-2016	5.966*	4,886*
2016-2017	6,040*	4,821*
2017-2018	5,882	4,415
2018-2019	6,043	4,477
2019-2020		4,958
2020-2021		5,092

* Actual enrollments/graduates, which do not include satellite campuses.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 159 such out-of-state graduates had an address in the Los Angeles region. Additionally, 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, 176 of whom had an address in the Los Angeles region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Los Angeles region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California. Inter-region migration was calculated by counting the total number of RNs who lived outside the Los Angeles region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Los Angeles region in 2018, and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a Los Angeles region address.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	34.7%	8.0%
26-29	31.5%	33.5%
30-34	12.4%	27.3%
35-39	12.4%	11.9%
40-44	3.6%	8.0%
45-49	3.6%	5.7%
50-54	0.9%	2.8%
55-59	0.9%	1.7%
60-64	0.1%	0.6%
65+	0.0%	0.6%

The region's in-migration was computer as the sum of RNs who migrated to the Los Angeles region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 4. Movement of RNs into Los Angeles region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	65	73	7.7%
25-29	371	218	5.5%
30-34	322	145	3.0%
35-39	209	93	2.2%
40-44	171	53	1.6%
45-49	144	46	1.3%
50-54	110	42	1.3%
55-59	112	25	1.1%
60-64	82	19	0.8%
Over 64	39	7	0.3%
Total	**1,625**	**721**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Los Angeles region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	41	1.9%
30-34	145	6.6%
35-39	178	8.1%
40-44	193	8.8%
45-49	256	11.7%
50-54	236	10.8%
55-59	236	10.8%
60-64	300	13.7%
65-69	286	13.0%
70-74	189	8.6%
75+	132	6.0%
Total	**2,192**	**100.0%**

Migration out of the region

Estimates of migration out of the Los Angeles region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Los Angeles region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Los Angeles region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Los Angeles region

Source: California BRN licensing records.

Age group	Average annual number moving out of region 2016-18	Total as a share of RNs living in region
Under 25	46.5	2.6%
25-29	348.5	3.3%
30-34	423	2.8%
35-39	263	1.9%
40-44	204.5	1.5%
45-49	190	1.3%
50-54	163.5	1.4%
55-59	182.5	1.5%
60-64	167.5	1.3%
65-69	76	1.0%
70-74	36	1.1%
75+	0	0.0%
Total	**2,101**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Los Angeles region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

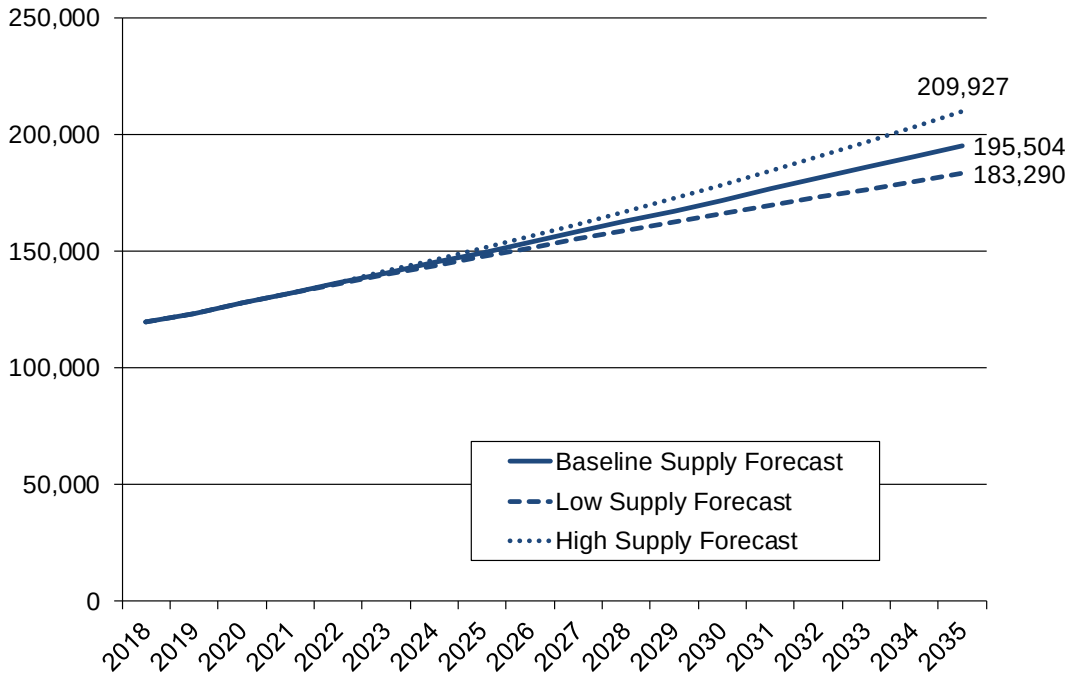
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	23.5	1.3%
25-29	151.5	1.4%
30-34	200.5	1.3%
35-39	157.5	1.1%
40-44	175	1.3%
45-49	161	1.1%
50-54	179.5	1.6%
55-59	268.5	2.2%
60-64	554	4.2%
65-69	686.5	8.7%
70-74	675	12.9%
Total	**3,232.5**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Los Angeles region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Los Angeles region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Los Angeles region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	92.9%	92.9%	97.4%	95.2%
30-34	91.9%	91.9%	95.5%	93.7%
35-39	94.5%	92.3%	95.2%	93.8%
40-44	92.2%	89.7%	92.2%	91.0%
45-49	96.2%	92.1%	96.2%	94.1%
50-54	91.6%	89.8%	91.6%	90.7%
55-59	88.5%	85.3%	88.5%	86.9%
60-64	79.4%	75.5%	79.4%	77.4%
65-69	51.0%	51.0%	65.2%	58.1%
70-74	50.8%	40.5%	50.8%	45.6%
75-79	8.4%	8.4%	36.0%	22.2%
80+	0.0%	0.0%	24.2%	12.1%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Los Angeles region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

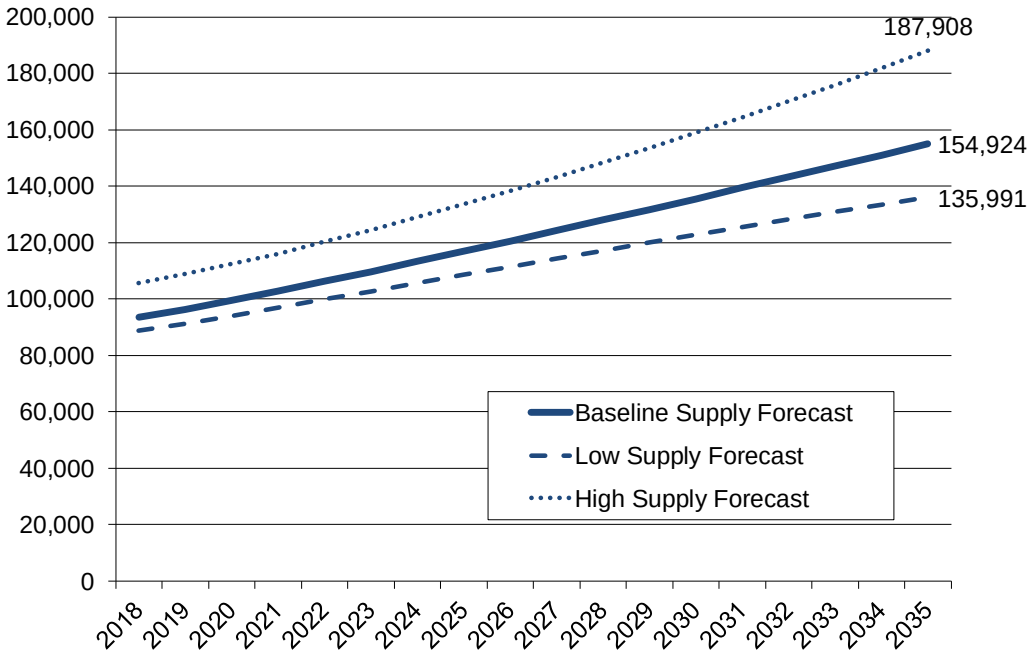
Table 9. Hours worked per week by employed RNs in the Los Angeles region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	36.6	36.6	47.1	41.8
25-29	36.0	35.8	36.4	36.1
30-34	36.3	35.8	36.6	36.2
35-39	36.1	35.8	36.2	36.0
40-44	35.2	35.2	37.0	36.1
45-49	35.6	35.6	37.4	36.5
50-54	39.5	36.9	39.5	38.2
55-59	38.2	36.6	38.2	37.4
60-64	37.1	35.3	37.1	36.2
65-69	36.0	32.0	36.0	34.0
70-74	32.5	24.0	32.5	28.2
75-79	32.9	18.8	32.9	25.8
80+	40.0	25.2	40.0	32.6

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Los Angeles region. These estimates in 2035 range from 135,991 to 187,908, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Los Angeles region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Los Angeles region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 86,680,762 productive RN hours were reported by hospitals in the Los Angeles region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 12.26 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 49,028 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the Los Angeles region was 94,917 (Spetz et al. 2017); thus, total RN employment was 1.94 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 1.94 times greater than hospital RN demand in future years. The projections indicate there will be a need for 64,781 FTE RNs in hospitals and 125,416 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 110,920 RN jobs in the Los Angeles region in 2024 (California Employment Development Department 2018). The EDD projection does not distinguish between full-time

and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.914 was used, which is the average number of hours worked per week by RNs in the region in 2016 (36.56), divided by 40 (Spetz, Chu, and Jura 2017). This results in an projected 101,378 FTE jobs across the region in 2024.

Comparing the demand forecasts

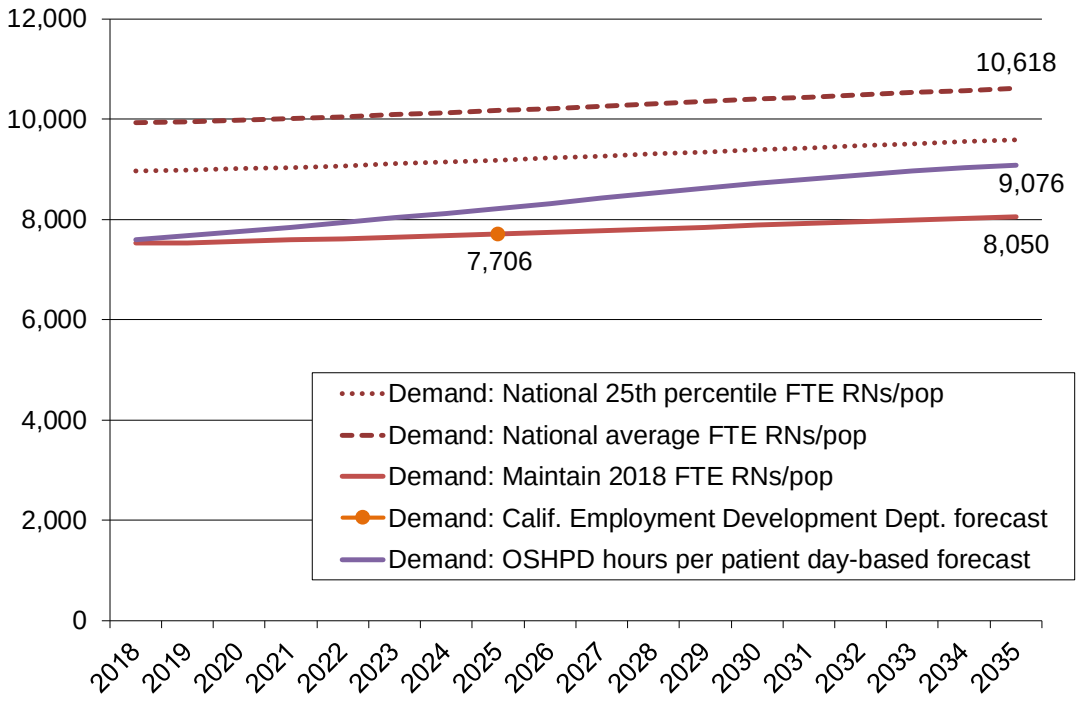
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Los Angeles region, 101,010 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 118,085 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 142,539 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is slightly above the trajectory of demand based on maintaining the region's current RN-to-population ratio.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018, there were 93,442 FTE RNs available to work; the low supply forecast estimates there were 88,770 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 96,232 RNs that year, suggesting the market faced a shortage. It is worth noting that RN supply in 2018 was 22.7% lower than demand based on the national per capita ratio at the 25th percentile, which is consistent with the assessment that the region now has an RN shortage. In the long term, the baseline supply forecast predicts that nurse supply

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



will increase more rapidly than the Los Angeles region's population as a whole, but RN supply will not reach the national 25th percentile of FTE RNs per 100,000 until 2028. The low projection of supply also indicates it is likely that the Los Angeles region will have adequate supply in the future.

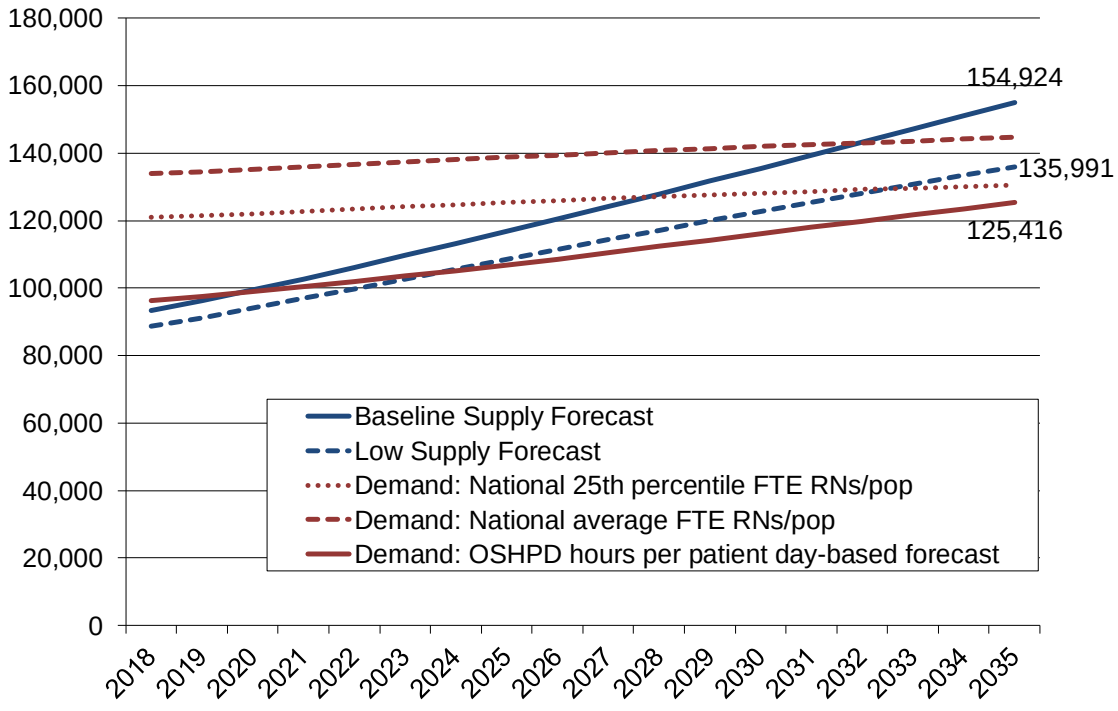
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Los Angeles region. Data from the 2016 BRN Survey of RNs indicates that 96.7% of employed RNs who lived in the Los Angeles region also worked in the region. Approximately 1,524 RNs worked in the Inland Empire region (1.6%), 1,001 worked in the Central Coast region (1.0%), and 325 worked in the Southern Border area (0.3%). Conversely, some nurses living in other regions worked in the Los Angeles region: approximately 5,499 from the Inland Empire region, 495 from the Central Valley region, 296 from the Southern Border area, and small numbers from the Central Coast, San Francisco Bay Area, and Northern Counties. In sum, in 2016 the Los Angeles region had an estimated 3,400 more RNs crossing regional boundaries to work in the area versus to work outside the area.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Los Angeles region, 6.6% of RNs are NPs, 0.2% are CNMs, and 0.4% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 7.2% (7,131 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average share of hospital RN hours provided by contract staff in the Los Angeles region was 6.7%, which was equivalent to a total of 3,763 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Los Angeles region might be 3,700 fewer than the model calculation, and demand might be approximately 3,750 greater in 2018. The baseline supply and demand forecasts estimate that the region has a shortage of more than 2,500 FTE RNs, and addition of inter-region commuting and the use of contract RNs suggests that the total shortage may be more than 10,000 FTE RNs (10.4%) in 2018. However, this shortage is projected to dissipate over the next decade since RN supply is forecasted to grow more rapidly than demand and a surplus could emerge in the Los Angeles region by 2025.

Policy Implications

The Los Angeles region of California may have a shortage of RNs now, and has a lower-than-average RN-per-100,000 population ratio. However, recent growth in RN education programs will mitigate the shortage over the next decade, and a surplus of RNs is possible in the future. The growth of supply will allow health care systems the opportunity to employ nurses in a wide variety of roles that fully utilize their skills in direct patient care, care management, patient education, home health, and ambulatory care.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Los Angeles region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine whether local RN education programs have expanded sufficiently to eliminate the shortage that now exists.

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Forecasts of the Registered Nurse Workforce in the Sacramento Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The Sacramento region of California, which consists of the counties in the Sacramento and Yuba City metropolitan statistical areas, has a growing supply of registered nurses (RNs) due to expansion of local RN education programs and satellite campuses of schools from other regions. Projections of supply and demand through 2035 indicate that an RN shortage may exist in 2018 but will dissipate over the next decade, with an over-supply of RNs possible by 2035.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Sacramento region of California, based on a statewide projection model developed for the California Board of Registered Nursing (BRN).

The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Sacramento Region

The Sacramento region of California is defined by the counties in the Sacramento and Yuba City metropolitan statistical areas, as defined by the U.S. Census Bureau: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. There are 24 short-term general, children's, and specialty hospitals in the region, as well as six associate degree (AD), two bachelor's degree (BSN), and one entry-level master's degree (ELM) RN education programs. There also are two RN education programs based outside the region that have satellite campuses in the region: Samuel Merritt University and University of San Francisco.

The Supply of RNs

In February 2018, there were 27,003 RNs with current, active licenses living in the Sacramento region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

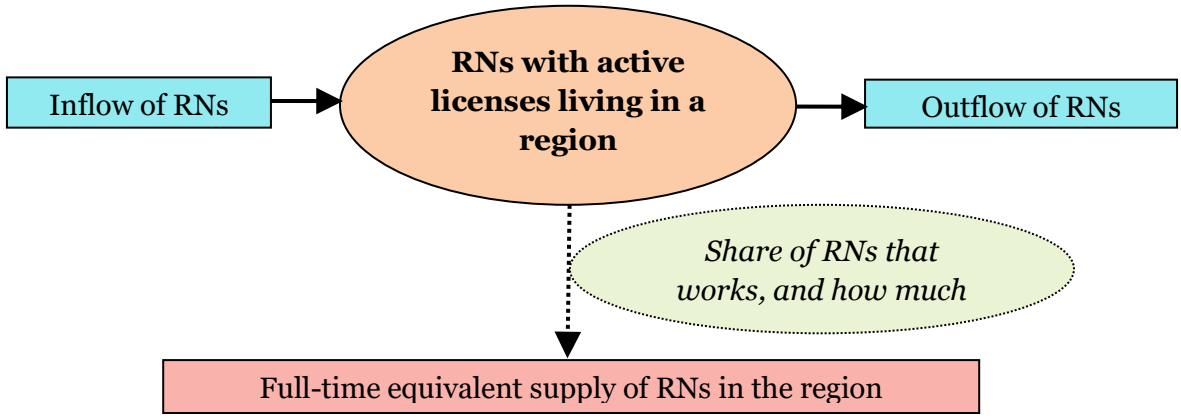
1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of

Figure 1. A model of the supply of RNs



each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 27,003 RNs had active licenses and an address in the Sacramento region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Sacramento region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	308	1.1%
25-29	1,683	6.2%
30-34	2,956	11.0%
35-39	3,343	12.4%
40-44	3,506	13.0%
45-49	3,588	13.3%
50-54	2,696	10.0%
55-59	2,924	10.8%
60-64	3,109	11.5%
65-69	1,829	6.8%
70-74	718	2.7%
75-79	244	0.9%
80+	99	0.4%
Total	**27,003**	**100.0%**

Graduates from RN education programs

RN education programs in the Sacramento region produced 448 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Sacramento region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 81.8% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 708 and that 2018-2019 new student enrollments would be 712. These estimates were multiplied by 81.8% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. To these totals were added 162 projected graduates from satellite campuses located in the region. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	712*	517*
2013-2014	611*	533*
2014-2015	503*	477*
2015-2016	563*	620*
2016-2017	620*	448*
2017-2018	892	623
2018-2019	896	669
2019-2020		741
2020-2021		744

* Actual enrollments/graduates, which do not include satellite campuses.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 38 such out-of-state graduates had an address in the Sacramento region. Additionally, 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, 41 of whom had an address in the Sacramento region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Sacramento region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the Sacramento region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Sacramento region in 2018, and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a Sacramento region address. The region's in-migration was computed as the sum of RNs who migrated to the Sacramento region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	38.4%	4.9%
26-29	21.7%	41.5%
30-34	13.6%	24.4%
35-39	13.6%	12.2%
40-44	4.8%	12.2%
45-49	4.8%	4.9%
50-54	1.5%	0.0%
55-59	1.5%	0.0%
60-64	0.2%	0.0%
65+	0.0%	0.0%

Table 4. Movement of RNs into Sacramento region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	24	17	13.2%
25-29	151	49	11.9%
30-34	181	53	7.9%
35-39	147	36	5.5%
40-44	145	23	4.8%
45-49	85	17	2.8%
50-54	67	10	2.9%
55-59	74	6	2.7%
60-64	54	1	1.8%
Over 64	27	2	1.0%
Total	**955**	**214**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Sacramento region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	13	2.6%
30-34	25	5.0%
35-39	37	7.3%
40-44	34	6.7%
45-49	41	8.1%
50-54	58	11.5%
55-59	57	11.3%
60-64	90	17.8%
65-69	75	14.9%
70-74	46	9.1%
75+	29	5.7%
Total	**505**	**100.00%**

Migration out of the region

Estimates of migration out of the Sacramento region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Sacramento region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Sacramento region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Sacramento region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Total as a share of RNs living in region
Under 25	10.5	3.4%
25-29	72	4.3%
30-34	74.5	2.5%
35-39	45.5	1.4%
40-44	42	1.2%
45-49	42	1.2%
50-54	50	1.9%
55-59	50	1.7%
60-64	47	1.5%
65-69	25.5	1.4%
70-74	8.5	1.2%
75+	0	0.0%
Total	**467.5**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Sacramento region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

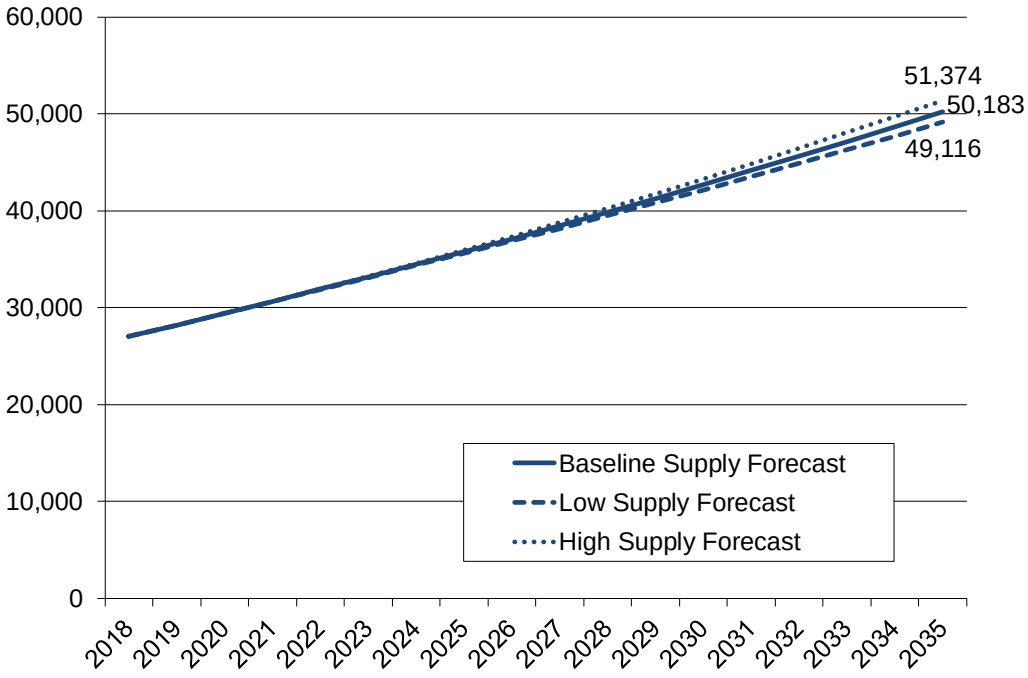
Age group	Annual average number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	5	1.6%
25-29	20.5	1.2%
30-34	24	0.8%
35-39	20	0.6%
40-44	22	0.6%
45-49	36	1.0%
50-54	37	1.4%
55-59	79	2.7%
60-64	171.5	5.5%
65-69	191	10.4%
70-74	156	14.7%
Total	**762**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Sacramento region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Sacramento region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Sacramento Region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	78.4%	78.4%	97.4%	87.9%
30-34	96.1%	92.1%	96.1%	94.1%
35-39	96.5%	92.3%	96.5%	94.4%
40-44	95.9%	89.7%	95.9%	92.8%
45-49	92.6%	92.1%	93.4%	92.7%
50-54	92.8%	89.8%	92.8%	91.3%
55-59	85.7%	85.3%	87.5%	86.4%
60-64	84.0%	75.5%	84.0%	79.8%
65-69	34.7%	34.7%	65.2%	49.9%
70-74	35.7%	35.7%	43.0%	39.4%
75-79	0.0%	0.0%	36.0%	18.0%
80+	0.0%	0.0%	24.2%	12.1%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Sacramento region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

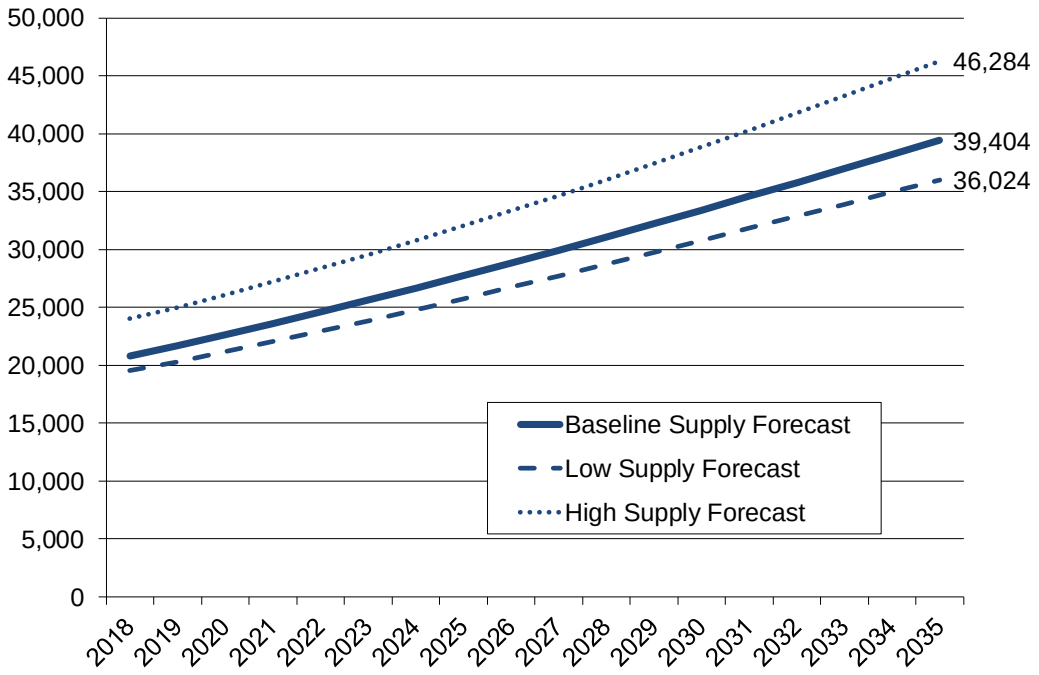
Table 9. Hours worked per week by employed RNs in the Sacramento Region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	35.9	35.9	47.1	41.5
25-29	36.0	35.8	36.4	36.1
30-34	35.5	35.5	36.6	36.0
35-39	34.1	34.1	36.2	35.1
40-44	37.1	36.4	37.1	36.8
45-49	36.4	36.4	37.4	36.9
50-54	36.8	36.8	37.6	37.2
55-59	35.9	35.9	37.4	36.6
60-64	37.3	35.3	37.3	36.3
65-69	35.2	32.0	35.2	33.6
70-74	28.4	24.0	28.4	26.2
75-79	33.3	18.8	33.3	26.1
80+	0.0	0.0	31.1	15.6

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Sacramento region. These estimates in 2035 range from 36,024 to 46,284, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Sacramento region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Sacramento region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 13,763,353 productive RN hours were reported by hospitals in the Sacramento region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 11.33 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 7,785 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the Sacramento region was 20,950 (Spetz et al. 2017); thus, total RN employment was 2.69 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 2.69 times greater than hospital RN demand in future years. The projections indicate there will be a need for 10,940 FTE RNs in hospitals and 29,442 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 22,090 RN jobs in the Sacramento region in 2024 (California Employment Development Department 2018). The EDD projection does not distinguish between full-time

and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.897 was used, which is the average number of hours worked per week by RNs in the region in 2016 (35.88), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 19,813 FTE jobs across the region in 2024.

Comparing the demand forecasts

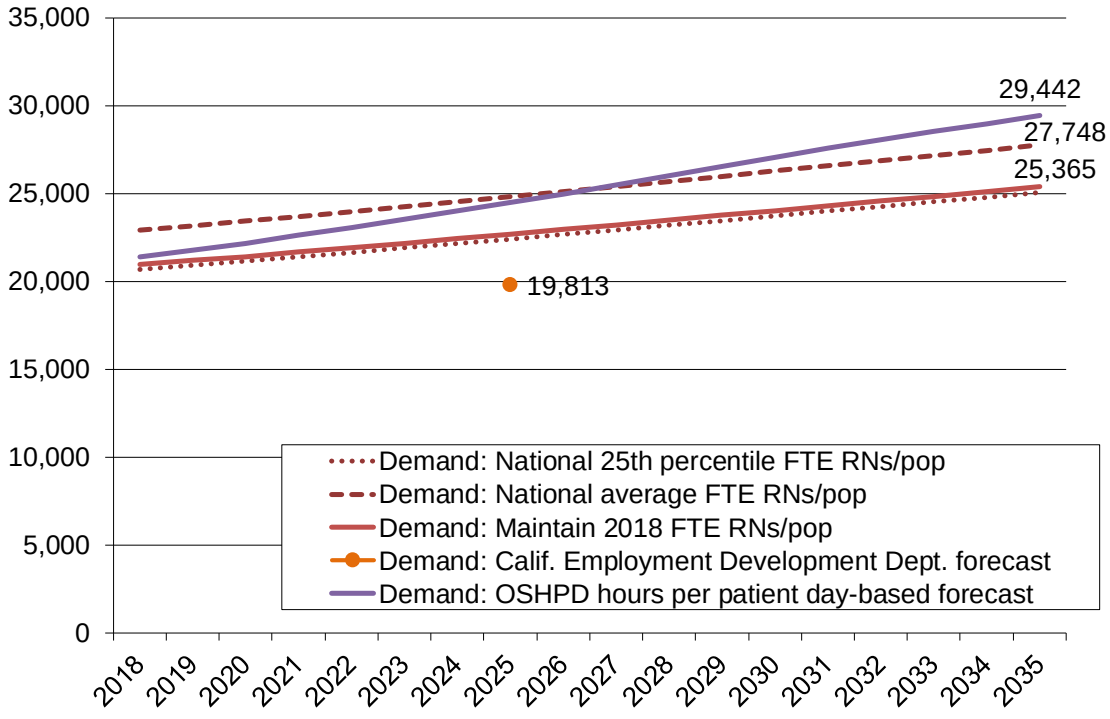
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Sacramento region, 25,365 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 29,442 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 27,748 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is notably lower than all of the other projections of future demand for RNs.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 20,819 FTE RNs available to work; the low supply forecast estimates there were 19,543 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 21,364 RNs that year, suggesting the market was fairly balanced. It is worth noting that RN supply in 2018 was nearly equal to demand based on the national per capita ratio at the 25th percentile; the Sacramento region is the only region in California with RN FTE supply at this level. In the long term, the baseline supply forecast predicts that

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



nurse supply will increase more rapidly than the Sacramento region's population as a whole, and will exceed all projections of demand in this region. The low projection of supply also indicates that there will be a greater supply of RNs in this region than demand for RNs.

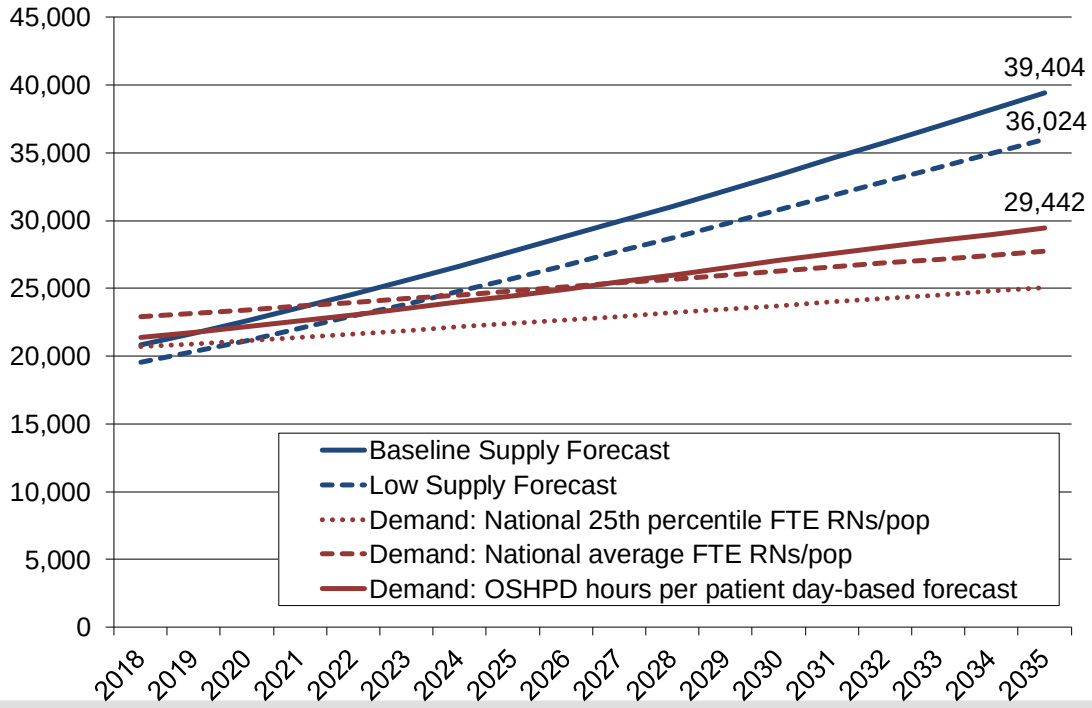
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Sacramento region. Data from the 2016 BRN Survey of RNs indicates that 89.9% of employed RNs who lived in the Sacramento region also worked in the region. Approximately 467 RNs worked in the Northern region (2.1%), 907 worked in the San Francisco Bay Area (4.1%), and 648 worked in the Central Valley/Mountains (2.9%). Conversely, some nurses living in other regions worked in the Sacramento region: approximately 385 from the Northern region, 266 from the San Francisco Bay Area, and 509 from the Central Valley/Mountains region. In sum, in 2016 the Sacramento region had an estimated 1,060 more RNs crossing regional boundaries to work outside the region versus to work within the region.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Sacramento region, 4.8% of RNs are NPs, 0.7% are CNMs, and 0.9% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 6.4% (1,460 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



share of hospital RN hours provided by contract staff in the Sacramento region was 4%, which was the second-lowest regional rate across the state and equivalent to a total of 386 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Sacramento region might be 2,520 fewer than the model calculation, and demand might be up to 400 greater in 2018. The baseline supply and demand forecasts estimate that the region has balanced RN supply and demand, with a gap of no more than 500 FTE RNs (2.5%), but the addition of inter-region commuting and use of contract RNs suggests that the Sacramento region may have a shortage of more than 3,000 FTE RNs (15%) in 2018. However, this shortage is projected to dissipate over the next decade since RN supply is forecasted to grow more rapidly than demand and a surplus could emerge in the Sacramento region by 2025.

Policy Implications

The Sacramento region of California appears to have a shortage of RNs in 2018. However, recent growth in RN education programs will mitigate the shortage over the next decade, and a surplus of RNs is possible in the future. Even if there is growth in the share of RNs who become APRNs, supply will grow more rapidly than demand, allowing health care systems the opportunity to employ nurses in a wide variety of roles that fully utilize their skills in direct patient care, care management, patient education, home health, and ambulatory care. The projected oversupply in the Sacramento region may lead to a greater share of RNs moving to other regions of California and other states where there are shortages.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Sacramento region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine whether local RN education programs have expanded sufficiently to eliminate the shortage that now exists.

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Forecasts of the Registered Nurse Workforce in the Inland Empire Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The Inland Empire region of California, which consists of Riverside and San Bernardino counties, has a substantial shortage of RNs now, largely due to large numbers of RNs working in other regions. The shortage is projected to lessen in severity over time due to growth in RN education programs in the region, including satellite campuses, but could persist through 2035. It is important to note that the supply and demand projections are for the entire region and cannot assess differences between the urban and rural portions of the Inland Empire.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Inland Empire region of California, based on a statewide projection model developed for the California Board of Registered

Nursing (BRN). The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Inland Empire Region

The Inland Empire region of California is defined by the counties of Riverside and San Bernardino. This region corresponds to the combined Employment Development Department Riverside-San Bernardino-Ontario Metropolitan Statistical Area (MSA). There are 43 short-term general, children's, and specialty hospitals in the region, as well as seven associate degree (AD), three bachelor's degree (BSN), and one entry-level master's (ELM) RN education programs. There also are four RN education programs based outside the region that have satellite campuses in the region: Azusa Pacific University, West Coast University, California State University San Marcos, and San Joaquin Valley College.

The Supply of RNs

In February 2018, there were 41,197 RNs with current, active licenses living in the Inland Empire region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

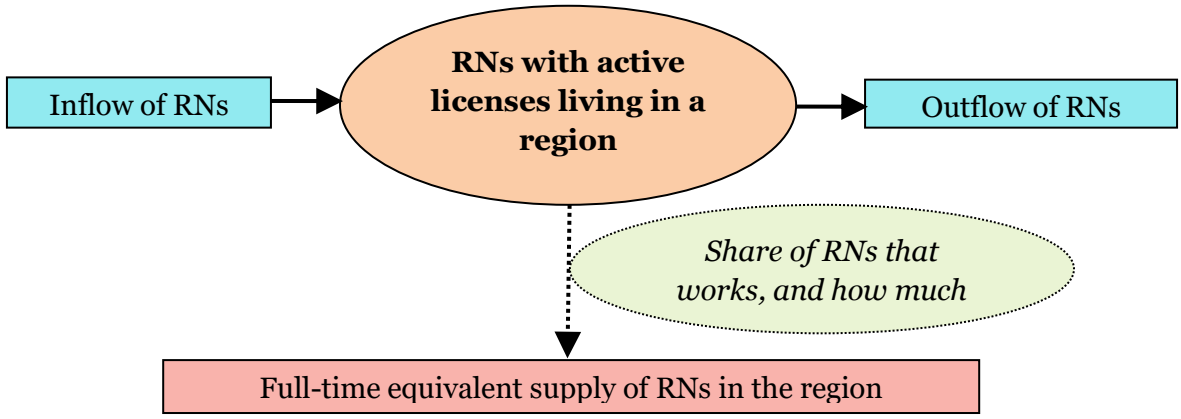
1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of

Figure 1. A model of the supply of RNs



each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 41,197 RNs had active licenses and an address in the Inland Empire region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Inland Empire region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	620	1.5%
25-29	3,478	8.4%
30-34	4,911	11.9%
35-39	4,800	11.7%
40-44	4,998	12.1%
45-49	5,314	12.9%
50-54	4,185	10.2%
55-59	4,431	10.8%
60-64	4,523	11.0%
65-69	2,449	5.9%
70-74	1,007	2.4%
75-79	353	0.9%
80+	128	0.3%
Total	41,197	100.00%

Graduates from RN education programs

RN education programs in the Inland Empire region produced 946 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Inland Empire region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 72.2% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 1,444 and that 2018-2019 new student enrollments would be 1,451. These estimates were multiplied by 72.2% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. To these totals were added 696 projected graduates from satellite campuses located in the region. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	1,721*	1,389*
2013-2014	1,725*	1,354*
2014-2015	1,068*	897*
2015-2016	1,067*	923*
2016-2017	954*	946*
2017-2018	2,379	1,466
2018-2019	2,386	1,385
2019-2020		1,738
2020-2021		1,743

* Actual enrollments/graduates, which do not include satellite campuses.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 42 such out-of-state graduates had an address in the Inland Empire region. Additionally, 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, 36 of whom had an address in the Inland Empire region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Inland Empire region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the Inland Empire region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Inland Empire region in , and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported an Inland Empire region address.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	39.7%	11.1%
26-29	26.2%	36.1%
30-34	12.3%	25.0%
35-39	12.3%	8.3%
40-44	3.7%	11.1%
45-49	3.7%	0.0%
50-54	1.0%	5.6%
55-59	1.0%	2.8%
60-64	0.0%	0.0%
65+	0.0%	0.0%

The region's in-migration rate was computed as the sum of RNs who migrated to the Inland Empire region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 4. Movement of RNs into Inland Empire region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	24	18	6.8%
25-29	163	51	6.1%
30-34	227	38	5.4%
35-39	158	31	3.9%
40-44	124	22	2.9%
45-49	103	20	2.3%
50-54	93	12	2.5%
55-59	84	11	2.1%
60-64	73	6	1.7%
Over 64	39	4	1.1%
Total	**1,088**	**213**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Inland Empire region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	16	2.4%
30-34	45	6.7%
35-39	38	5.7%
40-44	38	5.7%
45-49	77	11.5%
50-54	82	12.2%
55-59	99	14.8%
60-64	95	14.2%
65-69	85	12.7%
70-74	54	8.1%
75+	41	6.1%
Total	**670**	**100.00%**

Migration out of the region

Estimates of migration out of the Inland Empire region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Inland Empire region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Inland Empire region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Inland Empire region

Source: California BRN licensing records.

Age group	Average annual number moving out of region 2016-18	Total as a share of RNs living in region
Under 25	26	4.2%
25-29	157.5	4.5%
30-34	158.5	3.2%
35-39	104	2.2%
40-44	97	1.9%
45-49	88	1.7%
50-54	68.5	1.6%
55-59	81	1.8%
60-64	64.5	1.4%
65-69	30	1.2%
70-74	13	1.3%
75+	0	0.0%
Total	**888**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Inland Empire region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

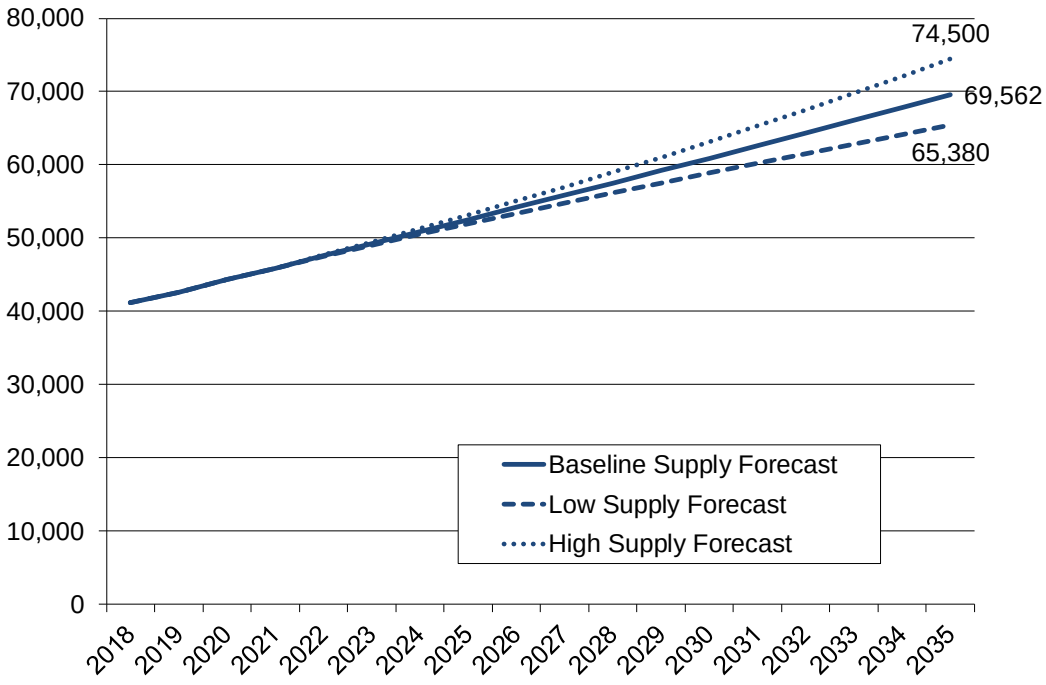
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	9.5	1.5%
25-29	59	1.7%
30-34	57	1.2%
35-39	50.5	1.1%
40-44	51.5	1.0%
45-49	47	0.9%
50-54	61.5	1.5%
55-59	116	2.6%
60-64	217.5	4.8%
65-69	239	9.8%
70-74	212.5	14.3%
Total	**1,121**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Inland Empire region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Inland Empire



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Inland Empire region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	88.5%	88.5%	97.4%	92.9%
30-34	85.2%	85.2%	95.5%	90.3%
35-39	95.7%	92.3%	95.7%	94.0%
40-44	94.1%	89.7%	94.1%	91.9%
45-49	94.4%	92.1%	94.4%	93.3%
50-54	95.9%	89.8%	95.9%	92.8%
55-59	88.1%	85.3%	88.1%	86.7%
60-64	65.9%	65.9%	78.5%	72.2%
65-69	58.1%	57.5%	65.2%	61.3%
70-74	56.3%	40.5%	56.3%	48.4%
75-79	40.0%	32.0%	40.0%	36.0%
80+	0.0%	0.0%	24.2%	12.1%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Inland Empire region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

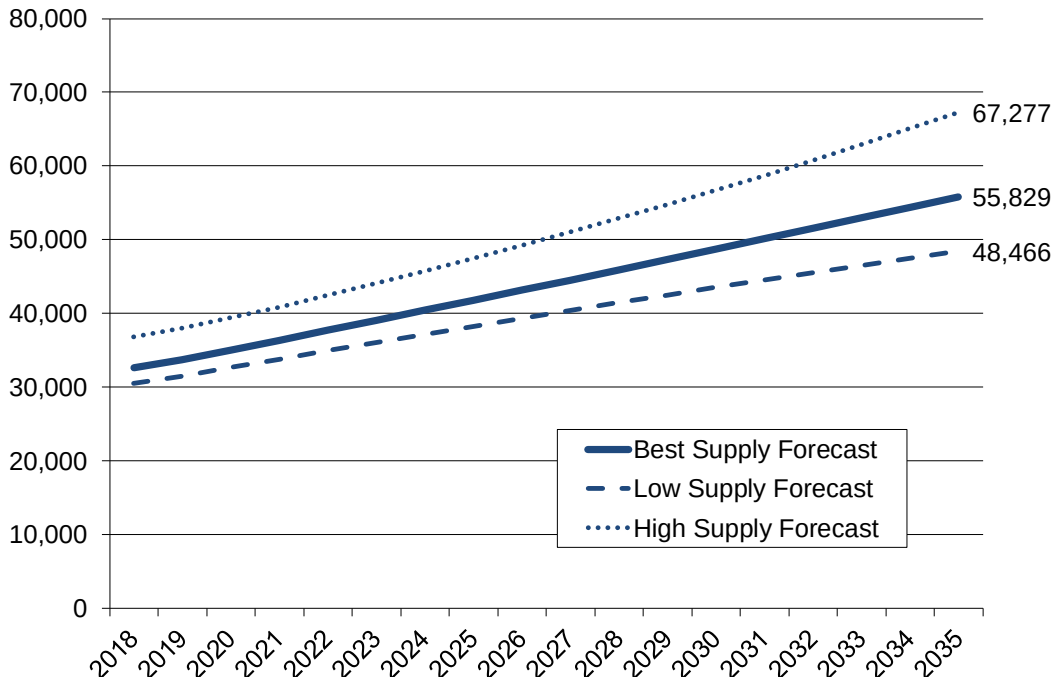
Table 9. Hours worked per week by employed RNs in the Inland Empire region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	37.6	37.6	47.1	42.3
25-29	39.0	35.8	39.0	37.4
30-34	36.0	35.8	36.6	36.2
35-39	37.1	35.8	37.1	36.4
40-44	37.9	36.4	37.9	37.1
45-49	36.7	36.7	37.4	37.1
50-54	38.6	36.9	38.6	37.8
55-59	38.3	36.6	38.3	37.5
60-64	38.4	35.3	38.4	36.8
65-69	37.9	32.0	37.9	34.9
70-74	36.1	24.0	36.1	30.0
75-79	32.1	18.8	32.1	25.5
80+	38.0	25.2	38.0	31.6

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Inland Empire region. These estimates for 2035 range from 48,466 to 67,277, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Inland Empire region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Inland Empire region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 25,858,279 productive RN hours were reported by hospitals in the Inland Empire region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 14.63 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 14,626 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the Inland Empire region was 33,551 (Spetz et al. 2017); thus, total RN employment was 2.29 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 2.29 times greater than hospital RN demand in future years. The projections indicate there will be a need for 21,033 FTE RNs in hospitals and 48,248 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 27,820 RN jobs in the Inland Empire region in 2024 (California Employment Development Department 2018). The EDD projection does not distinguish between full-

time and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.939 was used, which is the average number of hours worked per week by RNs in the region in 2016 (37.57), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 26,133 FTE jobs across the region in 2024.

Comparing the demand forecasts

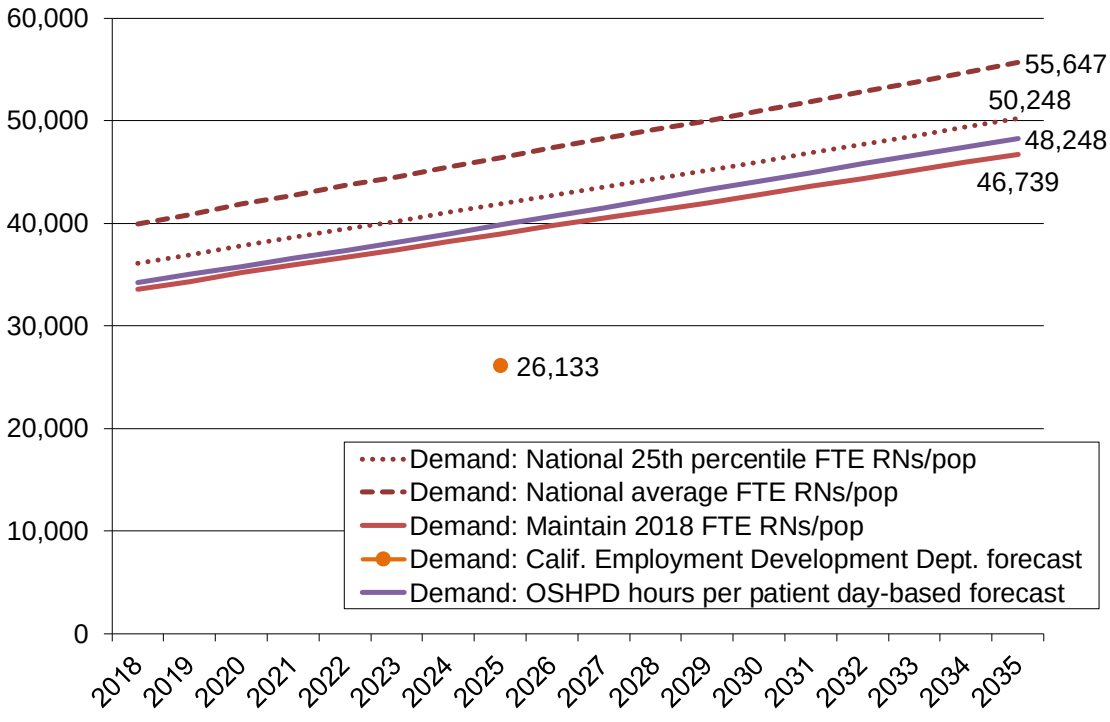
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Inland Empire region, 46,739 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 48,248 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 55,647 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is far below the other projections.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 32,658 FTE RNs available to work; the low supply forecast estimates there were 30,527 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 34,239 RNs that year, suggesting there is now a small shortage of RNs. It is worth noting that RN supply in 2018 was 9.5% lower than demand based on the national per capita ratio at the 25th percentile, which is consistent with the assessment that the region now has an RN shortage. In the long term, the baseline supply forecast predicts that nurse

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



supply will increase more rapidly than the Inland Empire region's population as a whole, and RN supply will reach the national 25th percentile of FTE RNs per 100,000 by 2026. The low projection of supply indicates that it is possible a shortage could emerge in the Inland Empire if graduations from RN education programs decrease; otherwise, a surplus is projected.

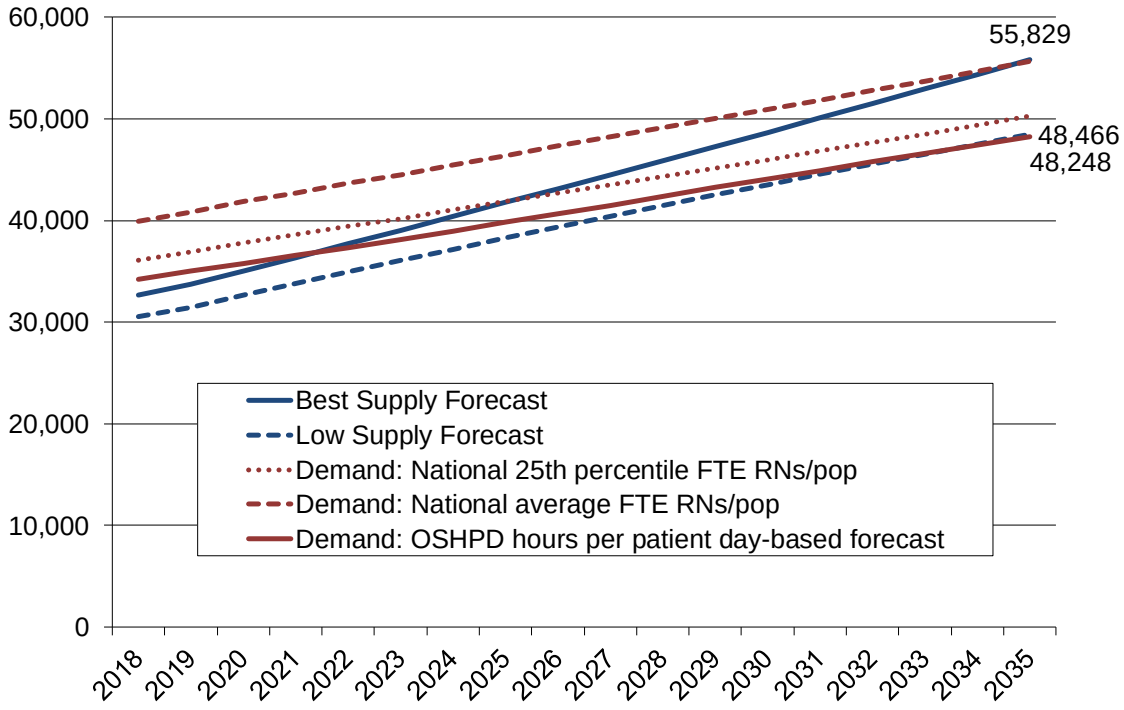
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Inland Empire region. Data from the 2016 BRN Survey of RNs indicates that 78.9% of employed RNs who lived in the Inland Empire region also worked in the region, which is the lowest rate in the state. Approximately 5,499 RNs worked in the Los Angeles region (17.6%), 874 worked in the Southern Border region (2.8%), and 221 worked in the Central Coast area (0.7%). Conversely, some nurses living in other regions worked in the Inland Empire region: approximately 1,524 from the Los Angeles region, 471 from the Southern Border region, and 103 from the Central Valley. In sum, in 2016 the Inland Empire region had an estimated 4,500 more RNs crossing regional boundaries to work outside the region versus to work within the region.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Inland Empire region, 3.2% of RNs are NPs, 0.4% are CNMs, and 0.2% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 3.9% (1,240 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average share of hospital RN hours provided by contract staff in the Inland Empire region was 5.4%, which was equivalent to a total of 778 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Inland Empire region might be 5,700 fewer than the model calculation, and demand might be approximately 800 greater in 2018. The baseline supply and demand forecasts estimate that the region has a shortage of more than 1,500 FTE RNs, and addition of inter-region commuting and the use of contract RNs suggests that the total shortage may be more than 8,000 FTE RNs (23.4%) in 2018. This shortage is projected to persist through 2035 but will become less severe over time due to the growing number of RN graduations from local and satellite campuses. In the long-term, a surplus of RNs could emerge, but this is of less concern than the likelihood of a persistent shortage.

Policy Implications

The Inland region of California appears to have a shortage of RNs in 2018. Growth in RN education programs and satellite campuses in the region will gradually remedy this shortage, but RN supply may continue to be inadequate through 2035. It is important to note that the supply and demand projections are for the entire region and cannot assess differences between the urban and rural portions of the Inland Empire.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Inland Empire region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine whether and to what extent local RN education programs should expand.

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Healthforce Center at UCSF

The mission of the Healthforce Center is to equip health care organizations with the workforce knowledge and leadership skills to effect positive change.

Forecasts of the Registered Nurse Workforce in the Northern Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The Northern region of California, which consists of the counties north of the San Francisco Bay Area and Sacramento region, has a growing supply of registered nurses (RNs) due to expansion of local RN education programs. A small shortage of RNs may exist now in this region, but it will dissipate rapidly, even when accounting for population growth, aging of the population, and rising shares of RNs who enter advanced practice.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Northern region of California, based on a statewide projection model developed for the California Board of Registered Nursing (BRN).

The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Northern Region

The Northern region of California is defined by the counties north of the San Francisco Bay Area and Sacramento region: Butte, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Nevada, Plumas, Shasta, Sierra, Siskiyou, Tehama, and Trinity. This region corresponds to the combined Employment Development Department regions of Chico Metropolitan Statistical Area (MSA), North Coast, North Valley, Northern Mountain, and Redding MSA. There are 33 short-term general, children's, and specialty hospitals in the region, as well as five associate degree (AD) and two bachelor's degree (BSN) RN education programs.

The Supply of RNs

In February 2018, there were 10,503 RNs with current, active licenses living in the Northern region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

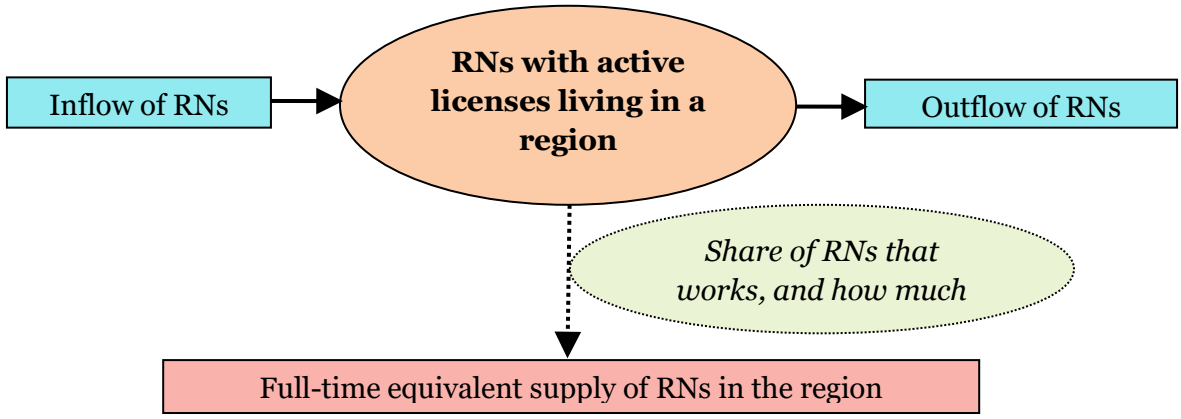
1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of

Figure 1. A model of the supply of RNs



each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 10,503 RNs had active licenses and an address in the Northern region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Northern region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	95	0.9%
25-29	558	5.3%
30-34	1,070	10.2%
35-39	1,108	10.6%
40-44	973	9.3%
45-49	1,015	9.7%
50-54	1,028	9.8%
55-59	1,361	13.0%
60-64	1,606	15.3%
65-69	1,099	10.5%
70-74	428	4.1%
75-79	126	1.2%
80+	36	0.3%
Total	**10,503**	**100.0%**

Graduates from RN education programs

RN education programs in the Northern region produced 363 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Northern region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 92.9% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 493 and that 2018-2019 new student enrollments would be 505. These estimates were multiplied by 92.9% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	377*	367*
2013-2014	362*	329*
2014-2015	366*	350*
2015-2016	351*	347*
2016-2017	373*	363*
2017-2018	493	326
2018-2019	505	347
2019-2020		458
2020-2021		469

* Actual enrollments/graduates.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 12 such out-of-state graduates had an address in the Northern region. Additionally, 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, one of whom had an address in the Northern region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Northern region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the Northern region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Northern region in 2018, and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a Northern region address.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of US RN programs	Internationally-educated graduates
18-25	29.8%	0.0%
26-29	23.1%	0.0%
30-34	16.7%	100.0%
35-39	16.7%	0.0%
40-44	5.5%	0.0%
45-49	5.5%	0.0%
50-54	1.2%	0.0%
55-59	1.2%	0.0%
60-64	0.3%	0.0%
65+	0.0%	0.0%

The region's in-migration rate was computed as the sum of RNs who migrated to the Northern region divided by the total number of actively licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 4. Movement of RNs into Northern region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	7	8	15.8%
25-29	45	13	10.4%
30-34	57	28	7.9%
35-39	34	15	4.4%
40-44	33	5	3.9%
45-49	38	12	4.9%
50-54	45	10	5.4%
55-59	55	5	4.4%
60-64	44	7	3.1%
Over 64	25	1	1.5%
Total	**383**	**104**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Northern region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	1	0.3%
30-34	11	3.8%
35-39	18	6.1%
40-44	20	6.8%
45-49	23	7.8%
50-54	27	9.2%
55-59	38	13.0%
60-64	60	20.5%
65-69	54	18.4%
70-74	28	9.6%
75+	13	4.4%
Total	**293**	**100.00%**

Migration out of the region

Estimates of migration out of the Northern region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Northern region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Northern region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Northern region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Total as a share of RNs living in region
Under 25	8.5	9.0%
25-29	40.5	7.3%
30-34	32	3.9%
35-39	30.5	2.8%
40-44	29	3.0%
45-49	24	2.4%
50-54	31	3.0%
55-59	36.5	2.7%
60-64	28	1.7%
65-69	20	1.8%
70-74	8	1.9%
75+	0	0.0%
Total	**288**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Northern region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

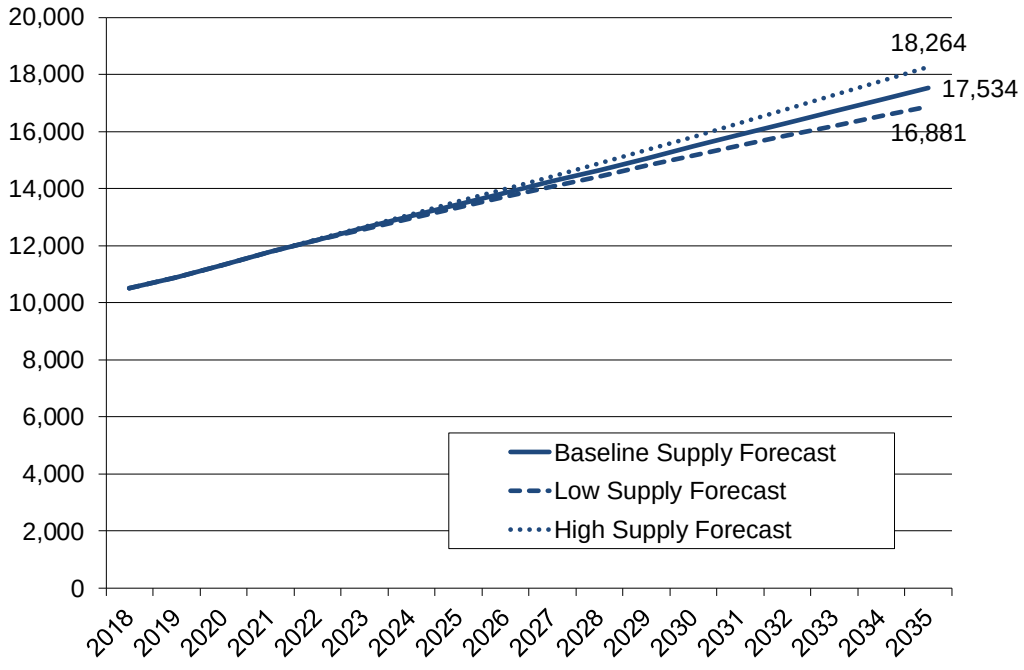
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	3.5	3.7%
25-29	15.5	2.8%
30-34	22.5	2.1%
35-39	21	1.9%
40-44	23	2.4%
45-49	20	2.0%
50-54	28	2.7%
55-59	49	3.6%
60-64	101.5	6.3%
65-69	118	10.7%
70-74	82	13.9%
Total	**484**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Northern region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Northern region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Northern region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	28.3%	28.3%	100.0%	64.1%
25-29	92.9%	92.9%	97.4%	95.1%
30-34	94.2%	92.1%	95.5%	93.8%
35-39	91.0%	91.0%	95.2%	93.1%
40-44	100.0%	89.7%	100.0%	94.8%
45-49	97.4%	92.1%	97.4%	94.7%
50-54	89.7%	89.7%	91.1%	90.4%
55-59	90.6%	85.3%	90.6%	87.9%
60-64	58.8%	58.8%	78.5%	68.6%
65-69	45.1%	45.1%	65.2%	55.1%
70-74	44.4%	40.5%	46.2%	43.3%
75-79	25.0%	25.0%	36.0%	30.5%
80+	100.0%	10.0%	100.0%	55.0%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Northern region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

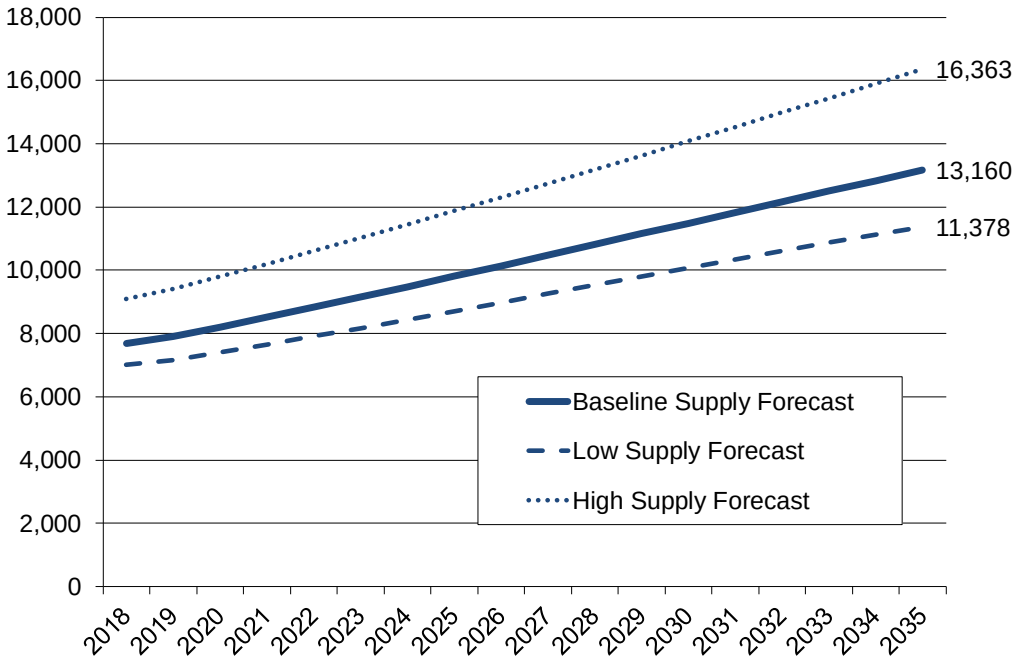
Table 9. Hours worked per week by employed RNs in the Northern region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	35.4	35.4	47.1	41.2
25-29	36.0	35.8	37.0	36.4
30-34	31.5	31.5	37.3	34.4
35-39	36.3	35.3	36.3	35.8
40-44	33.5	33.5	37.0	35.3
45-49	38.1	36.7	38.1	37.4
50-54	37.4	36.9	38.0	37.5
55-59	36.8	36.6	38.1	37.4
60-64	36.4	35.3	36.4	35.8
65-69	35.1	32.0	35.1	33.6
70-74	26.5	24.0	26.5	25.2
75-79	26.9	18.8	26.9	22.8
80+	24.0	22.8	31.1	26.9

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Northern region. These estimates in 2035 range from 11,378 to 16,363, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Northern region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Northern region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 7,157,667 productive RN hours were reported by hospitals in the Northern region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 14.14 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 4,048 FTE RN employment in 2017

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the Northern region was 7,528 (Spetz et al. 2017); thus, total RN employment was 1.86 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 1.86 times greater than hospital RN demand in future years. The projections indicate there will be a need for 4,881 FTE RNs in hospitals and 9,076 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 8,720 RN jobs in the Northern region in 2024 (California Employment Development Department 2018). The EDD projection does not distinguish between full-time

and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.884 was used, which is the average number of hours worked per week by RNs in the region in 2016 (35.35), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 7,706 FTE jobs across the region in 2024.

Comparing the demand forecasts

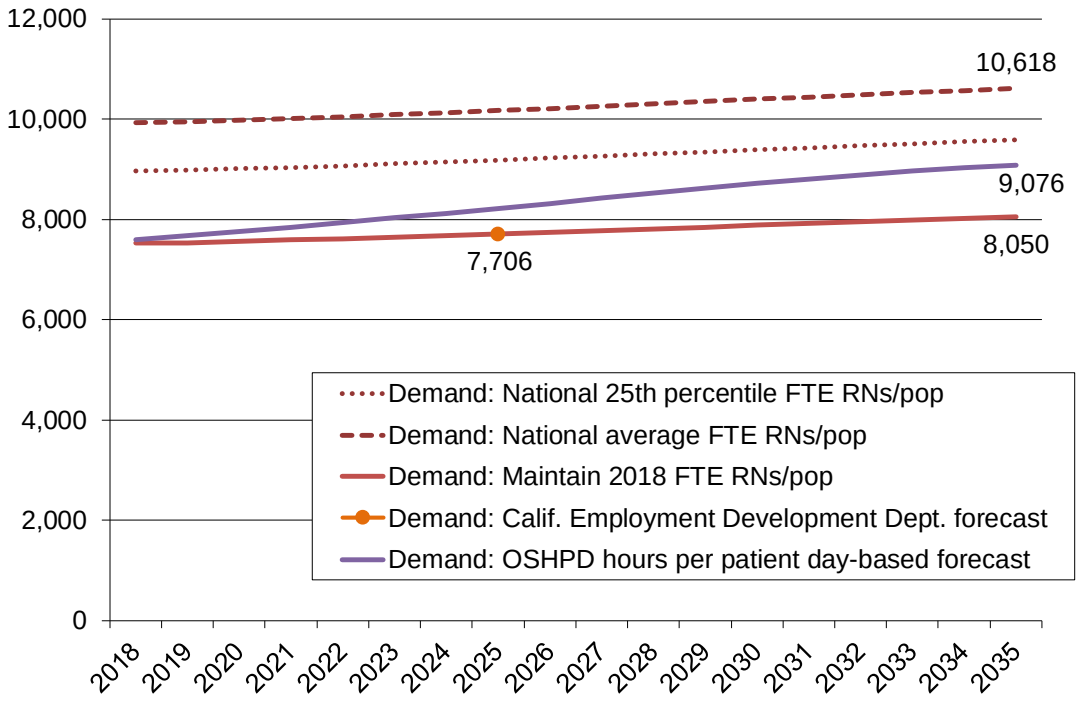
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Northern region, 8,050 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization resulted in 9,076 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 10,618 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is along the trajectory of demand based on maintaining the region's current RN-to-population ratio.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 7,680 FTE RNs available to work; the low supply forecast estimates there were 7,005 FTEs. The projections of RN demand based on hours per patient day (OSHPD data) indicate there was demand for 7,599 RNs that year, suggesting the market was fairly balanced. However, it is worth noting that RN supply in 2018 was 16.7% lower than demand based on the national per capita ratio at the 25th percentile, which may indicate that current demand for RNs is lower than optimal. In the long term, the baseline supply forecast predicts that nurse

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



supply will increase more rapidly than the Northern region's population as a whole, and RN supply will reach the national 25th percentile of FTE RNs per 100,000 by 2023. The low projection of supply also indicates that it is likely the Northern region will have adequate supply in the future.

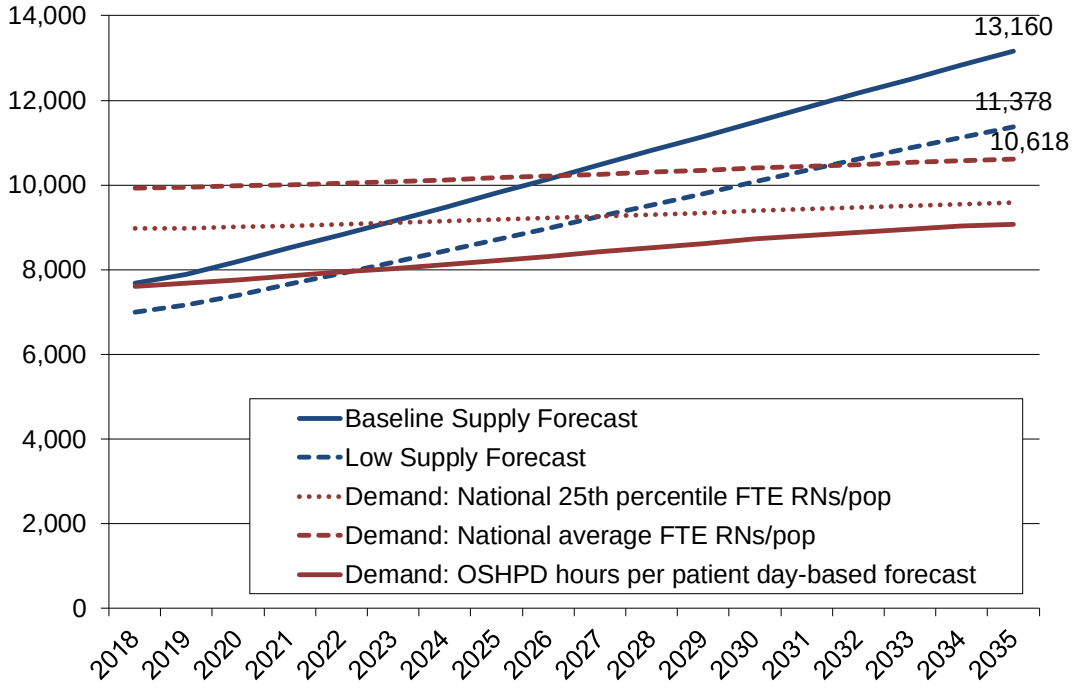
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Northern region. Data from the 2016 BRN Survey of RNs indicates that 90.3% of employed RNs who lived in the Northern region also worked in the region. Approximately 385 RNs worked in the Sacramento region (4.9%), 328 worked in the San Francisco Bay Area (4.1%), and 54 worked in the Los Angeles area (0.7%). Conversely, some nurses living in other regions worked in the Northern region: approximately 467 from Sacramento, 21 from the San Francisco Bay Area, and 325 from the Los Angeles area. In sum, in 2016 the Northern region had similar numbers of RNs crossing regional boundaries to work in the area versus to work outside the area.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Northern region, 4.1% of RNs are NPs, 0.4% are CNMs, and 0.2% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 4.7% (400 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



share of hospital RN hours provided by contract staff in the Northern region was 8.6%, which was the highest regional rate across the state and equivalent to a total of 197 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Northern region might be 400 fewer than the model calculation, and demand might be approximately 200 greater in 2018. The baseline supply and demand forecasts estimate that the region has balanced RN supply and demand, but the addition of inter-region commuting and use of contract RNs suggests that the Northern region may have a shortage of up to 500 FTE RNs (6.6%) in 2018. However, this shortage will dissipate in the near future since RN supply is projected to grow more rapidly than demand.

Policy Implications

The Northern region of California appears to have a small shortage of RNs in 2018, but recent growth in RN education programs will ensure adequate supply in the near future. Even if there is growth in the share of RNs who become APRNs in the Northern region, RN supply will grow more rapidly than demand, allowing health care systems the opportunity to employ nurses in a wide variety of roles that fully utilize their skills in direct patient care, care management, patient education, home health, and ambulatory care.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Northern region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel, to determine whether and to what extent local RN education programs should expand.

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Forecasts of the Registered Nurse Workforce in the Southern Border Region of California

by Joanne Spetz
Healthforce Center at UCSF
December 2018

Abstract

The Southern Border region of California, which consists of San Diego and Imperial counties, has a well-balanced labor market for registered nurses (RNs). Projections of supply and demand through 2035 indicate that a small RN shortage may exist in 2018 but will dissipate in the near future, even when accounting for population growth, aging of the population, and rising shares of RNs who enter advanced practice.

This report was developed in collaboration with HealthImpact and with funding from the California Community College Chancellors Office.

Background

Recent data suggest that a shortage of registered nurses (RNs) may be emerging in California. The Fall 2017 Survey of Nurse Employers found that many Chief Nursing Officers are experiencing difficulty recruiting RNs for specialized positions and that more than 85% of hospitals reported demand for RNs being greater than the available supply (Chu, Bates, & Spetz 2018). Hospital vacancy rates have been rising since 2013, reaching 6.3% in 2017. There also has been growth in the share of newly-graduated RNs reporting they are employed within 12 months of licensure, increasing from 59% in 2013 to 81% in 2017 (HealthImpact 2018). There is variation across regions in the reported difficulty of finding qualified staff, with some employers suggesting there is a surplus of recently-graduated nurses and others indicating severe shortfalls of nurses at all levels of experience.

Rising retirement rates contribute to the challenge of recruiting nurses, particularly those with specialized skills and experience (Buerhaus & Auerbach 2011). In addition, 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% in 2011 (Charles 2015) to 8.1% in 2015 (Cohen et al. 2016). Growing numbers of insured people will demand more health care services, which in turn drives demand for health professionals, including RNs. Moreover, the ACA established programs to encourage improved care management in order to deliver health care more efficiently and effectively; this type of care provides incentives for health care systems to increase their utilization of RNs (Spetz 2014).

This report provides forecasts of regional RN supply and demand in the Southern Border region of California, based on a statewide projection model developed for the California Board of Registered

Nursing (BRN). The data used to construct the model were derived from the 2016 BRN Survey of Registered Nurses (Spetz, Chu, & Jura 2017), the 2015-2016 BRN Annual Schools Report (Blash & Spetz 2018), and BRN license records. The supply forecast is compared with several benchmarks of demand, including national ratios of RNs per capita, estimates of future hospital utilization, and projections published by the California Employment Development Department (EDD 2017).

Definition and Description of the Southern Border Region

The Southern Border region of California is defined by San Diego and Imperial counties. This region corresponds to the combined Employment Development Department Metropolitan Statistical Areas (MSAs) of El Centro and San Diego-Carlsbad. There are 25 short-term general, children's, and specialty hospitals in the region, as well as seven associate degree (AD), four bachelor's degree (BSN), and one entry-level master's (ELM) RN education programs. There also is a satellite campus of Azusa Pacific University in the region.

The Supply of RNs

In February 2018, there were 34,500 RNs with current, active licenses living in the Southern Border region. The RN workforce constantly changes with the entrance of newly graduated nurses; migration of nurses from other regions, 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:

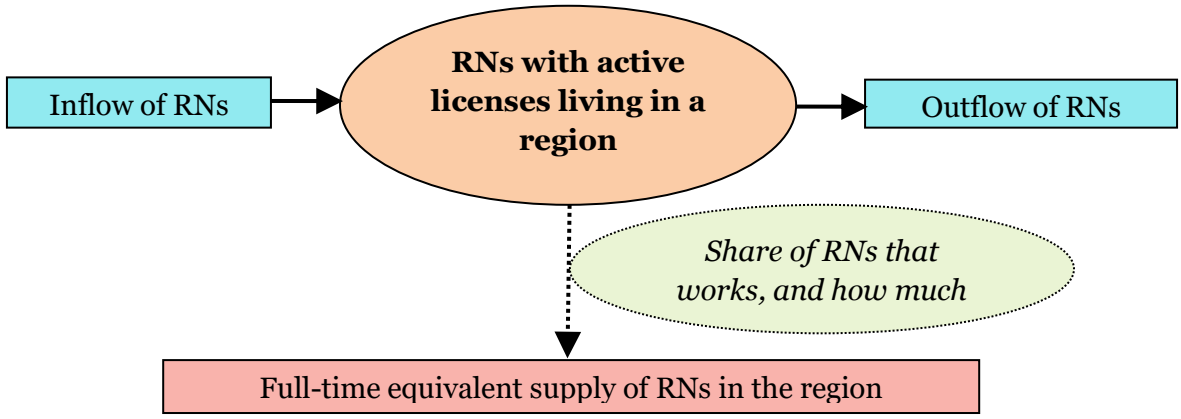
1) Inflows of nurses: Additions to the number of RNs in the region
    a) Graduates from regional nursing programs
    b) Graduates of nursing programs in other states and regions who obtain their first RN license in California and move to the region
    c) Internationally-educated nurses who immigrate to the region and obtain their RN license
    d) Inter-regional and interstate migration of RNs
    e) Changes from inactive to active license status
    f) Changes from lapsed to active license status
2) Outflows of nurses: The departure of RNs from the region
    a) Migration out of region (to another region, state or country)
    b) Movements from active to inactive or lapsed license status
3) Labor force participation factors: Decisions to work, and how much to work
    a) Share of RNs with active licenses that work in nursing
    b) Average number of hours worked per week by RNs working in nursing

The inflows are added to the number of RNs living in the region 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. Figure 1 illustrates this model of the supply of RNs, commonly called a "stock-and-flow model."

Method of calculating RN supply

As inflows, outflows, and employment decisions change over time, so does the RN workforce. The total supply of employed RNs is determined by the age distribution of the stock of RNs, as well as of

Figure 1. A model of the supply of RNs



each inflow and outflow component. In the supply model, the number of RNs with active licenses who reside in the region 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. The model assumes that nurses are evenly distributed within each 5-year age group. Therefore, in each year, 20% of the RNs in each age group – or 1 in 5 RNs – moves into the next (older) age group, until they reach the oldest age group. The youngest age group (under 25) spans 7 years, but because there were so few RNs under 20 years old in 2018, the 20% assumption is used for this group as well.

For each year of the model, the inflow estimates are added to each age group and the outflow estimates are subtracted from each age group, resulting in a forecast of the new stock of RNs for the subsequent year. For each age category, the basic formula is:

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

Employment rates and hours worked per week in nursing are then applied to the estimated stock of RNs in each age group, resulting in an estimated FTE supply. This calculation is iterated through 2035 to obtain yearly forecasts of the region's RN supply.

It is important to acknowledge sources of variability and uncertainty in the supply model. 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, Chu, & Jura 2017). However, it also is possible that "baby boomer" nurses have different intentions regarding retirement than did previous generations, and that higher rates of employment in older age groups will reemerge as a result. This variability in estimated employment participation rates contributes to uncertainty in the supply model. Thus, a range of estimates representing the highest and lowest plausible values is used. In the final models, the "baseline estimate" for each parameter is the average of the low and high estimates, unless otherwise noted.

Stock of RNs in 2018

Data describing the number of RNs with active licenses in February, 2018, were obtained from the BRN. At that time, 34,500 RNs had active licenses and an address in the Southern Border region. Table 1 presents the number of actively licensed RNs living in the region for each age group.

Table 1. Counts of actively-licensed RNs living in the Southern Border region, by age group, February, 2018

Source: California BRN licensing records.

Age group	Count	% of total
Under 25	447	1.3%
25-29	2,734	7.9%
30-34	4,897	14.2%
35-39	4,412	12.8%
40-44	3,848	11.2%
45-49	3,862	11.2%
50-54	3,138	9.1%
55-59	3,550	10.3%
60-64	3,945	11.4%
65-69	2,321	6.7%
70-74	905	2.6%
75-79	322	0.9%
80+	119	0.3%
Total	**34,500**	**100.0%**

Graduates from RN education programs

RN education programs in the Southern Border region produced 1,136 new graduates during the 2016-2017 academic year, according to the BRN Annual School Report (Blash & Spetz 2018). Growth in new student enrollments leads to growth in graduates in future years. AD programs are designed so that students can complete the nursing component of the degree in two years, and in most BSN programs, students are formally enrolled in nursing major courses during the last two to three years of the program; the duration is shorter for accelerated BSN programs. In general, student enrollment changes translate to changes in the number of RN graduates two to three years in the future.

To predict the number of future graduates, actual new student enrollments in a given year were compared with the number of graduates two years later. In the Southern Border region over the period 2012-2013 through 2016-2017, on average, the number of graduates totaled 89.4% of the number of new student enrollments two years prior. This average rate was used to estimate the number of future graduates as a function of new enrollments.

Forecasting the number of graduates beyond the 2018-2019 academic year is difficult because total new student enrollments after 2016-2017 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 2016-2017 survey, schools were asked to report expected student enrollment totals for the 2017-2018 and 2018-2019 academic years. Schools in the region estimated that 2017-2018 new student enrollments would be 1,406 and that 2018-2019 new student enrollments would be 1,406. These estimates were multiplied by 89.4% to obtain the forecasted number of graduates for 2019-2020 and 2020-2021. From these totals, 117 projected graduates who attended satellite campuses in other regions were subtracted. The forecast model assumes that new student enrollments will be stable after the 2018-2019 academic year. Actual numbers of graduates from 2012-2013 through 2016-2017 and predicted numbers of graduated from 2017-2018 through 2020-2021 are presented in Table 2.

Table 2. Actual and forecasted numbers of new RN enrollments and graduations

Source: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018.

Academic year	Actual/forecasted new student enrollments	Actual/forecasted number of graduates
2012-2013	1,033*	1,049*
2013-2014	1,303*	1,047*
2014-2015	1,383*	1,181*
2015-2016	1,354*	1,250*
2016-2017	1,394*	1,136*
2017-2018	1,266	1,093
2018-2019	1,266	1,129
2019-2020		1,140
2020-2021		1,140

* Actual enrollments/graduates, which do not include satellite campuses.

Graduates from nursing programs in other states and countries

Each year, some graduates of nursing programs in other states obtain their first RN license in California. According to the BRN, in 2016, 60 such out-of-state graduates had an address in the Southern Border region. Additionally, n 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, 34 of whom had an address in the Southern Border region.

Age distributions of new graduates and licensees

Inflows of new graduates are added to the stock of RNs by age group. The BRN Annual School Report uses an uneven set of age groups for new graduates: 18-25, 26-30, and then ten-year age groups for graduates over age 30. To be consistent with the forecasting model, the region's new graduates were allocated into five-year age groups and assumed that graduates of nursing programs in other states who obtain initial RN licensure in California have the same age distribution as the region's graduates.

BRN records of internationally-educated nurses who received initial U.S. licensure in California include the birth year, so these nurses were added to the model by age group. Table 3 presents the age distribution of new RN graduates used in the model.

Inter-region and interstate migration of RNs

Estimates of migration to the Southern Border region were calculated from BRN licensing files for 2016 and 2018, as well as from BRN records of nurses requesting endorsement of their out-of-state license to California in 2016. Inter-region migration was calculated by counting the total number of RNs who lived outside the Southern Border region in 2016 (including those with out-of-state addresses), who then reported a mailing address within the Southern Border region in 2018, and dividing this number by two to obtain an annual average for each age group. This was added to the number of RNs who requested endorsement of their license from another state in 2016 and reported a Southern Border region address.

Table 3. Estimated age distributions of new graduates

Sources: 2016-2017 BRN Annual Schools Report: Data Summary and Historical Trend Analysis, 2018, & California BRN licensing files.

Age group	Graduates of U.S. RN programs	Internationally-educated graduates
18-25	32.4%	17.6%
26-29	29.6%	23.5%
30-34	14.8%	26.5%
35-39	14.8%	11.8%
40-44	3.6%	5.9%
45-49	3.6%	5.9%
50-54	0.6%	5.9%
55-59	0.6%	0.0%
60-64	0.0%	2.9%
65+	0.0%	0.0%

The region's in-migration rate was computed as the sum of RNs who migrated to the Southern Border region divided by the total number of licensed RNs residing in the region in 2018 (per BRN licensing records). These data are presented in Table 4.

Table 4. Movement of RNs into Southern Border region

Source: California BRN licensing records.

Age group	Average annual number moving to region 2016-18	Number requesting endorsement	Total as a share of RNs living in region
Under 25	43	39	18.3%
25-29	220	147	13.4%
30-34	211	119	6.7%
35-39	107	54	3.6%
40-44	79	42	3.1%
45-49	68	21	2.3%
50-54	61	22	2.6%
55-59	65	19	2.4%
60-64	48	8	1.4%
Over 64	20	4	0.6%
Total	**922**	**475**	

Movements from inactive and delinquent to active license status

BRN data were obtained describing the number of RNs changing from inactive to active license status and from delinquent to active status in 2016, by age group. These data are presented in Table 5.

Table 5. Number and age distribution of RNs changing status from inactive or delinquent to active license status, Southern Border region, 2016

Source: California BRN licensing records.

Age group	Count	% of total
Under 30	16	2.7%
30-34	51	8.5%
35-39	50	8.3%
40-44	44	7.3%
45-49	60	10.0%
50-54	61	10.1%
55-59	89	14.8%
60-64	91	15.1%
65-69	73	12.1%
70-74	36	6.0%
75+	30	5.0%
Total	**601**	**100.0%**

Migration out of the region

Estimates of migration out of the Southern Border region to other regions or states were derived from 2016 and 2018 BRN licensing files. Out-migration was calculated by taking the total number of RNs in each group who lived in the Southern Border region in 2016, but then reported a mailing address outside of the region in 2018, and dividing it by two to obtain an annual average. The region's out-migration rate was computed as the sum of RNs who left the Southern Border region divided by the total number of actively licensed RNs residing in the region in 2018, by age group (per BRN licensing records). Table 6 presents the rates used in the model.

Table 6. Estimated annual rates of RNs migrating out of the Southern Border region

Source: California BRN licensing records.

Age group	Average annual number moving out of region 2016-18	Total as a share of RNs living in region
Under 25	334	74.7%
25-29	24.5	0.9%
30-34	153.5	3.1%
35-39	183.5	4.2%
40-44	122	3.2%
45-49	73.5	1.9%
50-54	59.5	1.9%
55-59	62	1.7%
60-64	51.5	1.3%
65-69	43.5	1.9%
70-74	23	2.5%
75+	8.5	1.9%
Total	**1,139**	

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 BRN licensing files for 2016 and 2018. The number of RNs who lived in the Southern Border region in 2016 but who were no longer actively licensed in 2018 was calculated and divided by two to obtain an annual average for each age group. This was divided by the number of RNs in each age group in 2018 to obtain the rates at which RNs allow their licenses to lapse or become inactive. The data are presented in Table 7.

Table 7. Estimated annual rates of RNs allowing licenses to lapse or become inactive

Source: California BRN licensing records.

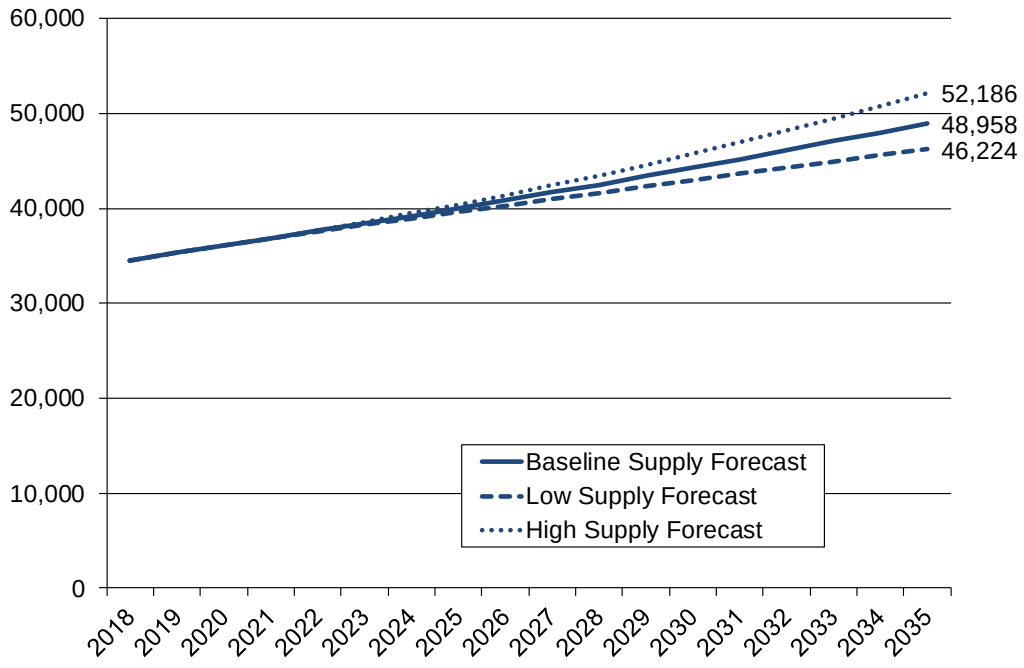
Age group	Average annual number changing to lapsed/inactive status 2016-18	Total as a share of RNs living in region
Under 25	10	2.2%
25-29	82.5	3.0%
30-34	124	2.5%
35-39	90	2.0%
40-44	70.5	1.8%
45-49	60.5	1.6%
50-54	63.5	2.0%
55-59	106	3.0%
60-64	211.5	5.4%
65-69	218	9.4%
70-74	175.5	13.0%
Total	**1,212**	

Supply forecasts of the region's RN workforce

Figure 2 presents the supply forecasts based on the projection model described above. A range of supply estimates were calculated; the baseline forecast assumes that RN education programs maintain the number of graduates, after 2022, the low forecast assumes that RN graduations shrink by 1% per year, and the high model assumes that graduations increase by 1% per year after 2022.

The forecasted number of RNs with active licenses does not account for variation in hours worked, or the fact that some RNs with active licenses do not work in nursing. 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 than in other years. To account for variation in employment rates over time, multiple years of data were examined. The proportion of RNs in the Southern Border region employed in nursing in 2016, by age group, was calculated from the 2016 BRN Survey of RNs. Statewide employment rates by age group were obtained from BRN Surveys of RNs from 2008 through 2016 (Spetz, Chu, & Jura 2017). The employment rate used for the "low" forecast was the lowest of these employment rates, and the

Figure 2. Forecasted number of RNs with active licenses residing in the Southern Border region



employment rate used for the "high" forecast was the highest of these rates. The baseline estimate is the average of the low and high rates and is presented in Table 8.

Table 8. Employment rates of RNs in the Southern Border region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	100.0%	89.6%	100.0%	94.8%
25-29	89.7%	89.7%	97.4%	93.5%
30-34	97.0%	92.1%	97.0%	94.5%
35-39	93.9%	92.3%	95.2%	93.8%
40-44	97.7%	89.7%	97.7%	93.7%
45-49	95.7%	92.1%	95.7%	93.9%
50-54	86.7%	86.7%	90.8%	88.8%
55-59	90.4%	85.3%	90.4%	87.9%
60-64	80.5%	75.5%	80.5%	78.0%
65-69	36.9%	36.9%	65.2%	51.0%
70-74	46.7%	40.5%	46.7%	43.6%
75-79	14.3%	14.3%	36.0%	25.2%
80+	50.0%	23.3%	50.0%	36.7%

The supply model also utilized data from the 2016 BRN Survey of RNs to calculate average usual hours worked per week in all nursing jobs in the Southern Border region, by age group, as well as statewide average hours per week from 2008 through 2016 (Spetz, Chu, & Jura 2017). Estimated hours per week were divided by 40 to obtain the average full-time equivalent employment (FTE) for each age group. In the forecasts, the high for each age group is the highest of these FTE rates and the low estimate is the lowest of the FTE rates. The baseline estimate is the average of the high and low estimates and are presented in Table 9.

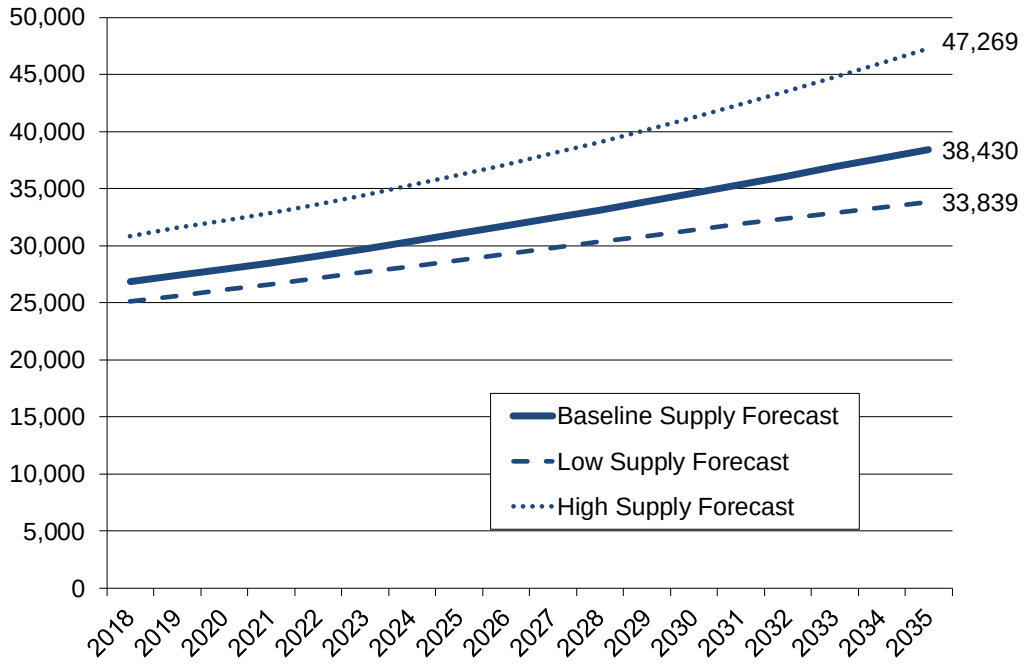
Table 9. Hours worked per week by employed RNs in the Southern Border region

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

Age group	Actual region 2016	Low estimate	High estimate	Baseline estimate
Under 25	36.0	36.0	47.1	41.5
25-29	36.3	35.8	36.4	36.1
30-34	35.5	35.5	36.6	36.1
35-39	37.2	35.8	37.2	36.5
40-44	37.5	36.4	37.5	37.0
45-49	36.7	36.7	37.4	37.1
50-54	35.5	35.5	37.6	36.5
55-59	33.3	33.3	37.4	35.3
60-64	37.7	35.3	37.7	36.5
65-69	36.1	32.0	36.1	34.0
70-74	29.8	24.0	29.8	26.9
75-79	20.9	18.8	24.5	21.6
80+	12.0	12.0	31.1	21.6

Figure 3 presents projected high, low, and baseline estimates of FTE supply of actively licensed RNs for the Southern Border region. These estimates in 2035 range from 33,839 to 47,269, demonstrating the importance of assumptions about education program growth and labor force participation of RNs.

Figure 3. Forecasted full-time equivalent supply of RNs, 2018-2035



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 in determining demand 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% of newborn deliveries being attended by a skilled birth attendant (WHO 2006). Similarly, demand for RNs could be defined as a specific number of nurses per capita. It is important to recognize, however, that demand based on population needs is not the same thing as demand based on economic factors. 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 decide that investment in a new electronic health record will produce more value to patients. In this context, demand for nurses is derived from economic forces, which may not be aligned with population needs.

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

- Fixed benchmarks based on current RN-to-population ratios in the region
- 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
- Regional employment forecasts for 2024 published by the California Employment Development Department (EDD 2017)

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. For decades, California has had one of the lowest ratios of employed RNs per capita in the U.S., usually ranking in the bottom 5 nationwide. Many policy advocates have supported efforts to increase California's FTE employment of RNs per capita to be on par with that of other states, targeting either the current 25th percentile ratio (916 RNs per 100,000) or the national average ratio (1,038 RNs per 100,000). Data on the current and forecasted population of the Southern Border region (California Department of Finance 2018) were used to calculate the number of RNs that would be needed to maintain the current RN-to-population ratios, reach the 25th percentile ratio, and reach the national average ratio.

The main shortcoming of targeting a fixed number of RNs per population, such as a national average, is that the target may not reflect the unique population and health care system of the state or region. An additional shortcoming is that fixed nurse-to-population ratios do not account for increased demand for health care services resulting from an increase in the number of persons with insurance coverage or an aging population.

Forecasts based on hospital staffing of RNs per patient day

A second approach to forecasting demand for RNs is to use current hospital utilization and staffing patterns to estimate growth in future demand for RNs. The first step in this process was to obtain the total number of hospital patient discharges in 2015 (the most recent data available) from short-term, acute-care hospitals in the Southern Border region (Office of Statewide Health Planning and Development 2016). In order to estimate the total number of patient days per age group (10-year ranges), these data were multiplied by the average length of stay per age group, as reported by 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 in the region. Age-specific population estimates and forecasts were sourced from the California Department of Finance (2018). These rates of patient days per age group were then applied to the population projections to forecast total patient days by age group.

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 2017). In 2016, a total of 22,175,615 productive RN hours were reported by hospitals in the Southern Border region. The number of RN hours per discharge was calculated by dividing total productive RN hours by the number of patient days in 2017, resulting in an estimated 13.78 productive RN hours per patient day. Multiplying the number of productive RN hours per patient day by the forecasted total number of patient days produces an estimate of hospital-based RN hours needed in the future. To equate these estimates to FTE jobs, RN hours were divided by 1,768 (average annual productive hours per FTE), resulting in 12,543 FTE RN employment in 2017.

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). The 2016 BRN Survey of Registered Nurses indicates that total FTE employment in the Southern Border region was 26,979 (Spetz et al. 2017); thus, total RN employment was 2.15 times greater than hospital RN employment. To forecast total demand for RNs, it was assumed that total RN demand would continue to be 2.15 times greater than hospital RN demand in future years. The projections indicate there will be a need for 16,577 FTE RNs in hospitals and 35,657 FTE RNs throughout the region in 2035.

Employment Development Department forecasts

The most recent projection by the California Employment Development Department (EDD) indicates that there will be 26,410 RN jobs in the Southern Border region in 2024 (California Employment Development Department 2018). The EDD projection does not distinguish between full-

time and part-time jobs. To estimate the FTE employment implied by the EDD projection, an adjustment factor of 0.9 was used, which is the average number of hours worked per week by RNs in the region in 2016 (36.0), divided by 40 (Spetz, Chu, and Jura 2017). This results in a projected 23,766 FTE jobs across the region in 2024.

Comparing the demand forecasts

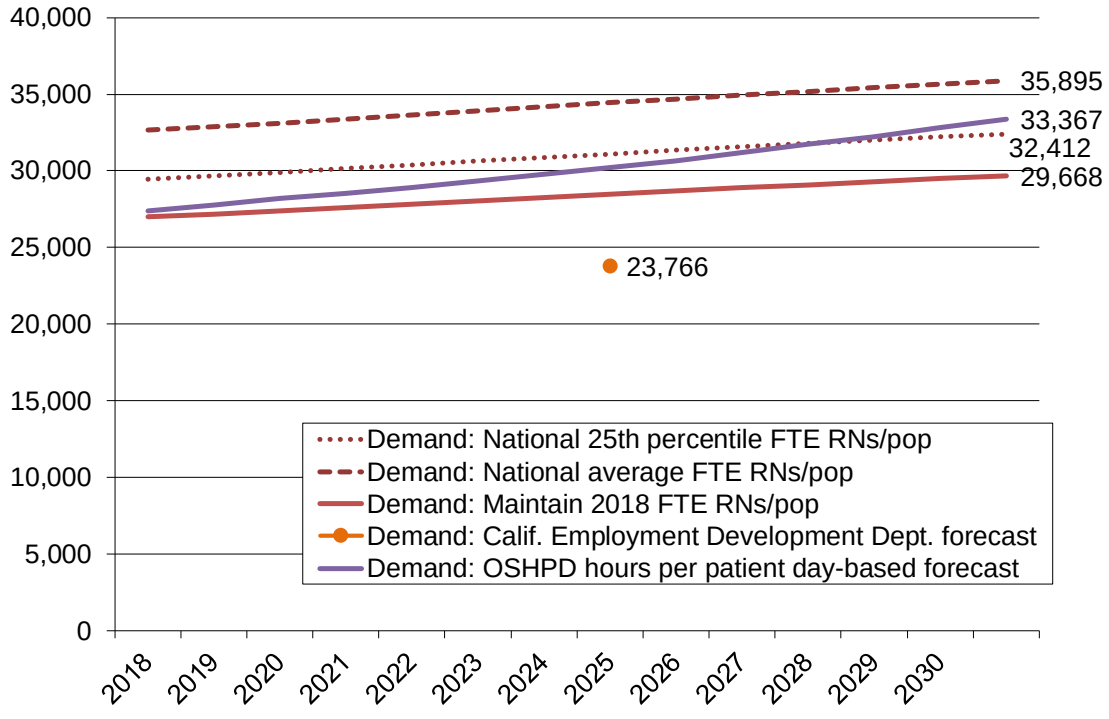
Figure 4 compares alternative forecasts of demand for full-time equivalent RNs. In order to maintain the current RN-to-population ratio in the Southern Border region, 29,668 FTE RNs will be needed in 2035. The forecast based on projected growth in hospital utilization results in 33,367 FTE RNs needed in 2035. To reach the national average ratio of RNs per population, 35,895 FTE RNs will be needed in 2035. Figure 4 also shows that the projected number of FTE RN jobs in 2024 derived from EDD is substantially lower than the other demand projections.

Comparing Supply and Demand for RNs

Figure 5 compares the baseline supply forecast and the low supply forecast with three alternate demand forecasts: (1) demand based on attaining the national per capita ratio at the 25th percentile; (2) demand based on attaining the national average per capita ratio; and (3) demand based on forecasted growth in hospital patient days. All forecasts are for FTE employment.

The baseline supply forecast estimates that in 2018 there were 26,835 FTE RNs available to work; the low supply forecast estimates there were 25,107 FTEs. The projections of RN demand based on OSHPD data indicate there was demand for 27,389 RNs that year, suggesting the market was fairly balanced. However, it is worth noting that RN supply in 2018 was 9% lower than demand based on the national per capita ratio at the 25th percentile. In the long term, the baseline supply forecast predicts that nurse supply will increase slightly more rapidly than the Southern Border region's population as a whole,

Figure 4. Forecasted full-time equivalent demand for RNs, 2018-2035



and RN supply will reach the national 25th percentile of FTE RNs per 100,000 by 2026. The low projection of supply also indicates that it is likely the Southern Border region will have adequate supply in the future.

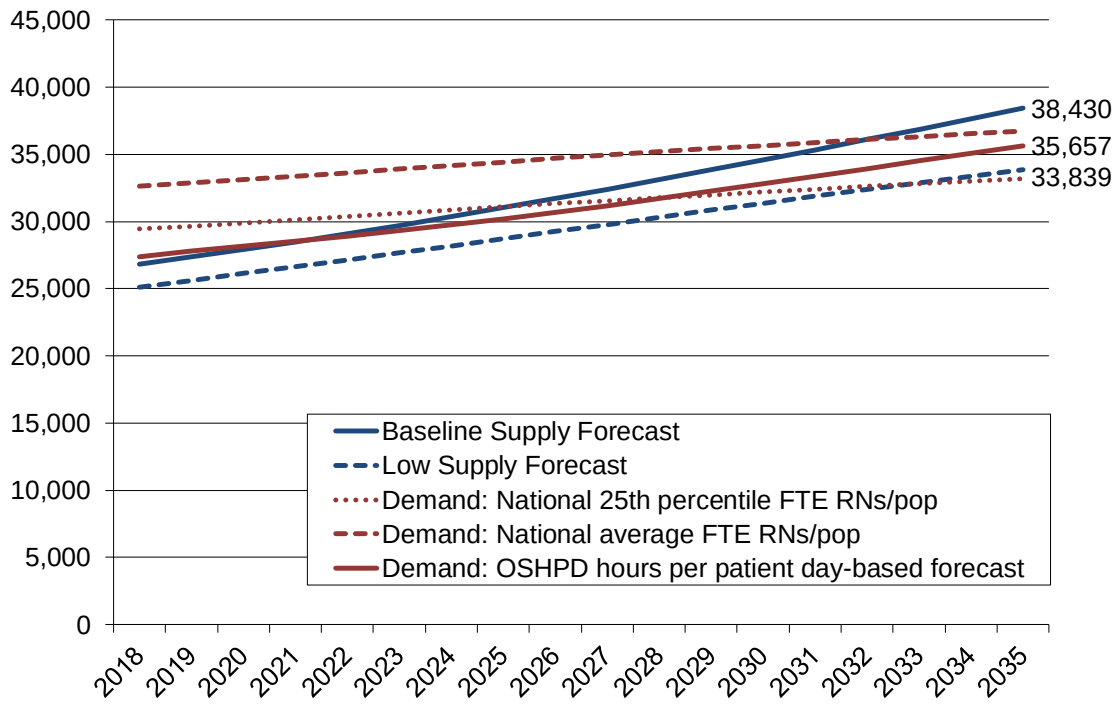
Additional factors that affect regional RN shortages

Some RNs travel across regions for work, which could result in fewer or more nurses working in the Southern Border region. Data from the 2016 BRN Survey of RNs indicates that 97.2% of employed RNs who lived in the Southern Border region also worked in the region. Approximately 471 RNs worked in the Inland Empire region (1.7%) and 296 worked in the Los Angeles region (1.1%). Conversely, some nurses living in other regions worked in the Southern Border region: an estimated 874 from the Inland Empire region, 325 from the Los Angeles region, and 224 from the Sacramento area. In sum, in 2016 the Southern Border region had an estimated 657 more RNs crossing regional boundaries to work in the area versus to work outside the area.

A second factor that may affect the supply of RNs is that some are also advanced practice RNs (APRNs) – nurse practitioners (NPs), certified nurse-midwives (CNMs), clinical nurse specialists (CNSs), and nurse anesthetists (CRNAs). Both the supply projections and the projections of demand for RNs based on RN-to-population ratios and hospital patient utilization treat all these APRNs as RNs. The EDD projection does not include APRNs. In the Southern Border region, 5.4% of RNs are NPs, 0.4% are CNMs, and 0.9% are CRNAs. If these APRNs are not considered part of the RN supply, together they reduce the region's baseline supply by approximately 7.3% (2,124 RNs).

Hospital employment data sourced from OSHPD were examined to identify the number of RN hours worked by contract personnel in 2016. Use of contract staff by hospitals may indicate the degree to which hospitals are experiencing a shortage of RNs with the skills required for open positions. However, since contract personnel are used to fill gaps during staff vacations and leaves of absence, as well as normal seasonal fluctuations in hospital utilization, this is not a perfect measure of the magnitude of RN shortage. The OSHPD data indicated that the average share of hospital RN hours provided by contract staff

Figure 5. Forecasted full-time equivalent supply and demand for RNs, 2018-2035



in the Southern Border region was 3.5%, which was the lowest regional rate across the state and equivalent to a total of 519 FTE RNs.

Overall assessment of RN labor market in the region

Together, data on inter-regional commuting, the size of the advanced practice workforce, and the employment of agency personnel suggest that RN supply in the Southern Border region might be 1,450 fewer than the model calculation, and demand might be approximately 520 greater in 2018.

The baseline supply and demand forecasts estimate that the region has balanced RN supply and demand, with a gap of no more than 500 FTE RNs (2%), but the addition of inter-region commuting and use of contract RNs suggests that the Southern Border region may have a shortage of up to 2,500 FTE RNs (9.1%) in 2018. However, this shortage is projected to dissipate over the next decade since RN supply is forecasted to grow more rapidly than demand; overall, the RN labor market in the Southern Border region is well-balanced.

Policy Implications

The Southern Border region of California may have a small shortage of RNs in 2018, but recent growth in RN education programs will ensure adequate supply in the future. Even if there is growth in the share of RNs who become APRNs, supply will grow more rapidly than demand, allowing health care systems the opportunity to employ nurses in a wide variety of roles that fully utilize their skills in direct patient care, care management, patient education, home health, and ambulatory care.

These projections could change if any of the variables in the model change. The most important changes that could change the projections are increases or decreases in: (1) the number of graduates from RN education programs; (2) inter-regional migration; and/or (3) employment rates of RNs. These factors and any other potential influences on the Southern Border region's nursing supply, 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.

Regional health care and education 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 monitor new student enrollments in nursing programs, as well as the degree to which employers are reliant on contract personnel and commuters, to determine whether local RN education programs have expanded sufficiently to eliminate the shortage that now exists.

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