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United States Registered Nurse Workforce Report Card and Shortage Forecast: A Revisit

Xiaoming Zhang, PhD[1,2], Daniel Tai, BA[3], Hugh Pforsich, PhD[4], and Vernon W. Lin, MD, PhD[5,6,7]

Abstract

This is a reevaluation of registered nurse (RN) supply and demand from 2016 to 2030 using a previously published work forecast model and grading methodology with more recent workforce data. There will be a shortage of 154 018 RNs by 2020 and 510 394 RNs by 2030; the South and West regions will have higher shortage ratios than Northeast and Midwest regions. This reflects a nearly 50% overall improvement when compared with the authors' prior study, and the low-performing states have improved from 18 "D" and 12 "F" grades as published earlier to 13 "D" and 1 "F" in this study. Although progress has been made, efforts to foster the pipelines for improving the nursing workforce need to be continued.

Keywords

nursing workforce, RN demand, RN supply, report card

Nursing is the largest health care profession in the United States and a registered nurse (RN) plays a crucial role in health care delivery and has a wide range of responsibilities involving patient care (Table 1).[1,2] In 1998, it was reported that the United States was facing an RN shortage.[3] This initial report was followed by several other studies investigating the RN shortage,[4-6] including the study team's own published in 2012.[7] These studies showed that the United States was facing an unprecedented shortage of up to 1 million RNs by 2020[4,7] primarily because of the aging RN workforce, the growing elderly population, and the downswing in the number of younger nurses.

Much has changed since then with there now being reports of a surplus in the RN workforce.[8] This drastic turnaround has prompted the study team to reexamine the RN labor force utilizing the same models they used previously to forecast future RN supply and demand. Moreover, the team again uses a published grading methodology to facilitate comparison between current and future regional RN staffing levels. The team takes into account the possible effects of the recession, recent nursing school enrollment trends, and the aging population on the current dynamics of the RN workforce. The team also compares the present study and methodology with other published studies in the field.

Methods

Design and Sample

This article utilized the same forecast model and grading methodology developed in previous studies.[7,9-11] RN job shortages were projected by examining the difference between RN demand and RN supply in all 50 states. The grading methodology was then used to compare shortage ratios between 2015 and 2030. To facilitate regional analysis, states were aggregated into 4 large regions (West, Midwest, South, and Northeast) as defined by the Bureau of Labor Statistics (BLS).[12]

[1]Cleveland Clinic Lerner College of Medicine, Cleveland, OH
[2]Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH
[3]University of California at Berkeley, CA
[4]California State University, Sacramento, CA
[5]University of Mississippi Medical Center, Jackson, MS
[6]G.V. (Sonny) Montgomery VA Medical Center,Jackson, MS
[7]Methodist Rehabilitation Center, Jackson, MS

Corresponding Author:
Vernon W. Lin, MD, PhD, Division of Physical Medicine and Rehabilitation, The University of Mississippi Medical Center, 1350 East Woodrow Wilson Avenue, Jackson, MS 39216.
Email: vlin@umc.edu

Table 1. Explanation of Key Terms.

Key Terms	Definition
Bureau of Labor Statistics (BLS)	The official source of labor economic and statistical data for the federal government. Through a semiannual survey, the BLS produces employment and wage estimates for 800 different occupations on the national, state, and subregional levels (http://www.bls.gov).
Current Population Survey (CPS)	CPS is a monthly survey of about 50 000 households conducted by USCB and BLS. CPS is the primary source of information on the labor force characteristics of the US population.
Full-time equivalent (FTE) RNs	FTE RNs are used as a means to measure and reconcile the variation in workforce participation among RNs by converting individuals who work full-time or part-time into a single unit of measure. It does not represent the number of RN workers but the number of full-time positions fulfilled by all existing workers in a workforce.[23]
Health Resources and Services Administration (HRSA)	HRSA is an agency of the US Department of Health and Human Services that collects, analyzes, and disseminates health workforce information and facilitates national, state, and local workforce planning efforts.
Report card	A collection of grades assigned to each state based on a grading rubric used for determining RN shortage ratios.
National mean	852 RN jobs per 100 000 people. This value was based on the number of RNs in the United States per 100 000 people in 2015.[16]
Personal health care expenditure (PHE)	An estimate that takes into account "spending for hospital care, physician and clinical services, dental care, other professional services, home health care, nursing home care, and health care products purchased in retail outlets." This estimate does not include spending on public health programs, health facility administration, health care research, and the construction of health care facilities.[13]
Registered nurse (RN)	A RN is a health care professional defined by BLS as responsible for implementing the practice of nursing through the use of the nursing process in conjunction with other health care professionals. RNs work as patient advocates for the care and recovery of the sick as well as for the maintenance of their health.
RN jobs	A worker who can be classified as a full-time or part-time RN. This is a fundamental unit of measure used to estimate RN populations and is counted through a survey conducted by the BLS every 3 years.
RN demand	The estimated number of RN jobs needed to meet population needs.
RN demand ratio	The number of RN jobs needed per 100 000 people.
RN shortage	The difference between a region's demand for RN jobs and that region's supply of RN jobs.
RN shortage ratio	RN shortage per 100 000 people.
RN supply	The estimated number of RN jobs.
RN supply ratio	The number of RN jobs per 100 000 people.
US Census Bureau (USCB)	USCB is the government agency that is responsible for the US Census for collecting and providing relevant data about the people and economy of the United States.
American Community Survey (ACS)	A survey conducted by the USCB that is modeled after the long form of the decennial census with a questionnaire that is mailed to approximately 295 000 addresses a month.

Demand Model

The demand model was based on the previous model with updated values. The study team continued to convert demographic changes of population growth and age into projected personal health expenditures (PHE) for each of the 50 states using the Centers for Medicare & Medicaid Services published age-based PHE estimates for 2010.[13] Age–population projections were from the US Census Bureau (USCB)[14] and were used with the age-based PHE estimates to forecast future demand for health services until 2030 as a single dollar amount. Using a linear regression analysis, the BLS-reported number of RN jobs nationally was plotted against this monetary value for 2004-2015. This resulted in a linear slope of 1.30×10^{-6} ($R^2 = 0.902$). Thus, this linear slope was multiplied against the yearly change in PHE to produce an estimated demand of RN jobs nationally and in each state. The

baseline was the 2015 national mean of RN jobs per 100 000 of 852. The equation for the demand model follows:

$$D_{R,N} = 852 \times \left[\text{2015 Projected State Population}\right]/10^5 + 1.30 \times 10^{-6} \times (\Delta PHE_{R,2015,2016} + \Delta PHE_{R,2016,2017} + \cdots + \Delta PHE_{R,N-1,N})$$

where $D_{R,N}$: D = Demand, R = Region or State, N = Year; $\Delta PHE_{R,N-1,N} = PHE_N - PHE_{N-1}$; 852 is the national mean of RN jobs (RN Jobs per 100 000); 1.30×10^{-6} is the linear slope of change in PHE to number of RN jobs.

Supply Model

In the supply model, the propensity or likelihood of a US individual to work as a nurse was calculated using the RN age–population estimates provided by the Current Population Survey.[15] RN population estimates were collected over a 10-year period, from 2006 to 2015, in the following 7 age groups: 16 to 19, 20 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and older. These estimates were then divided by the USCB population estimates in the same age categories over the same time span,[14] yielding RN propensity values. The following formula contains details of the supply model:

$$S_{R,N} = BLS_{2015} + \sum_R (L_A \times \left(\Delta POP_{A,2015,2016}\right) + \sum_R (L_A \times \left(\Delta POP_{A,2016,2017}\right) + \cdots + \sum_R (L_A \times \left(\Delta POP_{A,N-1,N}\right)$$

where $S_{R,N}$: S = Supply, R = Region or State, N = Year; L_A: L = Likelihood averaged over 10 years, A = Age group; $\Delta POP_{A,N-1,N}$ = Age-group specific Population_N − Population_{N-1}; BLS_{2015} = the number of RN jobs reported by the BLS in 2015.

Report Card

The metric used for grading in this article is the RN shortage ratio, which is defined as the difference between RN demand and RN supply per 100 000 people in each region as shown by the following equation:

$$\frac{\left[\text{State}\right]\text{RN Demand} - \left[\text{State}\right]\text{RN Supply}}{\left[\text{State}\right]\text{Total Population}} \times 10^5 = \left[\text{State}\right]\text{RN Shortage Ratio}$$

The national and state numbers of RN jobs in 2015 were retrieved from the BLS.[16] Population projections were obtained from the USCB.[14] The report card was based on the national RN supply ratio, or national mean, of 852 RN jobs per 100 000. This value served as the standard value for comparison for state performances in years to come. The standard deviation (SD) of the RN supply ratios across the 50 states formed the framework of the grading rubric. Letter grades were given based on the difference between the national mean and each state's shortage ratio with the national mean serving as the "C" grade. A and F grades were given for RN job shortage ratios ±2 SD from the mean, B and D were ±1 SD from the mean, and C+ and C− were ±0.5 SD from the mean.

Results

This study breaks down RN shortages into 3 different levels: national, regional, and state. Nationally, RN shortages will continue to grow across the country between 2015 and 2030. This shortage, though significant, will have varying impacts in each region of the United States. Among the 4 regions, those with the largest shortages in 2030 will be the South (248 964 jobs) and the West (241 434 jobs); the Northeast and Midwest will have lower shortages of 14 578 and 5422, respectively (Table 2). In terms of RN shortage ratios in 2030, the West is forecasted to have the greatest shortage (262 RN jobs per 100 000) followed by the South with 174 RN jobs per 100 000. The Northeast and Midwest will have shortage ratios of 25 and 8 RNs per 100 000, respectively.

On the state level, states with the largest shortages (ie, the largest number of RN jobs) will be California (141 348 jobs), Florida (77 527), and Texas (62235). States with the largest shortage ratios (RN shortage per 100 000 people) will be New Mexico, Arizona, and California (Table 2). Each state shows an increase in RN shortage ratio, ranging from 60 to 245, when comparing 2015 and 2030 projections. States with the largest increase in shortage ratios are New Mexico, Wyoming, and Montana. With regard to grades, in 2015, there were 3 As, 9 Bs, 8 C+s, 18 Cs, 8 C−s, 4 Ds, and zero Fs. Massachusetts, North Dakota, and South Dakota were the only states with an A grade. In 2030, there will be 1 A, 2 Bs, 4 C+s, 15 Cs, 14 C−s, 13 Ds, and 1 F with South Dakota being the only state with an A grade.

Discussion

Nursing shortage continues to play a significant role in the future of the American health care landscape; as this study pointed out, 37 out of 50 states studied will experience significant nursing shortages by 2030 (Figure 1). The majority of these states are located in the South and West regions, which is comparable to other findings.[8,17] This shortage is partly reflected by the total population growth and the growing elderly population in these 2 regions (Table 3).

Table 2. Fifty States' 2030 RN Surplus/Shortage Ratios and Grade Trends.

Rank	States	Regions	Change in Population	2030 RN Surplus	2030 RN Shortage	2030 Shortage Ratio	2030 Ratios RN Surplus | RN Shortage	2015 Grade	2030 Grade	Change in Shortage Ratios
1	South Dakota	Midwest	3508	3633		−454		A	A	194
2	North Dakota	Midwest	−28 567	1755		−289		A	B	177
3	Massachusetts	Northeast	253 429	15 911		−227		A	B	161
4	Nebraska	Northeast	31 739	2695		−148		B	C+	152
5	Ohio	Midwest	−84 918	12 406		−107		B	C+	126
6	West Virginia	South	−102 799	1685		−98		B	C+	148
7	Missouri	Midwest	360 617	5694		−89		B	C+	145
8	Pennsylvania	Northeast	57 246	9807		−77		B	C	142
9	Rhode Island	Northeast	13 398	576		−50		B	C	147
10	Iowa	Midwest	−71 208	1380		−47		B	C	146
11	Delaware	South	85 258	449		−44		B	C	222
12	Minnesota	Midwest	637 919	2413		−38		B	C	162
13	Kentucky	South	203 810	442		−10		C+	C	141
14	Indiana	Midwest	292 477		2414	35		C	C	118
15	Kansas	Midwest	87 394		1215	41		C+	C	143
16	North Carolina	South	2 216 969		5152	42		C+	C	146
17	Maine	Northeast	22 219		660	47		C+	C	218
18	Alabama	South	211 132		2913	60		C+	C	151
19	Colorado	West	742 864		4253	73		C	C	128
20	Wisconsin	Midwest	268 004		4785	78		C+	C	169
21	Mississippi	South	78 001		2467	80		C	C	150
22	Louisiana	South	128 912		4114	86		C	C	138
23	New York	Northeast	−69 270		20 017	103		C	C-	130
24	Illinois	Midwest	335 674		14 023	104		C	C-	115
25	Connecticut	Northeast	53 216		3891	105		C	C-	146
26	Vermont	Northeast	38 698		797	112		C+	C-	205
27	Montana	West	45 409		1196	114		C+	C-	227
28	South Carolina	South	506 432		6117	119		C	C-	181
29	Michigan	Midwest	95 050		12 960	121		C	C-	129
30	Tennessee	South	878 617		9463	128		C	C-	133
31	New Jersey	Northeast	546 671		13 037	133		C	C-	129
32	Maryland	South	813 859		9745	139		C	C-	110
33	Oregon	West	820 994		6801	141		C	C-	98
34	New Hampshire	Northeast	189 792		2469	150		C	C-	171
35	Wyoming	West	−5026		847	162		C	C-	240
36	Alaska	West	135 130		1454	168		C	C-	122
37	Washington	West	1 674 191		15 963	185		C-	D	94
38	Texas	South	6 731 943		62 235	187		C-	D	82
39	Utah	West	702 327		6837	196		C-	D	60
40	Hawaii	West	80 094		3106	212		C	D	153
41	Arkansas	South	271 295		7057	218		C-	D	123
42	Idaho	West	339 579		4295	218		C-	D	111
43	Virginia	South	1 358 155		21 959	224		C-	D	120
44	Oklahoma	South	251 557		9922	254		C-	D	114
45	Florida	South	7 481 637		77 527	270		C	D	215
46	Georgia	South	1 787 260		32 868	273		D	D	96
47	Nevada	West	1 223 912		12 922	302		D	D	86
48	California	West	6 321 629		141 348	304		D	D	88
49	Arizona	West	3 217 159		34 915	326		D	D	138
50	New Mexico	West	58 169		7496	357		C-	F	245
	All 50 states		41 291 557	58 846	569 240					
	2030 National Net RN Shortage				510 394					

Abbreviation: RN, registered nurse.

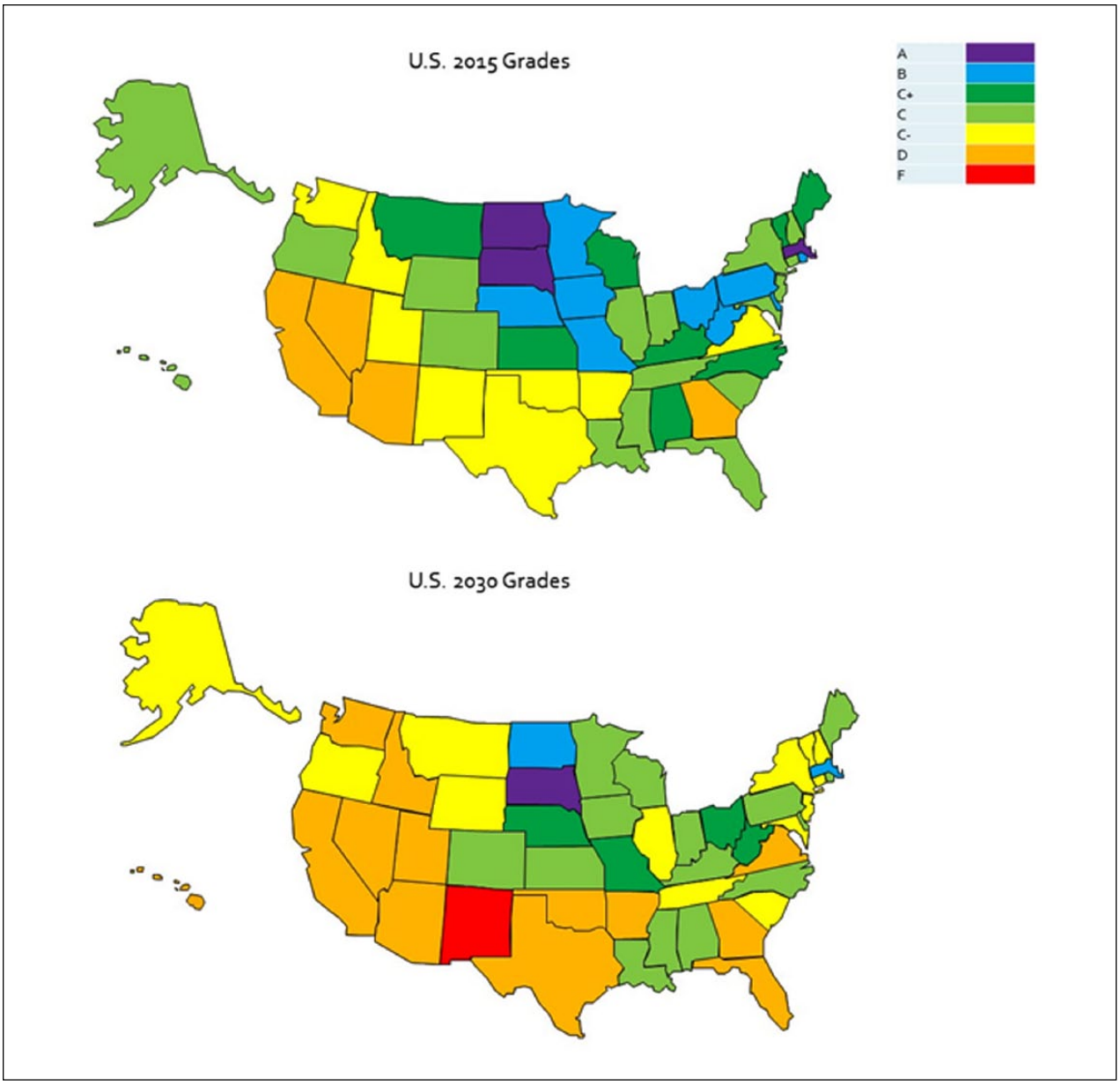

Figure 1. US map comparison of state grades, 2015 versus 2030.

By 2030, the 3 states with the most severe nursing shortage ratios are New Mexico, Arizona, and California. The key reason for the high shortage ratio in New Mexico is attributed to high RN demand from the growth of the total population and aging population without adequate commensurate increase in RN supplies. The total population and elderly population will grow by 103% and 161% between 2015 and 2030, respectively. In 2014, 48% of RNs in New Mexico were older than age 50,[18] meaning that almost half of New Mexico's nurses are within 15 years of retirement. Meanwhile, New Mexico produces approximately 1000 RNs annually, which is grossly inadequate to meet the rising demands. Consequently, New Mexico is receiving a grade of C− by 2015 (ranking no. 43) and, ultimately, will have the worst nursing ratio (ranking no. 50) by 2030. Arizona and California will face significant growth in their total population during the next 15 years (142% for Arizona and 116% for California), which is a significant factor contributing to the severe RN shortage ratio in these states. It was reported that between 2002 and 2012, the supplies of RNs in Arizona and California have increased by 166%[19] and

Table 3. Total Population and Elderly Population in 4 Regions in 2015 and 2030.

	Total Population			Elderly Population			
Region	In 2015	In 2030	Change in Percentage	In 2015	In 2030	% of Elderly Population in 2015	% of Elderly Population in 2030
Northeast	56 565 669	57 671 068	1.95%	8 836 598	12 171 269	15.62%	21.10%
Midwest	68 569 609	70 497 298	2.81%	9 957 062	13 858 370	14.52%	19.66%
South	117 697 516	140 463 389	19.34%	17 119 221	27 738 407	14.55%	19.75%
West	76 790 301	92 146 732	20.00%	10 423 275	17 097 983	13.57%	18.56%

192%,[20] respectively; however, the number of RNs produced each year are not quite adequate to match the increase in demand. Thus, continual efforts to increase the pipeline of RNs in these states are paramount.

South Dakota is the only state receiving an A grade in 2030, because of its long term-efforts to expand its supply of RNs. As early as 2002, the South Dakota legislature passed 3 critical bills: one bill funded a permanent nursing workforce center to study the state dynamics of the nursing workforce, the second bill expanded enrollment in state universities and colleges, and the third bill was designed to provide funds to reward nurses who practiced in South Dakota facilities for 2 years following graduation.[21] The results of these efforts have been most gratifying. The RN supply increased from 13 803 in 2005 to 21650 in 2016, a 57% increase.[22]

This study is a revisit of the previous article published in 2012.[7] In 2030, the projected number of RN shortage was adjusted from 918 232 to 510 394 (Table 2), a decrease of approximately 400 000. One key difference between the 2 studies is that the current forecast has a lower demand and a higher supply. The present study differs in terms of demand because of the updated PHE values and a lower slope or correlation value. The current demand forecast is based on the 2010 PHE values instead of the 1998 PHE values as was done previously. Although health care spending always continues to grow, the 2010 PHE is likely lower than projected as a consequence of the slow in growth of PHE (partly affected by the great recession of 2008) that began in 2002 and persisted until 2009.[23] A lower than expected PHE would yield a lower than expected demand. In terms of the linear slope used in the demand model, the value has been updated from 2.69×10^{-6} to 1.30×10^{-6}. This is a more than 2-fold difference and lowers demand for RNs.

As already mentioned, the study team's prior projections did not account for an unexpected, large inflow of RNs into the workforce. First, the effects of the recession brought an increase in the supply of RNs as many who left the workforce returned because of financial stress.[21] It has been reported in recent years that there has been a trend of a growing number of RNs who enter into the RN workforce in their late 20s and early 30s as a second career choice.[5] In addition, the entry-level baccalaureate nursing programs increased for over 12 consecutive years, starting in 2001.[24] As more students enter into nursing programs, more RNs with a 4-year baccalaureate degree will enter into the workforce. This also implies that a greater number of younger nurses will be injected into the RN supply, lowering the average age of RNs and delaying the aging of the labor force (Figure 2).

There are several limitations and assumptions. In the demand model, one significant assumption is using the 2015 national mean as the starting point. This essentially states that the nation reported no shortage in 2015. In addition, the national slope was used in converting change in PHE to RN jobs to avoid state variations in RN workforce responsiveness to health expenditures. Further analysis indicated that change in PHE translates to a larger change in RN demand in some states than represented by the national slope.[7] The responsiveness of RN jobs to PHE also may vary depending on the work setting for RNs.

The primary assumption in the supply model is that the average likelihood or propensity of an individual to choose to be an RN at a certain age is the same across every state and will be the same in the coming years. This does not address the individual states' differences in ability to recruit young people into nursing as a profession and each state's difference in the capacity of its nursing schools and in the number of its nursing faculty.[17] Moreover, the study team used an average propensity value over the past 10 years. This does not account for the increasing enrollment rates into nursing schools. If enrollment continues to increase as it has for the past decade, the RN propensity value for those between ages 21 and 34 will be an underestimation. Another limitation that may underestimate the RN supply is the exclusion of future arrivals of foreign-born nurses. Other models also incorporated age and population change into their projections. The Health Resources and Services Administration (HRSA) used microsimulation to integrate more predictive variables into their demand and supply models.[8] Carnevale et al from Georgetown University used similar demand and supply models to those of HRSA with different data sources.[25] The model developed by Auerbach et al[26] used their own RN supply model and the projected demand from HRSA to project RN shortage.[27] These

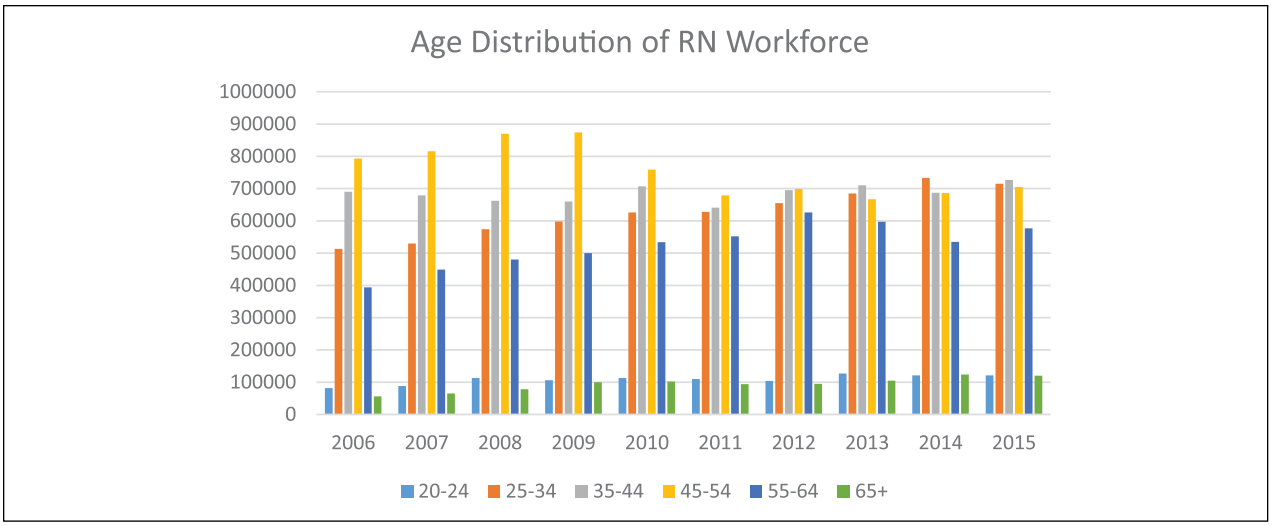

Figure 2. Age distribution of registered nurse workforce between 2006 and 2015.
RN, registered nurse.

studies show that although the RN supply has increased rapidly in recent years, in part because of the effects of the recession and rising enrollment in nursing schools, the benefits of this may not be enough to outweigh RN demand in the future. HRSA projects that there will be a surplus of 340 000 RNs in 2025.[8] Carnevale et al projected there to be a shortfall of nurses: 193 000 RNs by 2020.[25] Auerbach et al[27] projected a shortage of 128 000 RNs by 2025. In comparison, the present study shows that there will be a shortage of 154 018 RNs by 2020, 336 336 RNs by 2025, and 510 394 RNs by 2030. All of these studies project that there will be a shortage, but the shortage is much smaller compared with those in previous publications.[8,27]

As already stated, there has been an overall growth in the supply of the RN workforce within the last 15 years, which has resulted in a lessening of the RN shortage.[8,24] The study team applauds the significant efforts of the health care industry and nursing school faculties and administrations for improving the pipeline of students enrolling in nursing programs, and predicts that this trend may continue for some time. Nevertheless, a number of factors remain that may significantly affect the supply of the RN workforce in the future. Because the Trump administration is trying to rein in the national debt by trimming all non–defense-related items in the national budget, the health care budget may be restricted.[28] Moreover, the national unemployment rate is currently at 4.5% and continues to decrease; many competing industries are looking for capable young people to enter into their respective industries, and the recent surge of RNs may also make it more difficult for younger RNs to find jobs.[27,29,30] In addition, as health care-related technology continues to evolve, there may be improved efficiency in distributing and performing nursing responsibilities; thus, this may reduce the future RN demand.[31,32] Regardless, continued and strengthened efforts to address these issues regarding the RN workforce will mitigate any potential shortage in the future.[23]

Conclusion

This study projects that there will be an estimated shortage of a half million RN jobs in the United States by 2030—a reduction of nearly 50% when compared with the previous publication—which can be attributed primarily to the increase in the supply of the RN workforce. Although the study team hopes these positive trends will continue, there are growing concerns that as the labor market tightens, there may not be a sufficient number of young people who will be able to meet the demands in health care. It is important for stakeholders and health care administrators to continue to monitor the dynamics of the nursing workforce in the next 10 to 15 years and to produce adequate numbers of practitioners to meet the growing demands of health care.

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Declaration of Conflicting Interests

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