Will the RN Workforce Weather the Retirement of the Baby Boomers?

David I. Auerbach, PhD, Peter I. Buerhaus, PhD, RN, FAAN,† and Douglas O. Staiger, PhD‡§*

Importance: After forecasts made more than a decade ago suggested dire nursing shortages, enrollment in nursing schools doubled. The implications of this unprecedented change for the nursing workforce have not yet been fully explored.

Objective: To forecast the size and age distribution of the nursing workforce to the year 2030 and to compare to demand recently projected by the Health Resources and Services Agency.

Design: A retrospective cohort analysis of employment trends by birth year and age were used to project age and employment of registered nurses (RNs) through 2030.

Setting: Data on employed RNs from the United States Bureau of the Census Current Population Survey (1979–2000, N = 72,222) and American Community Survey (2001–2013, N = 342,712).

Participants: RNs between the ages of 23 and 69 years.

Main Outcome Measure: Annual full-time equivalent (FTE) employment of RNs in total and by single year of age.

Results: Annual retirements from the nursing workforce will accelerate from 20,000 a decade ago to near 80,000 in the next decade as baby boomer RNs continue to age. We project that this outflow will be more than offset by continued strong entry of new RNs into the workforce. Overall, we project that the registered nursing workforce will increase from roughly 2.7 million FTE RNs in 2013 to 3.3 million in 2030. We also find that the workforce will reach its peak average age in 2015 at 44.4. This increase in workforce size, which was not expected in forecasts made a decade ago, is contingent on new entry into nursing continuing at its current rate. Even then, supply would still fall short of demand as recently projected by the Health Resources and Services Agency in the year 2025 by 128,000 RNs (4%).

Conclusions: The unexpected surge of entry of new RNs into the workforce will lead to continued net growth of the nursing workforce, both in absolute FTE and FTE per capita. While this growth may not be sufficient to meet demand, such projections are uncertain in the face of a rapidly evolving health care delivery system.

Key Words: nursing, workforce, supply and demand, shortage

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Over a decade ago, forecasters predicted shortages exceeding 500,000 registered nurses (RNs) beginning in the middle of the current decade, as baby boomer RNs would begin to retire and be replaced by smaller cohorts of RNs who had entered the workforce following them.[1,2] However, in an unexpected development, nursing school graduates doubled during the 2000s, spurred by 2 economic recessions and national initiatives promoting nursing as a career.[3] Combined with baby boomer RNs continuing to work into their late 50s and 60s,[4] today's workforce numbers 2.7 million full-time equivalent (FTE) RNs, an increase of 40% since 2000.

Despite these gains, the RN workforce is at an important cusp—the implementation of health reform is adding new nursing roles and responsibilities affecting how nurses work with physicians to assure quality and access to care. At the same time, almost 40% of RNs are over age 50. Although many are retiring later than expected, nearly all of the baby boomer RNs will retire by 2030. The Health Resources and Services Administration (HRSA) recently forecast robust growth in RN demand over the next 10 years.[5] Yet even with the new growth in nursing school graduates, it is unclear whether there will be enough RNs to replace the baby boomer RNs rapidly enough to meet future demand.

Other recent supply forecasters have come to different conclusions. HRSA also projected the supply of RNs along with its demand estimate using an updated version of its nursing supply model. The model uses an input-output approach that begins with a workforce snapshot in the most recent year available and then forecasts the workforce in future years by successively adding cohorts of new graduates and removing those expected to retire or reduce their work output. They estimate a number of scenarios, but their baseline forecasts yields a surplus of 300,000 RNs by 2025. Another recent paper by Juraschek et al[6] forecasts RN supply by using 10 years of CPS data (2000–2009) to estimate the

From the *External Adjunct Faculty, Vanderbilt University Medical Center, Newton MA; †Department of Health Policy, Institute for Medicine and Public Health, Vanderbilt University Medical Center, Nashville, TN; ‡Department of Economics, Dartmouth College, Hanover, NH; and §National Bureau of Economic Research, Cambridge, MA.

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Reprints: David I. Auerbach, PhD, External Adjunct Faculty, Vanderbilt University Medical Center, 200 Church St #3, Newton, MA 02458. E-mail: davea@alum.mit.edu.

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likelihood of individuals to work as an RN in each state among 10-year age groups (eg, age 30–39)—and assumes those rates will hold constant into the future. The authors forecast national shortages on the order of 800,000 RNs by 2030. A third group at the Georgetown Center on Education and the Workforce recently forecast nursing supply through the year 2020 using a model similar in nature to that of HRSA, but it is unclear whether their estimate represents a shortage or a surplus and their methodology is not described in detail.[7]

We use a workforce model that we developed and have modified over the past 15 years to assess whether future supply will meet projected demand.[1,8,9] The model derives from the field of labor economics where similar models have been used extensively in the past to describe various employment outcomes such as changes in earnings over time.[10] It uses multiple years of data (35 y in our application) to separate the effects of age and year of birth in describing observed trends in the size of the nursing workforce. This is a critical feature of the model given the dramatic dynamics that have driven changes in the nursing workforce over the past several decades, and sets it apart from those discussed above. For example, in 2013, there were similar numbers of RNs in their 20s as there were in 1983, but nearly 7 times as many RNs in their 60s. A naive model might conclude that the difference is due to RNs being more likely to work when they are older, but the majority of the differences is, in fact, driven by the aging of the large baby boomer cohorts that entered nursing at unprecedented rates beginning in the late 1970s.

We use HRSA's estimate of demand as our benchmark for comparison with our supply forecast.[5] Although Juraschek and colleagues have estimated demand for RNs, HRSA's demand model is much more thoroughly laid out, developed, and justified.

Just as earlier forecasts of shortages likely contributed to the doubling of nursing school enrollments over the last decade, our updated supply projections send important signals to stakeholders including policymakers, health care delivery organizations, the nurse staffing industry, nursing education programs, and students making career choices.

METHODS

We project the future supply of RNs using a workforce model that decomposes the proportion of each birth cohort (defined by birth year) working as RNs in each year into the product of 2 components: (1) a cohort effect that estimates the propensity of individuals born in any given year to work as an RN (which captures, for example, changes across birth cohorts in the perceived attractiveness of a nursing career relative to other occupations); and (2) an age effect that captures the propensity of RNs to be working at different ages (which captures, for example, life-cycle patterns such as retirement and the tendency of RNs to work less during their childbearing years).

Intuitively, with respect to the age effects, the model seeks to estimate the production of RNs from a given cohort of birth as the cohort ages—for example, for all people born in 1950, how many FTE RNs do we observe in 1975 (when they are 25 y old) and in 2000 (when they are 50 y old)? These patterns naturally incorporate factors such as RNs leaving to work part-time in their 30s to care for children (which would manifest as fewer FTE RNs for a given cohort when they are in their 30s compared with when they are in their 50s), or an inflow of internationally educated RNs (which would manifest as an increase in the number of RNs at the ages at which such RNs tend to enter into practice in the United States). Because of how critical these factors are to the model, we examine the stability of the age patterns routinely and make adjustments where necessary. For example, in the 1990s, RNs began entering nursing school later than had their predecessors. We described this phenomenon and adjusted the model accordingly to capture this effect (reflected in the different age curve in the Appendix Figure, Supplemental Digital Content 1, http://links.lww.com/MLR/B9).[9] Similarly, when we observed RNs retiring later, this implied that the number of 65-year-old RNs from a given birth cohort would not be as small a fraction of the number of 55-year-old RNs observed working 10 years earlier from that same cohort. Fewer would have retired. Again, we described the phenomenon and added an interaction term to the model to capture the effect.[4]

In contrast, the cohort effects are more straightforward to describe. While the age effects describe the FTE RN production of the 1950 cohort at age 50 versus at age 25, the cohort effects describe the FTE RN production of the 1975 cohort at age 50 versus the 1950 cohort at age 50 (or any given age). Factors such as alternative career opportunities for women or economic conditions at the time career decisions are made are incorporated into the cohort effects. Thus, in contrast to some other models, all factors influencing cohort and age effects are subsumed naturally and assumed to be permanent features of that cohort. If declines in manufacturing jobs and expanded opportunities for nurses due to the ACA leads more women born in the 1990s to become RNs, we implicitly assume that those cohorts will be permanently larger than other cohorts, having invested significant resources in a nursing career. Because the future workforce is more and more strongly affected by what is happening with the newest cohorts as time goes on (because the older ones retire), then trends that are captured in newer cohorts will become more prominent in our forecast in the more distant years—a desirable feature.

In prior work, this model has accurately predicted the number and age distribution of FTE RNs both in sample and in out-of-sample forecasts.[1] For example, using data through 1988, the model predicted 43% total workforce growth by 1998, near the 35% growth that occurred. The model also successfully captured a dramatic aging dynamic of the workforce—predicting that the percentage of the workforce that was under age 40 would drop from 59% in 1988 to 38% in 1998 (the actual percentage in 1998 was 42%).

Data

Data on RN employment from 1979 to 2013 were obtained from the United States Bureau of the Census Current Population Survey (CPS) and American Community

Survey (ACS). The CPS is a household-based, nationally representative survey of over 100,000 individuals administered monthly by the Bureau of the Census.[11] The CPS has asked detailed questions about employment (including occupation and hours worked) in a consistent manner since 1979 and is used extensively by the Department of Labor to estimate current trends in unemployment, employment, and earnings. We have used the CPS data in our prior work to estimate employment trends for RNs and project the age and supply of RNs and of physicians.[12]

The ACS, which began reporting data in 2001, is modeled after the long form of the decennial census and although it contains fewer questions than the CPS, it obtains a much larger sample size.[13] While the CPS surveys roughly 3000–4000 RNs per year, the ACS surveyed approximately 12,000 RNs in each year from 2001 to 2004, and >30,000 RNs in each year starting in 2005 (when the sample was enlarged). Because these larger sample sizes allow for recent workforce trends to be analyzed with greater accuracy, we use ACS data rather than CPS data beginning in 2001. The occupation and employment questions in the ACS are similar to the CPS and generate similar estimates of total RN employment for overlapping years. HRSA has also begun using the ACS in its estimates of nursing supply and demand.

We analyzed all individuals aged 23–69 who reported being employed as an RN during the week of the survey between 1973 and 2013 (N = 72,222 in the CPS, N = 342,712 in the ACS). For consistency with prior work, we assigned RNs reporting fewer than 30 hours worked in a typical week as a 0.5 FTE. In a sensitivity analysis, we separately analyzed RNs with and without an advanced degree (a Master's or doctorate) as a proxy for Advanced-Practice RNs (APRN) status. Such RNs were defined as those with fewer than 18 years of schooling before 1992; until 1992, educational attainment was specified in the CPS by years of education rather than degree types. To make estimates representative of the US noninstitutionalized population, observations were weighted by sampling weights provided by the CPS and ACS.

Additional data on the US population by year and age between 1979 and 2013 were obtained from the US Bureau of the Census. Forecasts of the US population by age through 2030 were obtained from the "middle series" projections prepared by the US Bureau of the Census.

Statistical Analysis

Statistical Model

Details of our projection model are described elsewhere.[1,14] Briefly, the model predicts the proportion of the population in a given birth cohort that are working as RNs at each age as the product of the cohort effect (defined by birth year) and age effects. On the basis of evidence from prior work, we allow for different age effects below age 30 for cohorts born after 1964 to capture a secular shift toward older entry into nursing school, and we allow for different age effects above age 50 for cohorts born after 1940 to capture a secular shift toward delayed retirement.

Estimation

We estimated our model in log form, using ANOVA to estimate the age and cohort effects. The dependent variable in the model was the logarithm of the number of FTE RNs of every age between 23 and 69 for every year between 1979 and 2013 (47 y of age times 35 y equals 1645 total observations) divided by the total US population in that given year-age cell. The ANOVA model estimated main effects for cohort (birth year) and age, as well as interaction effects that allowed for (1) a different set of age effects below age 30 for cohorts born after 1964 and (2) a different set of age effects above age 50 for cohorts born after 1940 as described above. The predictions from this model were exponentiated and multiplied by the US population in that cohort-age cell to yield predictions of the number of FTE RNs. All statistical analyses were performed using Stata 13.1.

We used these estimates to predict net "entry" and "exit," which illustrate changes in workforce dynamics as larger cohorts enter and exit, and allow for more facile comparisons with other models that rely on estimates of entry and exit more explicitly. To estimate net entry, we compare the number of FTE RNs between the ages of 23 and 49 in 1 year (year 1) with the number between the ages of 23 and 50 in the next year (year 2). This measure combines 2 concepts: (1) the number of new 23-year-olds in year 2 and (2) any changes between year 1 and year 2 among the cohort of 23- to 49-year-olds in year 1, who are 24–50 in year 2 (eg, new waves of RN graduates in their 20s or 30s, or return to work among existing RNs). Exit is defined similarly as the number of RNs of age 51–69 in year 2 minus the number aged 50–69 in year 1.

Projections

Estimates of age and cohort effects were used to project the numbers of FTE RNs through the year 2030. We assumed that age effects in future years and for future cohorts will be the same as those estimated for the cohorts born after 1964. For cohorts that have already entered the labor market (age 23 or older in 2013, born 1990 or before) we used these age effects in combination with the estimated cohort effect for each birth year to project the FTE RNs supplied by each cohort as they grow older. For cohorts that will enter the workforce in the future (born after 1990) we assumed that their cohort effect will equal the average of the 5 most recent cohorts observed (the 1986 through 1990 birth cohorts, who were observed at age 23 in 2009–2013). In other words, we assume that the propensity of future cohorts to enter nursing will be similar to the most recently observed cohorts.

RESULTS

Figure 1 plots the cohort effects from our model (age effects are provided in the Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/B9), which are estimates of the relative propensity of individuals born in any given year to work as RNs (reported as a percentage relative to the cohort born in 1955). After peaking for the cohort born in 1955 (who were age 58 in 2013) the propensity to work as

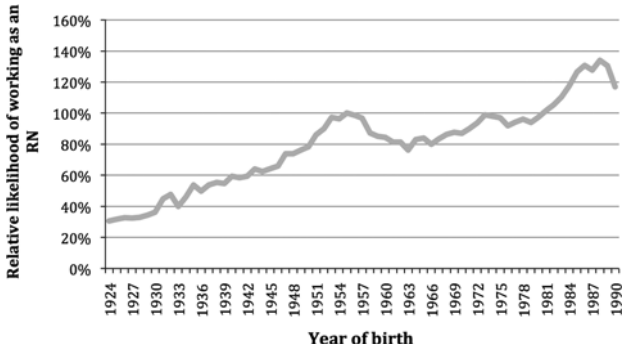

FIGURE 1. Propensity of people born in a given year to become a registered nurse (RN), relative to those born in 1955 (1955 = 100%), 1924–1990. *Source*: Authors' modeled estimates based on Current Population Survey and American Community Survey.

RNs fell roughly 20% and did not fully recover for >20 years. This decline in the propensity of cohorts born in the 1960s and 1970s to work as RNs was the key factor leading to earlier projections of severe nursing shortages. However, beginning with cohorts born around 1980, there was a sharp increase in the propensity to work as an RN, and now the most recent cohorts are >30% more likely to work as RNs than the previous peak cohort born in 1955. The relatively high propensity of recent cohorts to work as RNs in their 20s implies that these cohorts will provide large numbers of working RNs for years to come.

The model's ability to predict the number of FTE RNs for each cohort at each age was good, with an overall R^2 of 0.91. The fit is apparent in Figure 2, which plots the average predicted and actual number of FTE RNs for selected 5-year birth cohorts, where each point represents an average over 5 single birth-year cohorts (eg, "1980" indicates people born between 1980 and 1984). The solid lines plot the average number of RN FTEs supplied by each 5-year birth cohort at each age and the dashed lines plot the predicted number. The predictions for each cohort trace out the life-cycle pattern implied by the age effects, whereas those cohorts with larger cohort effects in Figure 1 (eg, 1980–1984) are predicted to provide more RN FTEs at every age. The actual number of RN FTEs supplied by each of these cohorts at each age is quite close to the predictions of the model, suggesting that the model will be a good guide to the number of RN FTEs these cohorts will provide at older ages in the future.

Figure 3 shows the size of the actual RN FTE workforce from 1979 to 2013 along with our forecast from 2014 to 2030, and Table 1 provides additional details. The nursing workforce grew steadily from 1979 to the early 2000s and then more rapidly from 2004 to 2013 (by 31%) due to the large influx of new graduates occurring as the majority of baby boomer RNs continued working steadily into their 50s and 60s. For the next 12 years (2013–2025), although the workforce is projected to increase significantly (15%), the rate of growth will be slowed by the retiring baby boomers.

Figure 4 plots our model's estimates of the annual net entry and net exit from the workforce between 1981 and 2030, where 2014–2030 are based on the model's forecast. The number of RNs over the age of 50 exiting the workforce each year grew slowly from 10,000 to 30,000 between 1981 and the mid-2000s. Starting around 2010, as the leading edge of the baby boomers begin to retire, exits accelerated and are expected to approach 80,000 by 2020 and level off thereafter. While we forecast continued growth in workforce entry over this period, exits grow faster than entry (ie, the difference between the red and green bars shrinks after 2010) and thus the workforce is projected to grow more slowly in the next decade.

Table 1 provides additional details of our RN forecast, along with a comparison with the demand for RNs projected by HRSA for the year 2025.[5] In addition to steady overall workforce growth in absolute terms, we project that the rate of growth of the RN workforce will exceed the population growth rate such that the number of FTE RNs per capita will increase by 2% from 2013 to 2020 and by 9% from 2013 to 2030, reaching 942 FTE RNs per 100,000 US residents compared with 868 in 2013. The faster rate of growth in the 2020s occurs because the number of retiring baby boomer RNs levels off and declines, whereas the large cohorts of RNs entering today reach their peak labor force productive years as they age into their 40s and 50s. HRSA estimates that the demand for RNs will grow 19% between 2013 and 2025. Compared with our projection of 15% supply growth in these years, we forecast a deficit of roughly 128,000 FTE RNs in 2025 (or 3.9% of the workforce).

We also investigated supply growth of RNs with and without advanced degrees as a proxy for APRNs, who are not identifiable in our data until 2010. Most APRNs play somewhat different roles in the health care system than other RNs, and there is some concern that increasing proportions of RNs entering advanced practice could worsen shortages of staff-level nurses. We forecast supply growth for advanced-degree RNs to be 27% between 2013 and 2030, exceeding the 23% growth of all RNs over this period. This difference is relatively small; given that APRNs represent roughly 10% of all RNs, our overall assessment of the supply and demand balance of RNs does not change markedly when APRNs are excluded from the analysis. However, if RNs continue to obtain advanced education at increasing rates relative to today, this trend would become more important to consider in our forecasts.

Finally, not apparent in the data in Table 1 and Figure 3 is the underlying age dynamics captured in the projection model. We find that the nursing workforce will reach its peak average age in 2015, at 44.4 (the average age was 37.9 in 1985). As more of the baby boomer RNs retire and more new graduates continue to enter the workforce, the average age will shift slightly back to younger ages—to 43.9 in 2030.

DISCUSSION

We project that the size of the nursing workforce will continue to increase over the next 2 decades, both in absolute and per-capita terms, despite the retirement of roughly 1 million baby boomer RNs. In forecasts made a decade ago,

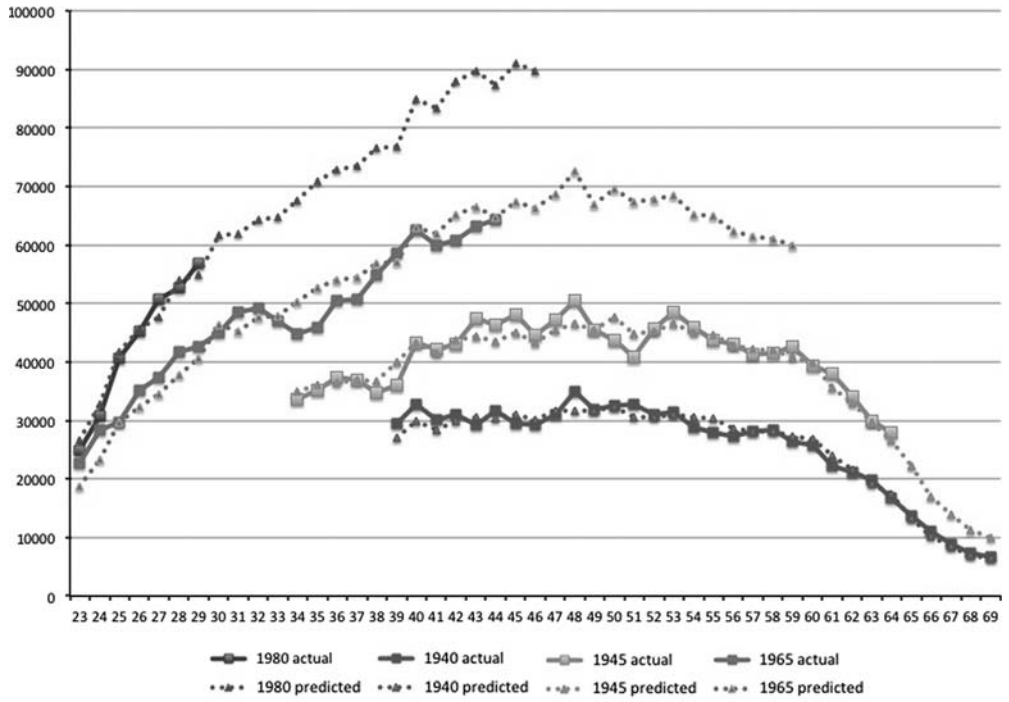

FIGURE 2. Number of actual and predicted FTE RNs for selected 5-year cohorts. Solid lines and square markers represent the average number of FTE RNs accounted for by the 5 birth cohorts beginning with the birth year shown in the legend (eg, 1940 = people born between 1940 and 1944) and the age shown on the *x*-axis. *Source*: Authors' modeled estimates based on Current Population Survey and American Community Survey. FTE indicates full-time equivalent; RNs, registered nurses.

the workforce was not expected to grow quickly enough to replace the retiring boomers but would, instead, peak at roughly 2.1 million RNs by 2013, and begin shrinking in absolute size toward the end of this decade, leaving nursing shortages approaching 30% by 2025.[1] By comparison, our forecast of continued workforce growth beyond 3 million RNs represents a remarkable turnaround. Yet it is unclear whether even this degree of workforce growth will be sufficient to meet demand—our estimate of future RN supply falls slightly below HRSA's recent estimate of RN demand.

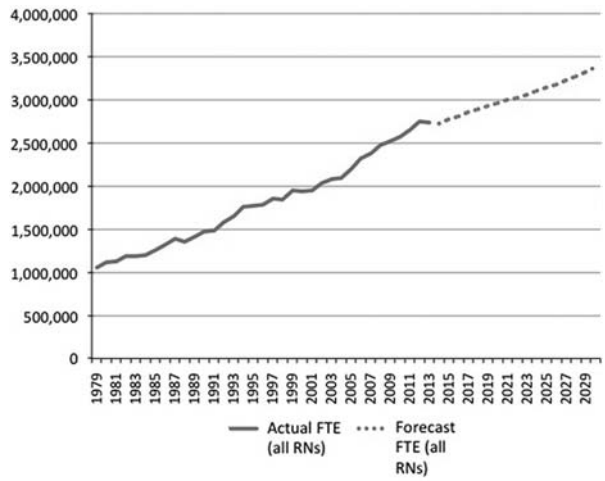

FIGURE 3. Total full-time equivalent registered nurses, actual and forecast, 1979–2030. *Source*: Authors' modeled estimates based on Current Population Survey and American Community Survey. FTE indicates full-time equivalent; RNs, registered nurses.

Assessing the supply and demand of the future RN workforce is complicated by a number of uncertainties. On the supply side, while the retirement of baby boomer RNs is assured, the number of RNs that will enter the workforce over the next 2 decades (and to a lesser extent, their work activity after becoming an RN) is not. We assume that future population cohorts will produce RNs that will enter the workforce at roughly the same population-adjusted rates as those who entered in the previous 5 years. This assumption is bolstered by observations of recent trends in first-time test-takers of the NCLEX, the examination required for licensure as an RN and an early if imperfect indicator of future workforce entry. According to the National Council of State Boards of Nursing, the number of first-time test-takers was increasing by roughly 8% annually in the mid-2000s, but has slowed to around 3% annually over the past several years.

Additional uncertainty arises when considering that 2 recent projections of the nursing workforce indicate significant shortages developing over the next 15 years. One study projected a shortage of RNs and licensed practical nurses of 200,000 by 2020,[7] and the other projected substantial shortages in all but a handful of states by 2030.[6]

In contrast, HRSA's 2014 projection found a surplus of RNs by 2025. The key difference between our projections and HRSA's lies in how each model projects net entry into

TABLE 1. Characteristics of the Projected Registered Nurse Workforce, 2013–2030

	FTE RN Supply		FTE RN Demand*	Deficit (Demand – Supply)	
Year	**No. FTE**	**FTE per 100,000 US Residents**	**No. FTE**	**No. FTE**	**%**
2013, Actual	2,740,000	868	2,740,000*	—	0
2020, Projected	2,958,000	885			
2025, Projected	3,139,000	906	3,267,000	128,000	3.9
2030, Projected	3,377,000	942			
Growth, 2013–2020 (%)	8	2			
Growth, 2013–2025 (%)	15	4	19		
Growth, 2013–2030 (%)	23	9			

*Demand is estimated based on projections from HRSA (2014). HRSA provided a demand estimate for the year 2025 only, assuming supply and demand were equal in 2012. We make that same assumption in 2013, the first year of our data, and adjust HRSA's estimate slightly to apply to our span of 2013–2025, rather than their span of 2012–2025.

FTE indicates full-time equivalent; HRSA, Health Resources and Services Administration; RNs, registered nurses.

the workforce. While HRSA's supply model also assumes that future rates of workforce entry will resemble recent rates, the model approximates the number of entering RNs with the number of domestic first-time NCLEX test-takers in the same year, which have averaged roughly 150,000 in the past several years. In contrast, our approach is based on the number of observed FTE RNs who are employed in nursing relative to past cohorts, and projects much more modest entry of roughly 100,000–120,000 per year (Fig. 3). One way to evaluate which of these 2 assumptions about workforce entry is more plausible is to compare how each would have estimated growth in the workforce in recent years. Over the 6 years between 2007 and 2013, nearly 270,000 RNs retired while the workforce grew by a net 350,000 RNs, implying entry of approximately 620,000 RNs. Over these same years, there were approximately 850,000 US first-time NCLEX test-takers, while our model estimates net entry of 580,000—more in line with the actual entry of 620,000. The gap between first-time NCLEX test-takers and actual entry is likely due to a sizeable number of younger RNs not working on a full-time basis. According to data from the 2008 National Sample Survey of Registered Nurses, 24% of licensed RNs aged 35–39 were working part-time and 9% were not working in nursing.[15]

Beyond these projection uncertainties is the question of whether RNs will be prepared with the type of education and skills that are needed for a reformed delivery system characterized by care coordination, teamwork, and both a patient-centered and population-focused approach to care. Supported by studies showing better outcomes when hospitals use a higher proportion of RNs educated with a bachelors degree, the Institute of Medicine recommended that 80% of the RN

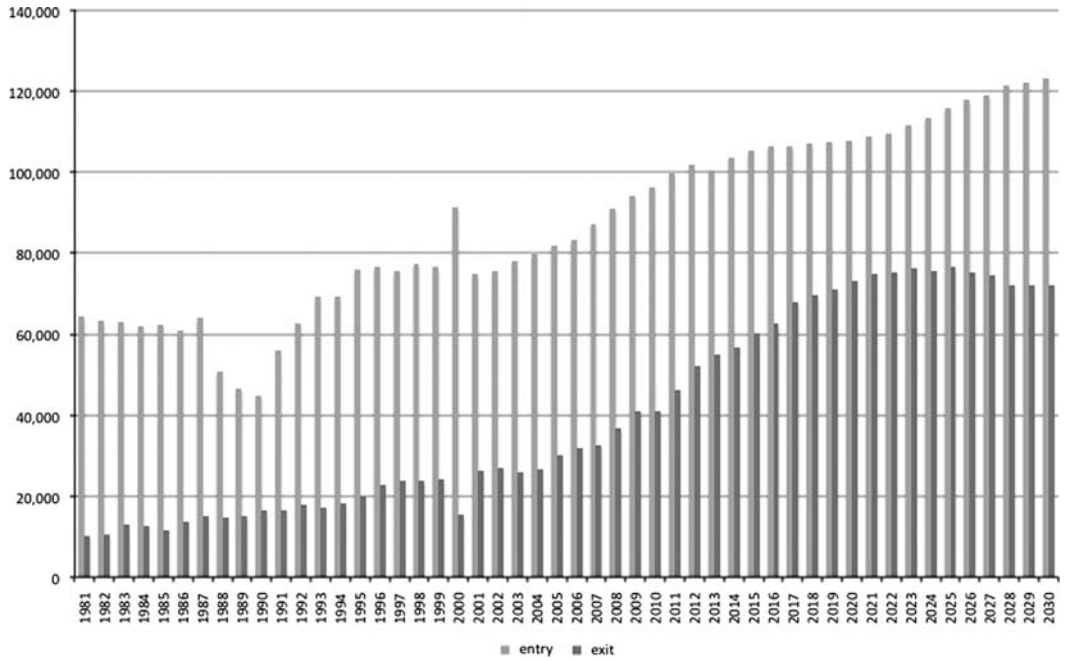

FIGURE 4. Registered nurse workforce net entry and exit, 1981–2030. The green bars represent the number of FTE RNs aged 23–50 in the year shown minus those aged 23–49 in the previous year. The red bars represent the number of FTE RNs aged 50–69 in the previous year minus those aged 51–69 in the year shown. *Source*: Authors' modeled estimates based on Current Population Survey and American Community Survey. FTE indicates full-time equivalent; RNs, registered nurses.

workforce be composed of nurses with such education—though only about 50% of RNs had a baccalaureate degree at the time the report was issued in 2010.[16] Consistent with this recommendation, we have found that hospitals have shown a preference for hiring RNs with a bachelor's degree.[17] We do not seek to forecast the number of RNs by degree type because of the relative ease by which RNs are able to enter RN-to-BSN programs, but this is an important consideration affecting the skill-mix of the RN workforce.

Despite the impending retirement of >1 million baby boomer RNs, we project that the nursing workforce will continue to grow over the next 2 decades. This growth represents a dramatic turnaround from forecasts made in the early 2000s and is attributable to the increase in the proportion of recent cohorts working as RN as reflected by the doubling in nursing school graduates over the last decade. Assuming this entry continues at recent rates, we project the workforce will still grow, both in absolute and per-capita terms. This growth would not quite keep pace with demand if HRSA's recent demand estimates prove accurate. Nevertheless, given the uncertainties surrounding workforce forecasts, our results suggest that the future nurse workforce will be much closer to meeting requirements than previously thought, as long as entry into nursing remains robust.

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