# South Carolina Nurse Supply and Demand Models 2008 – 2028 Technical Report

## Overview

This document provides detailed information on the projection models used to estimate the supply of and demand for Registered Nurses (RNs) in South Carolina from 2008 to 2028 by the Office of Healthcare Workforce Analysis and Planning. The methodology and assumptions used in the projection models are reviewed, as well as the resulting estimates.

The goals of this study were:

- to estimate the number of RNs available to and active in the South Carolina workforce in future years
- to better understand the relative impact of factors affecting the number of RNs holding an active license to practice in the state
- to estimate the demand for RNs in South Carolina in future years
- to estimate the balance of RN supply and demand for RNs in future years
- to create a tool that can help guide policy planning around the RN workforce in South Carolina.

## The Nurse Supply Model

### Methodology

Our model is based on a 'stock and flow' methodology which captures the dynamics affecting a particular population. In this case, the stock is the population of RNs with an active license to practice in South Carolina in any given year. The 'flows' are the factors that add to or subtract from that stock each year. In addition, the population of licensed RNs ages each year, moving individuals through time. Each of the flow elements in the model are measured by age, since workforce dynamics are very age sensitive.

Our RN supply model starts with the number of RNs with an active license to practice in 2008. During that year the model incorporates new graduates who become licensed, plus the number of experienced RNs moving into South Carolina from other states and countries, plus the number of RNs who reactivate a license to practice that has been allowed to lapse in the past. Subtracted from the pool of licensed RNs are those who allow their license to lapse for any reason. The resulting year-end estimate then becomes the beginning value for the following year's projection.

The model also estimates the number of RNs likely to be actively employed in nursing positions by age based on age-specific work behavior reported by RNs in our baseline year of 2008. The workforce estimates are further refined by applying age-specific measures of work effort (i.e. the number of hours worked each week) to create an estimate of RN full time equivalents (FTEs) in the workforce. A work week of 40 hours equals one FTE. See Figure 1 for a summary of the data elements in the model.
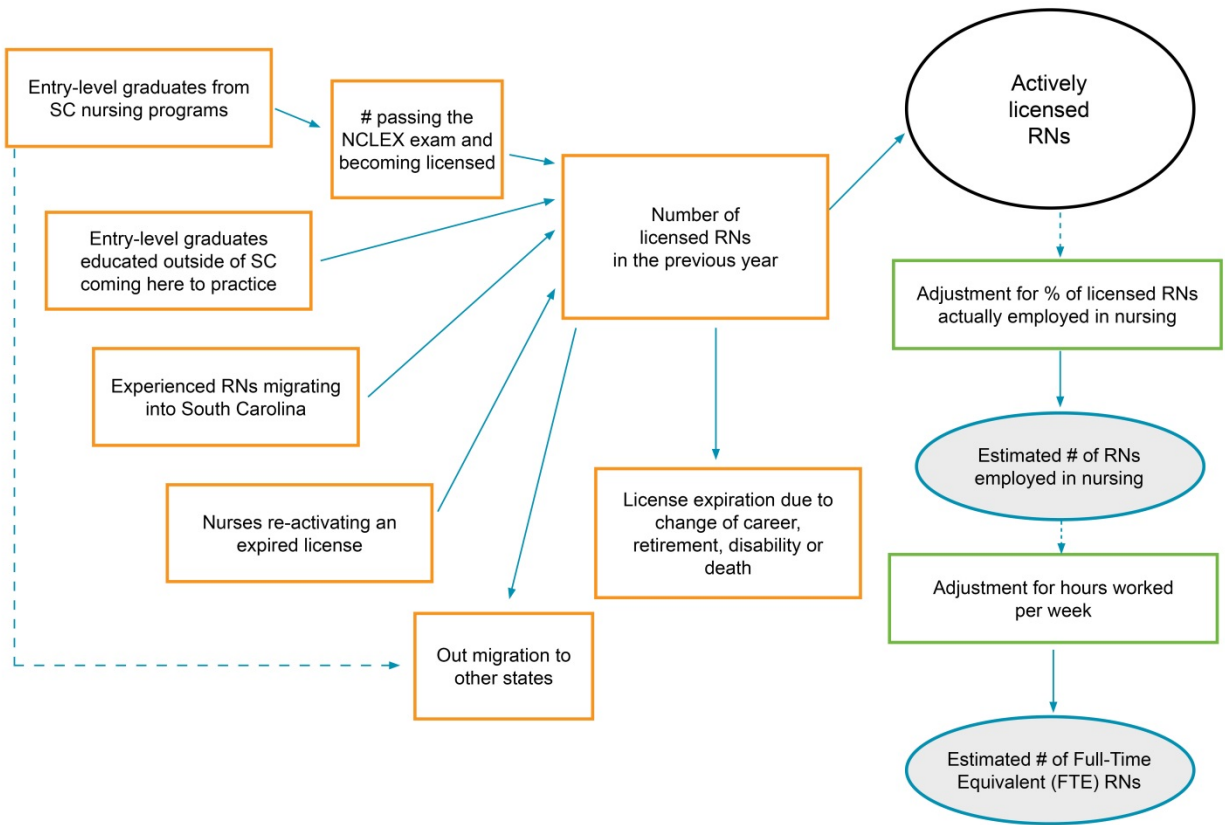


**Figure 1. Conceptual stock and flow model used to estimate the RN workforce in South Carolina**

## ACTIVELY LICENSED RNs IN SOUTH CAROLINA AT BASELINE

### Data sources:
Information about licensed RNs and RNs in the workforce used in our supply projection model comes from data supplied by RNs during the license application and/or renewal process. In South Carolina, RNs renew their license in the Spring of even-numbered years. We obtained the RN license data through the

South Carolina Office of Research and Statistics, Health and Demographic Section - the official repository for health professions information in the state. That database includes demographic information on each RN licensee such as birth year, race, gender, education level, and program location; as well as information about license status (active or not active), workforce status (employed full or part time as a nurse, employed in a non-nursing position, unemployed, or retired), and the number of hours worked each week as a nurse within the state of South Carolina. Our model includes all actively licensed RNs which includes advanced practice Registered Nurses (APRNs).

We chose 2008 as our baseline (starting) year, in part so that we could determine the short range accuracy of the estimates by seeing how our projection to 2010 matched the actual number of RNs licensed and in the workforce in that year. We also wanted to use an average of 2008 and 2010 values to estimate new graduate entry into the licensed pool in order to account for growth in our entry-level nursing programs over that period.

Birth year was used to calculate age in 2008 for each active licensee. In 2008 there were 44,981 actively licensed RNs in South Carolina. The number of RNs in this study was limited by age to include only those nurses between the ages of 20 and 75 under the assumption that RNs over the age of 75 would not be participating in the workforce. A total of 157 cases were removed from the analysis as they did not fall within the age limits, resulting in an analysis group of 44,824 at baseline. Tables 1 and 2 provide basic demographic and workforce status information about the supply of actively licensed RNs at baseline.

| Table 1.  Baseline age distribution of RNs | | |
|---|---|---|
| **Age Category** | **Actively Licensed RNs in 2008** | **Percent of All Licensed RNS** |
| **20 - 24** | 873 | 1.95% |
| **25 - 29** | 3,751 | 8.37% |
| **30 - 34** | 4,777 | 10.66% |
| **35 - 39** | 5,572 | 12.43% |
| **40 - 44** | 5,419 | 12.09% |
| **45 - 49** | 6,163 | 13.75% |
| **50 - 54** | 6,721 | 14.99% |
| **55 - 59** | 5,682 | 12.68% |
| **60 - 64** | 3,685 | 8.22% |
| **65 - 69** | 1,625 | 3.63% |
| **70 - 75** | 556 | 1.24% |
| **Total** | **44,824** | **100%** |

| Table 2.  Characteristics of actively licensed RNs in South Carolina: 2008 Baseline | |
|---|---|
| **RNs with active SC licenses age 20 - 75** | 44,824 |
| **Mean age in 2008** | 45.7 |
| **Percentage 55 years or older** | 25.8% |
| **Percent Female** | 97.1% |
| **RNs active in the nursing workforce** | 35,521 |
| **Total Full-Time Equivalent RNs in the workforce** | 32,608.2 |

## Measuring flows in and out of the RN supply

The model to project RN supply over time makes the following assumptions:

- the number of new graduates, in-migrants and license reactivators entering the nurse supply each year will remain constant from 2008 to 2028
- the age-specific rate of loss from the population of licensed RNs will remain constant each year from 2008 to 2028
- RNs likely to be actively employed as nurses in the workforce would include only those between the ages of 20 and 75

**New RN Graduates:**   The number of new graduates produced each year is an important 'flow' factor into the supply of licensed RNs each year.  We identified new graduates from the RN license files by the year of their graduation from an RN entry-level education program. Due to growth within nursing education programs in recent years, we counted the number of newly licensed RNs in the 2008 data file who had graduated in either 2006 or 2007 plus the number in the 2010 data file who had graduated in 2008, 2009 or 2010.  These new graduates totals were then divided by four (the number of years between 2006 and 2010) to estimate the number of new graduates becoming licensed in South Carolina in a single year.

New graduate figures were then disaggregated according to the state or country in which they were educated so that we could identify the number of new graduates coming from South Carolina nursing education programs.  From a policy perspective, this is an important matter. Any policy intervention to change the future supply of RNs in South Carolina by increasing the production of new graduates, or by expanding enrollments, or by increasing the number of nursing education programs in the state requires that we be able to distinguish between those educated in state and those educated elsewhere and their relative impact in the projection model.

The result of our new graduate analyses provided an estimate of 1560.75 new graduates expected to obtain an active license to practice in South Carolina each year. An additional 297.25 new graduates educated outside of the state are expected to obtain an active South Carolina license to practice each year.

**License Reactivators:**   Reactivators are defined in our model as RNs who had an active license to practice in 2006, did not hold an active license in South Carolina in 2008, but held an active license in the state again in 2010. Our estimates were calculated by dividing the total number of reactivators in half to get a single year estimate. These cases were then distributed by age to create age-specifc estimates of the number of RNs expected to reactivate a license in any given year. This annual estimate was confirmed by the South Carolina Board of Nursing as being in line with the annual number of applications they have received in recent years for reactivation. A total of 139.5  RNs are estimated to

reinstate their lapsed license each year. The age-specific number of reactivators was held constant throughout the study.

**RNs migrating into South Carolina:** In-migrants are defined as any RN receiving a new active license to practice in South Carolina who was not a new graduate or reactivating a prior license. We gathered information on the number of in-migrants entering the pool of licensed RNs from one license renewal period to the next - in this case between 2006 - 2008 and 2008 - 2010. To estimate the yearly increase of in-migrants to the nursing supply we summed the total number of in-migrants by age in 2008 and 2010 and averaged these totals. These totals were then divided by two to produce a single year estimate. The age-specific numbers of in-migrant RNs were held constant for each year of the study. In our baseline year 2008, RNs migrating into the state were the largest contributors to the RN supply. We estimate that 1913.25 RNs migrate into South Carolina each year, based on the activity seen between 2006 and 2010.

| Table 3. Factors affecting the supply of licensed RNs in South Carolina and annual estimates | | | |
|---|---|---|---|
|  | annualized average 2008 | annualized average 2010 | annual value used in supply forecast |
| **Gains to the RN supply:** | | | |
| New graduates total | 1,687.5 | 2,028.5 | 1,858 |
| Educated in South Carolina programs | 1,423 | 1,698.5 | 1,560.75 |
| Educated out of state or other countries | 264.5 | 330 | 297.25 |
| In-migrant RNs | 2,236.5 | 1,590 | 1,913.25 |
| License reactivators | not available | 139.5 | 139.5 |
| **Losses to the RN supply:** | | | |
| Licenses deactivated or lapsed | 1,696.5 | 1,823 | 1,759.75 |

**LOSSES TO THE STATE RN SUPPLY**

RNs may drop their license to practice in South Carolina for many reasons: out-migration to other states, a career change away from nursing, retirement, temporary or permanent disability, and death. We were not able to identify a data source or sources that would allow us to estimate each of these factors separately. For the purposes of this study, we have aggregated all of these factors into a single measure of RNs who deactivated or allowed their South Carolina license to lapse in the single year. We measured these losses at two points in time by examining the age-specific number who dropped their license between 2006 and 2008, and those who dropped their license between 2008 and 2010. These age-specific figures were averaged and then divided by two to arrive at age-specific single year estimates.

Age-specific single year estimates were then divided by the total number of actively licensed nurses in 2008 to produce an age-specific rate of loss - the percentage of each age group that is likely to allow their license to lapse each year. This rate of loss was applied to the supply of licensed RNs in each year

of our model. The resulting estimate of losses to the RN supply each year ranges from 1759.7 in 2008 to 2720.95 in 2028. The yearly estimates differ because the age distribution of the supply of licensed RNs changes each year as nurses in the model move through time.

### RNs EMPLOYED IN NURSING

In addition to estimating the number of RNs holding an active license to practice in South Carolina each year, the model also estimates the number of licensed RNs likely to be employed in the nursing workforce. Not all RNs holding a license are actively employed in nursing in any given year. We used data in the RN license renewal files to determine the percentage of licensed RNs in each age group who were actively employed as nurses in 2008. These age-specific percentages, held constant over time in our model, are used to estimate the number of RNs likely to be in the nursing workforce in any given year.

### FULL TIME EQUIVALENT (FTE) NURSES

A more consistent way to measure the size of a workforce is to translate the number of people into full-time equivalents (FTEs), based on the number of hours worked each week. We used self-reported information about the number of hours worked in an average week supplied by RNs during the license renewal process to calculate FTE weights for each RN, using a value of 40 hours per week for 1.0 FTE. For FTE calculation purposes, we assume that all RNs are employed for the full year.

The forecasting model uses the average FTE weight for all RNs in an age group multiplied by the number of RNs in that age group who are employed in nursing to calculate an estimate the FTE workforce for that age group. All age groups were summed to estimate the entire FTE RN workforce in a given year.

## RN Supply Projection Results

The supply model projects that the number of RNs likely to hold an active license to practice in South Carolina will increase from a baseline of 44,824 in 2008 to 69,308 in 2028 – an overall increase of 55% over that period. However, the annual rate of growth in RNs is not consistent and drops from 4.7% between 2008 and 2009 to a low of 0.4% between 2027 and 2028 (see Figure 2). This is due primarily to the fact that the baby boom generation makes up a significant portion of the entire RN supply, and that generation will be aging out of the workforce during the next 20 years. This is not unique to the nursing profession, but is a demographic phenomenon that will be repeated in most occupational groups during the next two decades.

While the actual number of RNs employed in nursing and the number of FTEs are also expected to increase, the model shows a widening gap between the number employed in nursing and the number of licensed RNs, as illustrated in Figure 3. Again, this is due to the aging of the workforce and the fact that older nurses active in the workforce tend to work fewer hours per week than younger nurses, and older nurses tend to leave the workforce altogether but retain their license to practice – at least for a period of time.

The extent to which the aging of the RN workforce influences the supply model results can be more easily seen in Figures 4 and 5. Figure 4 shows how, based on the assumptions of the model, the age distribution of RNs actively employed in the nursing workforce shifts over time to one dominated by nurses over the age of 50.



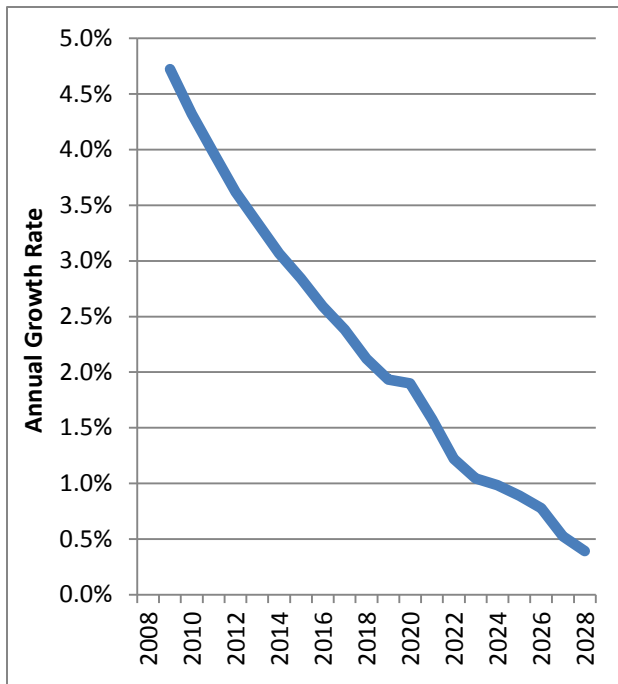<p style="text-align:center"><strong>Figure 2. Declining growth rates in the number of RNs expected to be licensed in South Carolina</strong></p>
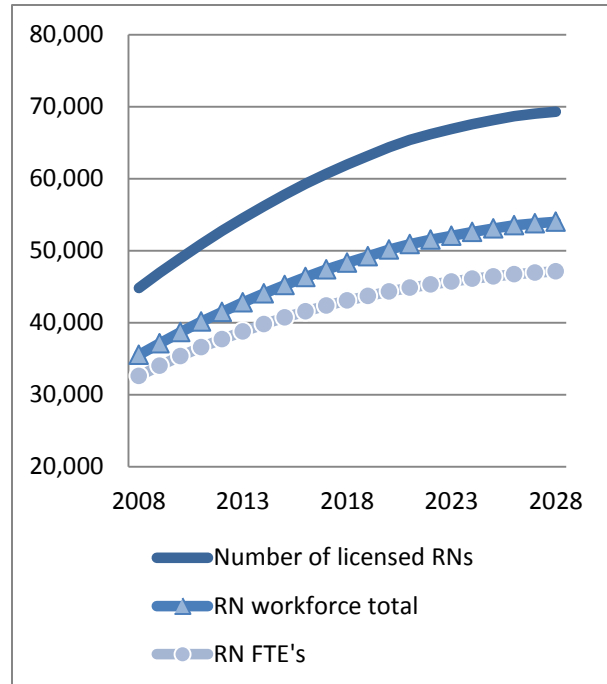
<p style="text-align:center"><strong>Figure 3. RN Supply Projections: number licensed, in the workforce, and total workforce FTEs</strong></p>

Figure 5 illustrates the relatively large number of older nurses likely to be in the workforce, but the fewer full-time equivalents they will constitute, relative to their younger colleagues. This is due to the tendency of older nurses, especially those over age 65, to work less than full-time. The fact that they are likely to stay attached to the workforce, but work only part-time explains why the gap between the workforce total and the number of RN FTEs in Figure 3 widens over time as the nursing workforce ages.
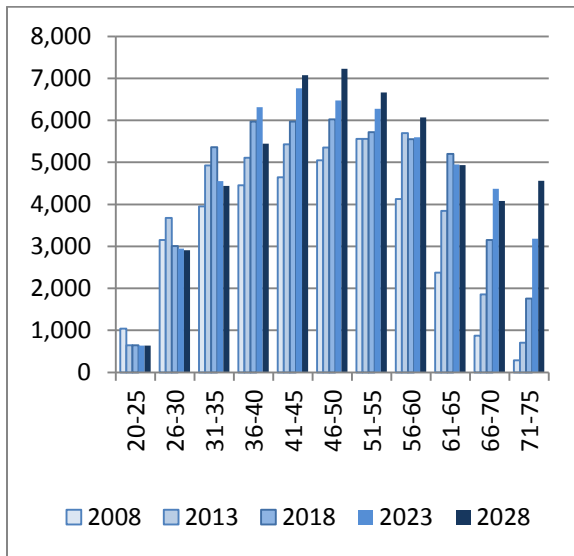
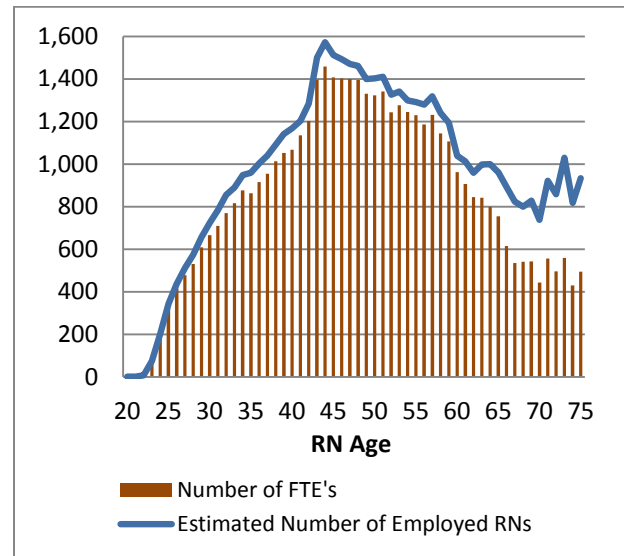**Figure 4. Estimate of RNs in the workforce by age group**



**Figure 5. 2028 estimated RN workforce and FTEs by age**

## Demand Model Projections for South Carolina

We relied on information developed by the U.S. Bureau of Labor Statistics (BLS) and the South Carolina Labor Market Information (LMI) office within the Department of Employment and Workforce (DEW) for their biennial estimate of growth in occupations. Their estimates of occupational employment are drawn from their Quarterly Census Employment and Wages (QCEW) surveys of industry groups in the state. These employment estimates are then paired with information about how specific industry groups are expected to grow or decline over the coming decade. The projections at the national level are published every two years by the Bureau of Labor Statistics. State level information for South Carolina was obtained directly from the DEW Labor Market Information office.

The baseline estimate provided by the LMI for the number of RNs employed in South Carolina in 2008 is an average of the RNs employed across all different employer types, over the four quarters of the year. The employment estimates include both full and part-time employees, and thus is a headcount estimate of those in the workforce. Because these figures are drawn from employment surveys, the estimate of employed RNs does not include the number of positions that were available, but unfilled at the time of the surveys.

In order to account for the demand of unfilled positions, we asked the LMI to estimate the vacancy rate

for RNs in 2008. They did so by analyzing the number of online ads for Registered Nurses each month. Those monthly totals were summed and averaged to get an estimate of the number of unfilled positions likely to be available at any time during 2008. To calculate the annual vacancy rate for RNs we divided the number of vacant positions by the employment estimate in 2008 and then used that vacancy rate for all subsequent years (7.53%).

The 2008 baseline demand estimate for RNs is the sum of the RNs employed in nursing positions and the estimated number of vacancies.  We used the actual number of RNs who reported they were employed in nursing in 2008 (N=35,521) rather than the LMI survey estimate of 38,401,[1] then added the number employed to the estimate of vacant positions (N=3,126) to arrive at  our baseline demand estimate of 38,647 RNs.

The occupational forecast for RNs in South Carolina produced by the BLS and LMI estimated a total percentage increase of 26% in the number of RNs employed in South Carolina between 2010 and 2020. However, they recommended that we use a 2.3% (rather than 2.6%) annualized rate of growth for our projection model.  It should be noted that this sort of stable growth pattern is unlikely to actually occur in a labor market as dynamic as healthcare and the associated industries that rely on Registered Nurses in their labor force.  However, without a detailed economic forecast for each year in our projection period it is not possible to know how that larger trend might vary by year.

## Comparison of Supply and Demand Projections

The impetus behind these projection models is to gain some understanding of how well the dynamics affecting the RN workforce are in balance and how that might change in the future – given a very specific set of assumptions.  The results of our supply and demand projections are graphed in Figure 6. The gap between the number of RNs in the workforce in 2008 and the estimate of demand for RNs in 2008 is the number of job vacancies estimated by the Labor Market Information system.

In general, comparison of the two projections suggests that the supply of and demand for RNs in South Carolina have been closely balanced in recent years and may remain in balance for several more years if the assumptions underlying both models are sustained.  The results also suggest that a nursing shortage may begin to develop in approximately 6 to 8 years, and grow to a shortage of approximately 6,400 RNs by the year 2028.

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[1] The LMI estimate is likely to count some RNs more than once since some RNs work more than one job.  Since this estimate of demand is based on the number of RNs in the workforce, plus vacant positions, we used the more accurate count of RNs in the workforce based on what RNs reported of their own workforce attachment.
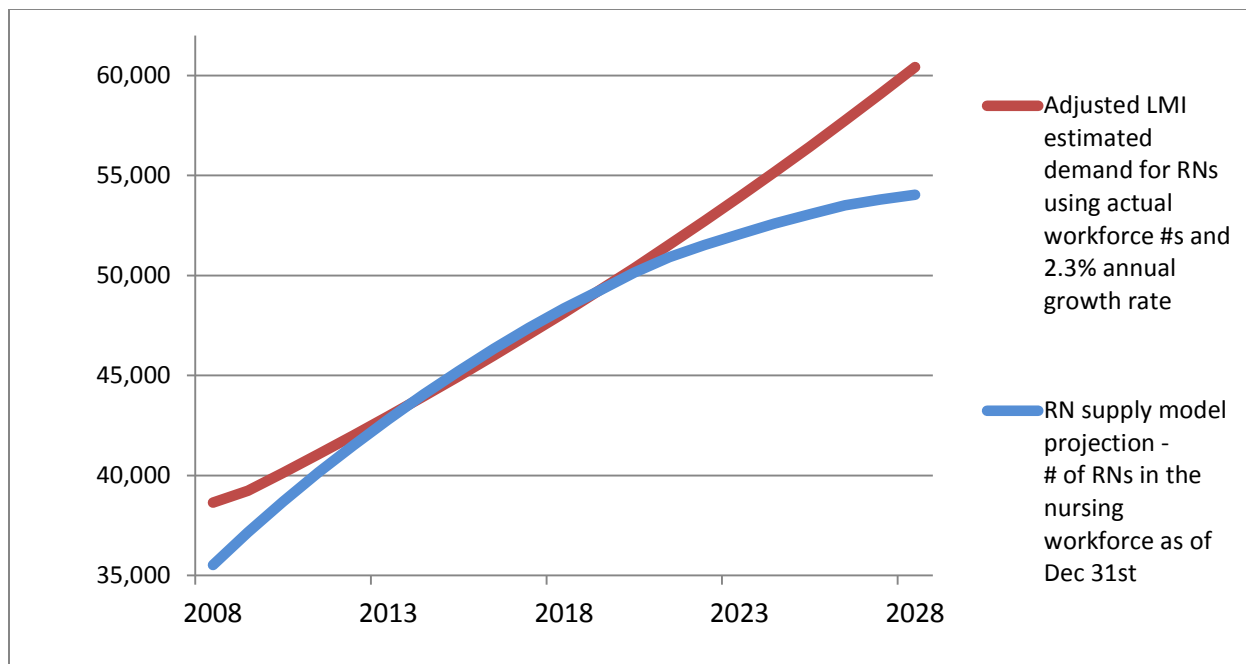
**Figure 6. Comparison of RN Supply and RN Demand Projections 2008 - 2028**

The current balance in the nursing workforce suggested by the models is likely to be a temporary thing. Nursing shortages have been a cyclical event in the United States for almost 100 years. Between the changes occurring in the healthcare system and the large number of baby boomers likely to retire in the next decade, a future shortage is not unlikely. However, several things can happen to change the dynamics that lie behind our projections:

- Another recession – keeping older RNs in the workforce later in life and/or increasing the number of hours RNs work each week

- A rapidly improving economy – resulting in RNs reducing the number of hours worked each week, or increasing the rate at which RNs retire in the next decade

- A substantial increase or decrease in the number of experienced RNs migrating into South Carolina and joining the nursing workforce

- Stronger growth in demand for RNs as a result of changes in healthcare delivery models and/or the increase in the number of people with health insurance

Also, the assumptions made in the models are something that can be challenged or intentionally changed. One of the advantages of creating projection models is that assumptions about the workforce dynamics can be tested with 'what if' scenarios that postulate different levels of the 'gains' or 'losses' elements used to drive the supply estimates, or the growth rates used to estimate future demand. To that end, we created a spreadsheet application that allows policy makers and researchers to question

the assumptions of our RN supply model and introduce their own.

## Scenario Builder

We developed an interactive scenario builder as a companion piece to our nurse supply projection model which allows a user to hypothesize how changes in the number of new graduates obtaining a license each year, the number of RNs reinstating an active license, the number of experienced RNs coming into the state, age-related work patterns, or the number allowing their license to lapse, may affect the balance between our RN supply and demand projections for South Carolina.

For example, if the total number of new graduates passing the NCLEX exam and obtaining an active license to practice in South Carolina were to increase by 5% each year – beginning in 2018 – then the gap between the projected supply of RNs and the projected demand for RNs would be significantly reduced – all other model assumptions remaining constant.  See the chart in Figure 7 for the illustrated result.
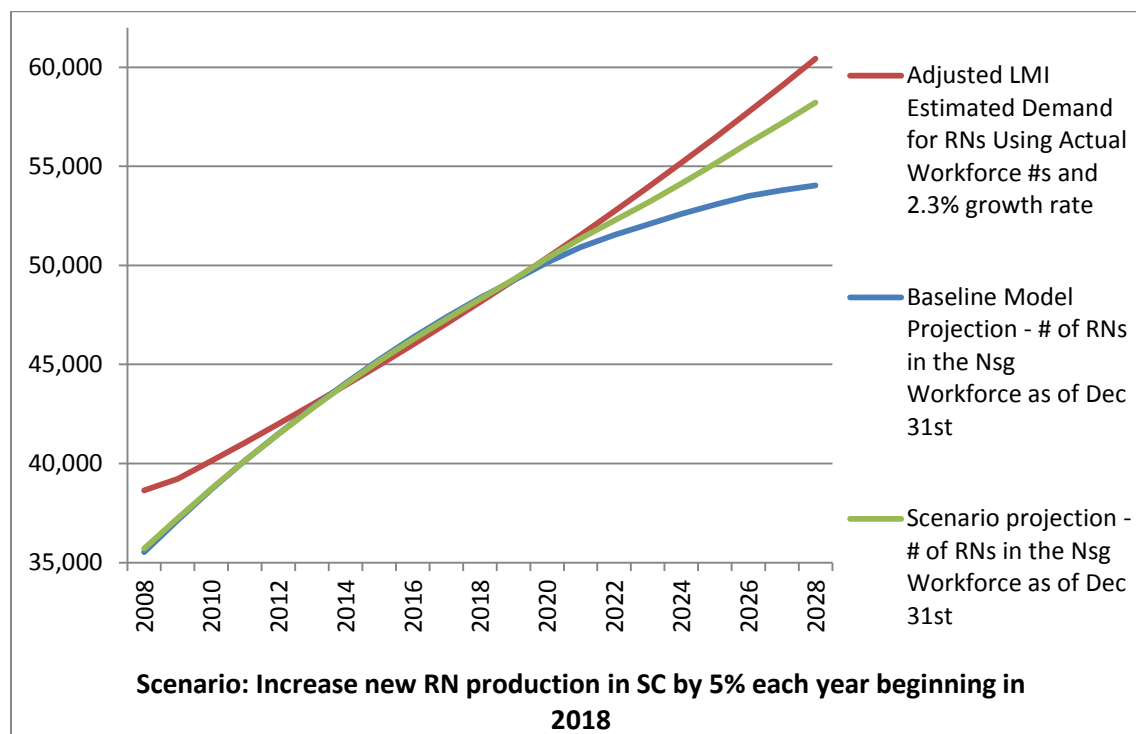


**Scenario: Increase new RN production in SC by 5% each year beginning in 2018**

Legend:
- Adjusted LMI Estimated Demand for RNs Using Actual Workforce #s and 2.3% growth rate
- Baseline Model Projection - # of RNs in the Nsg Workforce as of Dec 31st
- Scenario projection - # of RNs in the Nsg Workforce as of Dec 31st

**Figure 7.  Results of a scenario adjustment to the RN supply projection**

## Limitations of Supply and Demand Projections

Both the RN supply and RN demand model results presented here rely on a set of assumptions that are unlikely to be maintained over a long span of time. Individual workforce behavior changes in reaction to economic conditions, personal circumstances, and wage levels. Nursing education programs expand and contract in reaction to student demand, operating budgets, available faculty, and clinical site accessibility. In addition, the growth in demand for RNs may fluctuate up or down from the 2.3% annual estimate we used. The estimates generated by any long-range projection model become less accurate the farther they are from the baseline. For that reason, projection models should be updated and replicated on a regular basis in order to account for changing economic and labor force conditions.

In addition, our models do not reflect regional or urban/rural differences in the balance between supply and demand in the state. Nor do they differentiate between different types of RNs – especially among advanced practice Registered Nurses (APRNs). There is a need to understand supply and demand dynamics for each APRN group on their own. Finally, given the recent recommendations from the Institute of Medicine to increase the number of RNs with baccalaureate and graduate degrees, it is important to understand whether the demand for RNs with different levels of education is in balance with the supply of RNs at different education levels. Each of these limitations points to the need for more fine-grained study of supply and demand within the nursing workforce in South Carolina.