

Forecasting Supply, Demand, and Shortage of Nurses in Tennessee



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Tennessee Center for Nursing

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“This project is funded under an agreement with the state of Tennessee.”

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Executive Summary

The Tennessee Center for Nursing (TCN) used the updated 2004 Health Resources and Services Administration (HRSA) Nurse Supply and Demand Models to generate projections for the nursing population in Tennessee. Both models contain default input data on supply and demand for all 50 states with data derived from national surveys. Where possible more up to date information from Tennessee was used to replaced the default data. The Supply Model was created to project the FTE* Registered Nurse (RN) population, but can be modified to also project the Licensed Practical Nurse (LPN) population.² The Demand Model projects the RN, LPN, and Nurse Aide populations. This report shows the projection results using each of the models developed by HRSA and presents simulations to show how the shortage would be affected if educational capacity was increased.

Results from the baseline forecasts (the baseline data assumes that no additional effort to resolve the shortage is made) project a shortage of almost 15,000 RNs by 2020. This number is not as severe as the 35,300 that was projected in 2004 using the original models and default input data.¹ **The shortage of 2,800 RNs in 2008 is expected to grow to 14,910 in 12 years.** The demand will continue to exceed the supply for RNs as the population continues to age, older RNs retire, and no changes are made to current system.

Simulations were created using the Supply Model to represent incremental increases in the number of new nurse graduates and any effect that would have on the projected shortage. If the number of 2008 nurse graduates was increased by 40% (allowing for implementation in 2010 and actual enrollment increases in 2011) and was sustained through 2020, Tennessee would be able to avert the nursing shortage of over 14,000 in 2020. If this strategy was implemented in 2011, the projections show an initial surplus of RNs, but by 2020 would meet the demand.

By modifying the Supply Model, we were able to project supply and demand for LPNs. **Tennessee is projected to have a shortage of a little over 1,000 LPNs by the year 2020.** From 2010 until 2017, Tennessee is actually projected to produce a surplus of LPNs.

This report describes the forecasting process in more detail. In addition to increasing educational capacity, improving work environments, and retaining older nurses in healthcare facilities are also contributing factors to reducing the nursing shortage and warrant further investigation.

* FTE (Fulltime equivalent) supply is defined as the number of FTE RNs employed in nursing. The Supply Model defines an FTE in the following - RNs employed fulltime during the entire year are counted as one FTE, while RNs employed part time or for part of the year are counted as one-half of an FTE. Tennessee's licensure database only captures employment status as FT or PT. For the purposes of this study it was decided to assume that two PTs equal 1 FTE. The Demand Model defines demand as the number of FTE nurses that employers are able and willing to employ given their needs and contemporary market conditions.

Figure 1.

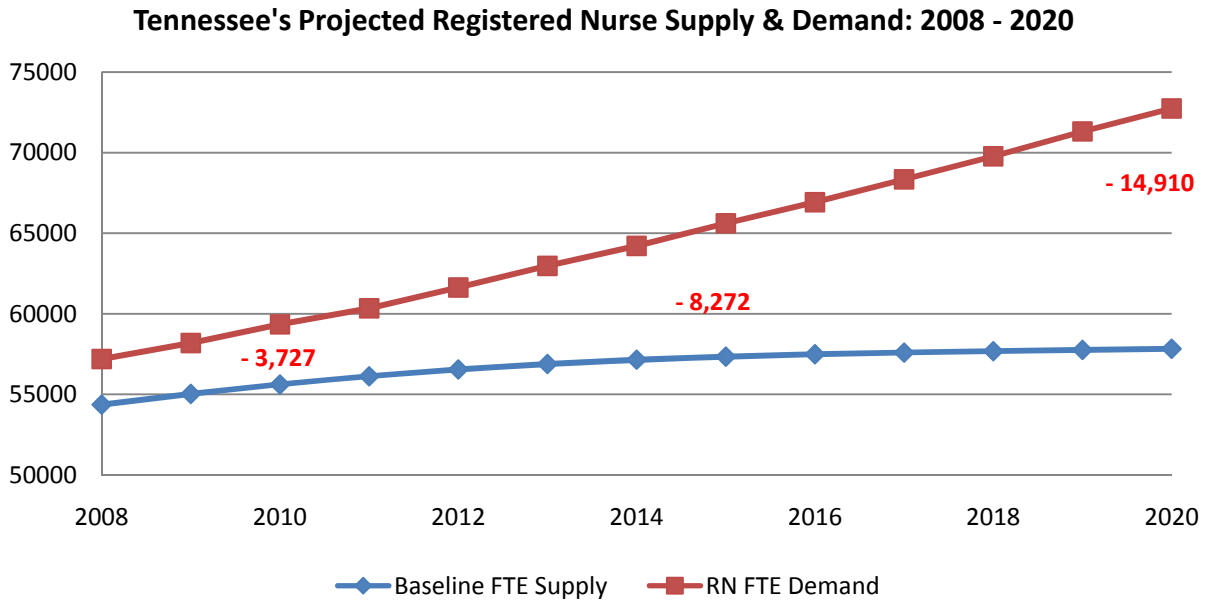
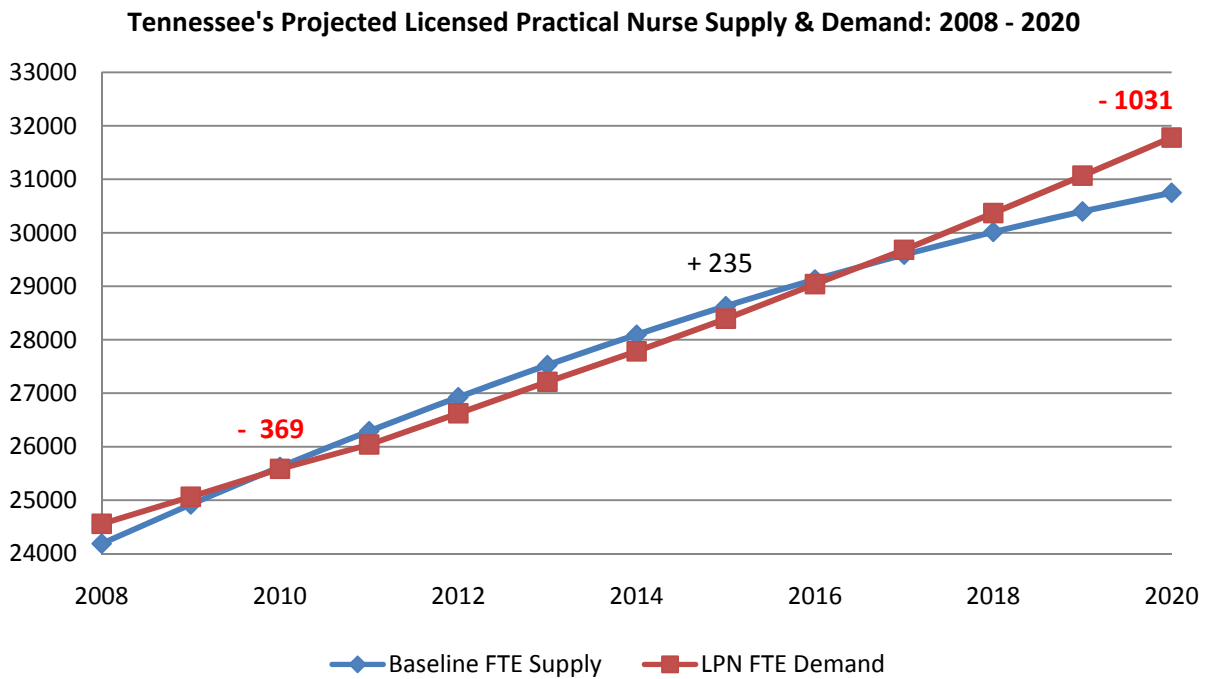


Figure 2.



Forecasting Supply, Demand, and Shortage of Nurses in Tennessee

Introduction

Knowledge of the supply and demand data surrounding the nursing profession is critical to planning. In order to ensure access to the affordable, high-quality healthcare Tennesseans have always strived to achieve, an adequate supply of nurses is essential. Due to the growth and aging of Tennessee's population, along with the continued demand for the highest quality of care, the increasing demand for services provided by RNs and LPNs will continue to magnify over the coming two decades. According to the US Census data in 2006, of the over 6 million Tennesseans almost 800,000 are 65 years of age or older – 13% of the population compared to 12.4% of the US population. This percent is projected to grow steadily and reach 18% by 2020. The US Census Bureau projects a rapid increase in the elderly population starting around 2010 when the leading edge of the baby boom generation approaches 65. Because the elderly have much greater per capita healthcare needs compared with the non-elderly, the rapid growth in demand for nursing services is especially prominent for long-term care settings that primarily provide care to the elderly. Tennessee is a state with a larger aging population. This, coupled with the fact that many RNs are approaching retirement age (average of Tennessee's RN 45.3 in 2007), and the difficulties the nursing profession continues to face with attracting new entrants and retaining the current workforce, the RN supply in Tennessee has only been increasing at a rate of 2-3% per year.

Although national data is available and used to estimate projections for each state, having a complete and accurate dataset from an individual state provides a much more accurate picture of the nursing workforce. Detailed data on nurse supply and demand includes the number of licensed nurses, how many are working as nurses and the number of hours they work, and data on current vacancies. The number of hours worked by nurses is not currently being collected for Tennessee, only the status of full time or part time employment.

This report provides the results of the nursing shortage projections using the models developed by the Health Resources and Services Administration (HRSA) with Tennessee specific data on the nurse workforce and demand for nurses. The models are a powerful tool for projecting the supply and demand of nurses and as such are limited by the accuracy of the input data used to determine the baseline levels of nurse supply and demand, and the validity of assumptions about the forces that drive changes in supply and demand. The report also represents the results of several simulations in which the nursing supply was increased based on educational capacity.

Methods

The HRSA Nurse Supply and Demand Models, revised and updated in 2004, were used to create Tennessee's projections. Both models are fully operational with input data on supply and demand for all 50 states. Most of the data elements for each state are derived from national surveys, and may not accurately reflect individual states due to small sample sizes. Where

possible, Tennessee data was used in place the default data. See the Addendum section for the database information from each model and the input data that were used.

HRSA's Nurse Supply Model (NSM) is a "stock and flow" model in which nurses enter the state's nurse supply through nursing program graduation or in-migration and leave the nurse supply through out-migration or failure to retain a nursing license (attrition). The supply model projects not only the licensed nurse population but also the number of full-time equivalent (FTE) nurses within the nursing workforce. Because data were not available in Tennessee on the number of hours PT nurses worked, the assumption was made that 2 PT = 1 FTE. The model looks at data by age, level of education, and geographic location. The NSM was designed to forecast RN supply only, but is adaptable to use for Licensed Practical Nurse (LPN) supply forecasts. Default data contains information from the National Sample Surveys of Registered Nurses (SSRN) to generate: the baseline year counts of nurses in each state, the rates of migration and attrition, and participation rates. Where possible, the most recent survey data were used. Counts of nurses by age and education in each state were estimated using the 2000 SSRN for the baseline year of 2000. The baseline year was adjusted to 2008 as more current state specific information was available through that year. Two main sources of data were used to implement the supply model: the 2nd Quarter 2008 RN and LPN licensure databases, and the TN Board of Nursing State Approved Professional Nursing Programs Annual Report 2008.

The assumptions for the NSM are 1) Rates of licensed nurse participation in the workforce, by age and education, remain stable over time, 2) Rates of state-to state migration, by age and education, remain constant in each state over time, 3) The number of foreign immigrants moving to each state remains constant, as does their age distribution, 4) Rates of attrition by age remain constant (through retirement, disability, and death), and 5) The number of new graduates each year changes based on the size of the potential applicant pool, defined as the population of women ages 20-44, but its age distribution remains constant. Each 1% change in the size of the applicant pool is assumed to cause a 1% change in the number of RN graduates. Assumptions regarding education upgrades can be modified.

The HRSA Nurse Demand Model (NDM) is a more complicated program in which demand for healthcare services is projected based on population size and composition, known variations in the healthcare use of individuals differing in age, sex, and rural or urban location, trends in healthcare market conditions, economic conditions, and expected patient acuity in different settings. The demand for healthcare and predicted nursing labor requirements are combined to generate an estimate of the number of FTE nurses demanded by employers in each year. The model is designed to project the demand for RN, LPN, and nurse aide FTEs. Default data are from the Census Bureau population projections by age and sex, the Area Resource File, the 1996 SSRN, the 1996 Health Cost and Utilization Project database, and survey data from several organizations that study setting-specific issues (such as the 1997 National Nursing Home Survey and the 1995 National Home and Hospice Care Survey). To replace the input data elements with Tennessee-specific values, revised population projections and annual report data from licensed healthcare facilities were obtained from the Tennessee Department of Health's Office of Vital Statistics.

The assumptions for the NDM are 1) Percentage of the population enrolled in a HMO increases by one-half percent each year (modifiable), 2) The “rate of uninsured” variable can be shifted up or down, but otherwise does not change over time, 3) Medicare home health & Medicaid Nursing Facility payments are assumed to grow at a rate of 1%, and 5) Outpatient Surgery prevalence is assumed that ½ % of all inpatient surgeries would be shifted to an outpatient basis each year.

The projection period for both models begins in 2008, as most of the data sources were assembled during this year, and extends to 2020. The default data for Tennessee were often inaccurate when compared with Tennessee data on the nurse and general populations in Tennessee. The differences in input data resulted in very different forecasts. Please see the Addendum section of this report for the list of data inputs for each model.

Baseline Forecasts for RNs and LPNs

The default data provided with the model were published in 2004. This publication reported that Tennessee could expect a shortage of 35,500 RN FTEs by the year 2020.¹ The results obtained using the same models but with more recent and accurate input data for the state provided a much less severe picture of the shortage. See Table 1 for the baseline demand, supply, and shortage projections for RNs and LPNs in Tennessee.

Table 1. Baseline FTE Demand, Supply, and Shortage Projections for RNs & LPNs

Year	RN FTE Demand	RN FTE Supply	RN FTE Shortage	LPN FTE Demand	LPN FTE Supply	LPN FTE Shortage
2008	57,196	54,366	2,830	24,188	24,557	369
2009	58,192	55,031	3,161	24,922	25,064	142
2010	59,347	55,620	3,727	25,623	25,585	- 38
2011	60,347	56,126	4,221	26,291	26,040	-251
2012	61,633	56,549	5,084	26,925	26,625	- 300
2013	62,978	56,887	6,091	27,526	27,213	- 313
2014	64,215	57,155	7,060	28,094	27,783	- 311
2015	65,620	57,348	8,272	28,627	28,392	- 235
2016	66,930	57,498	9,432	29,127	29,039	- 88
2017	69,345	57,598	10,747	29,591	29,681	90
2018	69,773	57,684	12,089	30,015	30,368	353
2019	71,320	57,762	13,558	30,399	31,067	668
2020	72,746	57,836	14,910	30,749	31,780	1,031

Simulated Forecasts of RN Supply

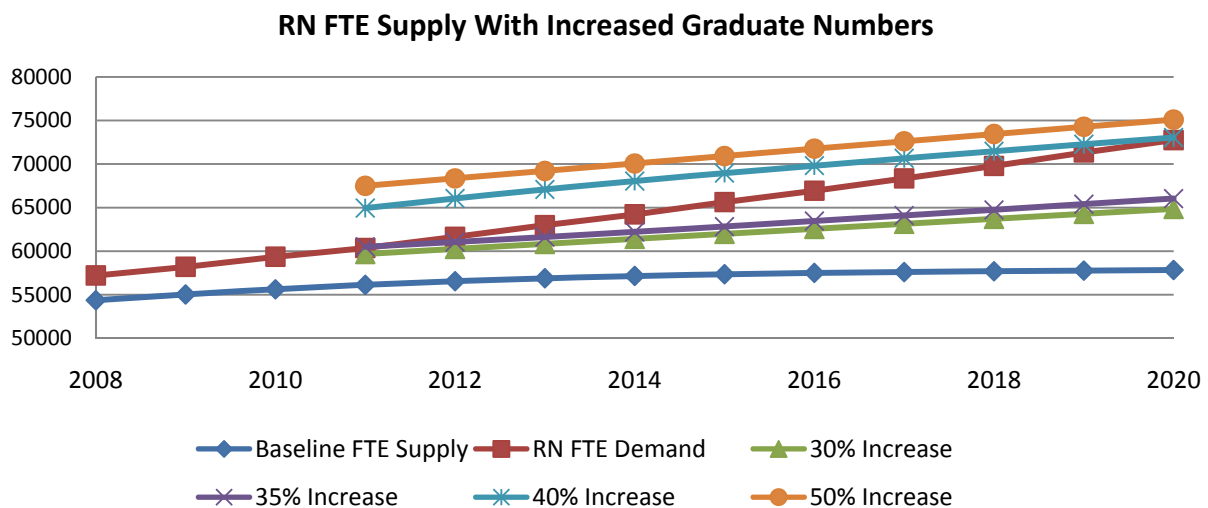
The Nurse Supply Model has the capacity to simulate changes in the nurse supply in response to increases in the number of new graduates. The number of RN graduates in the baseline year was manipulated to simulate an increase in the nursing educational supply by 30%, 35%, 40%, and 50%, assuming that the change was made in 2010 to affect the 2011 supply. Table 2 presents the baseline graduates for RNs and LPNs.

Table 2. Baseline Projections of New RN and LPN Graduates

	New RN Graduates	New LPN Graduates
2008	3,025	1,441
2009	3,023	1,440
2010	3,021	1,439
2011	3,030	1,444
2012	3,042	1,449
2013	3,053	1,455
2014	3,066	1,460
2015	3,082	1,468
2016	3,089	1,472
2017	3,098	1,477
2018	3,111	1,482
2019	3,122	1,488
2020	3,134	1,494

Figure 3 shows the supply implications of increase the baseline projections of new RN graduates. Each simulation begins with the new graduate increase in 2011, assuming that enrollment increases will occur in 2010. Increasing the educational supply by 30% and 35% still falls short of meeting the 2020 projected demand. A 40% increase in educational capacity would avert the projected 2020 shortage – supplying a surplus from 2011 through 2019.

Figure 3.



The projected RN shortage in 2020 could be averted by increasing the current number of graduates by 40%. With the current budget cuts in higher education, Tennessee may actually experience a decrease in enrollment due to lack of faculty, resulting in a decrease in the number of graduates. Neither model takes into account any sudden changes in the economy.

Table 3 shows the workforce attrition rates used by the supply model. These rates are intended to capture permanent departure from the nursing workforce (retirement). Because very little data are available regarding the rate of attrition from the nursing profession at different ages, the model's rates are based on mortality data from the Centers for Disease Control and Prevention and workforce data on all college-educated women from the Current Population Survey.³ The rates are not nurse specific, and do not reflect the probability that a nurse will change careers due to dissatisfaction with nursing. Note the percent attrition rates at ages 62 and 65. These are ages at which individuals become eligible for Medicare and/or Social Security benefits. Very little research surrounding the retirement behavior of nurses has been conducted to see if this assumption applies to the nurse profession.

The Florida Center for Nursing created simulations assuming retirement delays and found that this had an impact on the nursing shortage, but only short-term.² They also surmised that many older, experienced nurses could be retained in the workforce if work environments and workloads were redesigned to reduce the physical burdens associated with direct care.

Table 3. Nurse Supply Model Annual Attrition Rates by Age

Age	Annual Attrition Rate	Age	Annual Attrition Rate
<=22	.024%	44	.038%
23	.024%	45	.039%
24	.025%	46	.041%
25	.025%	47	.042%
26	.025%	48	.045%
27	.025%	49	.057%
28	.025%	50	.080%
29	.026%	51	1.19%
30	.026%	52	1.38%
31	.026%	53	1.42%
32	.027%	54	1.54%
33	.027%	55	1.59%
34	.028%	56	1.55%
35	.029%	57	2.09%
36	.029%	58	2.16%
37	.030%	59	1.44%
38	.031%	60	4.83%
39	.032%	61	4.91%
40	.033%	62	25.16%
41	.034%	63	6.91%
42	.035%	64	6.91%
43	.036%	>=65	23.16%

Discussion and Conclusions

The HRSA Nurse Supply and Demand Models released in 2004 provide much needed state-level projections. A newer version (2009) of both models has been created but no release date has been provided. The accuracy of the models are only as accurate as the input data used to determine the baseline levels of nurse supply and demand and the validity of assumptions about the forces that drive changes in supply and demand. There are other limitations to the models as well.¹ Each model is independent of the other. The Demand Model makes projections without considering the potential supply of nurses and vice versa. In reality, the nursing workforce is influenced by the combination of supply and demand.

The supply model's attrition rates are very low at young ages, reflecting an assumption that career change among newly licensed nurses is minimal. The rates in the model also reflect higher numbers for nurses leaving the workforce at ages 62 and 65. The ages were typical retirement ages, but with the current economic conditions, this may not continue to be the case. Further investigation into both of these assumptions – simulating different rates, would help provide another piece of the puzzle in addressing the nursing shortage issues in Tennessee.

Even with the limitations, together the NSM and NDM offer insight into the nursing workforce profession. The severity of the RN shortage projected by these models is not as large as projected in 2004. Resolving the shortage will require multiple interventions to increase the number of new graduate nurses, improve the work environment to retain all nurses, and redesign work to accommodate the older nurse.

The Tennessee Center for Nursing will continue to maintain a supply and demand database for the state of Tennessee and publish updates at periodic intervals.

References:

1. Biviano, M., et al. 2004. *What is Behind HRSA's Projected Supply, Demand, and Shortage of Registered Nurses?* Retrieved June 1, 2009 from <http://bhpr.hrsa.gov/healthworkforce/reports/behindrnprojections/index.htm>
2. Nooney, J., et al. 2008. *Technical Report: Use of HRSA's Nurse Supply and Demand Models in Florida.* Retrieved June 1, 2009 from <http://www.flcenterfornursing.org/workforce/researchreports.cfm>
3. National Center for Health Workforce Analysis. 2004. *Nursing Supply Model: Technical Report and User Guide.* Rockville, MD: Health Resources and Services Administration.

Addendum

1. Nurse Supply Model Database Information
2. Nurse Demand Model Database Information
3. Input Data for the Nurse Supply Model
4. Input Data for the Nurse Demand Model

Addendum 1. Nursing Supply Model (NSM) Database Information

Table	Variable Name	Variable Definition
Variables_SY	Year	Projection year
	State	State
	POPULATION	State-level population forecasts from 2000 to 2020
	WNPOP	State-level forecasts of the population of women age 20 to 44 from 2000 to 2020
Variables_A	AGE	RN age
	%POSTRNBA	Age distribution of associate degree and diploma RNs upgrading to a baccalaureate degree
	%MA	Age distribution of baccalaureate-degree RNs upgrading to masters or higher degree
	%DIPAD	Age distribution of new RNs graduating with an associate degree or diploma
	%BA	Age distribution of new RNs graduating with a baccalaureate degree
	FOREIGN	Age distribution of foreign-trained RNs
	ATTRITION	Attrition rate from the licensed RN population (e.g., mortality, disability, and retirement)
	FTE_AD	FTE labor force participation rates for RNs prepared at the associate and diploma level
	FTE_BA	FTE labor force participation rates for RNs prepared at the baccalaureate level
	FTE_MA	FTE labor force participation rates for RNs prepared at the masters or higher level
	ACTIVITY_AD	Labor force participation rates for RNs prepared at the associate and diploma level
	ACTIVITY_BA	Labor force participation rates for RNs prepared at the baccalaureate level
	ACTIVITY_MP	Labor force participation rates for RNs prepared at the masters or higher level
Variables_SA	STATE	State
	AGE	RN Age
	RN_AD	Nurse population in base year trained at the associate or diploma level
	RN_BA	Nurse population in base year trained at the baccalaureate level
	RN_MA	Nurse population in base year trained at the masters or higher level
	PEMIG_AD	Probability that RN prepared at the associate or diploma level will emigrate this year
	PEMIG_BA	Probability that RN prepared at the baccalaureate level will emigrate this year
	PEMIG_MA	Probability that RN prepared at the masters or higher level will emigrate this year
	PIMMIG_AD	Probability that RN prepared at the associate or diploma level immigrated last year
	PIMMIG_BA	Probability that RN prepared at the baccalaureate level immigrated last year
	PIMMIG_MA	Probability that RN prepared at the masters or higher level immigrated last year
Variables_S	STATE	State
	FNGRADS	Proportion of new foreign nurses migrating to individual states
	GRAD_DIPAD	Base year number of new RN graduates at the associate or diploma level
	GRAD_BA	Base year number of new RN graduates at the baccalaureate level
	POSTRN	Base year number of RNs upgrading from the associate or diploma level to the baccalaureate level
	MSGRADS	Base year number of RNs upgrading from the baccalaureate to the masters or higher level
FGRADS	Year	Projection year
	FGRADS	Total foreign-trained RNs immigrating to the U.S.

Addendum 2. Nursing Demand Model (NDM) Database Information

Variable	Description
AGE_M	Mean age of population
BASE_ED	Total population age 5-17 in 1996
BASE_OCC	Total population age 18-64 in 1996
BASE_POP	Total population in 1996
DROFF_RN	Base year FTE RNs in doctor's offices
ED_POP	Total population age 5-17
ED_RN	Base year RNs in nurse education
HH_MCR	Average Medicare payment per home health visit (1996\$, normalized for geographic cost-of-living differences)
HHSCALAR	Scalar variable used to adjust home health visit forecasts to account for changes in the home health industry attributed to Medicare program changes implemented after the 1997 Balanced Budget Act and the institution of a Home Health Prospective Payment System.
HISPANIC	Percent of population Hispanic
HMO	HMO enrollment rate
MEDICAID	Percent of population in Medicaid
NF_MCD	Average Medicaid payment/day for nursing facility care (1996\$, normalized for geographic cost-of-living differences)
NHADL	Average number of activities of daily living (ADL) limitations per nursing home resident
NONWHITE	Percent of population non-white
OCC_POP	Total population age 18-64
OCC_RN	Base year FTE RNs in occupational healthcare
OTH_LPN	Base year FTE LPNs in other healthcare
OTH_NA	Base year FTE NAs in other healthcare
OTH_RN	Base year FTE RNs in other healthcare
PCPI	Real per capita personal income (1996\$, normalized for geographic cost-of-living differences)
POPULATION	Total population in geographic unit
PUB_RN	Base year FTE RNs in public health
REG_ENC	Geographic unit is in the East-North-Central region of the U.S.
REG_ESC	Geographic unit is in the East-South-Central region of the U.S.
REG_MA	Geographic unit is in the Mid-Atlantic region of the U.S.
REG_MT	Geographic unit is in the Mountain region of the U.S.
REG_NE	Geographic unit is in the New England region of the U.S.
REG_PAC	Geographic unit is in the Pacific region of the U.S.
REG_SA	Geographic unit is in the South-Atlantic region of the U.S.
REG_WNC	Geographic unit is in the West-North-Central region of the U.S.
REG_WSC	Geographic unit is in the West-South-Central region of the U.S.
REGCENT	Geographic unit is in one of the Central regions
REGCOAST	Geographic unit is in one of the Coastal regions
REGEAST	Geographic unit is in one of the Eastern regions
REGWEST	Geographic unit is in one of the Western regions
SCH_RN	Base year FTE RNs in school healthcare
SURGERY	Percent of hospital surgeries performed in outpatient setting
TOT_RN	Base year FTE RNs excluding nurse educators
UNINSURED	Percent of population without medical insurance
URBAN	Percent of population living in metropolitan area (defined as city w/20,000+ population)
WAGE_HHA	Median hourly wage for home health aides (1996\$, normalized for geographic cost-of-living differences)
WAGE_LPN	Median hourly wage for LPNs (1996\$, normalized for geographic cost-of-living differences)
WAGE_NA	Median hourly wage for nurse aides (1996\$, normalized for geographic cost-of-living differences)
WAGE_RN	Median hourly wage for RNs (1996\$, normalized for geographic cost-of-living differences)

Addendum 3. Input Data for the Nurse Supply Model (NSM) RN Model

Variable	Variable Description	HRSA Default Source (2000 as Baseline Year)	New Source (2008 as Baseline Year)
Nurse Population in the Base Year			
RN_AD	Nurse population in base year trained a diploma or associate level	SSRN	2008 2 nd quarter BON Licensure Data – RNs distributed into education categories
RN_BA	Nurse population in base year trained at baccalaureate level	SSRN	2008 2 nd quarter BON Licensure Data - RNs distributed into education categories
RN_MA	Nurse population in base year trained at masters or higher level	SSRN	2008 2 nd quarter BON Licensure Data - RNs distributed into education categories
U.S. Graduates			
Grad_DIPAD	Base year number of new RN graduates at diploma or associate level	National Council of State Boards of Nursing - first-time NCLEX test takers in 2000	Persons passing NCLEX in Tennessee + 8.7% of the people who failed NCLEX under the assumption that these would eventually pass and join the nurse supply
Grad_BA	Base year number of new RN graduates at baccalaureate level	National Council of State Boards of Nursing - first-time NCLEX test takers in 2001	Same as above. Info obtained from TBON.
%DIPAD	Age distributions of new RNs graduating with diploma or associates degree	SSRN – national rates	BON 2008 Annual Report of State Approved Professional Nursing Programs
%BA	Age distributions of new RNs graduating with baccalaureate degree	SSRN – national rates	BON 2008 Annual Report of State Approved Professional Nursing Programs
Foreign Nurse Graduates			
FNGRADS	Proportion of new foreign nurses migrating to individual states	SSRN	Default
FOREIGN	Age Distribution of foreign trained RNs	SSRN – national rates	Default
FGRADS	Total foreign-trained RNs immigration to U.S. each year	assumed to be 3,500 nationally	Default

Attendum 3. (Supply continued)

Variable	Variable Description	HRSA Default Source (2000 as Baseline Year)	New Source (2008 as Baseline Year)
General Population			
POPULATION	State-level population forecasts	Census Bureau	Tennessee Department of Health, Office of Health Statistics
WNPOP	State-level population forecasts of women ages 20-44	Census Bureau	Tennessee Department of Health, Office of Health Statistics
Attrition			
ATTRITION	Attrition rate from licensed RN population (by age)	Centers for Disease Control and Prevention, Current Population Survey – national rates	Default
Educational Upgrades			
POSTRN	Base year number of RNs upgrading from diploma or associate level to baccalaureate level	SSRN	Default
MSGADS	Base year number of RNs upgrading from baccalaureate to masters or higher level	SSRN	Default
%POSTRNBA	Age distribution of diploma and associate RNs upgrading to baccalaureate degree	SSRN – national rates	Default
%MA	Age distribution of baccalaureate degree RNs upgrading to master's or higher degree	SSRN – national rates	Default
Nurse Immigration and Emigration			
PEMIG_AD	Probability that RN prepared at diploma or associate level will emigrate this year	SSRN	Default
PEMIG_BA	Probability that RN prepared at baccalaureate level will emigrate this year	SSRN	Default
PEMIG_MA	Probability that RN prepared at masters or higher level will emigrate this year	SSRN	Default

Addendum 3. (Supply continued)

Variable	Variable Description	HRSA Default Source (2000 as Baseline Year)	New Source (2008 as Baseline Year)
Nurse Immigration and Emigration			
PIMMIG_AD	Probability that RN prepared at diplomat or associate level immigrated last year	SSRN	Default
PIMMIG_BA	Probability that RN prepared at baccalaureate level immigrated last year	SSRN	Default
PIMMIG_MA	Probability that RN prepared at masters or higher level immigrated last year	SSRN	Default
FTE Participation Rates			
FTE_AD	FTE workforce participation rates for RNs prepared at diploma and associate level	SSRN – national rates	Default
FTE_BA	FTE workforce participation rates for RNs prepared at baccalaureate level	SSRN – national rates	Default
FTE_MA	FTE workforce participation rates for RNs prepared at masters or higher level	SSRN – national rates	Default
Participation Rates			
ACTIVITY_AD	Workforce participation rates for RNs prepared at diploma and associate level	SSRN – national rates	Default
ACTIVITY_BA	Workforce participation rates for RNs prepared at baccalaureate level	SSRN – national rates	Default
ACTIVITY_MA	Workforce participation rates for Runs prepared at masters or higher level	SSRN – national rates	Default

Addendum 4. Nurse Demand Model (NDM) Input Data and Sources

Field	Field Description	Fixed or Variable	HRSA Default Source (Baseline Year=1996)	New Source (Baseline Year=2008)
Exogenous Variables				
AGE_M	Mean age of population	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
BASE_ED	Total population age 5-17 by state in the base year	Fixed	Census Bureau	Tennessee Department of Health, Office of Health Statistics
BASE_OC	Total population age 18-64 by state in the base year	Fixed	Census Bureau	Tennessee Department of Health, Office of Health Statistics
BASE_POP	Total population by state in the base year	Fixed	Census Bureau	Tennessee Department of Health, Office of Health Statistics
ED_POP	Total population age 5-17 by state over time period	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
HH_MCR	Average Medicare payment per home health visit by state	Variable	Assumes 1 percent annual increase	Default
HISPANIC	Percent of population Hispanic by state	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
HMO	HMO enrollment by state	Variable	Assumes ½ percent increase annually	Default
MEDICAID	Percent of population in Medicaid by state	Variable	Extrapolated based on projected population changes	Default
NF_MCD	Average Medicaid payment/day for nursing facility care	Variable	Assumes 1 percent annual increase	Default
NHADL	Average number of activities of daily living (ADL) limitations per nursing home resident	Variable	Assumes ½ percent annual increase	Default
NONWHITE	Percent of population non-white by state	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
OCC_POP	Total population age 18-64 by state over time period	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
PCPI	Per capita personal income by state	Variable	Assumes 1 percent annual increase	Default

Addendum 4. (Demand continued)

Field	Field Description	Fixed or Variable	HRSA Default Source (Baseline Year=1996)	New Source (Baseline Year=2008)
Exogenous Variables				
POPULATION	Total population in state over time period	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
SURGERY	Percent of hospital surgeries performed in outpatient setting by state	Variable	Assumes 2 percent increase annually	Default
UNINSURED	Percent population without medical insurance by state	Variable	Extrapolated based on projected population changes	Default
URBAN	Percent of population living in metropolitan area by state	Fixed	Census Bureau	Default
WAGE_HHA	Wage for home health aides by state	Variable	Assumes fixed ratio against other nurse types	Default
WAGE_LPN	Wage for LPNs state average	Variable	Assumes fixed ratio against other nurse types	Default
WAGE_NA	Wage for Nurse Aides, state average	Variable	Assumes fixed ratio against other nurse types	Default
WAGE_RN	Wage for RNs state average	Variable	Assumes fixed ratio against other nurse types	Default
Population Table				
	State population in 8 age categories by gender and year	Variable	Census Bureau	Tennessee Department of Health, Office of Health Statistics
Health Care Use in Base Year Table				
	ST Hospitals (outpatient)	Fixed	2000 and 2001 Area Resource File (ARF)	Default
	ST Hospitals (inpatient)	Fixed	2000 and 2001 ARF	Default
	ST Hospitals (emergency)	Fixed	2000 and 2001 ARF	Default
	LT Hospitals (emergency)	Fixed	2000 and 2001 ARF	Default
	LT Hospitals	Fixed	2000 and 2001 ARF	Default
	Nursing Facilities (Residents)	Fixed	American Health Care Association publications	Default

Addendum 4. (Demand continued)

Field	Field Description	Fixed or Variable	HRSA Default Source (Baseline Year=1996)	New Source (Baseline Year=2008)
Health Care Use in Base Year Table				
	Home Health Visits	Fixed	Center for Medicare/Medicaid Services	Default
Utilization Rates Table				
	Utilization rates by Setting, Gender, Age, and Rural or Urban Location	Fixed	Health Cost Utilization Project, National Hospital Ambulatory Care Survey, National Nursing Home Survey, and other sources	Default
Nurse Population in the Base Year (RN, LPN, Nursing Assistant) Table				
	Nursing FTEs by nurse type and setting in the base year	Fixed	SSRN, Area Resource File, BLS Occupational Employment Statistics, American Health Care Association data	Default