



The Supply and Demand for Registered Nurses and Licensed Practical Nurses in Nebraska

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Executive Summary

Recent trends suggest that the expected demand for registered nurses (RN) and licensed practical nurses (LPN) may exceed the supply in coming years. This report examines the potential divergence in Nebraska.

National Center for Health Workforce Analysis (NCHWA) models are used to project demand and supply for full-time equivalent registered nurses (FTE RN) in Nebraska from 2006-2020. Results show that demand will grow from a current need for about 16,000 FTE RNs to more than 20,000 over the next 15 years. However, supply is projected to increase from about 15,000 RNs in 2006 to only 16,500 by 2020. The models suggest that by the year 2020, Nebraska will have a shortage of about 3,800 FTR RNs, or about 20 percent of demand.

The NCHWA model is used to project LPN demand as well. Projections increase from a demand of just under 6,000 FTE LPNs in 2006 to 7,680 FTE LPNs in 2020. Unfortunately, there is no model to project LPN supply. Alternative methods are used to estimate the supply of LPNs between 2006 and 2020. Supply increases from 5,506 LPNs in 2006 to 5,937 in 2020. As might be expected, there will be a shortage of LPNs each year, growing from eight percent of demand in 2006 to almost 23 percent of demand by 2020.

The most effective long-term policies to address the growing shortage are those that continually attract people into nursing. The advantage of such policies is that they add new nurses year after year. Thus, while the increase in any year may be modest, the cumulative effect can be significant. Reducing net annual out-migration and attracting more young people to nursing as a profession will have these accumulative effects.

Policies that just affect participation among the existing pool of nurses will have more limited long-term impacts. However, they will increase the supply of nurses in the short term. Delaying retirements, reducing career changes and increasing the percentage of nurses working full time as opposed to part time are examples of such policies.

The analysis also shows that no individual policy is likely to eradicate the nursing shortage by itself. Rather, eliminating the nursing shortage will most likely require participants developing a variety of policies to stimulate nursing supply. The most effective solution may be one that stimulates supply among existing nurses to stem the current shortage and simultaneously encourages more people into nursing to stem future shortages.

I. Introduction

The Analysis begins by examining nursing demand. Demand is modeled using the National Center for Health Workforce Analysis's Nursing Demand Model (NDM). Demand is tied to population projections and the health care needs of individuals in various age groups. The underlying data used in the NDM are adjusted to make them more reflective of Nebraska's experience.

The next section examines nursing supply using the National Center for Health Workforce Analysis's Nursing Supply Model (NSM). Supply is modeled as a function of the changing population of nurses, their participation in the labor market, and their decisions whether to work full or part time. The underlying data used in the NSM are also adjusted to make them more reflective of Nebraska's experience.

Then, results from the two models are combined to look at projected nursing shortages. The following section describes policies that can be used to reduce the shortage. Policies are broken into two types: those that increase the size of the labor pool by adding more nurses, and those that increase participation among the existing pool of nurses.

The NDM is used to project licensed practical nurses (LPN) demand between the years 2006 and 2020. Nebraska survey results are used to estimate the supply in 2002. Then, RN supply growth rates are used to predict LPN supply between 2006 and 2020. While the data do not allow for scenario analysis, it can reasonably be assumed that the same policies that will eliminate RN shortages may reduce or eliminate the expected LPN shortages as well.

II. The Nursing Demand Model (NDM)

The NDM uses a three-step process to predict annual demand for FTE nurses through the year 2020:

1. Estimates the number of people requiring care in 12 different health care settings. See Appendix.
2. Estimates the FTE RNs required per capita in each setting (also known as staffing intensity). See Appendix.
3. Multiplies step 1 x step 2 to project FTE RN demand.

For example, if there are 2.6 million outpatient hospital visits estimated for a year and there is one FTE RN per 1,000 visits, expected demand in that health care setting would be 2,600 FTE RNs.

The NDM assumes that a nurse is one FTE equivalent if that nurse works 30 or more hours per week. Nurses working anything less than 30 hours are treated as one half of an FTE.

The model suggests that demand will grow in Nebraska from a need for 16,000 full-time equivalent registered nurses (FTE RNs) in the year 2006 to over 20,000 FTE RNs by the year 2020. This represents an increase in demand of about 25 percent.

III. The Nursing Supply Model (NSM).

The NSM uses a three-step process to predict the annual supply of FTE nurses through the year 2020:

1. Estimates the annual potential RN population. See Appendix.

- Determines a participation rate and multiplies it by the RN population to determine the RNs that are participating in the nursing labor market. Participation means that an RN is either employed or looking for employment. See Appendix.
- Develops a measure of FTE RN equivalents. The FTE RN equivalent measure is multiplied by the number of RNs participating in the labor market to get the FTE RN labor supply each year.

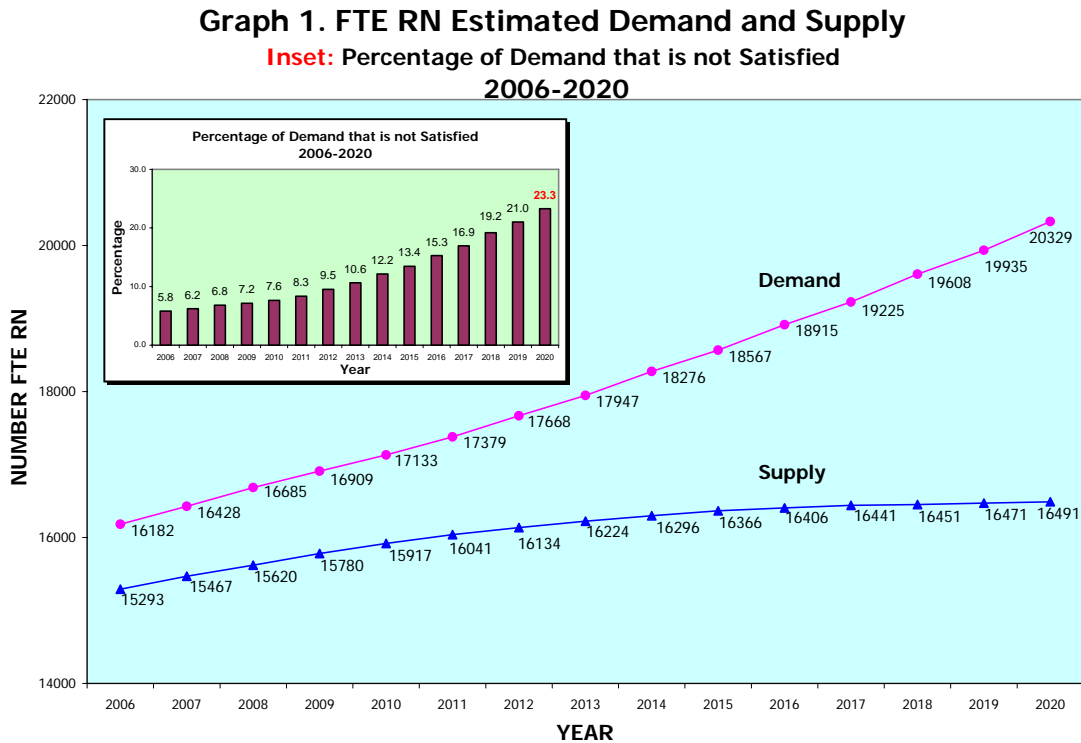
The Potential RN population, the participation rate, and the FTE equivalent rate are themselves dependent upon age and education level. Hence, the NSM keeps track of the nursing population by age and by education level.

Projections indicate an increase from a supply of 15,293 FTE nurses in 2006 to 16,491 FTE RNs in 2020. This represents an increase in supply of about eight percent over the 15-year period.

Slow growth in the supply of FTE RNs occurs for several reasons. The main drivers, however, are the aging of the RN supply and limited replacement with new nurses. In the year 2000, a relatively large percentage of nurses were ages 40 to 49. By 2015, this large segment of the labor market will be in the 55-64 age bracket. Most of these nurses will either work part time or leave the labor market altogether. This will decrease the supply of nurses.

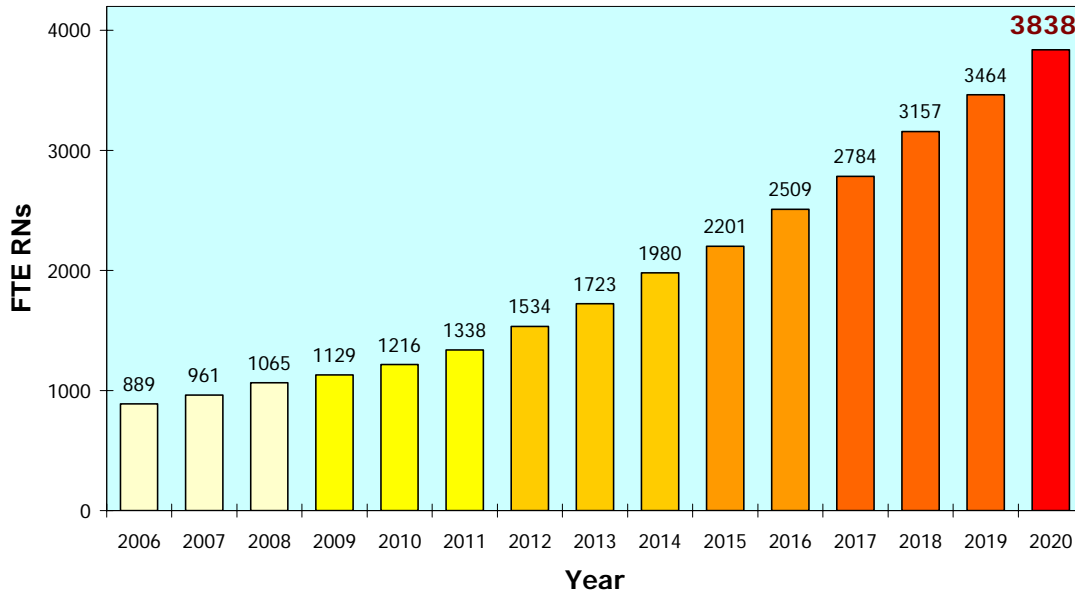
IV. Comparing RN Supply and Demand

The analysis and comparison of the NDM and NSM models establish what will be the estimated shortage of FTE RNs per year if additional policies are not implemented in Nebraska in the short term (Graph 1).



The shortage grows from 889 FTE RNs in 2006 to over 3,800 FTE RNs in 2020 (Graph 2). In relative terms, the market goes from not filling about six percent of demand to not meeting over 20 percent of demand.

**Graph 2. Estimated Shortage of FTE RNs in Nebraska
2006-2020**



V. Policies to impact RN shortages

Factors influencing demand:

One way to reduce the shortage is to slow the rate of demand growth. The steady increase in growth is fueled by Nebraska's aging population and its relatively nursing intensive health care needs. Clearly is not possible to change the state's demographic trends. Instead, it may be possible to change the number of FTE nurses required to care for an aging population.

Factors influencing Supply:

Several factors influence the supply of RNs. A number of major factors are addressed in the following subsections:

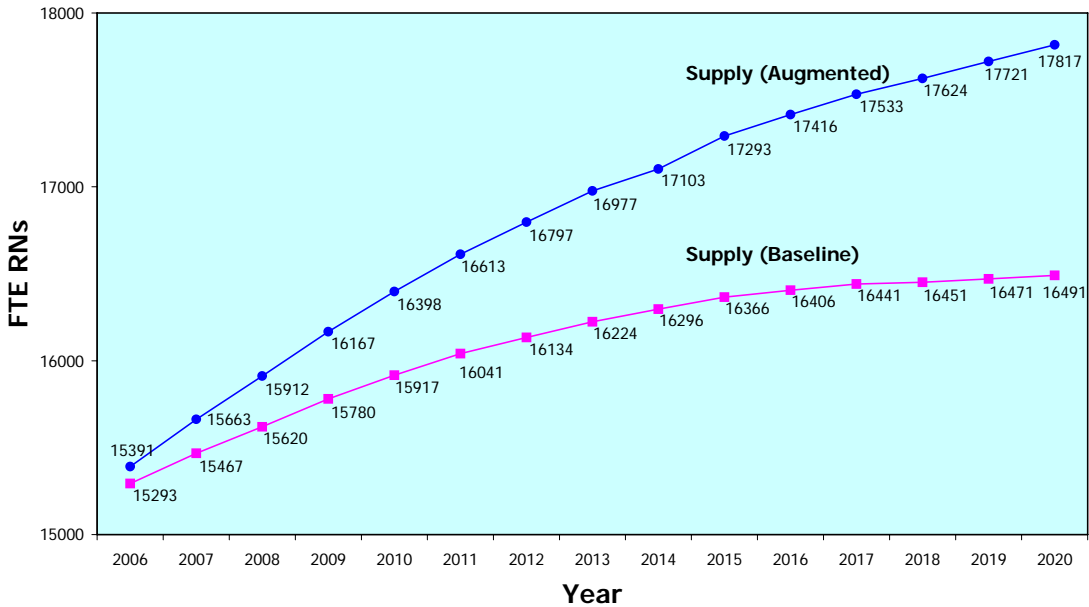
Migration

According to the NSM, Nebraska loses about 100 RNs every year due to net out-migration from the State. Migration typically occurs among younger nurses. Hence policies that discourage out-migration and encourage in-migration would help keep a larger and younger RN workforce in the State.

To explore the impact that migration policies may have, out-migration rates are reduced ten percent and in-migration rates are increased ten percent. Reducing out-migration rates and increasing in-migration rates clearly increases the supply of FTE RNs and reduces the predicted shortage. Compared to the baseline model, reducing out-migration rates and increasing in-migration rates reduces the year 2020 shortage from 3,898 to 2,512 FTE RNs, or by about 35

percent (Graph 3). The benefit of a policy to stimulate net in-migration is that its effects are cumulative over time.

Graph 3. Supply of FTE RNs by Changing Policies in Migration 2006-2020



Education

The NSM’s background research shows that nurses with advanced degrees tend to stay in the labor market longer and more likely to work full time than their less educated counterparts. The NSM assumes that the number of nurses upgrading their education is constant at the number that upgraded in the year 2000.

Results of the NSM show that upgrading education would have no impact on the projected FTE RN shortage. This occurs for several reasons. The number of nurses that upgrade is small. Nurses also generally upgrade at relative young ages. By the year 2020, most of the nurses with higher degrees are still in mid-career, a time when most nurses are working full time. Hence their change in education status has little impact on the market as a whole.

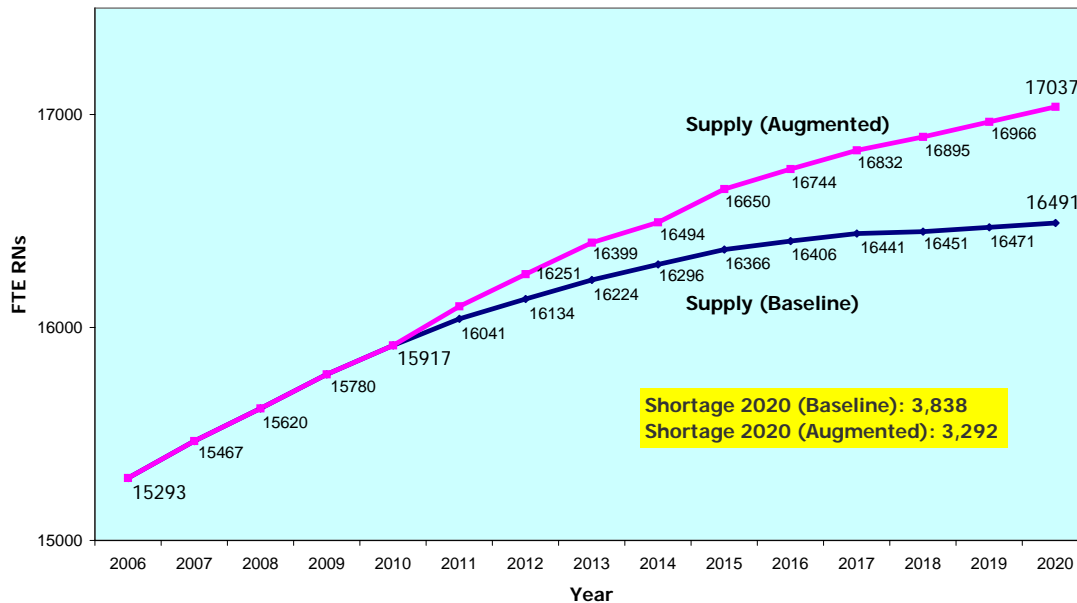
Attrition

Attrition is the percentage of nurses that permanently leave the labor market at a given age. At ages 60 and 61, about five percent of RNs are leaving the work force each year. At ages 63 and 64, nearly seven percent of RNs are leaving the work force. Almost a quarter of nurses ages 62 or 65 and older leave the market each year. These attrition rates imply that if there are 100 nurses in the labor market starting at age 62, only about 50 will remain by the time they reach 66. Attrition reduction policies will not be extremely successful because they impact only a relatively small percentage of nurses that are near the end of their careers.

New graduates

To examine the impact that increases in nursing school graduates will have on the FTE RN supply, the number of nurses that are expected to graduate in any year is increased by 10 percent. Since it will take time to educate these new nurses, it is assumed that the increased supply of new graduates will not start into the market until the year 2010.

**Graph 4. Additional Supply of FTE RNs
by New Graduates
2006-2020**



The impact of increasing nursing school graduates is shown in Graph 4. As more new nurses join the labor market, the shortage is slowly reduced. Eventually it is reduced by about 14 percent.

FTE Rate

The FTE rate measures the percentage of the RNs at any age that work full time as opposed to part time. Each full-time RN is counted as one FTE. Each part-time RN is counted as one half of an FTE. An increase in the FTE rate would increase the percentage of nurses working full time and increase the supply of FTE RNs.

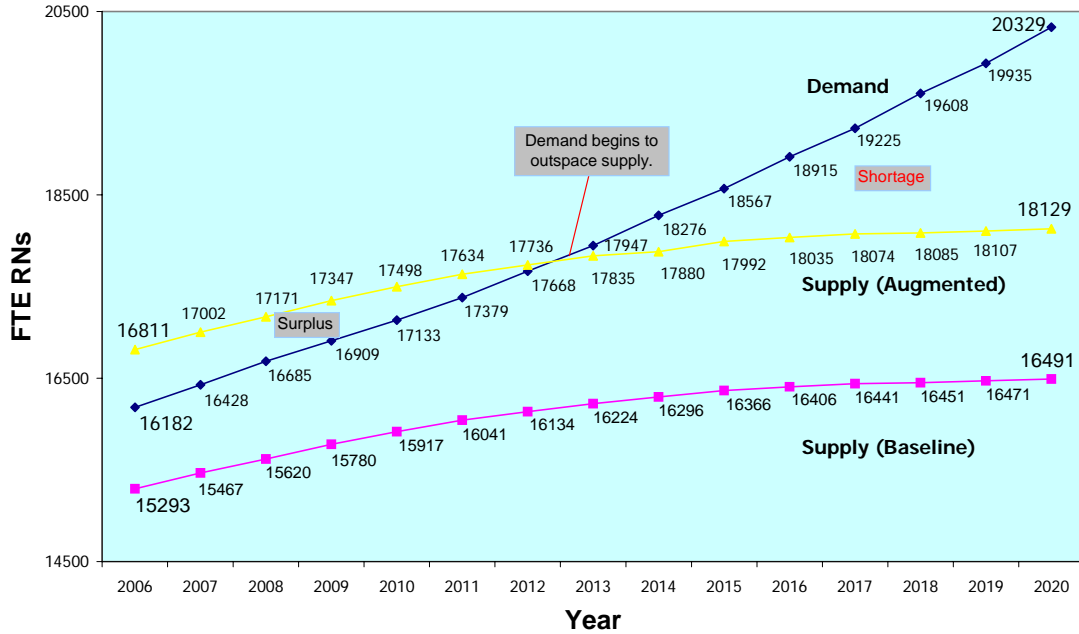
To examine the impact of getting a greater percentage of nurses to work full time, the FTE rate at each age is increased by ten percent. At some ages, especially for younger nurses, the percentage of nurses working full time is nearly 100 percent. Therefore, as the FTE rate is increased, it is constrained to be no higher than 100 percent.

Graph 5 shows the results of increasing the FTE rate. It has a significant and immediate impact on the FTE RN supply. Through 2012 the shortage is completely removed. But since it is not a policy that cumulatively increases the labor pool, the size of the impact remains relatively the same over time. As a consequence, by 2013, demand begins to outpace supply and a shortage returns. Over time, as supply remains static and demand grows, the shortage increases. By 2020, the reduction in the shortage is down to only 43 percent.

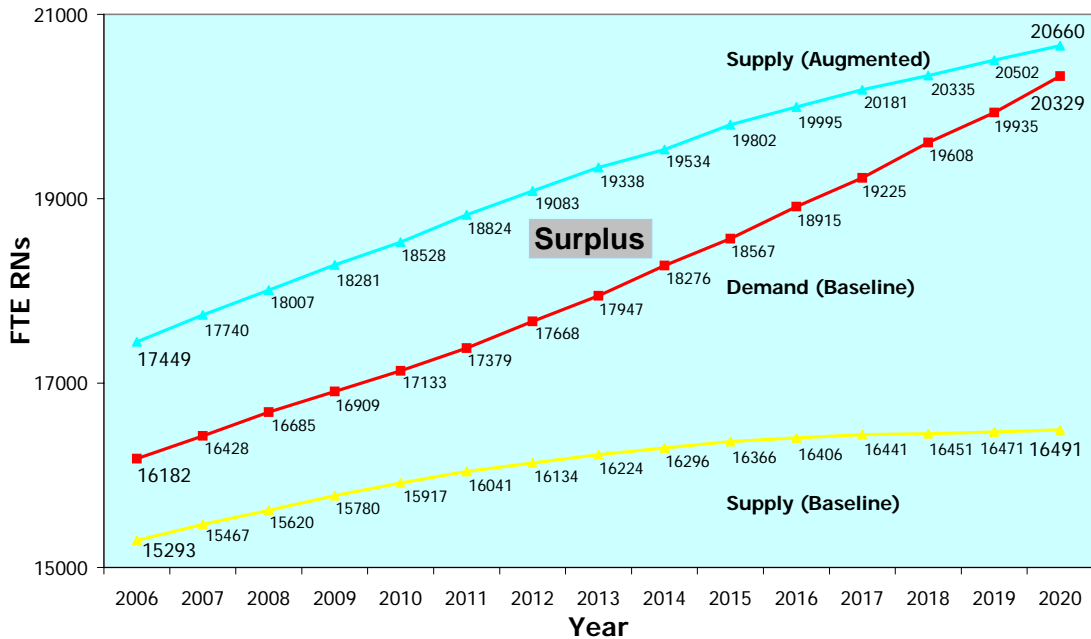
Cumulative Policies

Graph 6 shows the cumulative effects of instituting all of the supply enhancing policies previously discussed. This includes reducing net-out migration, delaying retirements, having more nurses work full time, and attracting new nurses on the market. The cumulative effects are substantial. The shortage is eliminated through the year 2020.

**Graph 5. Effects of Increasing FTE Rates
2006-2020**



**Graph 6. Cumulative Policies for FTE RNs Supply
2006-2020**



VI. The LPN Demand Model

The Nursing Demand Model also projects the demand for licensed practical nurses (LPNs). It uses a three-step process to predict annual demand for FTE LPNs through the year 2020.

1. The model estimates the number of people requiring care in five different health care settings (short-term hospitals, long-term hospitals, nursing care, home health care, and other settings).

2. The model estimates the FTE LPNs required per capita in each setting.
3. The last step multiplies these two figures to project LPN demand.

Graph 7 shows the model's projections for FTE LPN demand in Nebraska from 2006 through 2020. Projections increase from a demand of just under 6,000 FTE LPNs in 2006 to 7,680 FTE LPNs in 2020. This represents an increase in demand of about 28 percent. This strong growth in the demand for FTE LPNs is mainly a result of the aging of Nebraska's population and their relatively more care-intensive needs.

VII. LPN Supply

Unfortunately, there is no LPN supply model that can be used to predict supply in Nebraska. Therefore, a more rudimentary process will be used to estimate the supply of LPNs. First, data from Nebraska LPN survey will be used to estimate a supply of LPNs in the year 2002. Then rates of change in RN supplies will be applied to that figure to estimate LPN supply in the years 2006 through 2020.

The growth rate in the supply of RNs is used to estimate the growth in LPN supply. Between 2002 and 2006, supply grew by about 4.6 percent, or a little over one percent annually. Between 2006 and 2020, the annual rate of growth ranged between 1.14 and 0.06 percent. Multiplying the year 2002 supply by the growth rates gives the implied supplies. Supply increases from 5,506 LPNs in 2006 to 5,937 in 2020 (Graph 7).

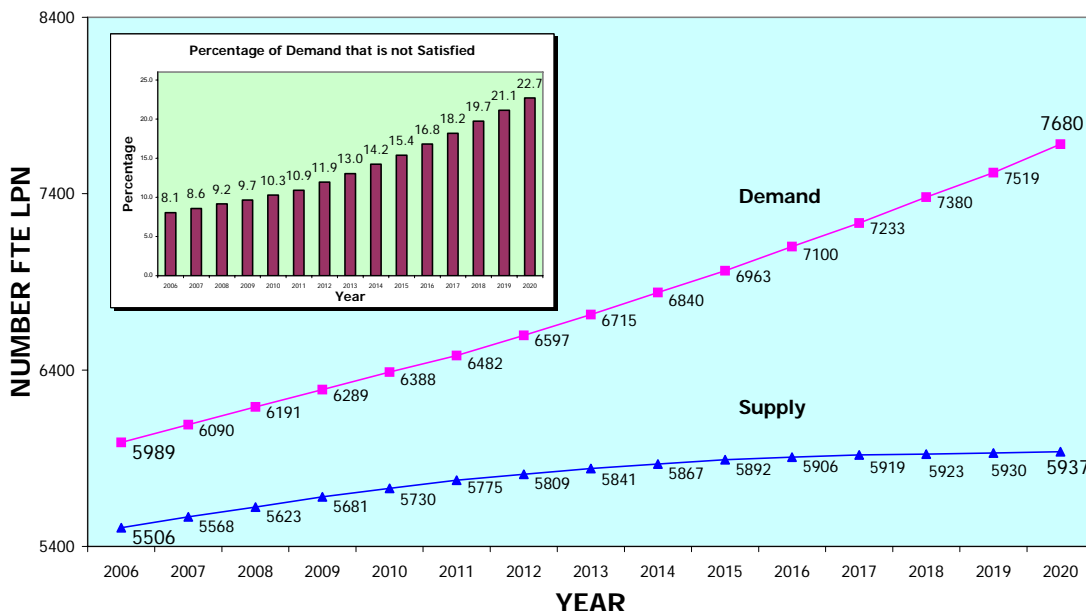
VIII. Comparing LPN Supply and Demand

The shortage grows from 483 FTE LPNs in 2006 to over 1,700 FTE LPNs in 2020. In relative terms, the market goes from not filling about eight percent of demand to not meeting 23 percent of demand (Graph 7).

Graph 7. FTE LPN Estimated Demand and Supply

Inset: Percentage of Demand that is not Satisfied

2006-2020



IX. Discussion and Conclusions

The steady increase in nursing demand is fueled by Nebraska's aging population and its relatively nursing intensive health care needs. There are several measures that may increase the number of RNs and LPNs in the market and reduced and/or eliminate the nursing shortage:

1. Reducing out-migration rates and increasing in-migration rates clearly increases the supply of FTE RNs and reduces the predicted shortage.
2. Increasing the number of new graduates also increases the supply of FTE RNs and LPNs, but only in the mid-long-term.
3. Increasing the FTE rate showed the most prominent measure in reducing the nursing shortage in the short-term.
4. Cumulative policies, such as the combination of reducing net-out migration, increasing FTE rates, and attracting new nurses to the market, showed that the nursing shortage could be eliminated.

Cumulative policies are the most effective way to overcome the nursing shortage, rather than isolated policies. The policies that are effective in the short-term (i.e. increasing FTE rates) fail in the long-term, because the growth they cause eventually fails to keep pace with the demand, and as a consequence, the nursing shortage returns.

X Recommendations

Several actions can be taken to prevent projected shortages in FTE RNs and LPNs over the next 15 years. Short-term shortages can be reduced or eliminated if greater participation can be coaxed from the existing supply of RNs and LPNs. This means delaying retirements, keeping more RNs and LPNs in the profession and convincing a greater percentage to work full time rather than part time.

At the same time, the supply of RNs and LPNs has to be increased. Since this will likely be a slow building process, it should start soon to meet projected shortages into the next decade. The supply can also be increased by reversing net out-migration trends, by getting more applicants into schools, and by increasing graduation rates.

Care should be taken in adjusting wages in these two markets. The markets are connected by relative wages. Increasing wages for RNs, for example, will increase the supply of RNs and likely decrease the supply of LPNs as current and future LPNs opt into the RN market. It will also decrease the demand for RNs and increase the demand for LPNs. The overall impact will be to help alleviate the RN shortage but exacerbate the shortage in the LPN market. A more reasonable policy may be to raise wages for RNs, LPNs and Aides simultaneously so as not to disrupt relative wages across the markets.

APPENDIX

The Nursing Demand Model (NDM) Factors considered in the Nursing Demand Model

Number of People Requiring Care

U.S. Census Bureau population projections form the basis for estimating the number of people requiring care in each health care setting. These projections are by age group, sex and rural/urban setting. The NDM then converts population projections into numbers of people needing care in each of the twelve care settings. Historic health care experience is used to determine the usage of health care facilities by people of different ages, sexes and urban/rural settings. These figures are then adjusted for trends in the health care market environment, economic conditions, demographics and geographic location.

The factors affecting numbers of patients in each health care setting are shown in Table 1. A negative sign (--) indicates that all else equal, an increase in that factor will decrease the number of people using that health care environment. For example, an increase in the percentage of the population in HMOs will decrease the number of people making in-patient visits to hospitals. A positive sign (+) indicates that an increase in that factor will increase the number of people using that health care environment, all else equal. For example, an increase in the percentage of hospital surgeries that are performed as outpatient surgeries will increase the number of people making out-patient visits to hospitals.

Table 1
Factors Affecting Numbers of Patients in Health Care Settings

	Short-Term Hospital			Long-Term Hospital	Nursing Facility	Home Health
	In-Patient	Out-Patient	ER			
Health Care Environment						
HMO Usage	(--)		(--)		(--)	(+)
Percent Hospital Surgeries as Outpatient Surgeries	(--)	(+)				(+)
Economic Conditions						
Population Uninsured				(--)	(--)	
Population Medicaid Eligible	(+)	(+)	(+)	(+)		(+)
Per Capita Income					(+)	
Demographics						
Population Non-White		(+)		(+)		
Population Hispanic			(--)			
Geographic Location						
Percent Urban	(--)	(+)		(--)	(--)	
West-North-Central			(--)			

Table 1 is important because it indicates the variables that can be influenced to affect nursing demand. Increasing Medicaid eligibility, for example, increases the population that uses a variety of health care facilities and, therefore, the demand for nursing in a variety of settings. HMO usage rates, on the other hand, decrease nursing demand.

FTE RNs per Capita

The second step in estimating the demand for FTE RNs is to calculate the required FTE RNs per capita in each health care setting, also referred to as staffing intensity. The nurse staffing intensity measures are shown in Table 2, below. Typically staffing intensity is measured either as FTE RNs required per 1,000 patient units or as FTE RNs per 10,000 in population. For nurse educators, staffing intensity is measured as a constant number of educators per RN.

In the first seven settings shown in Table 2 (inpatient, outpatient and emergency care in a short-term hospital; long-term hospital; nursing facility; home health; and physicians' offices), nurse staffing intensity is determined by regressing historic staffing intensities on factors reflecting the health care environment, economic conditions, health and acuity, and geographic location. In the final five settings shown in Table 2 (occupational health, schools, public health, other settings, nurse education) the ratio of FTE RNs per unit of population is assumed to remain constant over time, based on 1996 usage patterns.

Table 2
RN Staffing Intensity by Health Care Setting

Setting	RNs
Short-term Hospitals	
Inpatient	RNs/1,000 inpatient days
Outpatient	RNs/1,000 outpatient days
Emergency	RNs/1,000 ER visits
Long-term/Psychiatric/Other Hospitals	RNs/1,000 inpatient days
Nursing Facilities	RNs/resident
Home Health	RNs/1,000 Household visits
Physicians' Office	RNs/10,000 population
Occupational Health	RNs/10,000 population age 18-64
Schools	RNs/10,000 population age 5-17
Public Health	RNs/10,000 population
All Other Settings	RNs/10,000 population
Nurse Education	RN educators/total RNs

For the seven health care settings in the top of Table 2, the factors affecting staffing intensity are shown in Table 3, below. A negative sign (-) indicates that an increase in that factor will decrease staffing intensity, all else equal. For example, an increase in the ratio of RN to LPN wages will decrease the number of FTE RNs per 1,000 in-patient visits to hospitals. A positive sign (+) indicates that an increase in that factor will increase the staffing intensity, all else equal. For example, an increase in the Medicare payment per home health visit will increase the number of FTE RNs per 1,000 home health visits.

Table 3 is important because it indicates the variables that can be influenced to affect staffing intensity and, consequently, nursing demand. Increasing the percentage of hospital surgeries that are performed on an outpatient basis, for example, increases staffing intensity and, therefore, the demand for nursing in outpatient settings. An increase in RN wages relative to LPN wages, on the other hand, decreases nursing demand.

It is important to note that the NDM uses relative wages to determine nursing demand. For example, if wages for nurses, LPNs and nursing assistants all rise by ten percent, there would be no impact on nursing demand. However, if nurse wages rose by a greater percentage than LPN or aide wages, nursing demand would decline in some health care settings as relatively less expensive LPNs and aids are substituted for nurses.

Table 3
Factors Affecting RN Staffing Intensity in Health Care Settings

	Short-Term Hospital		ER	Long-Term Hospital	Nursing Facility	Home Health	Physician Offices
	In-Patient	Out-Patient					
Health care Environment							
RN/LPN Wage	(--)			(--)		(--)	(--)
HMO Usage	(+)	(+)				(+)	(--)
Medicare Payment/ Home Health Visit						(+)	
Medicaid Nursing Facility Daily Rate					(+)		
Percent Hospital Surgeries as Outpatient Surgeries	(+)						
Economic Conditions							
Population Uninsured	(--)			(+)			(--)
Population Medicaid Eligible			(--)		(--)		
Per Capita Income							(+)
Health/Acuity							
Mean Population Age							(+)
Acuity					(+)		
Geographic Location							
Percent Urban	(+)	(+)		(--)			

FTE Nursing Demand

The final step estimates FTE RN demand. The demand is calculated as the units of health care usage in each setting multiplied by FTE RNs per unit of health care usage. For example, if there are 2.6 million outpatient hospital visits estimated for a year and there is one FTE RN per 1,000 visits, expected demand in that health care setting would be 2,600 FTE RNs.

Making the Model Nebraska Specific

Most of the variables in the model reflected Nebraska’s nursing demand experience. However, there were a few that required adjustment.

Population

The U.S. Census Bureau publishes population projections by year, age group and sex to the year 2020. The age groups are 0-4, 5-17, 18-24, 35-44, 45-64, 65-74, 75-84, and 85+ years old. The Census projections were made in 1996 and again in 2003. The NDM creators adjusted the 1996 Census projections so they pass through actual census population counts for the year 2000.

The Census Bureau also publishes population estimates for the years 2000 through 2004. The NDM projections are compared to Census population estimates for those four years. Comparison shows that the NDM projections are, on average, about five percent too high for men age 65-74 and about five percent too low for men age 85 and over. All other NDM projections are consistent with Census data. The NDM projections for these two groups are adjusted to reflect actual population experience in Nebraska.

RN Usage

The NDM predicts FTE RN usage from 1996 through 2020. In its default setting, the model calibrates its predictions to actual nursing demand in the year 2000. Walburn and Kelly have

collected nursing demand data for Nebraska in the year 2002.¹ Adjustments are made to the NDM to calibrate to 2002 demand.

The NDM assumes a nurse is one FTE equivalent if that nurse works 30 or more hours per week. Nurses working anything less than 30 hours are treated as one half of an FTE. Walburn and Kelly show the number of nurses and the number of hours they work broken into ten-hour incremental blocks. According to their survey results, approximately 77 percent of Nebraska's nurses surveyed worked full time for one FTE each and the remaining 23 percent worked part time for one half of one FTE each. These figures are shown in Table 4, below.

Table 4
Adjusting the NDM to Reflect Nebraska FTE RNs in 2002

Percent of surveyed Nebraska nurses working full time (1 FTE)	77%
Percent of surveyed Nebraska nurses working part time (1/2 FTE)	23%
Nebraska nurses working in positions requiring an RN license in 2002	16,855
Full time RNs (1 FTE each)	12,949
Part time RNs (1/2 FTE each)	3,906
Implied Nebraska FTE RNs working in positions requiring an RN license in 2002	14,902
Percent of RNs working in hospital settings	55%
Percent of RNs working in non-hospital settings	45%
FTE RNs working in hospitals	8,241
Adjustment for demand shortage	7%
FTE RN demand from hospitals	8,818
FTE RN demand from non-hospital settings	6,661
Actual Nebraska 2002 FTE RN demand	15,479
NDM Nebraska 2002 FTE RN demand	15,200
Adjustment	1.84%

Walburn and Kelly show that in 2002 16,855 nurses worked in nursing positions that required an RN license. Assuming that 77 percent of the 16,855 nurses worked full time and the other 23 percent worked part time, this implies 12,949 working full time for one FTE and another 3,906 working part time for ½ FTE each. Adding implies that Nebraska had 14,902 FTE RN positions in 2002.

The NDM assumes that there was a shortage of nurses to work in hospital settings in the late 1990s and into the 2000s. It assumes that actual demand for FTE RNs in hospital settings was seven percent higher than observed employment. Data from the Walburn and Kelly study show that about 55 percent of nurses were employed in hospitals. Multiplying the 14,902 FTE RNs by 55 percent and adding seven percent estimates the demand in hospitals to be about 8,818 FTE RNs. The remaining 45 percent represents demand in non-hospital settings, or 6,661 FTE RNs. Adding demand in both settings indicates that Nebraska's actual 2002 demand was about 15,479 FTE RNs.

¹ Walburn, Cheryl and Charlene Kelly, *Nebraska RN Survey Report 2003*, Nebraska Health and Human Services, 2003.

The NDM predicts Nebraska's 2002 demand for FTE RNs as 15,200, an underestimate of 1.84 percent. The NDM is adjusted to account for this underestimate.

Nursing Supply Model (NSM)

Factors considered in the Nursing Supply Model

RN Population

The NSM begins by estimating the nursing population in each year. To do this, it starts with the population from the previous year. It then determines the net migration of nurses in to or out of the state, changes in education, attrition, foreign immigration and new graduates into the nursing labor pool.

Starting Population Pool

The starting population is the number of registered nurses in the state in the year 2000. This information is disaggregated by age and education.

Migration

To determine net migration, the model uses pre-estimated probabilities of immigration into or emigration out of each state. The probabilities depend on an RN's age and education level. Older or more educated nurses tend to be more stable than younger or less educated nurses. The actual number of immigrants into or emigrants out of a state in a particular year is the nursing population times the probability of immigration or emigration. Net migration is measured as the number of nurses entering the state minus the number of nurses leaving the state.

Education

The model predicts many changes in labor market supply based on education. Hence, it has to predict changes in education among the nursing pool. It assumes that all nurses earning a bachelor's degree are new entrants into the market. Only nurses earning master's degrees or higher are assumed to be current labor market participants upgrading their education. To predict how many nurses will earn advanced degrees, the model starts with pre-estimated probabilities of upgrading by current education and age. It applies those probabilities to the nursing labor pool to estimate the number of nurses that earn advanced degrees.

Attrition

Attrition is a permanent departure from the labor market. To estimate attrition, the model uses pre-estimated probabilities that a nurse with a specified education and age will leave the labor market. It applies the probabilities to the nursing labor pool to estimate the number of nurses that actually exit each year.

Foreign Immigration

The model's statistics show that there is almost no foreign immigration into the Nebraska RN labor market. This potential source of RN supply is insignificant.

New Graduates

The NSM assumes that every one percent change in the pool of potential applicants for nursing schools as compared to the pool that existed in the year 2000 results in a one percent change in the number of nursing school graduates as compared to the number of graduates in the year 2000. The pool of potential applicants to nursing schools is the number of women age 20 to 44. For example, if the proportion that women age 20 to 44 make up of Nebraska's population falls

by two percent in the year 2010 as compared to 2000, the number of graduates from nursing programs will fall by two percent in 2010 as compared to the number that graduated in 2000.

RN Participation

Participation measures the probability that a nurse will be either employed or looking for work. The model uses pre-estimated national participation rates by age and education. For example, there may be a 96 percent chance that a 30 year old with a Masters Degree is participating in the RN labor market and only a 30 percent chance that a 64 year old with a diploma is participating. The NSM applies the participation rates to the nursing labor pool to estimate the number of nurses that actually participate in the labor market each year.

RN FTE Equivalentents

FTE equivalent rates estimate the proportion of nurses that work full time (for one FTE) and the proportion that work part time (for ½ FTE). The NSM creators used national data stratified by age and education to pre-estimate FTE RN equivalent rates. The model multiplies the full time and part time proportions to the nursing labor pool to estimate the supply of FTE RNs each year.

FTE Nursing Supply

The model multiplies the population of nurses by participation rates and FTE RN equivalent rates to estimate the FTE RN supply in each year.

Making the Model Nebraska Specific

Most of the variables in the model reflected Nebraska's nursing supply experience. Two, however, required adjustment.

Initial Number of Nurses

Walburn and Kelly have collected nursing supply data for Nebraska in the year 2000.² They estimate that there were 19,580 registered nurses in the state. The NSM shows there were 18,571 registered nurses in the state in 2000. Hence, the NSM underestimates by 5.4 percent. The year 2000 beginning nurse population is increased by 5.4 percent to make the starting data more reflective of Nebraska.

Initial Number of Graduates

The nursing supply model uses an initial value of number of new combined Associate and Diploma graduates, as well as Bachelors graduates. The first row of Table 5 (ex 6) shows that the model assumed there were 259 Associate and Diplomas and 427 BSNs. The next five rows show Nebraska's actual graduation experience in the years 2000 through 2004. The averages over that period are 294 and 487. These figures are substituted into the model.

² Walburn, Cheryl and Charlene Kelly, *Nebraska RN Survey Report 2001*, Nebraska Health and Human Services, 2001.

Table 5
Number of Nurse Graduates from Nebraska Colleges and Universities

	Number of Associate and Diploma Degrees	Number of Bachelor's Degrees
Model Default	259	427
Nebraska Actuals		
Year		
2000	268	486
2001	260	443
2002	314	493
2003	300	463
2004	<u>326</u>	<u>554</u>
Average	294	487

The NSM uses the population of women aged 20 to 44 as the potential pool of applicants to nursing schools. This clearly leaves men out of the market. However, the model uses only relative changes in the population of women in this age group to predict changes in nursing school enrollments. As long as the male population increases at the same relative rate as the female population, there should be no inconsistency in estimating the nurse population.

Nursing Demand Model (NDM-LPN)

Factors considered in the NDM (LPNs)

Number of People Requiring Care

The model develops the number of people requiring care in five health care settings as a function of demographics. The settings are short-term hospitals, long-term hospitals, nursing care, home health care and other settings. Fewer settings are used than for predicting RN demand. However, data from Walburn and Kelly indicate that two-thirds of LPNs were employed in either long-term care facilities, hospitals, or public/community/home health. These employment categories match well with the five settings used in the model.³ Probably the only category missing from the demand model that Walburn and Kelly show as significant is LPN employment in physicians' offices. This LPN demand is combined into the "All Other Settings" category.

As with the nursing demand model, U.S. Census Bureau population projections form the basis for estimating the number of people requiring care in each health care setting. These projections are by age group, sex and rural/urban setting. The model then converts population projections into numbers of people needing care in each of the five health care settings. Historic health care experience is used to determine the usage of health care facilities by people of different ages, sexes and urban/rural settings. These figures are then adjusted for trends in the health care market environment, economic conditions, demographics and geographic location.

FTE LPNs per Capita

The second step in estimating the demand for FTE LPNs is to calculate the required FTE LPNs per capita in each of the five health care setting. The LPN staffing intensity measures are shown in Table 6 (ex 16), below. In the first four settings, LPN staffing intensity is determined by regressing historic staffing intensities on factors reflecting the health care environment, economic conditions, health and acuity, and geographic location. For the category "All Other Settings" the

³ Walburn, Cheryl and Charlene Kelly, *Nebraska LPN Survey Report 2004*, Nebraska Health and Human Services, 2004.

ratio of FTE LPNs per unit of population is assumed to remain constant over time, based on 1996 usage patterns.

Table 6 (ex 16)
LPN Staffing Intensity by Health Care Setting

Setting	LPNs
Short-term Hospitals	LPNs/1,000 inpatient days
Long-term/Psychiatric/Other Hospitals	LPNs/1,000 inpatient days
Nursing Facilities	LPNs/resident
Home Health	LPNs/1,000 Household visits
All Other Settings	LPNs/10,000 population

The factors affecting LPN staffing intensities in the first four settings are shown in Table 7 (ex 17), below. A positive sign (+) indicates that an increase in that factor will increase staffing intensity, all else equal. For example, an increase in the ratio of RN to LPN wages will increase the number of FTE LPNs per 1,000 in-patient and long-term hospital visits. A negative sign (--) indicates that an increase in that factor will decrease the staffing intensity, all else equal. For example, an increase in the ratio of LPN to nurse's aide wages will decrease LPN home health visits per 1,000 households.

Table 7 (ex 17)
Factors Affecting LPN Staffing Intensity in Health Care Settings

	Short-Term Hospital	Long-Term Hospital	Nursing Facility	Home Health
Health care Environment				
RN/LPN Wage	(+)	(+)	(+)	
LPN/Aide Wage				(--)
Medicare Payment/ Home Health Visit				(+)
Medicaid Nursing Facility Daily Rate			(+)	
Percent of Hospital Surgeries as Outpatient Surgeries	(+)			
Health/Acuity				
Mean Population Age				(+)
Acuity			(+)	
Geographic Location				
Percent Urban		(+)		

LPN Supply

Unfortunately, there is no LPN supply model that can be used to predict supply in Nebraska. Therefore, a more rudimentary process will be used to estimate the supply of LPNs. First, data from a Nebraska LPN survey will be used to estimate the supply of LPNs in the year 2002. Then rates of change in RN supplies will be applied to that figure to estimate LPN supply in the years 2006 through 2020.

Walburn and Kelly have collected LPN supply data for Nebraska.⁴ They show that in 2002 there were 5,943 LPNs licensed in the state. This figure is shown in Table 19 below. According to Walburn and Kelly's survey results, 98.7 percent of licensed LPNs were either working in a position that required a license or looking for an LPN position. Multiplying these two figures, it implies there were 5,866 licensed LPNs in Nebraska in 2002. Walburn and Kelly show the number of LPNs and the number of hours they worked broken into ten-hour incremental blocks. According to their survey results, approximately 80 percent of Nebraska's LPNs surveyed worked full time for one FTE each and the remaining 20 percent worked part time for one half of one FTE each. These figures are shown in Table 8 (ex 19) as well. Assuming that 80 percent of the 5,866 LPNs would work full time and the other 20 percent would work part time, this implies a supply of 5,262 LPNs in the state in 2002.

Table 8 (ex 19)
LPN FTE Supply in Year 2002

Nebraska LPNs	5,943
Percent either Employed as LPN or Looking for LPN Position	98.7%
Nebraska LPNs Employed or Looking for Employment	5,866
Percent of surveyed Nebraska LPNs working full time (1 FTE)	79.4%
Percent of surveyed Nebraska LPNs working part time (1/2 FTE)	20.6%
Full time LPNs (1 FTE each)	4,657
Part time LPNs (1/2 FTE each)	1,208
Implied Nebraska Supply of FTE LPNs	5,262

⁴ Walburn, Cheryl and Charlene Kelly, *Nebraska RN Survey Report 2003*, Nebraska Health and Human Services, 2003.