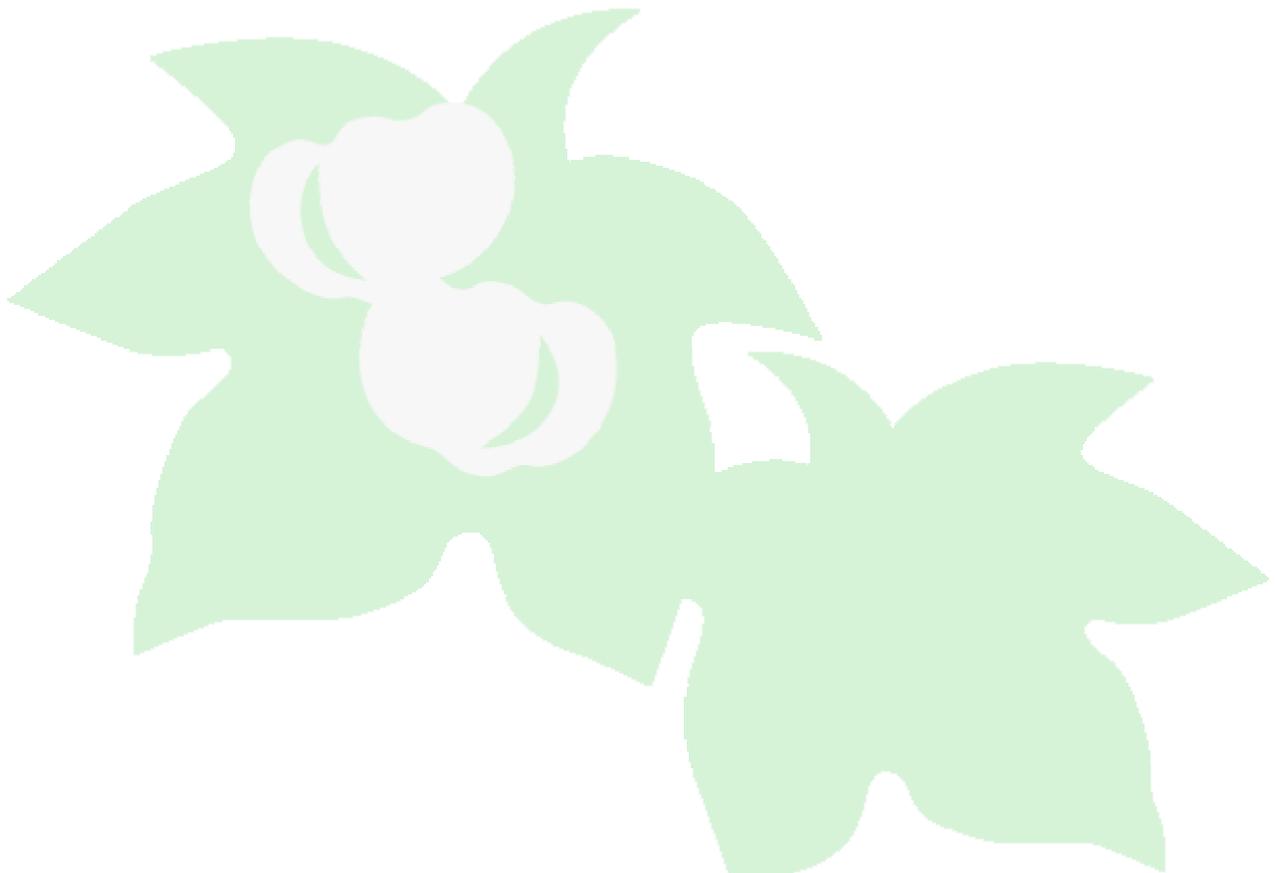**Hawai'i State Center for Nursing**

Projected Registered Nurse Workforce in Hawai'i 2005 - 2020

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Executive Summary

The Hawai'i State Center for Nursing (HSCFN) was established by the Hawai'i State Legislature in 2003 to address nursing workforce issues.
The Center's functions include

> 1) Collect and analyze data;
>
> 2) Prepare and disseminate written reports and recommendations regarding the current and future status and trends of the nursing workforce;
>
> 3) Conduct research on best practices and quality outcomes;
>
> 4) Develop a plan for implementing strategies to recruit and retain nurses;
>
> 5) Research, analyze and report data related to the retention of the nursing workforce.

One of the primary goals of the HSCFN is to establish "*an ongoing system that assists in estimating the future registered nursing workforce supply and demand needs in Hawai'i.*"

In accordance with the mission, the Hawai'i State Center for Nursing is developing and modifying forecasting models utilizing data relevant to the State of Hawai'i to project future nursing needs. Such detailed analysis will:

- Identify and refine elements predictive of nursing supply and demand.
- Evaluate supply-and-demand forecast model options.
- Report on projected supply and demand.
- Identify and suggest data driven policy solutions.

This report: 1) describes the national Nursing Supply Model (NSM) [1] and Nursing Demand Model (NDM); [2] 2) describes the procedures used in updating and adjusting the two independent models to reflect the current Hawaiian workforce environment; 3) provides Hawai'i specific estimates of current supply and

demand; and 4) lists model limitations and 5) potential policy initiatives to reduce the impact of the shortage.

Long range forecasting is described as 'an estimate or prediction of the future'. Forecast data are a best estimate of likely trends and are an essential component of nursing workforce planning. In order to plan future workforce needs, workforce demand requirements and supply availability need to be adequately estimated, and workforce shortages or oversupply conditions need to be predicted. Forecasting requires that past and current trends in the demand for and supply of nursing workforce are carefully assessed. Predictors of levels and trends in demand and supply must be identified and models created that weigh these factors and use them to project future demand and supply. Whether these projections prove to be close to the values observed in the future depends on the degree to which historical trends provide a guide to the future and the influences of unforeseen external factors.

Forecasting workforce demand and supply is a complex endeavor with many factors potentially influencing current and future levels. An adequate forecasting model must take into consideration as many of these factors as possible, and must accurately estimate trends in the factors and the effect they will have on supply and demand in the future. In addition, good forecasting models allow for different future scenarios, since factors such as the economy (affecting supply and demand), the nation's health (affecting demand), funding for nursing education (affecting supply), and retirement rates (affecting supply), can singularly or collectively change direction over time.

In this study, the National Center for Health Workforce Analysis (NCHWA) models are used to forecast the supply and demand of registered nurses (RN) in Hawai'i from 2005 - 2020. Preliminary estimates suggest that demand will grow from a current need for about 8,411 FTE RNs to more than 10,955 over the next 15 years. However, supply is projected to increase from an estimated 7,553 FTE

RNs in 2005 to an estimated 8,286 by 2020. The models indicate that by the year 2020, Hawai'i will have a shortage of approximately 2,669 FTE RNs, or about 24 percent demand shortfall.

Both immediate and long-term policy development is required to address this growing nursing shortage. We need to address the limited educational capacity issues faced by our nursing programs; to attract and ensure educational opportunities for people to the nursing profession. The advantage of such policies is that they add new nurses year after year. Thus, while the increase in any one year may be modest, the cumulative effect can be significant. Other factors such as reducing net annual out-migration and turnover rates; and attracting more people to nursing will have an accumulative effect.

Policies that affect participation within the existing pool of nurses may have a limited long-term impact while increasing the supply of nurses in the short term. Delaying time until retirement, reducing career changes and increasing the percentage of nurses working full time as opposed to part time are examples of such policies.

Data suggests that no individual policy is likely to alleviate the nursing shortage. Rather, eliminating the nursing shortage requires a series of policy initiatives targeted to ensuring nursing supply. The most effective strategy may be one that stimulates supply among existing nursing workforce to address the current shortage and simultaneously increase supply through nursing education to minimize future shortages.

Introduction

In order to plan future workforce needs, workforce demand requirements and supply availability need to be adequately estimated, and workforce shortages or oversupply conditions need to be predicted. Forecasting requires that past and current trends in the demand for and supply of nursing workforce are carefully assessed. Predictors of levels and trends in demand and supply must be identified and models created that weigh these factors and use them to project future demand and supply.

The Bureau of Health Professions (BHPr), part of the Health Resources and Services Administration in the U.S. Department of Health and Human Services, created the Nursing Supply Model (NSM) [1] and the Nursing Demand Model (NDM) [2] to project the national supply and demand of registered nurses (RNs) in the United States. This report discusses these two models as a framework for analyses of data generated by the Hawai'i State Center for Nursing. Results will be used to adjust the models to project future estimates of RN supply and demand in Hawai'i. Data will be presented to forecast the growing shortage of RNs and policy recommendations made that may impact on the shortage over the next fifteen years.

Section I of the report begins by examining nursing supply data using the National Center for Health Workforce Analysis Nursing Supply Model (NSM). Nursing supply is modeled as a function of the changing population of licensed registered nurses, registered nurses participation in the labor market, and their decisions whether to work full or part time. A number of the underlying NSM data elements are adjusted to reflect Hawai'i's environment.

Section II examines nursing demand data. Demand is modeled using the National Center for Health Workforce Analysis Nursing Demand Model (NDM). Demand is linked to Hawai'i's population projections and the health care needs of

individuals in various age groups. A number of the underlying NDM data elements are also adjusted to reflect Hawai'i's environment.

Section III examines the nursing shortage forecasts using gap analysis derived from the NSM and NDM. Some of the major limitations of the models will be highlighted along with policy recommendations that may have an important impact the growing nursing shortage.

Section IV identifies some of the limitations associated with the NSM and NDM.

Section V identifies major drivers of the nursing shortage, and a number of policy recommendations are presented for consideration.

I. The Nursing Supply Model

The Bureau of Health Professions (BHPr), Health Resources and Services Administration in the U.S. Department of Health and Human Services, created the Nursing Supply Model (NSM) [1] to project the national supply of registered nurses (RN) in the United States.

Three predominant measures are used by the NSM to predict the annual supply of registered nurses through to the year 2020. These measures are:

1) RN population, defined as the estimated number of licensed RNs;

2) Active RN supply, defined as the estimated number of licensed RNs participating in the nurse workforce (i.e., employed in nursing); and

3) Full time equivalent (FTE) RN supply, defined as the estimated number of FTE RNs employed in nursing (i.e., RNs employed full time during the entire year are counted as one FTE, while RNs employed part time or for part of the year are counted as some portion of an FTE).

The NSM projects the size of the RN population and then estimates the other two supply measures (i.e., active RNs and FTE RNs) based on projected workforce participation rates.

Other elements of the NSM include:

• **State-level estimates**. The NSM produces independent projections for each of the 50 states and the District of Columbia and aggregates these state-level projections to produce national projections.

• **Inter-state migration**. The NSM tracks the net flow of RNs across states. Some states are consistently net exporters of RNs, while other states are consistently net importers of RNs.

• **Age distribution**. The NSM tracks and reports the RN population by age.

• **Education level**. The NSM tracks and reports RNs by highest education attained using three levels: (1) associate degree or diploma, (2) baccalaureate degree, and (3) RNs upgrading; master's degree or higher.

The potential RN population, the participation rate, and the FTE equivalent rate are themselves dependent on age and education level. Hence, the NSM tracks the nursing population by age and highest level of education.

Factors considered in the Nursing Supply Model

A.   Estimating the Registered Nurse 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 uses pre-estimated probabilities to determine 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.

i.   The Starting Population

The default starting population is the number of registered nurses in the state in the base year 2000. This information is disaggregated by age and education. In the NSM the default base year may be changed.

ii.   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.

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Figure 1.1 Proportion of RNs who Emigrate from Hawai'i

Proportion of RNs who Emigrate from Hawaii
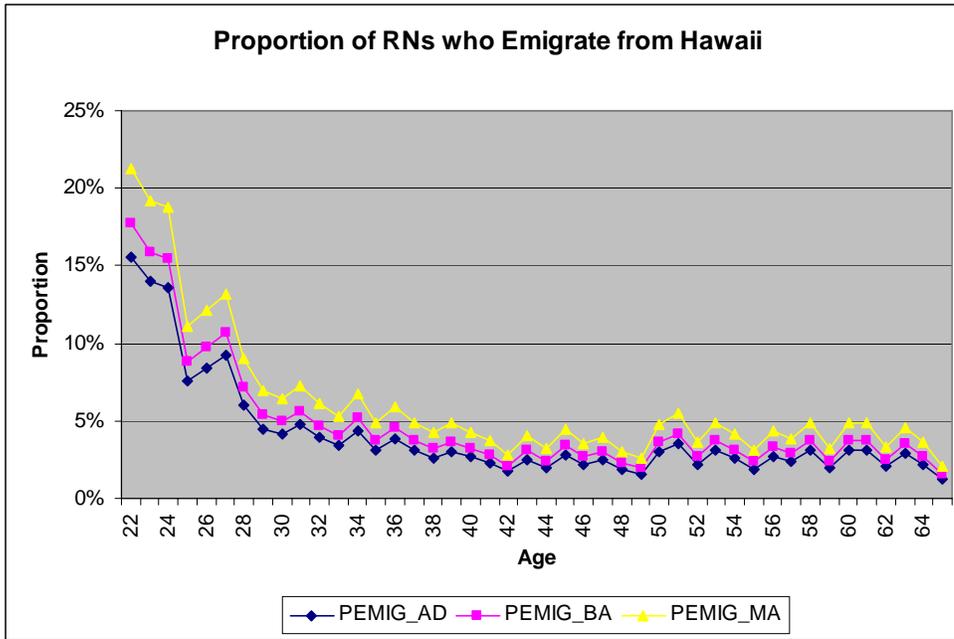
Figure 1.2 Proportion of RNs who Immigrate to Hawai'i

Proportion of RNs who Immigrate to Hawaii
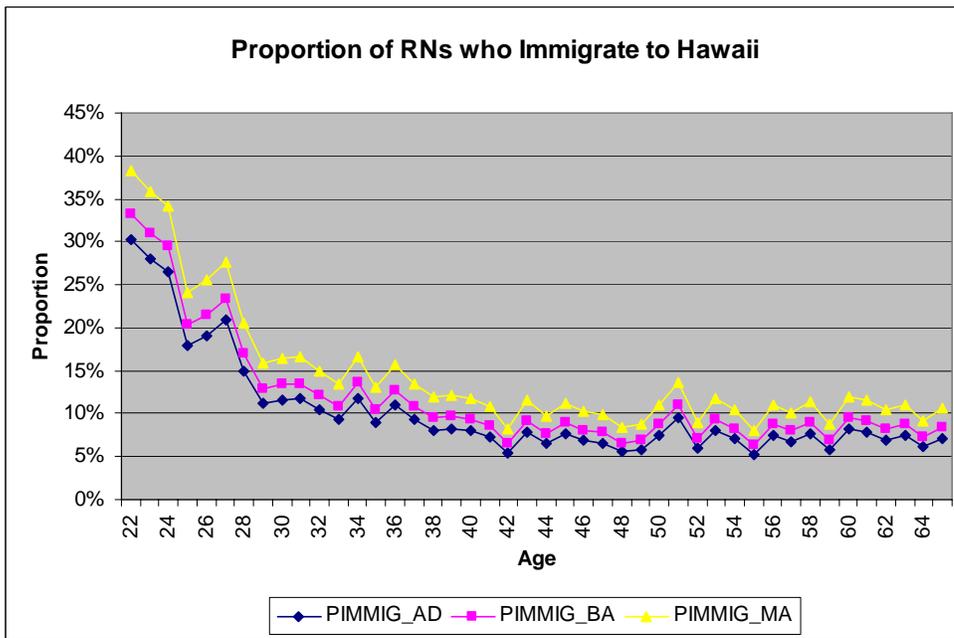
iii. *Education*

The model predicts many changes in labor market supply based on education. Hence, it has to predict changes in education among the nursing pool. The modal assumes that all new graduates earning associate or baccalaureate degrees are new entrants into the market. Licensed RNs earning baccalaureate degrees, master's degrees or higher are assumed to be current labor market participants upgrading their education. The model uses a pre-estimated default number of nurses upgrading and applies those to estimate the number of nurses that earn advanced degrees.

iv. *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 leave the profession each year.

Figure 1.3 Percent Participation Rate by Age
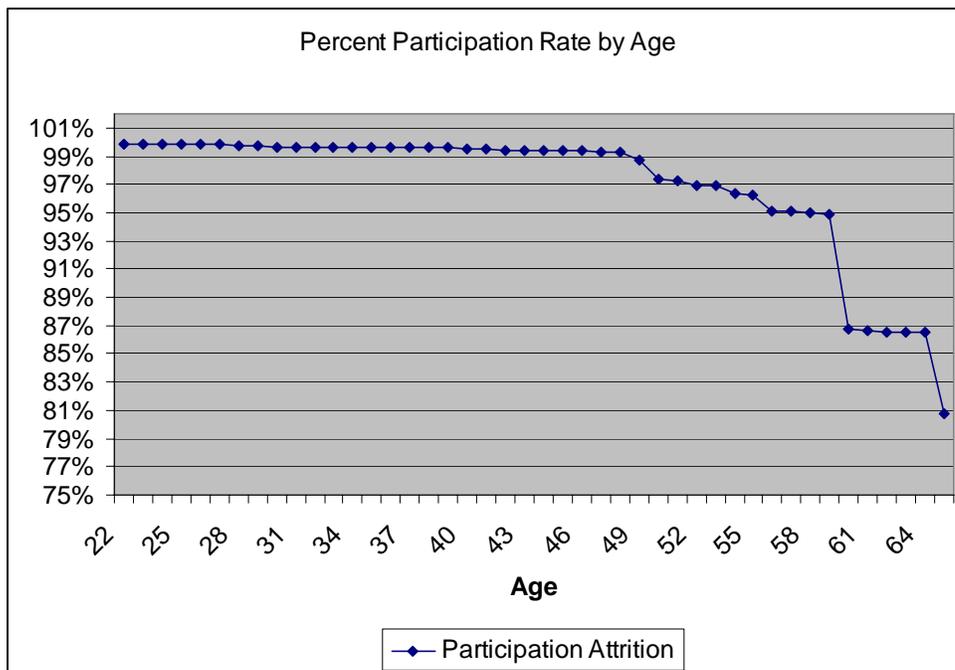
v.   *Foreign Immigration*

The model's statistics show that there is little foreign immigration into Hawai'i's RN labor market. This potential source of RN supply is insignificant.

vi.   *State Population and Potential Pool of Applicants to Nursing Programs*

The default NSM uses US Census data to determine state population projections and the population of women aged 20 to 44 as the potential pool of applicants to nursing programs and 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 program enrollments. As long as the male population increases at the same relative rate as the female population, it is assumed there is no inconsistency in estimating the nurse population.

The NSM assumes that every one percent change in the pool of potential applicants for nursing programs 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 of women age 20 to 44 that make up Hawai'i's population were to fall by two percent in the year 2010 as compared to 2000, the number of graduates from nursing programs would fall by two percent in 2010 as compared to the number that graduated in 2000.

Thus, a reduction in projected growth in Hawai'i's population may impact the future number of graduates from nursing programs. As shown in Table 1.1 (the default population projection and percent of women age 20 – 44) and Table 1.2 (the adjusted population projection and percent of women age 20 – 44).

Table 1.1 Default Population Projection & Percent of Women aged 20-44*

Year	Hawai'i estimated Population	Estimated number of women 20 - 44 yrs of age	Percent of Total population
2000	1,211,537	219,176	18.1
2001	1,226,943	219,501	17.9
2002	1,242,894	220,066	17.7
2003	1,259,296	220,896	17.5
2004	1,276,291	221,850	17.4
2005	1,293,601	223,027	17.2
2006	1,311,746	224,424	17.1
2007	1,330,301	226,032	17.0
2008	1,349,287	227,972	16.9
2009	1,368,605	230,265	16.8
2010	1,388,480	233,071	16.8
2011	1,408,856	236,858	16.8
2012	1,429,874	240,638	16.8
2013	1,451,410	244,603	16.7
2014	1,473,620	248,624	16.9
2015	1,496,318	252,664	16.9
2016	1,519,704	256,720	16.9
2017	1,543,353	260,936	16.9
2018	1,567,406	265,078	16.9
2019	1,592,010	269,408	16.9
2020	1,617,037	273,622	16.9

* Based on US Census data

Table 1.2 Adjusted Population Projection & Percent of Women aged 20–44**

Year	Hawai'i estimated Population	Estimated number of women 20 - 44 yrs of age	Percent of Total population
2000	1,211,537	219,176	18.1%
2001	1,226,943	219,501	17.9%
2002	1,242,894	220,066	17.7%
2003	1,259,296	220,896	17.5%
2004	1,261,600	211,954	16.8%
2005	1,276,553	211,703	16.6%
2006	1,290,984	211,974	16.4%
2007	1,304,704	212,385	16.3%
2008	1,317,607	212,638	16.1%
2009	1,329,479	212,914	16.0%
2010	1,340,675	213,600	15.9%
2011	1,351,330	214,682	15.9%
2012	1,361,296	215,523	15.8%
2013	1,370,471	216,084	15.8%
2014	1,378,731	216,238	15.7%
2015	1,385,952	215,360	15.5%
2016	1,391,956	214,332	15.4%
2017	1,397,259	213,340	15.3%
2018	1,402,403	212,553	15.2%
2019	1,407,471	211,966	15.1%
2020	1,412,374	211,534	15.0%

** CDC population estimates reflective of population and economic projections for the State of Hawai'i to 2030

vii.   *Registered Nurse Participation*

RN participation measures the probability that a nurse will be either employed or looking for work. The NSM 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 participating in the labor market each year.

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viii. ***Registered Nurse FTE Equivalents***

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.

ix. ***FTE Nursing Supply***

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

x. ***Nursing Supply Model & Hawai'i***

The assumption is that most of the variables in the model reflect Hawai'i's nursing supply experience. A number of variables, however, required adjustment. These variables, including population, were modified to reflect the recent population and economic projection for the state of Hawai'i using CDC data. Nurse graduate numbers from the recent HSCFN 'Education Capacity Survey 2004-05' were used. Policy adjustments include a reduction in retirement age of nurses by 5 years and a 5% increase in faculty to reflect current legislative support to the UH system and adjustments made by private schools of nursing to meet need.

B. Initial Number of Registered Nurses

The NSM projects the supply of licensed registered nurses, participation rates, and full time equivalent (FTE) of registered nurses. These numbers can be adjusted at the state level using a number of different elements found within the model.

C.   Number of Nurses

i.   *Projected Graduate Registered Nurses*

The NSM uses an initial value of the combined Associate and Diploma graduates, as well as pre-licensure BSN graduates. The first row of Table 1.3 shows that the default model assumed that in the year 2005 there were 133 Associate and 212 BSN graduates. The next row shows Hawai'i's actual graduation experience in 2005. These figures are substituted into the model. The default model assumed in the year 2005 there were 39 RNs upgrading to BSN and 46 RNs upgrading to Masters or PhD. Hawai'i's actual graduation numbers included 23 RNS upgrading to BSN and 23 RNS upgrading to MS or PhD. These numbers were added to the model.

Table 1.3 Numbers of Nurse Graduates from Hawai'i Nursing Programs

	Number of Associate Degrees	Number of Bachelor Degrees
Model Default 2005	133	212
Hawai'i (Actual)	140	196
	RNs upgrading to BSN	RNs upgrading to MS or PhD
Model Default 2005	39	46
Hawai'i (Actual)	23	23

ii.   *Changing Projection Assumptions*

The NSM allows RN supply projections to be made using alternate assumptions. Key assumptions about the determinants of the number of new RN graduates and the attrition and labor force participation rates can be changed using the model's policy adjustment features. Previous nursing supply surveys [3] suggest that nurses retire earlier than 65 years of age. To enable retirement patterns to

be simulated, a retirement adjustment was made by shifting attrition rates forward by 5 years. An adjustment was also made to reflect current activities to increase nursing faculty i.e., the Hawai'i Legislature appropriations to public nursing programs and adjustments made by private schools of nursing to meet need. These changes allow the simulations to reflect the number of new RN graduates produced with a 5% increase in faculty.

iii.   Projected Registered Nurse supply

Projections indicate an increase from a supply of 7,553 FTE RNs in 2005 to 8,286 FTE RNs in 2020. This represents an increase in supply of approximately 9.7% over the 15-year period. Figure 1.4 and Table 1.4 illustrate the projections of FTE RNs from 2005 to 2020 are well below both the projected licensed RN population and the active RN supply.

Figure 1.4 Hawai'i RN Supply and Population Projections 2005 to 2020
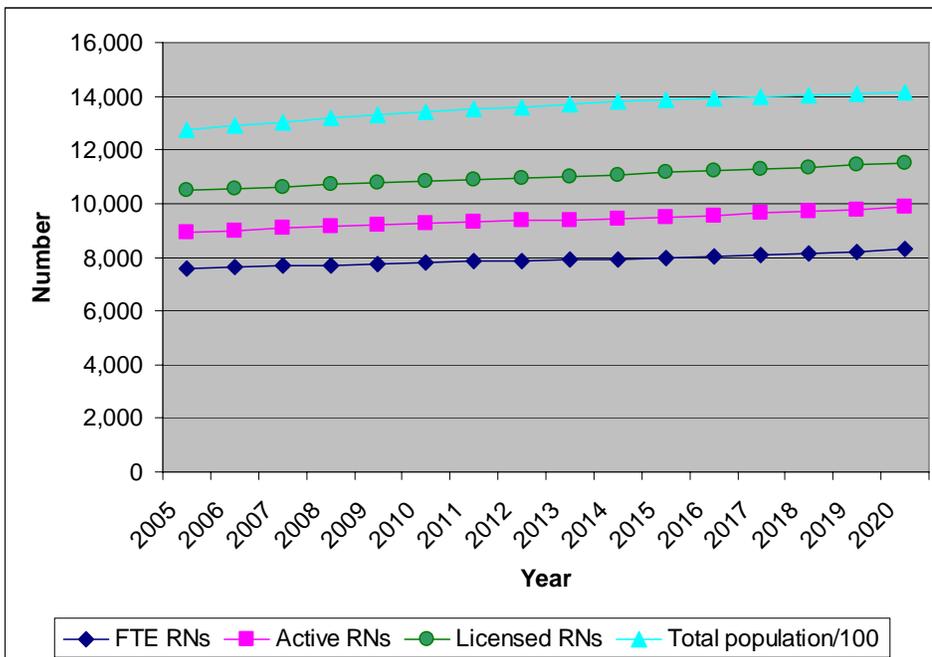
Table 1.4 Estimated Supply FTE RNs, Active RNs, Licensed RNs and Total Population/100 from 2005 to 2020

Year	FTE RNs	Active RNs	Licensed RNs	Total population/100
2005	7,553	8,927	10,479	12,766
2006	7,611	9,002	10,551	12,910
2007	7,666	9,073	10,630	13,047
2008	7,715	9,138	10,705	13,176
2009	7,767	9,198	10,773	13,295
2010	7,813	9,257	10,843	13,407
2011	7,850	9,311	10,910	13,513
2012	7,877	9,353	10,966	13,613
2013	7,908	9,398	11,024	13,705
2014	7,943	9,445	11,081	13,787
2015	7,992	9,509	11,149	13,860
2016	8,038	9,566	11,213	13,920
2017	8,097	9,636	11,288	13,973
2018	8,154	9,704	11,362	14,024
2019	8,218	9,781	11,439	14,075
2020	8,286	9,860	11,525	14,124
Change from 2005 to 2020	9.7%	10.5%	10%	10.6%

iv.   *Projected Age Distribution of Employed Registered Nurses 2005 to 2020*

Figure 1.5 shows projected age distribution of RNs in Hawai'i for 2005 and 2015. A significant aging of the RN population is occurring due to the large number of baby boom RNs, an increase in the age at which new RNs enter the profession, and a decline in younger women choosing nursing as a career. The aging bubbles are highlighted in Figure 1.5.

The age distribution of the RN population has important supply implications. As RNs age, they are more likely to leave the RN workforce due to retirement, disability, or death and are more likely to be working part time in nursing or to retain their license but not be working in nursing (Figure 2.5).

Figure 1.5 Projected Age Distribution of RNs in Hawai'i 2005 and 2015
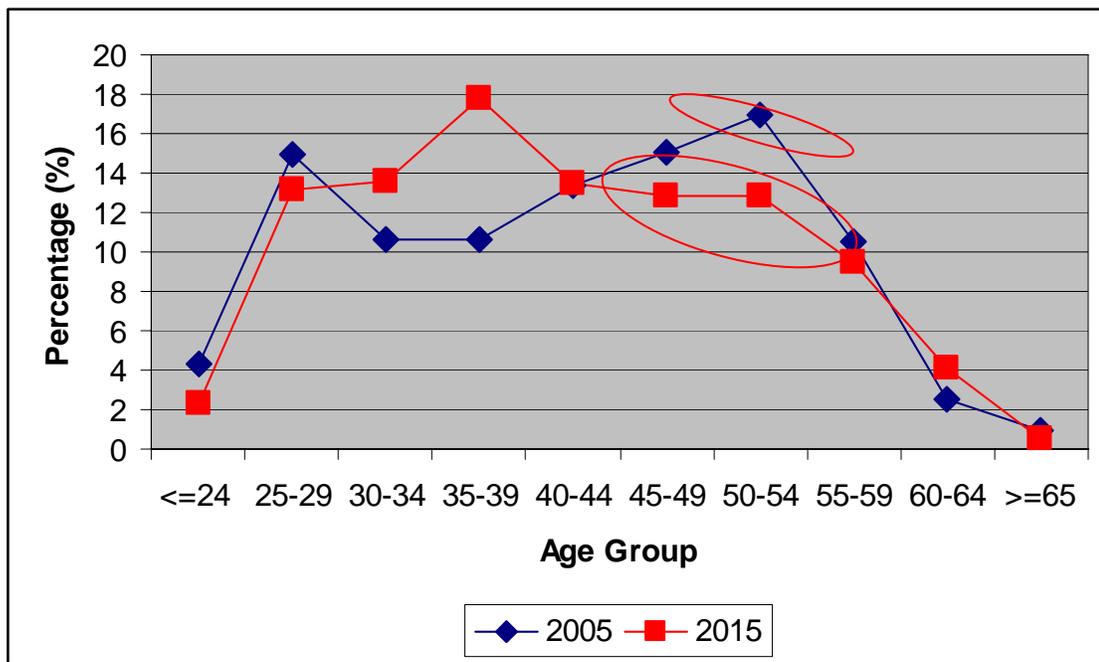
II. The Nursing Demand Model (NDM)

Factors considered in the Nursing Demand Model

A.   Factors Affecting the Number of People Requiring Care

The NDM [2] default uses U.S. Census Bureau population projections to estimate the number of people requiring care in each healthcare setting. These projections are by age group, sex and rural/urban setting. The NDM [2] then converts population projections into numbers of people needing care in each of the twelve care settings. Historic healthcare experience is used to determine the usage of healthcare facilities by people of different ages, sexes and urban/rural settings. These figures are then adjusted for trends in the healthcare market environment, economic conditions, demographics and geographic location.

The factors affecting the number of patients in different types of healthcare settings are shown below in Table 2.1.

- A negative sign (–) indicates that an increase in that factor will decrease the number of people using that health care setting. 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. 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 2.1 Factors Affecting Patient Numbers in Healthcare Settings

	Short-Term Hospital			Long-Term Hospital	Nursing Facility	Home Health
	In-Patient	Out-Patient	ER			
Healthcare Environment						
• HMO Usage	(−)		(−)		(−)	(+)
• Percent Hospital Surgeries as Outpatient Surgeries	(−)	(+)				(+)
Economic Conditions						
• Population Uninsured				(−)	(−)	
• Population Medicaid Eligible	(+)	(+)	(+)	**(+)**		(+)
• Per Capita Income					**(+)**	
Demographics						
• Population Non-Caucasian		(+)		**(+)**		
• Population Hispanic			(−)			
Geographic Location						
• Percent Urban	(−)				(−)	
• Pacific region	(−)		(−)	(−)		(−)

Table 2.1 highlights the variables that can be influenced to affect nursing demand. For example, increasing Medicaid eligibility increases the population that uses a variety of healthcare facilities and, therefore, the demand for nursing in a variety of settings. Increases in HMO usage rates conversely decrease the number of inpatient days. The number of emergency department visits and nursing facility residents also decline as HMO enrollment rates increase and thus, decrease nursing demand.

B.   FTE RNs per Capita

The next step in estimating the demand for FTE RNs is to calculate the required FTE RNs per capita in each healthcare setting, also referred to as staffing intensity. The nurse staffing intensity measures used by NDM are shown in Table 2.2, 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 Table 2.2 nurse staffing intensity in inpatient, outpatient and emergency care in short-term hospital; long-term hospital; nursing facility; home health; and physicians' offices were determined by regressing historic staffing intensities on factors reflecting the healthcare environment, economic conditions, health and acuity, and geographic location.

In occupational health, schools, public health, other settings, and nurse education; the ratio of FTE RNs per unit of population is assumed to remain constant over time, based on 1996 usage patterns.

Table 2.2 RN Staffing Intensity by Healthcare Setting

Healthcare Setting	Registered Nurses
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 first seven health care settings in Table 2.2, the factors affecting staffing intensity are shown in Table 2.3, below.

- A negative sign (–) indicates that an increase in that factor will decrease staffing intensity. 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. 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 2.3 identifies the coefficient 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.

The NDM uses "*relative wages*" to determine nursing demand. For example, if wages for registered nurses, LPNs and nursing assistants all rise by ten percent, there would be no impact on nursing demand. However, if registered nurse wages rose by a greater percentage than LPN or aide wages, nursing demand would decline in some healthcare settings as relatively less expensive LPNs and nursing aides are substituted for registered nurses.

Table 2.3 Factors Affecting RN Staffing Intensity in Health Care Settings

		Short-Term Hospital			Long-Term Hospital	Nursing Facility	Home Health	Physician Offices
		In-Patient	Out-Patient	ER				
Health care Environment								
•	Ratio of RN to LPN Hourly Wage	(−)			(−)		(−)	(−)
•	Percent of Population in an HMO	(+)	(+)				(+)	(−)
•	Avg. Medicare Payment per Home Health Visit						(+)	
•	Avg. Medicaid Nursing Facility Daily Rate					(+)		
•	Percent Hospital Surgeries performed in Outpatient settings	(+)						
Economic Conditions								
•	Population Uninsured	(−)			(+)			(−)
•	Population Medicaid Eligible			(−)		(−)		
•	Per Capita Income							(+)
Population Health/ Patient Acuity								
•	Mean Age of Population							(+)
•	Avg. Number ADL Limitations of NF Residents					(+)		
Geographic Location								
•	Percent Population in Urban Area	(+)	(+)		(−)			

C.   FTE Registered Nurse Demand

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

D.   Nursing Demand Model & Hawai'i

At the national level the variables in the model are assumed to reflect the nursing demand experience. However for smaller states, like Hawai'i, some adjustments are required to reduce error and better reflect the healthcare environment.

i.   *Hawai'i Population Projections*

The default NDM uses U.S. Census Bureau 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. However, recent population and economic projections for the State of Hawai'i indicate the U.S. Census Bureau figures to be high.

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.

Table 2.4 shows a comparison between US Census and CDC population projections for the State of Hawai'i. The comparison shows a small 1.3% difference at 2005, 3.4% difference at 2010, 7.4% difference at 2015, and 12.7% difference by 2020.

Table 2.4 Comparison of US Census and CDC population projections for the State of Hawai'i 2000 - 2020

Year	US Census projections for Hawai'i's Population	CDC projections for Hawai'i's population	Difference in projected population (%)
2000	1,211,537	1,211,537	n/c*
2001	1,226,943	1,226,943	n/c*
2002	1,242,894	1,242,894	n/c*
2003	1,259,296	1,259,296	n/c*
2004	1,276,291	1,261,600	14,691 (-1.2%)
2005	1,293,601	1,276,553	17,048 (-1.3%)
2006	1,311,746	1,290,984	20,762 (-1.6%)
2007	1,330,301	1,304,704	25,597 (-1.9%)
2008	1,349,287	1,317,607	31,680 (-2.3%)
2009	1,368,605	1,329,479	39,126 (-2.9%)
2010	1,388,480	1,340,675	47,805 (-3.4%)
2011	1,408,856	1,351,330	57,526 (-4.1%)
2012	1,429,874	1,361,296	68,578 (-4.8%)
2013	1,451,410	1,370,471	80,939 (-5.6%)
2014	1,473,620	1,378,731	94,889 (-6.4%)
2015	1,496,318	1,385,952	110,366 (-7.4%)
2016	1,519,704	1,391,956	127,748 (-8.4%)
2017	1,543,353	1,397,259	146,094 (-9.5%)
2018	1,567,406	1,402,403	165,003 (-10.5%)
2019	1,592,010	1,407,471	184,539 (-11.6%)
2020	1,617,037	1,412,374	204,663 (-12.7%)

* n/c = no change

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ii.   *Registered Nurse Usage*

The NDM predicts FTE RN usage from 1996 through 2020. In its default setting, the model calibrates its predictions to nursing demand in the base year 1996. The default NDM identifies Hawai'i's base year FTE RNs as 8,228, an over estimate of 23.7%. The NDM is adjusted to account for this over estimate by decreasing FTE RN population to 6,275 as shown in Table 2.5.

Table 2.5 Adjusting the NDM Base Year to Reflect Hawai'i Licensed RNs in 1996

Estimated FTE RNs in Hawai'i (1996)	6,275
Default NDM Base year FTE RNs in Hawai'i (1996)	8,228
Adjustment	-23.7%

III. Projecting RN Shortage using the NSM and NDM

The NSM and NDM models, as identified previously were developed independent of each other. However, the variables FTE RN supply and FTE RN demand generated from the models allows for creation of a new dataset to project estimates of FTE RN shortage.

A. The Projection of Hawai'i FTE RN Shortage

i. Previous Projections of FTE RN Shortage

A number of forecast projections have been carried out at the national level using the state level data captured from the 1996 and 2000 National Sample Surveys of Registered Nurses (NSSRN). However, as highlighted by the developers of the models, the smaller populated states are highly likely to display error in estimates due to small sample sizes.

After the release of the report '*Projected Supply, Demand and Shortages of Registered Nurses: 2000-2020*' in July of 2002. Hawai'i State representatives reported concerns with the accuracy of the projections. After discussions, the estimates for growth in Hawai'i supply were revised downward after adjustments for migration and initial graduates. [4] However, RN demand was left unchanged from previous projections. These projections were also reported in the "*Hawai'i Health in the Balance: A Report on the State of the Nursing Workforce*". [5]

The 2004 data reflect baseline FTE RN supply and demand projections. Both the NSM and NDM models, in this scenario, use NSSRN to estimate the number of RNs employed in the base year. The NSM uses the 2000 NSSRN to estimate supply of RNs by age, education level, and state. While the NDM uses the 1996 NSSRN to estimate FTE RNs by setting and state. Both baseline projections use the U.S. Census Bureau population data which constitutes a key determinant of

projected demand for FTE RNs in the baseline scenario. These estimates reveal the greatest FTE RN shortage over time. [6]

The current 2006 estimates use 2004-05 survey data of new RN graduates from statewide nursing programs and estimates of licensed nurses in the state (1996-2006). In addition to CDC projections that reflect a smaller growth in Hawai'i's population. The data continues to demonstrate that nursing supply will grow slowly. However nursing demand is less than previously projected.

Figure 3.1 demonstrate variation and range in the projected shortages of FTE RNs in 2003, 2004 and 2006.

Figure 3.1 Comparison in Hawai'i's Projected Shortage of FTE Registered Nurses in 2003, 2004 & 2006
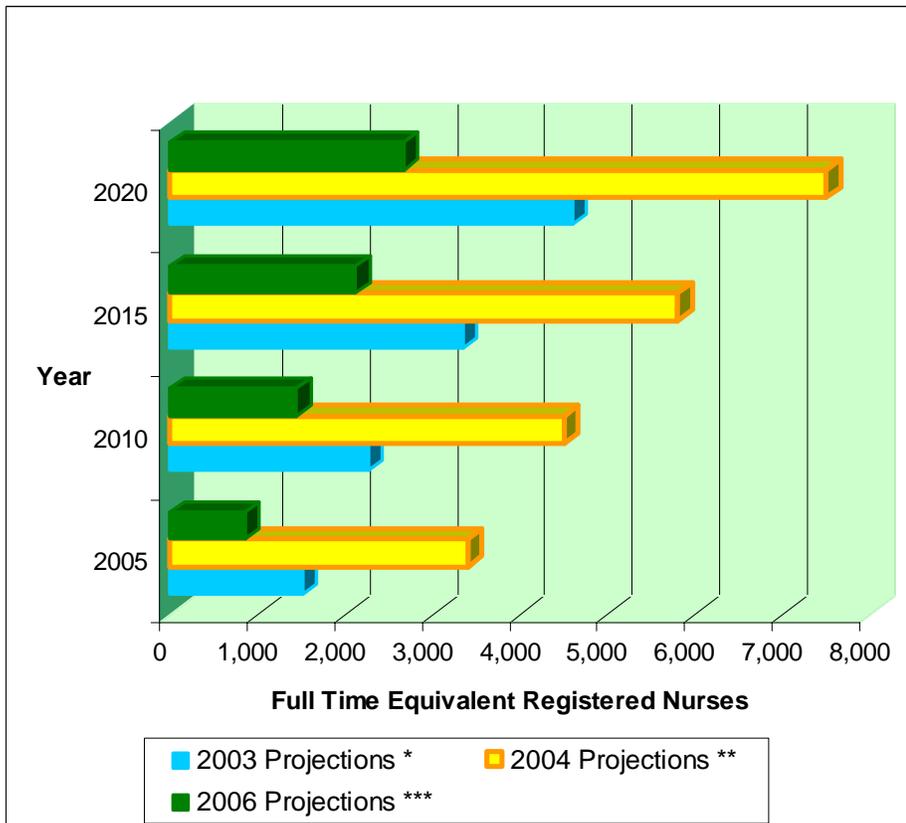
Table 3.1 highlights there is little difference between the three FTE RN supply projections. However, there are marked differences between the demand projections. For the current RN demand estimates adjusted for reduced population growth, reduced proportion of women aged 20-44, and the actual numbers of new RN graduates indicate the employer demand for RNs will also be smaller than previously forecasted. The current supply and demand estimates continue to indicate that there will be a growing shortage of registered nurses over the next fifteen years (Figure 3.1).

Table 3.1 Comparisons of Nursing Estimates 2003, 2004 & 2006

	2003 Projection	**2004 Projection**	**2006 Projection**
FTE RN Supply Estimates			
2005	7,650	7,700	7,553
2010	7,922	7,900	7,813
2015	8,052	8,100	7,992
2020	8,239	8,200	8,286
FTE RN Demand Estimates			
2005	9,168	11,100	8,411
2010	10,189	12,400	9,260
2015	11,402	13,900	10,112
2020	12,832	15,700	10,955
FTE RN Shortage (Demand – Supply)			
2005	1,518	3,400	858
2010	2,267	4,500	1,447
2015	3,350	5,800	2,120
2020	4,593	7,500	2,669

Figure 3.2 illustrates that the increase in nursing supply will be small while the demand for RNs will continue to increase. One of the prominent factors in the widening gap between supply and demand of Hawai'i's RNs over the next fifteen years will be the increase in retirement by nurses over 50 years of age.

Figure 3.2 Projected FTE Supply and Demand 2006 to 2020
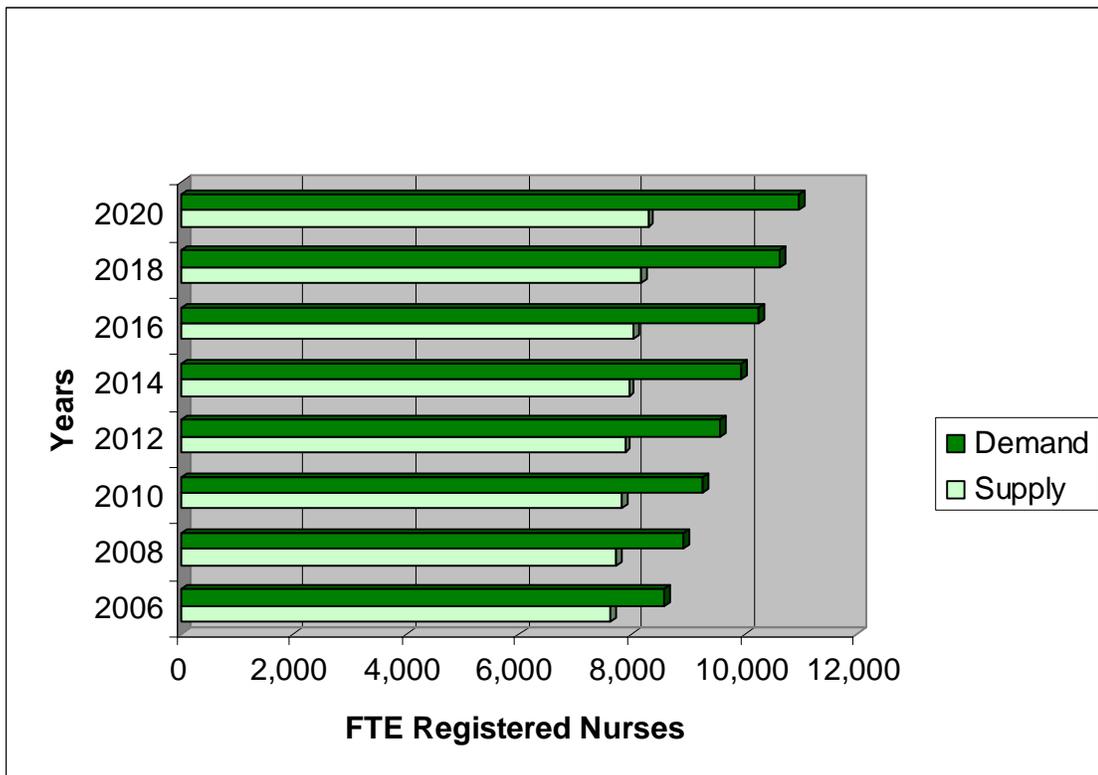
B.   Estimates of Registered Nurses Supply and Demand

Utilizing data generated from the NSM and NDM it was possible to project estimates of FTE RN shortage from 2006 to 2020. Figure 3.3 shows that in 2006, Hawai'i experienced a shortage of 960 RNs, which is estimated to grow to approximately 2,220 by 2016 and to 2,670 RNs by 2020.

Figure 3.3 Projected Hawai'i FTE RN Shortages, 2006 to 2020
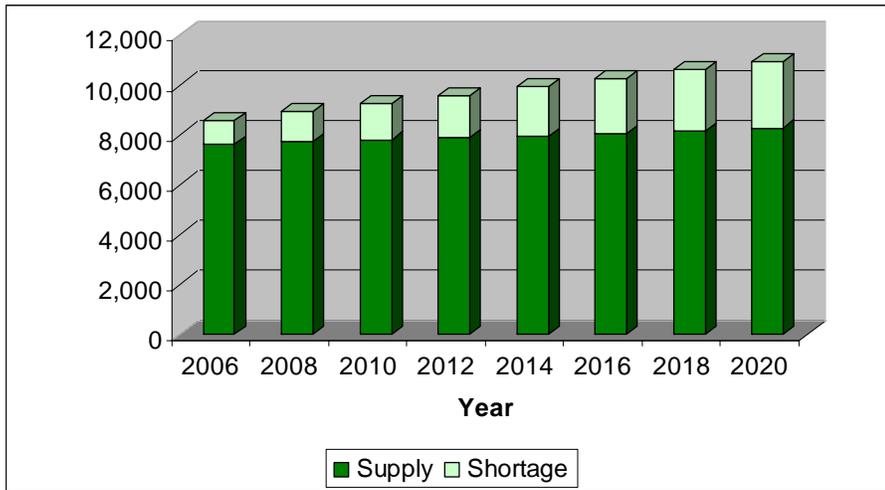
C.   Projected FTE Registered Nurses Supply, Demand and Shortages

Between 2006 and 2020, demand for RNs in Hawai'i is expected to grow by 28%, while supply of RNs is expected to grow by 8.9%. In relative terms, the shortfall in demand will increase from about 11 percent to 24 percent as shown in Table 3.2.

Table 3.2 Projected Hawai'i FTE RN Supply, Demand, and Shortages

	2006	2008	2010	2012	2014	2016	2018	2020
Supply	7,611	7,715	7,813	7,877	7,943	8,038	8,154	8,286
Demand	8,571	8,926	9,260	9,574	9,927	10,260	10,607	10,955
Shortage	960	1,211	1,447	1,697	1,984	2,222	2,453	2,669
Supply ÷ Demand	89%	86%	84%	83%	80%	78%	77%	76%
Demand Shortfall	11%	14%	16%	17%	20%	22%	23%	24%

IV. Limitations of the NSM and NDM Models

The creation of these two complex models was an ambitious undertaking. The models allow forecasting of RN supply and demand to the year 2020 at both the national and state levels. Nonetheless, major limitations of the models include:

- The two models are independent of each other. The NDM makes projections without considering the potential supply of nurses and vice versa.

- The capacity to refine and update the models is dependent on the availability of reliable data and adequate resources.

- Parts of both models are static. For example, in the NSM, the probability of cross-state migration is based on historical patterns and fails to consider the current shortage of RNs in each state. The NDM has limited ability to model substitution between types of nurses and between nurses and other healthcare workers. The NDM also has limited ability to capture the interaction of healthcare settings (e.g., home health as a viable substitute for nursing home facilities), while other settings might be complementary (e.g., increased use of outpatient services leads to increased use of home health services).

- Accuracy of projections are reduced by a number of factors:
  - The level of aggregation (e.g., national projections will likely be more accurate than state projections).
  - Sample size (e.g., larger states will likely be more accurate compared to smaller states).
  - The projection horizon (e.g., projections for the year 2005 will likely be more accurate than the projections for 2020).
  - The determinants of nursing supply and demand (i.e., currently there is no consensus on what are the most important determinants of nurse supply and demand, nor is there a consensus on the future value of these determinants).

V. Recommendations

By 2020, the Hawai'i State Center for Nursing projects a shortage of approximately 2,670 registered nurses in Hawai'i. Nationwide, the Health Resources and Services Administration (HRSA) estimates indicate there will be a shortage of more than 1 million registered nurses by 2020. [6] The broad set of complex and interwoven factors driving the shortage are impacting healthcare at a micro and macro level. These drivers include:

- An aging population that will require more RN managed/guided care [5,7-9]

- An aging nursing workforce that will find it difficult to meet the physical demands of employment [10-12]

- An inadequate supply pipeline of new nurses created by a lack of adequate nursing faculty to educate new nurses, fewer women choosing nursing as a career, and salary inequities [13]

- A poor image of nursing as a professional career option, particularly for men [14-17]

- Difficulty retaining nurses in work environments perceived as unattractive and unsupportive [18-20]

Trends indicate demand as well as supply factors contributing to the RN shortage will deepen as the baby boom generation consumes greater portions of healthcare services and the aging nursing workforce retires from the profession. A number of recommendations are presented for consideration.

1. *Promote and support the integration of nurse education and practice*
Nursing is a practice based profession. Programs that integrate education and practice may be the tipping point to generating new resources, improving education and addressing the myriad of quality and patient safety issues in the work environment.

2. *Link educational opportunities and resources across the State of Hawai'i*

A regional educational linkage integrated to the practice community offers providers greater opportunity for innovation. Simulation learning, shared information technology, a single uniform curriculum and shared faculty are some of the conceptual ideas proposed to revolutionize nursing in Hawai'i.

3. *New graduate nurse residency programs*

There is a growing body of evidence demonstrating that new nurses are not competent to work independently immediately after graduation. Evidence suggests new nurses that participate in residency programs after graduation transition into their professional role with less negative impact, are happier in their role, and are more likely to be retained by the facility.

4. *Develop strategies that promote the retention of mature nurses*

Create a system to develop and apply evidence based criteria for best practices focused on the retention of our aging nursing population. Strategies could include shortened working hours, adaptation of the work environment, and assignment to less physically demanding positions.

VI. Conclusions

The development of the NSM and NDM was undertaken by HRSA to allow for forecasting of the nursing workforce shortage to the year 2020. Projections indicate there will be a national registered nurse shortage of more than 1 million by 2020. Numerous factors are driving this deepening shortage and no one policy will help relieve the shortage. A variety of innovative policies will be required to not only increase the supply of nurses but also restrain the growth in demand for nurses. Future projections are required to examine different policy scenarios and how these impact the supply and demand of Hawai'i's nursing workforce.

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