Department of Health Professions

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Healthcare Workforce Data Center

Physician Forecasting in Virginia 2008 - 2030

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Table of Contents

Physician Forecasting in Virginia 2010-2030

Like the rest of the nation, Virginia is facing the prospect of the retirement of the baby-boomers. This will have a dramatic effect on Virginia's demographic profile (See Figures 1 to 4). As the baby-boomers begin to reach retirement age, the proportion of Virginia's population age 65 and older will grow. The US Census Bureau projects that the proportion of Virginia's population age 65 and over will grow from 12.4 percent in 2010 to 18.8 percent by 2030. Meanwhile, the proportion of the population that is of working age--those aged 25 to 64--is projected to decline from 53.7 percent to 48 percent of the population.

Many of Virginia's physicians will retire along with the baby-boomers. Virginia's physician population is older than Virginia's general population. According to the 2008 Virginia Physician Workforce Survey, over 10 percent of Virginia's active physicians are already age 65 or over. The rate of retirement will increase as 23.4 percent of physicians active in 2008 reach age 65 by 2018 and 31.6 percent in the following decade. Two-thirds of physicians in Virginia's workforce in 2008 were over the age of forty-five. All of these physicians will be over the age of 65 by 2028.

The remaining physicians, and the new physicians joining the workforce, will face a daunting workload. As Virginia's population ages, it will use more physician services. Senior citizens use significantly more health services than younger persons. In 1998, persons younger than age 65 used, on average, $1,810 worth of health services. Those aged 65 and over used $6,265 worth of health services-- almost 3 ½ times more.[1] Similarly, persons over the age of 65 make twice as many physician office visits as the general population, use emergency services four times as often and spend three times as many days in the hospital.[2] The growing senior population will likely use more physician services than their rising numbers alone would suggest.

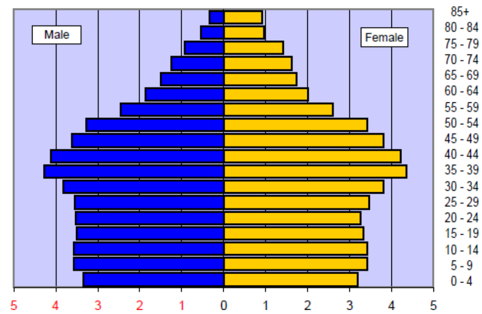

Figure 1: 2000 Virginia Population Pyramid
Working Age Population: 54.6 %
Population Age 65+: 11.2 %

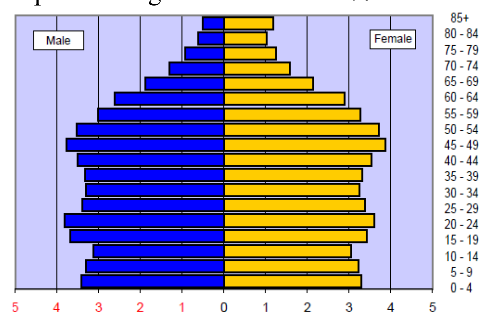

Figure 2: 2010 Virginia Population Pyramid
Working Age Population: 53.7 %
Population Age 65+ : 12.4 %

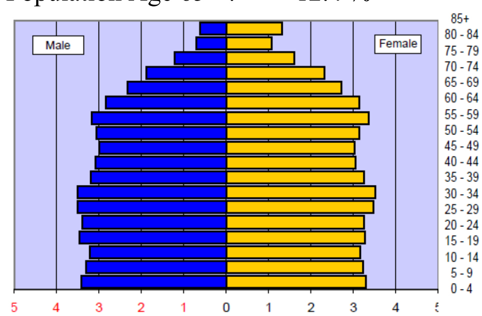

Figure 3: 2020 Virginia Population Pyramid
Working Age Population: 51.3 %
Population Age 65+: 15.8 %

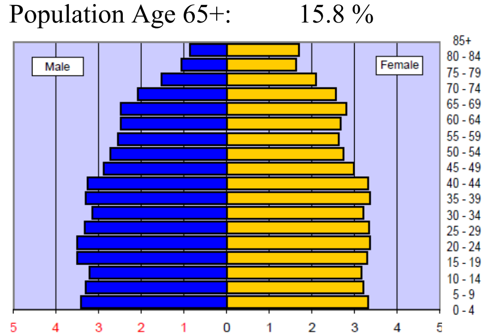

Figure 4: 2030 Virginia Population Pyramid
Working Age Population: 48.0 %
Population Age 65+: 18.8 %

Virginia's aging population and the concurrent reduction in the proportion of the working age population will have significant ramifications throughout Virginia's economy. Senior citizens' increased use of health services amplifies the effect of population growth on the health industry. Since it may take a decade or more to educate and train a physician, it is imperative that Virginian's policymakers have accurate projections of the future needs for physicians, physician specialties, and training.

Predicting the Physician Workforce

The Healthcare Workforce Data Center (HWDC) contracted with the Lewin Group to create the Virginia Physician Supply and Demand Model (VPSDM). This proprietary model includes estimates of both the future physician workforce and the demand Virginia will have for physicians through 2030. The HWDC did *not* use a model available from the Health Resources and Services Administration (HRSA) as it did to project supply and demand for nurses. The HRSA physician model uses older data from 2004 and earlier to develop key aspects of its physician model. In 2008, the Association of American Medical Colleges (AAMC) used an updated model provided by the Lewin Group, including new assumptions and data sources, to make projections through 2025. The Lewin Group further updated its model and included Virginia-specific data from the American Medical Association to create the VPSDM, providing an up-to-date glimpse of Virginia's future workforce needs. For ease of reading, this report refers to the HRSA model, the AAMC model and the VPSDM when referring to these three models. The AAMC model and the VPSDM both use a different iteration of the Lewin' Group's evolving model, each with its own particular inputs.

Box 1 **Requirements Defined**
Requirements: A broad term that refers to the number of units (e.g. number of physicians or hours of physician labor) need to provide a given level of service. A high level of service will create higher physician requirements, while a low level of services requires fewer physicians. **Need:** A normative judgment of requirements based on what society believes the level of service *should* be. **Demand:** The level of services used based on observed or estimated usage patterns.

The Lewin Group provided a general summary of the VPSDM and the data sources used to predict physician workforce and demand for physician services. The Lewin Group model is a proprietary model, so details about its workings are necessarily lacking. However, by examining and comparing these models, we can gain an understanding of the elements and issues involved in predicting the physician workforce and demand for physician services. Additionally, we can appreciate the strengths and weaknesses inherent in the Virginia-specific projections.

HRSA's Bureau of Health Professions issued a report, *The Physician Workforce: Projections and Research into Current Issues Affecting Supply and Demand*, which describes the HRSA model in detail. It is available on the Bureau of Health Profession's website at the following address: http://bhpr.hrsa.gov/healthworkforce/reports/physicianworkforce/default.htm.

The AAMC's Center for Workforce Studies issued a similar report for its model, entitled *The Complexities of Physician Supply and Demand: Projections Through 2025*. This report is available at the Center for Workforce Studies' website at the following address: http://www.aamc.org/workforce/start.htm.

Since the VPSDM shares many characteristics with these national models, these two reports, augmented by information provided by the Lewin Group, form the basis of the information in this description of the two models and of the VPSDM. It is important to note that this model was run in fall of 2009, prior to the passage of sweeping Federal health reform legislation-the Patient Protection and Affordable Care Act (PPACA). Thus the VPSDM does not take into account many important aspects of that legislation including an expanded number of residency slots or increased insurance coverage. It also does not consider other factors which occurred after model's 2008 base year.

Like the national models, the VPSDM includes both a physician supply model and a physician requirements model. By combining the results from each model, the VPSDM anticipates gaps or surpluses in Virginia's physician workforce. This report begins by describing key elements in the VPSDM's supply model and the predictions made by the model. The second section examines the requirements model. The third section compares the two and examines projections of the adequacy of Virginia's physician workforce.

Defining the Physician Workforce

Researchers conceptualize the physician workforce in various ways.

<u>All Physicians:</u> All licensed physicians, including retired or otherwise inactive physicians.

<u>Active Physicians:</u> Physicians active in the workforce. This may include physicians that spend all or most of their time teaching, performing research or performing administrative tasks.

<u>Patient Care Physicians:</u> Active physicians that provide patient care at least some of the time.

<u>FTE Physicians:</u> The ratio of hours worked per week to some standard representing full-time work (e.g. 40 hours per week, average hours worked per week in a specific year).

<u>FTE Patient Care Physicians:</u> The ratio of hours worked in patient care per week to some standard representing full-time work in patient care (e.g. 35 hours per week, average hours spent on patient care in a specific year)

<u>Residents and Fellows</u>: Residents and Fellows have completed medical school and are completing a rigorous version of on-the-job training. These physicians-in-training perform considerable amounts of physician services, but are not yet in independent practice.

The type of physician is important when making estimates and projections of supply and demand. These models focus on projections using FTE Patient Care Physicians, but also include estimates or projections of Active Physicians and Active Patient Care Physicians. The HRSA model provides supply projections that both include and exclude residents and fellows, but its demand projections include residents and fellows. The AAMC and VPSDM models *do not* include residents and fellows in their demand projections.

Physician Supply

Overview

At its simplest, a physician supply model begins with the number of physicians in a base year, adds the physicians that join the workforce, subtracts the physicians that leave the workforce, and uses the final figure as the basis of the next year's supply. A slightly more refined model will estimate hours worked or productivity to develop an actual estimate of the amount of services provided by these physicians (See Figure 5). For these types of models, the starting year is referred to as the base year.

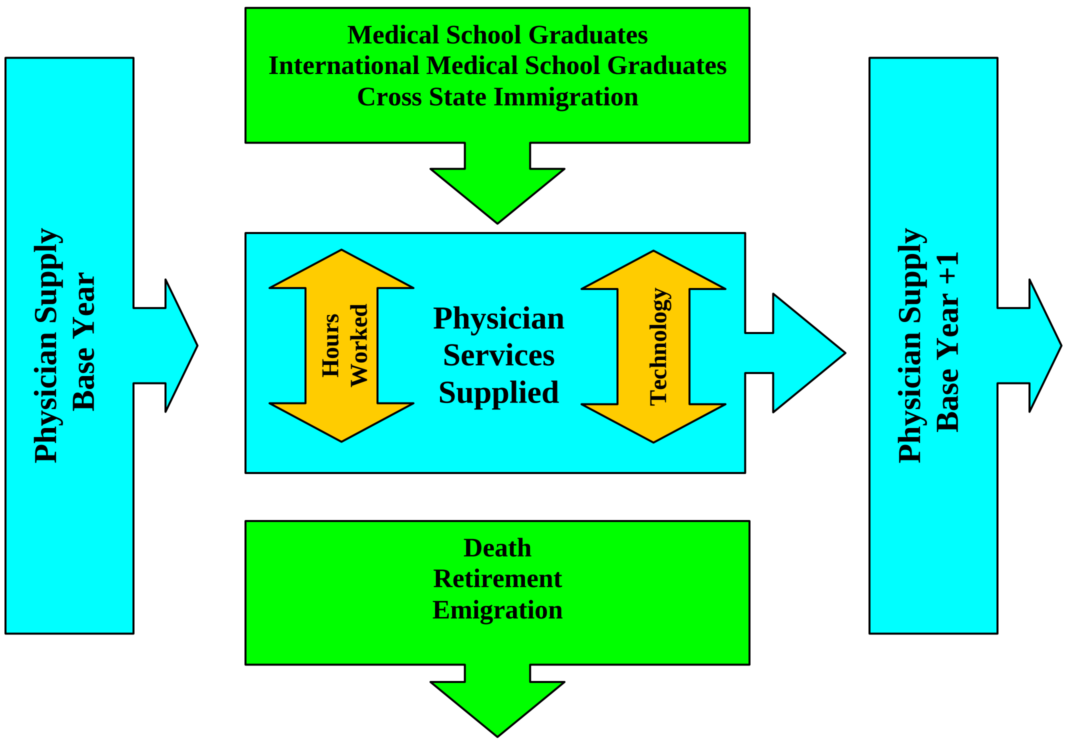

Figure 5: A Basic Physician Supply Model. Blue boxes represent the workforce, green boxes represent movement in or out of the workforce, and the yellow boxes represent physician productivity. Not modeled are long-term but temporary separations from the workforce (e.g., education, military service, overseas volunteer work, disability, family leave).

The HRSA model, the AAMC model and the VPSDM all follow this basic pattern. First, the models estimate counts of physicians in the base year (See Table 1), including separate counts of all active physicians and physicians involved in patient care. To get a more detailed picture, the models also predict the specialties, gender and age of physicians in the workforce. The model becomes even more complex, however, when estimating actual physician services provided. As a proxy for physician productivity, these models use the concept of full-time equivalents or FTEs. An FTE is the average patient care hours worked by physicians

Model	Base Year
HRSA	2000
AAMC	2006
VPSDM	2008

Table 1: Base Year for the three models

within a given medical specialty in the base year of the model. Thus FTE's depend on estimates of hours worked in the base year and vary by specialty. While not a true measure of productivity, FTEs allow researchers to make comparisons of physician output across specialties and over time.

For illustrative purposes, imagine that toe specialists worked, on average, 50 hours per week in the base year. An FTE physician toe specialist, then, works 50 hours per week. FTE's are expressed as a ratio. The models would count a toe specialist who, ten years later, works 40 hours per week as a 0.8 FTE physician, while they would count a toe specialist who works 60 hours as a 1.2 FTE physician. Similarly, if finger specialists worked, on average, 40 hours per week in the base year, an FTE finger specialist works 40 hours per week. The models would count a finger specialist who, ten years later, works 50 hours per week as a 1.25 FTE physician, and one that works 60 hours per week as a 1.5 FTE physician. Table 2 illustrates how a one FTE physician may work varying hours.

Specialty	Average weekly hours worked, base year	1 FTE	Weekly hours worked ten years on		
			40	**50**	**60**
Toe	50	50	0.80 FTE	1.00 FTE	1.20 FTE
Finger	40	40	1.00 FTE	1.25 FTE	1.50 FTE

Table 2: An FTE physician may work varying hours.

FTEs are a convenient method to create comparable units of physician services across specialties. FTEs, however, are not an indication of productivity but of hours worked. A true measure of productivity must also measure changes or advances in health delivery. That is, it must measure changes in organization, regulation, equipment and training that increase physician productivity. An FTE is, essentially, the output of one physician in the base year, standardized across specialties.

In most industries, units or income produced are good measures of productivity. In healthcare, however, these simple measures are not as useful. Obviously, a worker who produces twenty widgets per hour is more productive than a worker who produces two widgets per hour. Is a doctor who sees twenty patients per hour more productive than a doctor who sees two patients per hour? Probably not. A three minute office consultation may not provide much benefit to patients. On the other hand, advances such as electronic health records or effective use of auxiliary personnel may allow one physician to serve more patients *and* improve health outcomes. While physicians do provide a variety of measurable services (output), their main value lies in their professional judgment and its efficacy in improving the health of their patients (outcomes). Health outcomes are notoriously difficult to measure due to a variety of complicating factors.

FTEs are a proxy for productivity that allows researchers to compare supply across specialties. However, they are not a true measure of productivity. Readers should keep in mind that FTE's are highly dependent on the behavior of physicians in the base year, including their real productivity. Advances in health care delivery may allow physicians to improve the health of their patients while working fewer hours.

Elements of the Physician Supply Model

Each element of the physician supply model is itself made up of several components. The following sections describe these components, the sources used to model those components, and some issues inherent to the components and their sources. Where possible, they will also outline the similarities and differences between the HRSA model, the AAMC model and VPSDM.

Box 2: Physician Profile Information
Records of the Board of Medicine
• Licensee name • License number • Date of issue • Date of expiration • Any Virginia Board of Medicine notice or order
Self-Reported Information Required by Statute
Practice Information: • Location(s) • Telephone numbers(s) • Translating services • Percentage of time spent at each location *Physician Information:* • Education • Years in active clinical practice • Board Certifications • Hospital affiliations • Academic appointments • Publications • Medicaid participation • Actions • Felony convictions • Paid claims, last ten years
Optional Information
• Insurance plans accepted or managed care plans in which they participate • Self-designated practice area • Honors and awards • Medicare information • Hours of continuing education • Practice name • Days of the week at practice location • Maiden name • Web site address • Non-emergency email address

Base Year Physician Workforce

As noted earlier, each model begins with an estimate of the current workforce. The American Medical Association's Physician Masterfile provides the most comprehensive listing of physicians in the United States and is a commonly used source for workforce analysis. The AMA begins tracking physicians, including both Medical Doctors (MDs) and Doctors of Osteopathy (DOs)[i] when they enter medical school, and follows them through residencies, licensure and other professional milestones. International Medical Graduates (IMGs) are captured when they enter US residency programs or obtain licenses to practice medicine in the United States. Physicians may also self-report data by participating in surveys or updating their profiles on their own initiative. The Physician Masterfile includes demographic information, including the age and sex of physicians, as well as information on specialty choice.[3]

Although the Physician Masterfile is one of the best sources of information on the physician workforce currently available, it has some limitations. These are mostly related to delays in gathering or receiving information. In particular, the Physician Masterfile may overestimate the number of older physicians who are active in patient care. Analyses that use the Physician Masterfile to estimate workforce participation often underestimate the retirement rate of physicians.[4] Additionally, some studies have found that the Physician Masterfile may not accurately portray information on specialties or specialty changes.[4,5]

The HRSA model uses the Physician Masterfile as the basis for many of its estimates. For its estimates of the base year physician workforce, the HRSA model includes information

[i] Two categories of physician practice in the United States and are licensed to practice medicine in Virginia. Most physicians practice allopathic medicine and are referred to as Medical Doctors (MDs), while the remainder practice osteopathic medicine and are referred to as Doctors of Osteopathy (DOs). In modern times, the differences between the two groups are subtle. However, Medical Doctors tend to focus on treatments for specific conditions, while Osteopaths tend to focus on holistic health matters.

primarily from the Physician Masterfile, augmented by information from the American Osteopathic Association. This includes estimates of the number of physicians practicing, their age, gender, work status, and specialty. Since the Physician Masterfile likely overestimates the number of older, active physicians, the model removes all physicians aged 75 years or older. Physicians self-report their medical specialty, and the Physician Masterfile includes over 180 specialties. The HRSA model condenses these into 35 specialty categories (see Appendix A).

The AAMC model also uses the AMA Physician Masterfile as the basis for its base year supply estimates. In addition to removing all physicians aged 75 years or older, the AAMC model also makes adjustments based on analysis of the *AAMC-AMA Survey of Physicians Over Age 50*, conducted in 2006. This adjustment uses an algorithm to predict the probability that each physician age 50 and older has retired based on the age, gender and specialty of the physician. Additionally, the AAMC uses a broader definition of "active" than the Physician Masterfile, which defines only those physicians working 20 or more hours per week as active. Finally, the AAMC condenses the 35 specialty categories of the HRSA model into four major specialty categories: primary care, medical specialties, surgery and other patient care.

Two sources of information are available to inform the VPSDM's baseline for physician supply in Virginia: the AMA Physician Masterfile (limited to physicians with practice locations in Virginia) and information from the Virginia Board of Medicine's Virginia Physician Profile. These two sources of data create two very different accounts of Virginia's physician workforce. With the adjustments mentioned above, the AMA Physician Masterfile suggests that Virginia has 18,600 active physicians, 17,300 patient care physicians and 17,100 FTE patient care physicians. An additional 2,200 residents and fellows augment the physician workforce. The Virginia Physician Profile, however, suggests there are 22,600 active physicians, though some of them do not practice exclusively in the Virginia Workforce. This results in estimates of 14,900 FTE physicians active in Virginia. It is important to note that the Virginia Physician Profile does not include physicians working in Federal agencies.

The Virginia Department of Health's Physician Profile is based on information collected by the Virginia Board of Medicine. Some of this information is based on official license records. However, most is self-reported and is not verified by the Board of Medicine. Since the Board of Medicine collects much of this data in non-standard formats, the Virginia Department of Health (VDH) cleans the data for its own research purposes. The VDH provided the cleaned data to the Lewin Group for use in the VPSDM. A list of the information in the Physician Profile appears in Box 2 (previous page).

Initially, the Lewin Group had hoped to use the Virginia Physician Profile to form base year estimates in the VPSDM. However, the Virginia Physician Profile does not collect information on age, gender, race or ethnicity. These physician characteristics correlate with a variety of important factors, including specialty choice, hours worked and retirement age. It also does not include sufficient information on hours worked in other states. The Physician Profile is augmented by a survey provided to physicians that renewed online during the 2008 renewal period. The results of this survey are included in the accompanying report, *2008 Virginia Physician Workforce: Survey Findings and Recommendations*. Although this survey collected information on physician age and participation in the Virginia workforce, it excluded other important demographic information. Furthermore, the Virginia Physician Profile data does exclude physicians working for the Federal government, compounding problems matching this data to other model elements.

The Lewin Group attempted to fill gaps in the physician profile by matching records in the Virginia Physician Profile to their corresponding records in the AMA Physician Masterfile. However, differences in the two sources made this implausible under current resource restrictions and deadlines. Therefore the VPSDM uses Virginia-specific records from the AMA Physician Masterfile to form its base year estimates. The Lewin Group also ran projections using the Virginia Physician Profile. However, the Lewin Group was not able to use the Virginia Physician Profile as the basis for other model (particularly demand) elements. Therefore the model when run using Virginia Physician Profile data is internally invalid and the results are not useful for projecting physician adequacy (see page 27).

New Workforce Entrants

New medical graduates, international medical graduates (IMGs) and physicians moving to Virginia from other states are added to the base year physician workforce. The HRSA and AAMC models do not include cross-state migration due to their national scopes. The VPSDM does not model cross-state migration due to the difficulty in obtaining sufficient data and estimates. The model assumes migration is a wash.

Number of Medical School Graduates

Despite wide fluctuations in the number of applicants, the number of persons entering and graduating from U.S. allopathic medical schools has remained constant at around 15-16 thousand annually since the late 1970s.[6] The HRSA model assumes that this figure will remain constant. Added to this are the 2,500 or so physicians graduating from osteopathic medical schools. The HRSA model assumes this number will grow to 4,000 DO graduates by 2020.[ii] Additionally, it assumes that IMGs will continue to immigrate to the United States at the current rate—about 5,000 per year. Thus the HRSA model estimates that about 23,500 residents and fellows completed their Graduate Medical Education (GME) in 2000, and that this number will increase to 25,000 in 2020.

The AAMC model focuses on physicians that complete their residencies rather than medical school graduates. The AAMC model assumes this will also remain constant. About 22,200 physicians complete Accreditation Council for Graduate Medical Education Program (ACGME) accredited programs annually. Added to this is the AAMC estimate of 1,200 DOs that graduate from non-ACGME accredited programs, for a total of about 23,400 new physicians entering the national workforce annually. The AAMC model's baseline assumes the number of new entrants will remain constant, however it runs various scenarios. Its "most plausible scenario" assumes the number of new graduates will grow to 27,600, reflecting a growth in the number of DO and MD graduates.

[ii] The assumption of growth in the number of Doctor of Osteopathy graduates is accurate. There were 3,588 DO graduates in 2009.

The VPSDM uses the AAMC projections of new graduates to estimate the number of new physicians entering the national workforce. However, the AAMC figures are updated to predict 25,500 new physicians nationally in 2008, increasing to 27,600 by 2020, then constant thereafter. The model uses a simple assumption to estimate the number of these graduates that may enter the Virginia workforce. Using AMA Physician Masterfile estimates, the VSPDM predicts the number of Virginia physicians who will retire by 2030. The VSPDM also predicts the increase in Virginia demand (see the section on Demand, pg. 16) for physician services that will occur by 2030. By adding these two figures together, the model determines the change in *physician need.* This is simply the sum of the number of physicians projected to retire by 2030 and the number of new physicians needed to match population growth and changing demographics in 2030. VPSDM estimates physician need for Virginia by 2030 at 18,300 new physicians.

The VPSDM matches this figure to the same figure for the nation as a whole. Physician need by 2030 for the nation as a whole is estimated to be 692,000. Since Virginia's estimated physician need is about 2.6 percent of the nation's estimated physician need, the VPSDM assumes Virginia will attract a little over 2.6 percent of new physicians, or 674 new physicians per year, 626 of them in patient care. This equates to 14,828 by 2030, with 13,722 of them in patient care. See Table 3 and Figure 6 for details. The calculation is:

$$(18{,}300 \div 692{,}000) \times 25{,}500 = 674$$

	Change In Physician Need 2008 to 2030					New Graduates Assumptions
Region	**Retirements**		**Demand Gain**		**Total Change in Phy. Need**	**Graduates**
Virginia (AMA)	(12,000)	-65%	6,300	34%	18,300	674 (626 Pat. Care)
United States (AMA)	(484,000)	-66%	208,000	29%	692,000	25,500 to 27,600

Table 3: Physician Need and New Graduate Assumptions in the VPSDM.

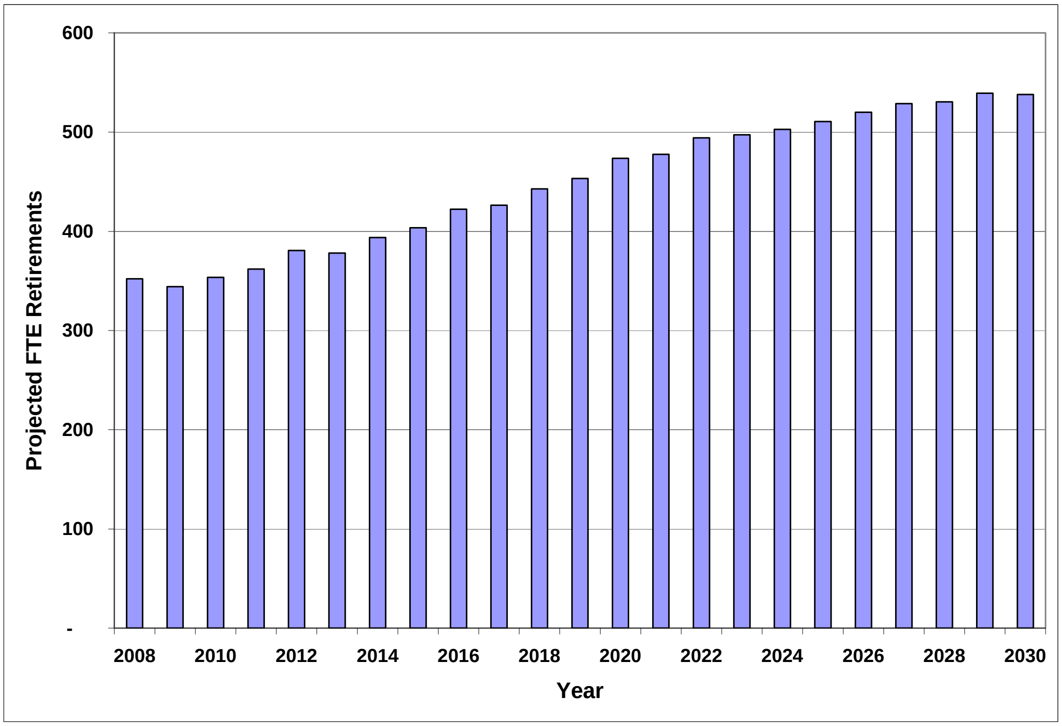

Figure 6: Projected Virginia Patient Care Physicians Retiring based on adjusted AMA physician count in 2007.

Predicting the number of new physicians that choose to set up shop in Virginia is a difficult task. This method assumes that physicians will choose practice locations based primarily on need. Implicit is the idea that higher need creates a "market" reaction. New physicians will choose to move to Virginia due to higher physician incomes, more patients or more practice opportunities. Need may also drive states to increase incentives and support to new physicians. However, it is unclear whether need is a good predictor of practice location choice or of physician income.

Compounding this is the fact that the new graduate assumption is based on factors internal to the model. If the demand portion of the VPSDM projects a higher growth in demand, the proportion of new graduates captured by Virginia's physicians will *automatically* increase to meet demand. Additionally, the assumption is a constant, based on total need *by* 2030. Even if need is a primary basis for decisions regarding practice locations, new graduates will likely consider current conditions as well as near future predictions of need.

Projections of future supply and the adequacy of Virginia's workforce are very sensitive to projections of new graduates moving to Virginia. Although data limitations are prominent in this area, reliance on a simple assumption places limitations on the usefulness of the model in predicting supply. The Lewin Group acknowledged that supply projections, and projections of the adequacy of the physician workforce, are sensitive to the assumption of new physicians locating in the state. The Lewin Group provided alternate projections of supply based on Virginia capturing 500, 600 and 700 new patient care physicians annually.

Specialty of Medical School Graduates

To forecast the future specialty mix, each model estimates the future specialty choice of new graduates. The HRSA model performs a historical analysis of the self-reported specialty of physicians 10 years after graduation, as listed in the AMA Physician Masterfile. The HRSA model uses this figure due to the belief that most physicians pick a permanent specialty by this point in their careers. The AAMC model uses the specialty mix of graduates from ACGME residencies and fellowships, base year 2006. The AAMC model assumes that DOs who complete residencies outside of the ACGME framework make the same specialty choices as those completing ACGME accredited programs. While the AAMC acknowledges that new physician specialty choices fluctuate substantially, the model assumes the 2006 specialty mix of graduates will remain constant. The VPSDM uses a similar method but augments it with information from the Feb. 2008 American Osteopathic Association Intern/Resident Registration Program Match for non-ACGME residencies.

Exiting the Workforce

Physicians leave the workforce through three main mechanisms: retirement, death or emigration. The HRSA and AAMC models do not model emigration due to their national scope. The VPSDM also does not model cross-state migration due to the difficulty in obtaining sufficient data.

As described earlier, the AMA Physician Masterfile tends to underestimate the retirement rate of physicians as they age. To account for this, the HRSA model uses three different sources to estimate retirement rates:

1. the AMA Physician Masterfile,
2. the Physician Worklife Survey conducted by the Sheps Center at the University of North Carolina on behalf of HRSA's Bureau of Health Professions in 1997 & 2003, and,
3. The Current Population Survey of the US Census Bureau from 1998-2003, using the retirement rates for "licensed professionals" which includes physicians, lawyers and accountants among other professionals.

The AAMC model uses the AAMC-AMA *Survey of Physicians Over Age 50*, which collected information on actual retirement age for retired physicians and age intending to retire for active physicians. The AAMC model augments this with mortality rate estimates from the Centers for Disease Control. Since physicians have low occupational risk, greater access to health services and higher income than the general population, the AAMC model assumes that physicians have mortality rates at 80 percent of the reported rates.[iii]

The VPSDM also uses the national AAMC estimates to model retirement and mortality rates. The historical probability that a physician is still in the workforce, by gender and age, appears in Figure 7, along with intention to retire rates.

[iii] The 80 percent figure is based on research in Johnson, N.J., Sorlie, P.D. & E. Backlund. "The Impact of Specific Occupation on Mortality in the U.S. National Longitudinal Mortality Study". *Demography*. 1999. 36:3, pp 355-367.

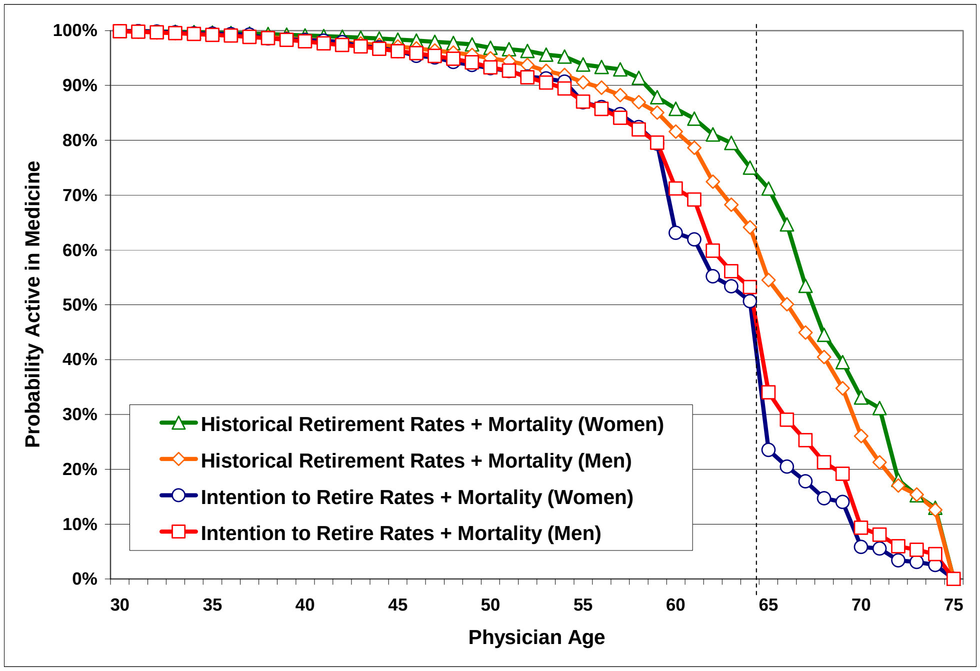

Figure 7: Probability a Physician is Active by Age and Gender

Physician Services

The number of hours worked is also integral to the provision of physician services. Each of these models creates comparable units of physician services using the concept of FTEs (see page 5). The models project the number of FTE physicians by projecting the number of hours physicians spend in patient care activities and, basically, dividing it by the number of hours performed by a one FTE physician. Patient care hours vary by a number of factors, but some of the most important ones are age, sex and specialty, employment type and metropolitan location.

The HRSA model projects patient care hours by age, sex and specialty using 1998 data from the AMA Socioeconomic Monitoring System. Additionally, it assumes that hours worked within each age by sex by specialty category remains constant over time. Thus if 35 year old female toe specialists worked, on average, 50 hours a week in 1998, the HRSA model assumes a 35 year old female toe specialist will work 50 hours a week in 2020.

The AAMC model also predicts patient care hours by age, sex and specialty and that hours worked within each age by sex by specialty category will remain constant. However, it uses updated information from the 2002-2003 HRSA Bureau of Health Professions Survey and the 2006 AAMC-AMA Survey of Physicians over Age 50.

The VPSDM also bases its estimates of patient hours worked by age, gender and specialty on information gathered in the 2002- 2003 HRSA survey and the 2006 AAMC-AMA survey. Figure 8 shows hours worked by age and certain specialties among male physicians.

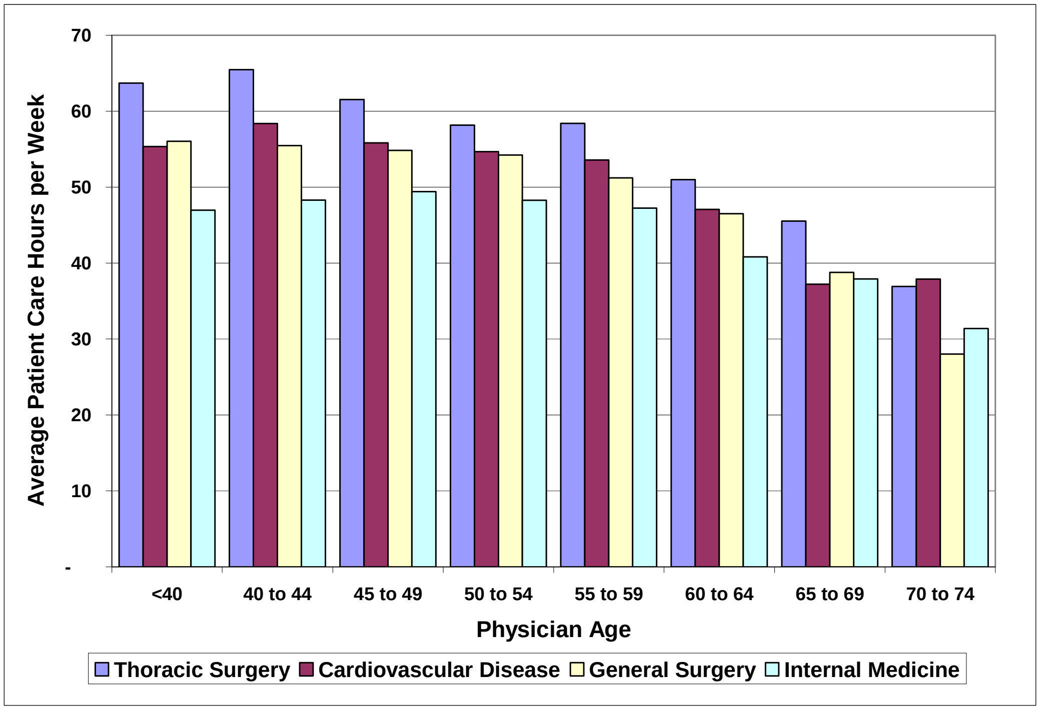

Figure 8: Patient Care Hours Worked: Male Physcians
Source: 2002-2003 HRSA Survey & 2006 AAMC Survey

Results

The VPSDM projects Virginia's physician workforce through 2030 in detail, including predictions of physician specialties, demographics and FTEs. Additionally, assumptions may be changed in the model, enabling predictions based on various scenarios. In particular, the VPSDM model was run using different assumptions for new graduates locating in Virginia, ranging from 500 to 700 per year. VPSDM projections through 2030 of the number of physicians active in patient care- excluding residents and fellows- appear in Table 4.

Year	Virginia	% Change
2010	15900	-
2015	17700	11.3%
2020	19400	9.6%
2025	21000	8.2%
2030	22600	7.6%
2010-2030	+6700	42.1%

Table 4: VPSDM Projections of Patient Care Physicians

While the VPSDM predicts that Virginia will add physicians steadily, the rate of projected growth steadily declines. The VPSDM projects Virginia will add 3,500 patient care physicians from 2010 to 2020. From 2020 to 2030, Virginia is only projected to gain an additional 3,200 patient care physicians. Since new graduate assumptions in the model are constant, the decline in the projected growth rate is due to increases in projected retirements and mortality as the baby-boomers reach retirement age.

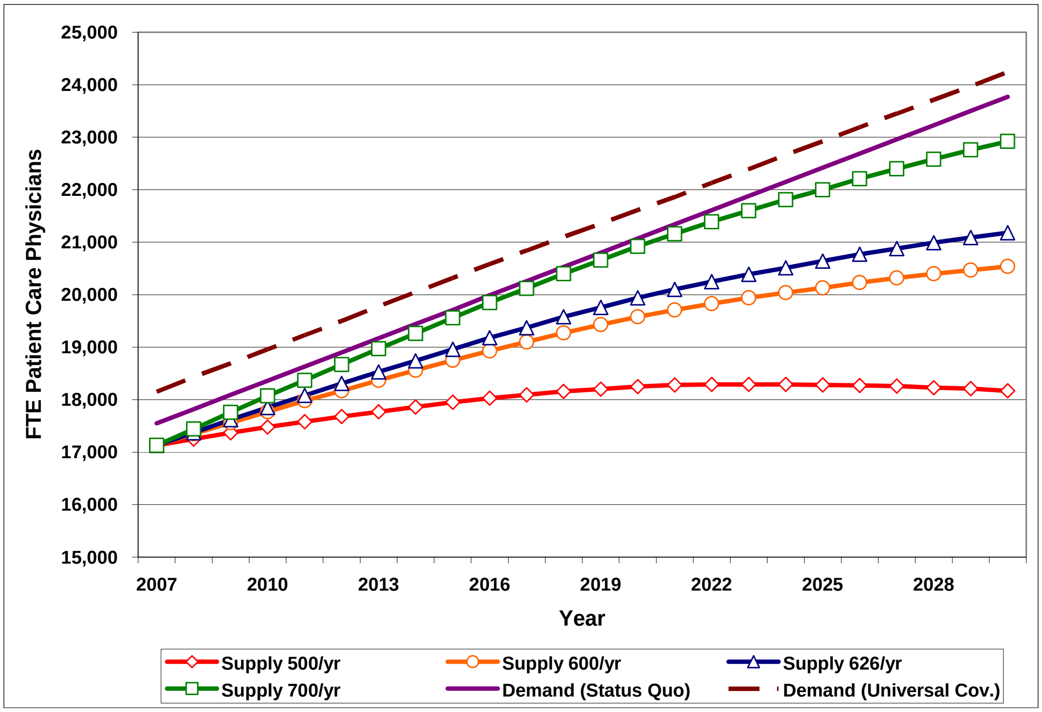

Figure 9: Supply projections under alternate new graduate scenarios.

Figure 9 illustrates supply projections for FTE patient care physicians. It also includes alternate assumptions of Virginia's ability to capture new graduates and projections of demand under a status quo and universal coverage scenario (see Physician Demand section, page 16). Like projections for active patient care physicians, the projected growth of FTE physicians begins to level off as projections approach 2030.

According to alternate scenario projections, Virginia's FTE patient care physician workforce will begin to decline by 2030 if the Commonwealth only captures 500 new physicians annually. If Virginia manages to capture 700 new physicians each year, the VPSDM projects that supply will begin to approach demand, suggesting that Virginia may need to capture just over 700 new physicians annually to meet projected demand.

Physician Demand

Overview

The HRSA, AAMC and VPSDM demand models share many conceptual similarities with the supply models. The demand model, in essence, counts patients instead of physicians. The models determine demand by determining physician utilization rates among individuals with certain characteristics. The factors that influence utilization of physician services play a prominent role in forecasting demand for physician services.

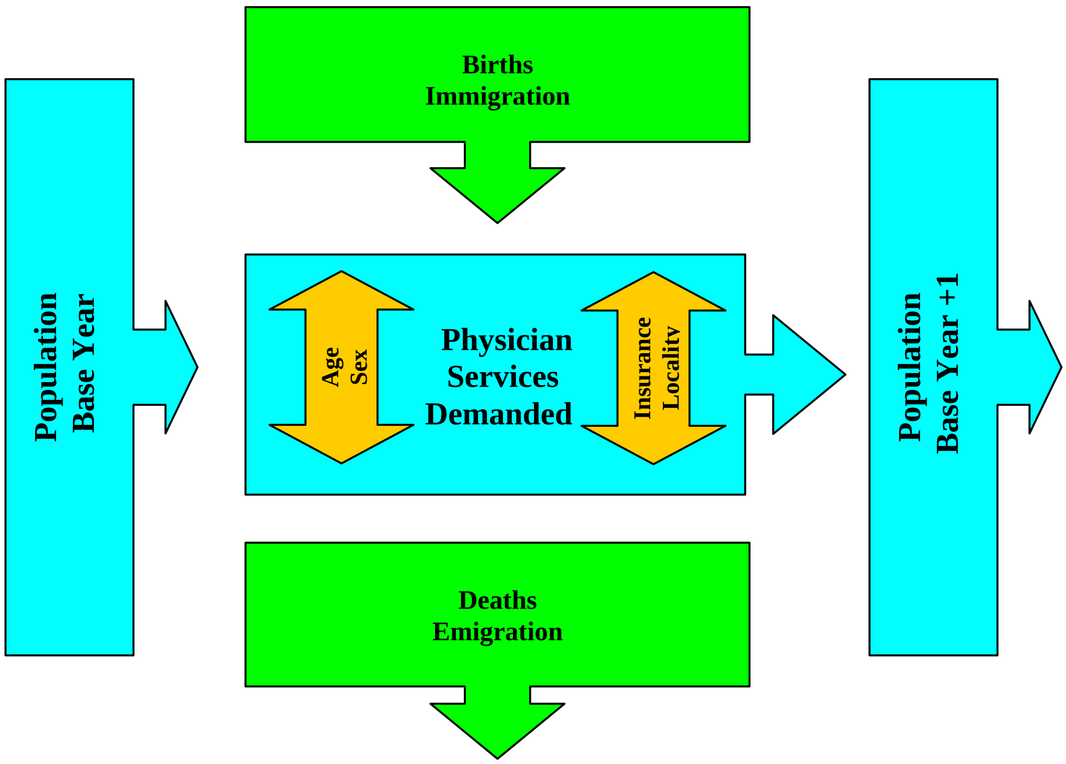

Figure 10: Conceptual diagram of the demand models.

The models use detailed physician-to-population ratios to model demand for physician services by individuals. Important characteristics include age, sex, race/ethnicity, insurance type, rural/urban locality, income and education. A demand model that includes measures of physician utilization by age, sex and insurance type, for instance, would develop a physician-to-population ratio for uninsured males age 25 to 29, uninsured females age 25 to 29, HMO-insured males age 30 to 34, etc. Once the model determines a ratio for each group, it counts the number of persons in each category for each projected year, multiplies it by the physician-to-population ratio and aggregates the figures for each group.

Broad Determinants of Physician Utilization

Box 3: Alternate Scenarios Modeled	
HRSA Model	AAMC Model
1. Economic growth 2. Non-physician clinician supply	1.Economic Growth 2. Non-physician clinician supply 3. Population demographics

Physician-to-population ratios are calculated for a base year and are assumed to remain constant through the duration of projections. Like the supply models, the demand models are highly dependent on patient behavior during the base year. There are several social factors that may influence individual patient behavior in the base year. Changes in these social determinants during the base year may have a significant impact on the model's projections. Changes after the base year may cause actual demand for physicians to stray from the model's projections. Moreover, these social determinants may vary geographically, meaning estimates of utilization may not be generalized across regions. The HRSA and AAMC models examine a variety of scenarios that may impact demand projections. A list of these scenarios appears in Box 3. A list of social factors that may influence base year projections appears below. These social factors influence utilization estimates in the base year, but possible changes in these factors are not accounted for in projections.

National Wealth

Countries with higher per capita GDP tend to spend a higher proportion of GDP on health care.[7,8] Some economists note that for individuals, health care acts like a necessity. However, at state or national levels, health care often acts like a luxury good.[9] Wealthy nations spend more developing health infrastructure, including physical infrastructure, financial infrastructure and educational infrastructure. In wealthier nations, and in wealthier regions, there are usually more physicians in more convenient locations with better facilities and better, often specialized, training. These factors will change patient behavior regardless of patient characteristics.

Culture

A population's culture may impact what people think appropriate health care entails. This is one reason utilization varies by race and ethnicity. However, culture and patient expectations also change over time and region. Expectations may vary due to changes in access, technology, public knowledge, advertising or other factors. Culture also impacts patient behavior and health. Decades ago, movies and television glorified tobacco use. Today, Americans largely view tobacco use negatively. Changes in patterns of food consumption, combined with an increasingly sedentary lifestyle, have led to increasing obesity. Both of these cultural or lifestyle characteristics impact health and utilization of health services.

Unique Health and Other Events

Unique health and other events may impact physician utilization patterns. The swine flu pandemic likely effected physician utilization in 2009. Other less significant events, such as regional flu outbreaks, a meningitis scare or even a large snowstorm, may effect physician utilization.

Government Policy and Regulations

The health industry is highly regulated. Federal, state and local governments regulate professional licensing, facility staffing, health benefits, health infrastructure development and reimbursement. Government programs and subsidies often support direct services to residents, health practitioner education and health infrastructure. Changes in any of these regulations, programs or subsidies may affect utilization patterns.

Advances in Health Care

Improvements in treatment and diagnostics may also affect physician utilization. Advances normally lead to increased productivity, which hints at decreased demand for physicians, however some advances may increase demand. A new treatment, for instance, may decrease demand for services by eliminating an illness or a new treatment—even a life-saving treatment-- may increase demand for services. Procedures that improve quality of life, such as bariatric surgery, fertility treatment and new pharmaceuticals, often spur demand. Other treatments, such as improvements in anti-retroviral drugs or cardiac surgeries increase life spans, but also often increase long-term medical needs. Similarly, improved diagnostics may help physicians discover health problems earlier, or even identify new diseases or conditions. This may lead to a reduced need for physician services or to increased demand for testing and treatments.

Non-physician Practitioners

Non-physician practitioners may influence demand in two ways. They may act as substitutes for physicians, or they may increase physician productivity.

<u>Non-physician Practitioners as Substitutes</u>

A variety of non-physician practitioners, including Nurse Practitioners, Physician's Assistants, Chiropractors, Midwives, Optometrists and Podiatrists, provide medical services--circumscribed by their limited training and scopes of practice. Alternative practitioners, including Acupuncturists, Oriental Medical Practitioners and Naturopaths, also provide some similar services. When patients choose to use these practitioners for services traditionally provided by physicians, the demand for *services* remains constant. However, the demand for *physicians* decreases.

Similarly, many allied health practitioners and nurses fill non-core roles previously filled by physicians. For instance, the role of first assistant to the surgeon has traditionally been filled by physicians, residents and fellows. For physicians and residents, first assisting at surgery is educational, and a way to keep skills sharp. Within the past few decades, however, a variety of practitioners, including Registered Nurses, Nurse Practitioners, Clinical Nurse Specialists, Physician Assistants and Surgical Assistants have begun to fill this role. Use of physicians, residents and fellows has diminished. The increasing use of non-physicians in this role diminishes the demand on physician's time.

Non-physician Practitioners as Productivity Boosters

Non-physician practitioners are often thought of as physician extenders. Nurse practitioners and physician assistants, for instance, perform delegated physician services within a physician's practice, often in a separate office. Other health practitioners work more closely with physicians, performing specialized tasks on behalf of physicians. In this manner, non-physician practitioners allow one physician to provide more physician services, increasing productivity.

Government regulations, industry organization, educational standards and professional innovation all influence how non-physician practitioners function. Regardless of how they are viewed in the health care field (as substitutes or extenders), non-physician practitioners influence the utilization of physicians.

Elements of the Demand Model

The HRSA, AAMC and VPSDM rely on population figures, beginning with a base year estimate and continuing with population projections for future years. The US Census Bureau provides annual population estimates and projections. Census Bureau projections at the state level extend to thirty years past the most recent Census while projections at the national level extend up to 100 years in the future. Census Bureau projections include detailed estimates by age, sex and race/ethnicity. Census Bureau projections are an excellent and easy to use source that already models entry and exit from the population.

Both the HRSA and AAMC models use US Census Bureau projections to provide population projections for various characteristics, including age, sex, race/ethnicity and metropolitan/non B metropolitan location. The US Census Bureau, however, does not create population projections at the level required by the VPSDM. The VPSDM projects demand for each of Virginia's five Health Services Areas (HSAs): Northwestern, North, Southwestern, Central and Eastern. The localities associated with each HSA appear in Appendix B.
To model population at the HSA level, the VPSDM uses projections provided by the Virginia Employment Commission. The growth rate of Virginia's elderly population, by HSA, appears in Figure 11 (next page). The elderly population in Northern Virginia is projected to grow more quickly than in other regions.

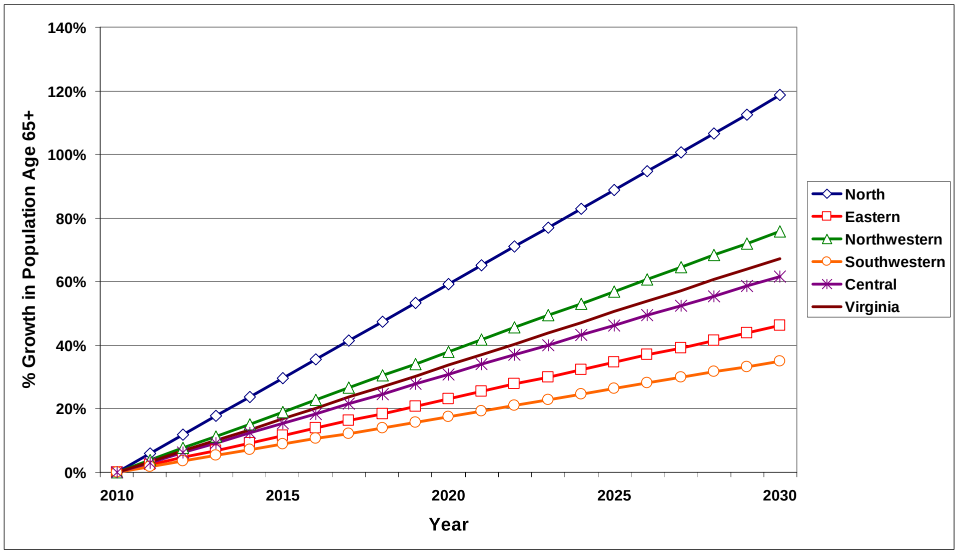

Figure 11: Growth of the Elderly Population in Virginia, based on extrapolation of projections data from the Virginia Employment Commission
Source: The Lewin Group. Projected Supply and Demand for Physicians in the Commonwealth of Virginia. *For Virginia Physician Workforce Committee. PowerPoint Presentation 10-28-2009*. Slide 13.

Insurance Status

To estimate and project insurance status, the HRSA and AAMC models use the National Health Interview Survey (NHIS) conducted by the US Census Bureau on behalf of the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS). The HRSA model analyzed data from the 1999, 2000 and 2001 NHIS, while the AAMC uses the 2005 NHIS. The HRSA models insurance status in four categories: fee-for-service, exclusive network HMO, all other managed care and uninsured. The AAMC models only insured and uninsured status. This change may be appropriate due to the declining influence of managed care on utilization. The VPSDM also models by insured and uninsured status. The Virginia Employment Commission provided estimates of insured and uninsured status in Virginia through 2030. The 2030 projections appear in Table 5.

HSA	Insured	Uninsured	Percent uninsured
North	3,079,705	141,131	4.4%
Eastern	1,832,725	89,607	4.7%
Northwestern	1,618,353	94,212	5.5%
Southwestern	1,154,897	88,657	7.1%
Central	1,364,372	154,309	10.2%
Virginia	**9,050,053**	**568,119**	**5.9%**
US	314,105,896	49,478,538	13.6%

Table 5: Insurance Status Estimates for Virginia, 2030.
Source: The Lewin Group. Projected Supply and Demand for Physicians in the Commonwealth of Virginia. *For Virginia Physician Workforce Committee. PowerPoint Presentation 09-29-2009*. Slide 23.

Utilization of Physician Services

Since the US Census Bureau provides detailed population projections, projecting utilization of physician services is the most complex part of the demand models. As noted earlier, these models predict utilization based on base year physician-to-population ratios for specific population groups. The models assume that utilization by each population group will remain constant throughout the projection period. Although each model uses this basic concept, the number and complexity of the population groups is different in each model.

Box 4: Medical Specialties in the HRSA Demand Model
Primary Care
• General Family Practice • General Internal Medicine • Pediatrics
Non-Primary Care
Medical Specialties: • Cardiology • Other Internal Medicine *Surgical Specialties:* • General Surgery • OB/GYN • Ophthalmology • Orthopedic Surgery • Other Surgery • Otolaryngology • Urology *Other Specialties* • Anesthesiology • Emergency Medicine • Pathology • Psychiatry • Radiology • Other Specialties

The HRSA model divides the population into 176 different categories based on age, gender, metropolitan/non-metropolitan location, medical insurance status and insurer type. It then estimates each category's physician-to-population ratio for each of 18 medical specialty categories (see Box 4).To develop the physician-to-population ratio, HRSA used five sources:

1) National Ambulatory Medical Care Survey: A national sample of visits to non-federal office-based physicians engaged in patient care, collected by the NCHS.

2) National Hospital Ambulatory Medical Care Survey: A national sample of visits to emergency and outpatient departments of noninstitutional general and short-stay hospitals, also collected by the NCHS.

3) Nationwide Inpatient Sample: A 40-state (including Virginia) sample of discharge data, approximating a 20 percent stratified sample of US community hospitals. This sample is a project of the Healthcare Cost and Utilization Project (H-CUP) of the Agency for Health Research and Quality. The NIS is a collaborative project involving the Federal government, state governments and the hospital industry.

4) National Nursing Home Survey: A national sample survey of nursing homes (either certified for participation in Medicare or Medicaid or licensed by their respective states), their residents and their staffs. This survey is also administered by the NCHS.

5) National Home and Hospice Care Survey: A nationally representative sample survey of home and hospice agencies, also administered by the NCHS.

For illustrative purposes, HRSA provided a *simplified* sample of physician-to-population ratio estimates by aggregate age and specialty categories. This simplified sample appears in Table 6.

Age Group	**Specialty Category**				
	Primary Care	**Medical Specialties**	**Surgery**	**Other Care**	**Total**
0-17 years	95	10	16	29	149
18-24 years	43	15	54	48	159
25-44 years	59	23	52	62	196
45-64 years	89	41	59	81	270
65-74 years	175	97	125	145	543
75+ years	270	130	161	220	781
Total	**95**	**33**	**55**	**70**	**253**

Table 6: National estimates of physicians per 100,000 population by aggregate age and specialty, 2000.
Source: HRSA 2008, Exhibit 29, pg 40.

The AAMC model uses a similar method, but documentation for the model provides a little more detail. The AAMC model first estimates the amount of time physicians in 24 specialties spend on different types of physician services (e.g. office visits, outpatient visits, hospital rounds, surgery, etc.). The AAMC uses results of the AMA's 2003 Physician Socioeconomic Statistics (collecting data from 2001) and some specialty surveys to make these estimates.

Box 5: Characteristics used to model physician-to-population ratios by population subset

HRSA Model	AAMC Model
Age Gender Metro/Non-Metro Insurance status Insurance type	Age Gender Race/ethnicity Insurance status

Using this data, the AAMC model then estimates physician-to-population ratios for 112 population groups based on age, gender, race/ethnicity and insurance status. The AAMC model uses FTE physician counts for 2006 that exclude residents and fellows, therefore comparisons with the supply model must be made using FTEs that also exclude residents and fellows. The AAMC model uses three of the data sources that the HRSA model uses to estimate utilization:

1) 2005 National Ambulatory Medical Care Survey

2) 2005 National Hospital Ambulatory Medical Care Survey

3) 2005 Nationwide Inpatient Sample

One of the limitations of these models is they use information from different years to calculate different aspects of the models, including base year physician-to-population ratios. The AAMC model provides an illustration. The AAMC model uses 2001 data to estimate the amount of time physicians spend providing various physician services in various settings. It then applies this data to FTE physician counts (excluding residents and fellows) from 2006 to determine physician FTEs in each category. Significant changes may have occurred in the interim. An increase in the use of hospitalists, for instance, may mean primary care providers spend less time on inpatient hospital rounds or less time working in general. In 2003, the ACGME placed voluntary limits on resident and fellow work hours. Other physicians or non-physician practitioners must make up for these reduced hours, either by shifting time to tasks normally performed by residents or fellows or by increasing total work hours. Finally, it uses 2005 utilization patterns to determine

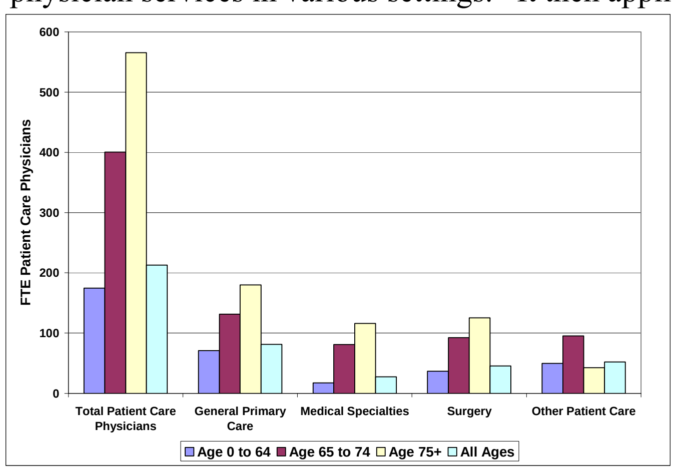

Figure 12: National Demand for Physicians Per 100,000 Population, by Age Group and Specialty, used in the VPSDM.
Source: The Lewin Group. Projected Supply and Demand for Physicians in the Commonwealth of Virginia. *For Virginia Physician Workforce Committee. PowerPoint Presentation 10-28-2009*. Slide 16.

physician-to-population ratios-utilization patterns which themselves may change with the availability of physicians in certain settings. Thus the physician-to-population ratios are an amalgam of work patterns in 2001, physician FTE counts in 2006 and utilization patterns in 2005, compounding existing limitations with the use of base year estimates. Although complex models usually must include data from different sources and years, and the models include the most up-to-date date, these differences influence base year estimates.

The VPSDM uses the AAMC model parameters to develop physician-to-population ratios. It is important to note that the VPSDM physician-to-population ratios are based on the *national* estimates of the AAMC model.[iv] Thus the demand portion of the VPSDM incorporates Virginia-specific population estimates into the AAMC model. It does not make Virginia-specific (or HSA-specific) utilization estimates, but uses national estimates of utilization. Simplified estimates of physician-to-population ratios by age and specialty category appear in Figure 12 (previous page).

[iv] See Minutes for the September 29, 2009 meeting of the Physician Workforce Advisory Committee of the Healthcare Workforce Data Center. http://www.dhp.virginia.gov/hwdc/meetings.htm

Results

The Lewin Group provided VPSDM demand estimates for two different scenarios: current insurance patterns and universal insurance patterns. It provided estimates for all of Virginia, and for each of Virginia's five HSAs. Additionally, it provided results for total patient care physicians and for four medical specialty categories: 1) General Primary Care, 2) Medical Specialties, 3) Surgery and 4) Other Patient Care. It also provided results for the Emergency Medicine Specialty, a subset of Other Patient Care, to illustrate the probable impact of the universal insurance coverage scenario. A list of specialties associated with each specialty category appears below. The VPSDM creates estimates for each of the listed specialties.

General Primary Care

Family Practice	General Internal Medicine	Geriatric Medicine	Pediatrics

Surgery

Colon & Rectal Surgery	General Surgery	Neurological Surgery	Plastic Surgery
Ophthalmology	Orthopedic Surgery	Otolaryngology	Obstetrics/ Gynecology
Thoracic Surgery	Urology	Other Surgical Specialties	

Medical Specialties

Allergy	Cardiology	Cardiology General	Clinical Cardiac Electrophysiology
Interventional Cardiology	Pediatric Cardiology	Critical Care	Critical Care Medicine (Adult)
Pediatric Critical Care	Dermatology	Endocrinology	Endocrinology (Adult)
Pediatric Endocrinology	Gastroenterology	Hematology & Oncology	Hematology & Oncology (Adult)
Pediatric Hematology & Oncology	Infectious Diseases	Rheumatology	Nephrology
Pulmonolgy	Pulmonology (adult)	Pediatric Pulmonolgy	

Other Patient Care

Anesthesiology	Emergency Medicine	Neonatal-perinatal Medicine	Neurology
Pathology	Physical Medicine & Rehabilitation	Preventive Medicine	Psychiatry
Psychiatry (Adult)	Child & Adolescent Psychiatry	Radiology	Radiation Oncology
Other Specialties			

2010 Estimates of Demand

The Lewin Group provided detailed estimates of 2010 demand for patient care physicians using status quo and universal coverage scenarios for each of the HSAs. As this scenario was run in fall of 2009, before Federal health reform legislation was passed in early 2010, the scenario is based on 100 percent coverage of those currently uninsured. These estimates appear in Table 7. Projected demand for physicians is highest in the North and Eastern HSAs (in the Northern Virginia and Hampton Roads areas respectively). Under the Universal Coverage scenario, projected demand for physicians would increase the most in the North and Central

HSAs, and mostly for primary care providers. Meanwhile, projected demand for Emergency Medicine specialists would decline under the universal coverage scenario.

Specialty	US	Virginia	North	Eastern	Northwestern	Southwestern	Central
General Primary Care							
Status Quo	273,410	7,070	2,050	1,620	1,070	1,150	1,180
Universal	287,280	7,190	2,090	1,640	1,080	1,160	1,220
Difference	13,870	120	40	20	10	10	40
% diff	5%	2%	2%	1%	1%	1%	3%
Medical Specialties							
Status Quo	106,170	2,700	730	610	420	480	460
Universal	109,370	2,730	740	620	420	480	470
Difference	3,200	30	10	10	-	-	10
% diff	3%	1%	1%	2%	0%	0%	2%
Surgery							
Status Quo	154,650	4,000	1,160	900	620	670	650
Universal	165,880	4,100	1,190	910	630	690	680
Difference	11,230	100	30	10	10	20	30
% diff	7%	3%	3%	1%	2%	3%	5%
Other Patient Care							
Status Quo	230,540	5,730	1,690	1,280	890	930	940
Universal	232,360	5,710	1,700	1,270	880	920	940
Difference	1,820	(20)	10	(10)	(10)	(10)	-
% diff	1%	0%	1%	-1%	-1%	-1%	0%
Total Physicians							
Status Quo	764,770	19,500	5,630	4,410	3,000	3,230	3,230
Universal	794,890	19,730	5,720	4,440	3,010	3,250	3,310
Difference	30,120	230	90	30	10	20	80
% diff	4%	1%	2%	1%	0%	1%	2%
Emergency Medicine							
Status Quo	31,580	780	210	180	120	130	140
Universal	29,310	740	210	170	110	120	130
Difference	(2,270)	(40)	-	(10)	(10)	(10)	(10)
% diff	-7%	-5%	0%	-6%	-8%	-8%	-7%

Table 7: Demand estimates for 2010 from the VPSDM. Provided by the Lewin Group.
Source: The Lewin Group. Projected Supply and Demand for Physicians in the Commonwealth of Virginia. *For Virginia Physician Workforce Committee. PowerPoint Presentation. 9-29-2009, Slide 24 & 25; 10-28-2009*. Slide 20.

Projections through 2030

The Lewin Group provided a series of graphs depicting projections of physician demand from 2008 to 2030. The graphs depict demand by region and for each specialty.

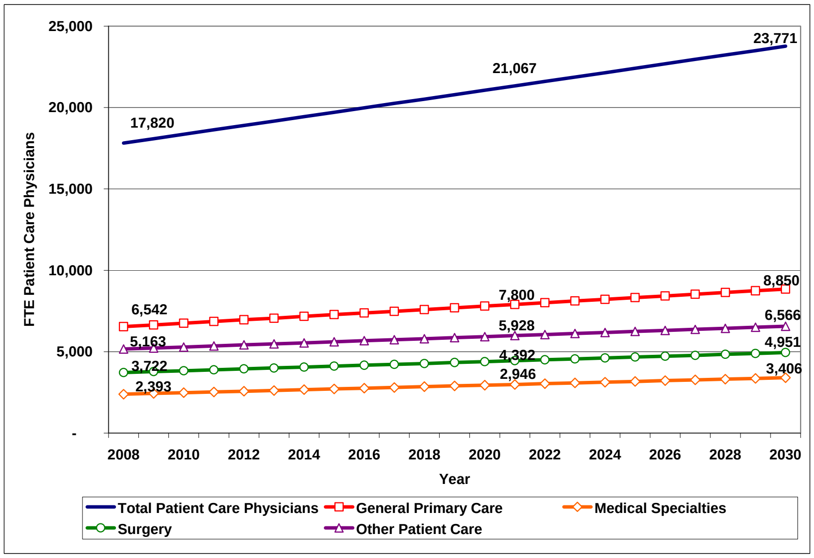

Figure 13: Virginia Demand for Patient Care Physicians

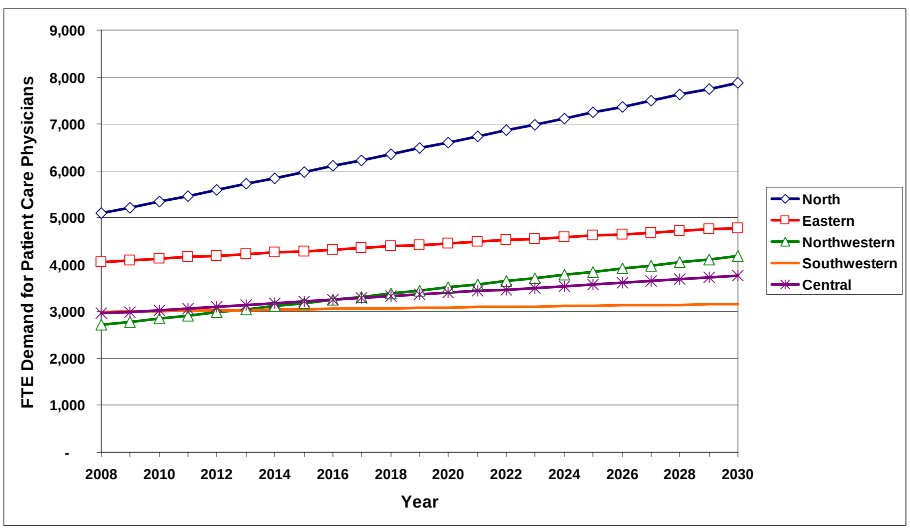

Figure 14: Demand for Patient Care Physicians by HSA

The VPSDM projects Virginia's demand for FTE physicians will grow steadily for each of the medical specialties. However, the projected growth in demand is not evenly distributed throughout the state's five HSAs. Projected demand grows more quickly in the North HSA (Northern Virginia), corresponding to the HSA's disproportionate projected growth in elderly population. The Northwestern and Central HSAs are projected to have moderate growth in demand. Projected demand in the Southwestern HSA is almost flat, while projected demand growth in the Eastern HSA is also subdued.

Adequacy of Physician Supply

Overview

The HRSA, AAMC and VPSDM models determine the adequacy of the physician supply by assessing the difference between physician supply and demand. If the projected supply of FTE physicians exceeds the projected demand for FTE physicians, the models project a surplus. If the projected demand for FTE physicians exceeds the projected supply of FTE physicians, the models project a deficit. The projections from each model for select years appear in Table 8.

Model	Physician Patient Care FTE Supply	Physician Patient Care FTE Demand	Surplus (Deficit)	Growth in Supply needed to meet demand
HRSA (2020)	866,400	921,500	(55,100)	6.36%
HRSA, excluding residents (2020)	719,940	NA	NA	NA
AAMC (2020)	729,800	805,800	(76,000)	10.41%
AAMC (2025)	734,900	859,300	(124,400)	16.92%
AAMC, including residents (2025)	869,900 (Active)			
VPSDM (2030)*	22,600 (Active)*	22,500 (Active)*	100	(0.44%)
VPSDM (2030)*	21,100*	23,771*	(2,671)	12.66%

Table 8: Supply and Demand Scenarios from the HRSA model, AAMC model and the VPSDM.
* The Lewin Group provided supply projections for active patient care physicians and demand projections for FTE physicians. Other figures are estimated from graphs (Supply: Lewin Group Presentation, 9-29-2009, Slide 14; Demand: Lewin Group Presentation, 9-29-2009, Slide 26; 10-28-2009, Slide 21.) Another Slide (Lewin Group Presentation 10-28-2009, Slide 25) stated FTE supply is projected to grow by 3,800 and FTE demand is expected to grow by 6,000, suggesting a gap of 2,200 physicians.

While there appear to be large differences in the projected deficits of the HRSA and AAMC models, the projections are not apples to apples comparisons. The HRSA model included supply projections for a variety of scenarios; however HRSA demand projections *include* residents and fellows in physician-to-population ratios. The AAMC model *excludes* residents and fellows from its demand-side physician-to-population ratios. Residents and fellows accounted for 116,380, or over 16 percent, of the FTE physician estimates in HRSA's 2000 base year and 180,700, or almost 14 percent, of the total physician count in AAMC's 2006 base year. As the ACGME has put increased limits on resident duty hours, estimates of the amount of the proportion of services provided by residents have declined. At a recent conference, ACGME representatives predicted that residents now provide one eighth of all services provided by physicians.[10] The impact of the different handling of residents and fellows in the models is likely significant. The higher deficit predicted by the AAMC model may merely be a testament to the large workload carried by residents and fellows—a workload that may diminish with new ACGME restrictions on resident duty hours.

Both the HRSA and AAMC models provide at least some supply projections that exclude or include residents and fellows (See Table 8). HRSA estimates of FTE physician supply in 2020 are much closer to the AAMC model when residents and fellows are excluded. Likewise, AAMC FTE physician supply projections appear much closer to HRSA projections when residents and fellows are included. The HRSA report does not provide projections of FTE physician demand excluding residents and fellows, and the AAMC report does not provide projections of FTE physician demand including residents and fellows.

Several other characteristics inherent to the models may explain differences in physician supply and demand projections, including:

- The HRSA assumes a slight increase in annual number physician graduates (from 23,500 to 25,000) while the AAMC baseline model assumes the number of new graduates will remain constant (at 23,400).
- The HRSA model measures managed care utilization in 2000, while the AAMC model does not separately measure managed care.
- The AAMC model defines physicians that work under 20 hours per week as active, while the HRSA model does not.[v] This may increase the number of physicians in the AAMC's base year, but may decrease hours worked when calculating FTEs in the base year. While more accurate, this may result in more FTE physicians predicted compared to the HRSA model.
- Finally, the AAMC model includes updated data and an updated base year, making base year estimates more current.

Following the AAMC model's methodology, the VPSDM projects a deficit in FTE patient care physicians in Virginia similar to the national deficit projected by the AAMC model (see Figure 15, page 30). This, however, depends on forecasts of average hours worked. Using AMA physician workforce data, the VPSDM projects Virginia will maintain a slight surplus in the number of patient care physicians (see Figure 13).

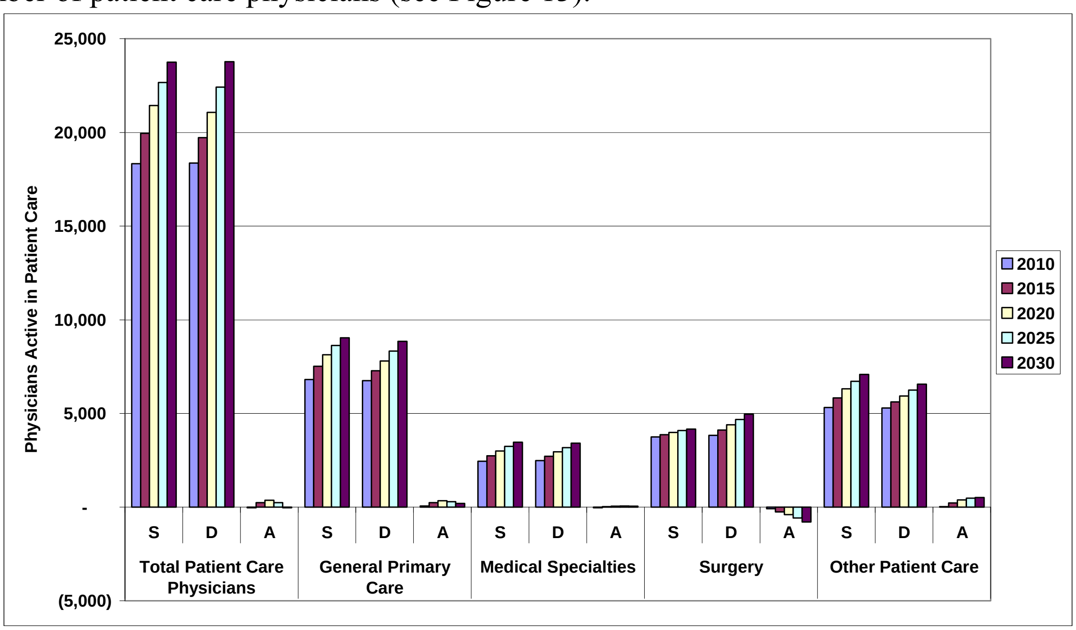

Figure 13: Physician Supply, Demand and Adequacy Projections in the VPSDM model by Specialty Category.

S= Supply, D=Demand, A=Adequacy

[v] The AMA Physician Masterfile defines "active in patient care" as working 20 or more hours per week in patient care. The HRSA model accepted this definition, the AAMC model counted reported hours.

The Lewin Group also ran projections of active patient care physicians using Virginia Physician Profile data (See Figure 14). For anyone familiar with these types of inventory models, the projected physician deficit for 2010 should raise a red flag. The VPSDM considers the base year, 2008, the standard. Years closer to the base year should have similar characteristics in both supply and demand. Changes in population and physician supply would have to be drastic to cause a ≈ 2,000 FTE physician deficit in just two years. The projected deficit in this case is actually caused by using two different sources for physician counts. The supply side uses Virginia Physician Profile data, while the demand side uses national physician-to-population ratio estimates based on AMA data. Ideally, the VPSDM would use Virginia-specific data to formulate physician-to-population ratios. As noted earlier, data and resource limitations have precluded this effort.

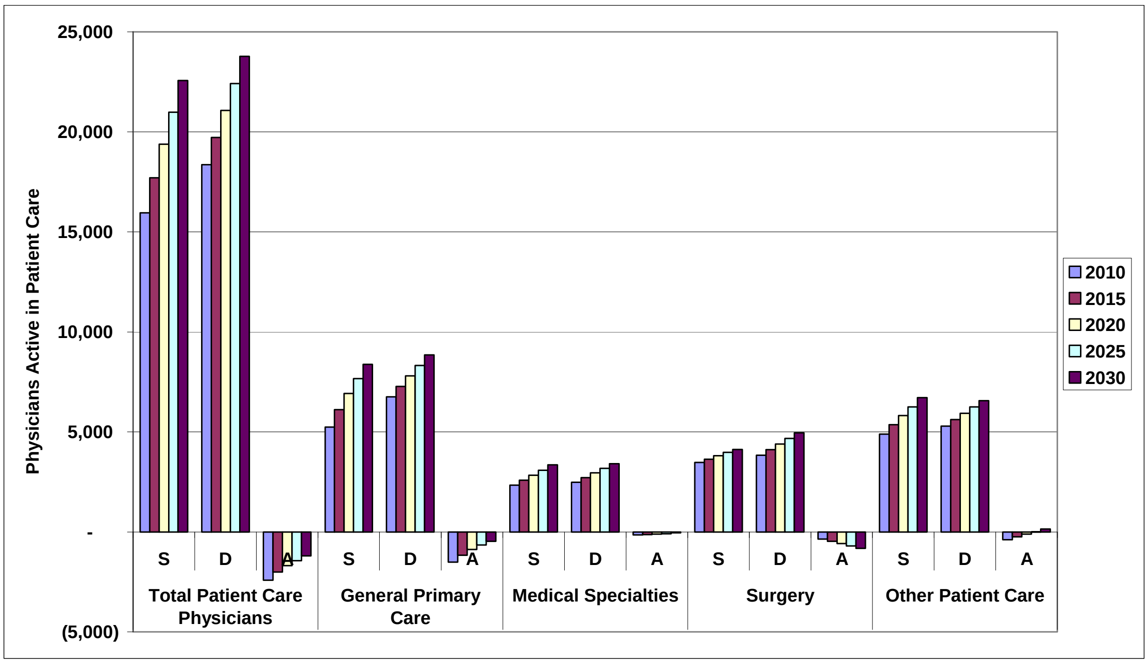

Figure 14: Physician Supply, Demand and Adequacy Projections in the VPSDM model using VDH data. S= Supply, D=Demand, A=Adequacy.

The Lewin Group predicts that under the universal coverage scenario, demand may increase by "several hundred". As a rough estimate, "several hundred" could represent 500 FTE physicians, growing the projected FTE physician deficit by 18.72 percent to about 3,175 FTE patient care physicians. Additionally, demand would shift away from emergency departments and towards office visits.

VPSDM Projections by Specialty

Despite the relatively small projected deficit in physicians, the VSPDM projects some pressing needs by specialty. While the VPSDM projects a slight surplus in patient care physicians, it projects a deficit of surgeons active in patient care (see Figure 13, page 28). When hours worked is taken into account, all four specialty areas suffer deficits. Significantly, the VPSDM projects the deficit of FTE primary care physicians will account for almost half of the total FTE physician deficit by 2030. The deficit of FTE surgeons also accounts for a significant part of the overall deficit in FTE physicians (see Figure 15). The other specialty categories, by contrast, maintain a comparably stable but growing deficit of FTE physicians. These results suggest that addressing the FTE physician specialty mix--and the projected deficit in surgeons and primary care providers--is as important as addressing the overall projected deficit of FTE physicians.

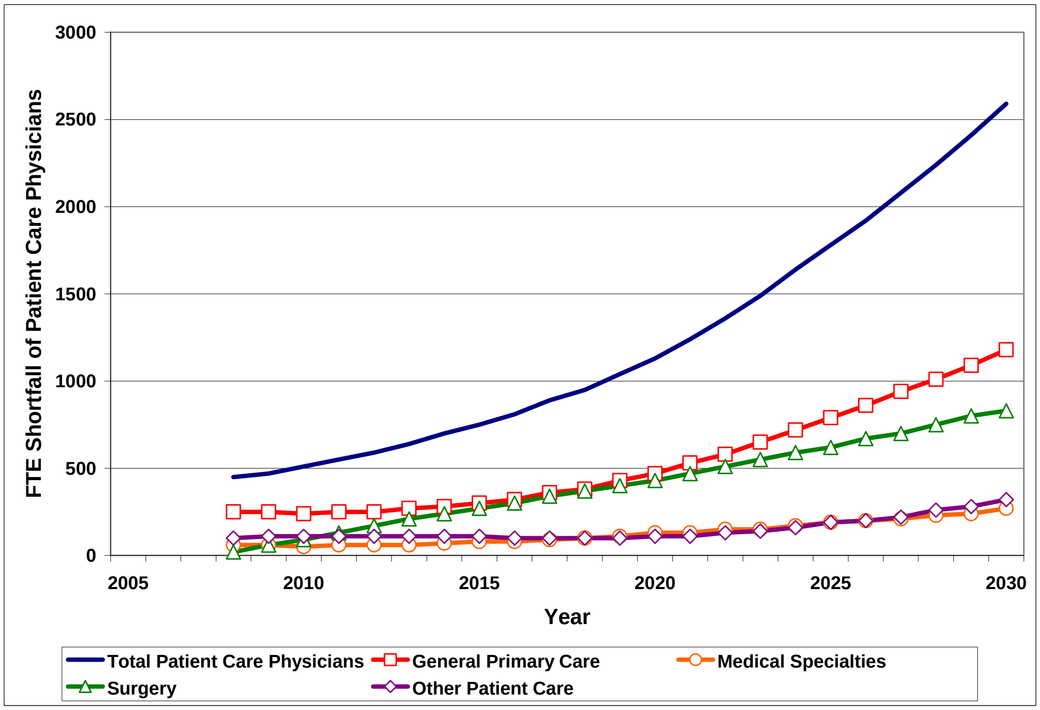

Figure 15: VPSDM shortfall projections

Readers should note the estimated deficit in 2008 and the 2010 deficit estimate of 500, equal to about 3 percent of physician supply for 2010. The 2008 deficit is the result of matching national physician-to-population ratios from 2005 to Virginia-specific FTE physician estimates from 2008, noted earlier. Although this deficit is also caused by a mismatch in data, it is significantly lower than the 2010 deficit predicted when using the Virginia Physician Profile data. The projected shortfalls are shortfalls compared to national utilization rates—providing a useful measure of physician adequacy in lieu of Virginia-specific utilization estimates.

Physician-to-Population Ratios

Some simplified comparisons of physician adequacy, using only the supply projections and population projections also provide some insight into the adequacy of Virginia's workforce and the VPSDM. Table 9 shows physician-to-population ratios using active patient care physician results (excluding residents and fellows) from the supply portion of the VPSDM and 2009 US Census Bureau population projections.[vi] It also includes similar, national estimates from the HRSA and AAMC models, using available figures. Each projected ratio is for active patient care physicians excluding residents and fellows.

Year	Virginia Population Projection	Virginia Patient Care Physicians	Patient Care Physician Per 100,000	United States Population Projection	HRSA Patient Care Physicians*	Patient Care Physicians* per 100,000	AAMC Patient Care Physicians	Patient Care Physicians Per 100,000
2000	7,078,515	-	-	281,421,906	597,440	212	-	-
2005	7,552,581	-	-	295,507,134	641,380	217	680,500	230
2010	8,010,245	15,900	198	308,935,581	681,130	220	-	-
2015	8,466,864	17,700	209	322,365,787	718,620	223	-	-
2020	8,917,395	19,400	218	335,804,546	744,990	222	-	-
2025	9,364,304	21,000	224	349,439,199	-	-	761,200	218
2030	9,825,019	22,600	230	363,584,435	-	-	-	-

Table 9: Comparisons of patient care physician-to-population ratios excluding residents and fellows.
* All columns exclude residents and fellows

The results of this simple measure of physician workforce adequacy suggest that supply projections may be ambitious. Both national projections result in declining patient care physician-to-population ratios after 2015, while the Virginia projections result in a growing ratio. Based on population growth alone, the VPSDM predicts that Virginia will be very successful at attracting new medical graduates compared to other states. This is likely due to the higher need (the basis of VPSDM's new graduate assumptions) caused by a disproportionate growth in high utilization populations such as the elderly. Although this section only looks at supply, demand projections are incorporated into the supply model through new graduate assumptions.

The picture becomes clearer when looking at physician-to-population ratios using projections of FTE physicians (see Table 10, next page). FTE physician-to-population ratios are significantly lower than patient care physician-to-population ratios. FTE physician-to-population ratios follow national patterns—a rise in FTE physicians per 100,000 residents through the 2010s, followed by a decline. The VPSDM projects that Virginia will have FTE physician-to-population ratios slightly higher than national projections, but following national trends.

[vi] Physician-to-population ratios may vary from those reported in corresponding reports for the HRSA & AAMC models. This is due to the different release dates used for Census Population Projections. This section uses the 2009 release to create comparable figures.

Year	Virginia Population Projection	Virginia* FTE Physicians	FTE Physician Per 100,000	United States Population Projection	HRSA FTE** Physicians	FTE** Physicians per 100,000	AAMC Patient Care Physicians	Patient Care Physicians Per 100,000
2000	7,078,515	-		281,421,906	597,430	212	-	
2005	7,552,581	-		295,507,134	635,780	215	680,500	230
2010	8,010,245	17,500	218	308,935,581	669,010	217	-	
2015	8,466,864	18,850	223	322,365,787	699,450	217	-	
2020	8,917,395	19,900	223	335,804,546	719,940	214	-	
2025	9,364,304	20,600	220	349,439,199	-	-	734,900	210
2030	9,825,019	21,100	215	363,584,435	-	-	-	-

Table 10: Comparisons of FTE physician-to-population ratios excluding residents and fellows.
* Estimates from unlabeled line graphs
**All columns exclude residents

Readers should note that until 2020 the VPSDM projects *more* FTE physicians than active patient care physicians while after 2020 the VPSDM projects *fewer* FTE physicians than active patient care physicians. This means that until 2020 the VPSDM projects Virginia physicians will work more hours per week, on average, than they do currently. After 2020, the VPSDM projects Virginia physicians will work fewer hours per week, on average, than the average physician does today. Several demographic trends among the physician workforce may explain this phenomenon.

Gender

Women make up a growing segment of the physician workforce, growing from 8 percent in the 1980s to almost 25 percent by 2008. Similarly, the proportion of medical school graduates who are women is increasing, from around 20 percent in 1980 to almost 50 percent today. As a result, women in the physician workforce tend to be younger than the physician population as a whole, and will make up a growing proportion of the physician workforce as their male counterparts retire. Currently, female physicians report working fewer hours than men—up to 8 less hours per week (49 hours per week vs 57 for men in some surveys).[11,12]

Age

As noted in the introduction, Virginia's physician workforce is aging. Older physicians tend to work fewer hours than their younger counterparts. Findings from the Virginia Physician Workforce Survey indicate that physicians begin to cut down their work hours at age 55, with many switching to part-time work (See Figure 16).

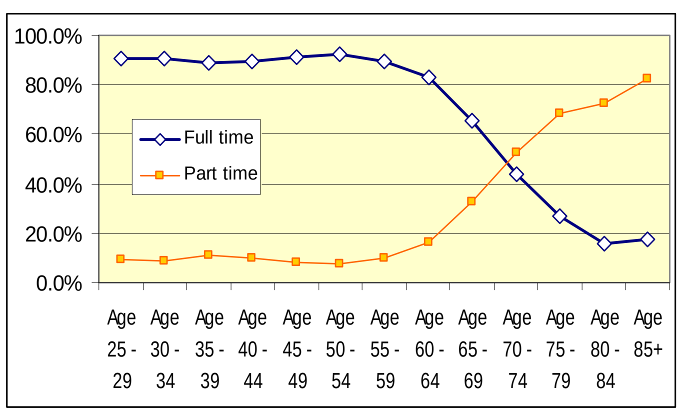

Figure 16: Physician work hours and age.
Source: Profile of the Physician Workforce in Virginia: Findings from the 2008 Physician Workforce Survey; Virginia Department of Health Professions.

Lifestyle Choices

Since the 1980s, the number of hours worked by younger physicians seems to be declining. This may be due in part to the growing proportion of women in the younger physician workforce.[13] Women physicians tend to place more importance on family time, flexible scheduling and other quality of life issues than their male counterparts.[14] Disentangling the influence of age and gender on the lifestyle choices of younger physicians is a challenge for researchers.

Whatever the cause of projected declines in hours worked, these figures clearly demonstrate the need to look at projected hours worked by physicians and not just the projected number of physicians. Although the VPSDM projects more physicians per 100,000 population in Virginia by 2030, it also projects fewer total hours worked. Additionally, the population in 2030 will likely be older than it is now, placing further strain on projected declines of FTE physicians.

Conclusions

Models are simplified versions of reality. They cannot hope to capture the multitude of variables that may influence the physician workforce and demand for physician services. Researchers must select variables that seem to be the most important. They must make compromises based on available data sources. They must choose from competing theories and methods of projecting supply and demand. No one model should be considered definitive and all projections should be approached with caution and an understanding of each model's limitations. Nevertheless, well constructed models add clarity to a confusing world—especially when models of varying types come to similar conclusions.

The HRSA model, the AAMC model and the VPSDM are inventory models. Like all models, they have certain limitations. The most important among them is their assumption that conditions in the base year represent normalcy and that conditions will, for the most part, remain static. For this reason they tend to *over predict* surpluses and deficits. In the real world, people respond to changing conditions—including responding to predictions of future conditions. These models are also limited by available data and the need to make assumptions about the future. Thus these models tell us, within their limits, the consequences of failing to adapt to changing conditions.

Additionally, it is important to know *what* you are measuring. The baseline HRSA model projects "a modest but growing . . . shortfall of physicians" through 2020.[15] Under its projections, a six percent increase in supply or a corresponding reduction in demand by 2020 are all that's needed to stabilize the national market for physician services. The baseline AAMC model projects a shortfall 38 percent larger than the HRSA model for the same year, requiring a ten percent increase in supply to meet demand. Only five years later it projects a shortfall 125 percent larger, requiring a seventeen percent increase in supply to meet demand. At first glance, these projections suggest an alarming increase in the growth of shortfall projections over only a few years. However, the HRSA model includes residents and fellows in its adequacy projections, whereas the AAMC model does not. Which method is better for predicting physician adequacy is a judgment call. The VPSDM follows the AAMC model's methodology and does *not* include residents and fellows in its projections of physician adequacy.

The VPSDM suffers from some additional challenges that its national brethren do not. At the state level, cross-border migration and employment is uncontrolled and largely uncounted, but influences the supply of physician services. The VPSDM does not include projections of cross-border migration. The VPSDM's assumption about the number of new graduates Virginia will capture may be overly simple and may be over reliant on self-created projections of demand gain. A proxy external to the model (proportion of persons aged 25 to 35 that live in the state?) could improve the new graduate assumptions. The model is very sensitive to this estimate, so a stronger basis for the assumption is warranted.

Additionally, the VPSDM projects national estimates of physician and patient behavior onto Virginians. Ideally, Virginia-specific estimates of physician and patient behavior-preferably using the improved information collected by the Healthcare Workforce Data Center-would be incorporated into the model. Overcoming these challenges will require additional investments in time and resources, along with the improved data the Healthcare Workforce Data Center is gathering.

Finally, while the VSPDM looks closely at physician adequacy among the physician specialties, it does not examine another important source of variation in physician adequacy: geography. Many rural and urban areas suffer from reduced access to physicians. A recent study by the Joint Commission on Health care determined that Virginia needed 149 additional and appropriately located physicians to exceed the federal Health Professional Shortage Areas (HPSA) program's physician shortage requirements for Virginia's HPSAs in 2008. The VPSDM does examine demand at the HSA level; however, this is not specific enough to provide insight into these disparities. Due to data limitations, the supply-side does not examine region at all.

Despite these limitations, the VPSDM using AMA physician counts provides insight into the adequacy of Virginia's future workforce. Perhaps more important than the actual projected figures are the trends revealed. Virginia will likely have a shortage of FTE physicians--even if it successfully grows its count of patient care physicians relative to the population, and more quickly than other states. This is due to the increased needs of the growing elderly population and to the potential reduction in hours worked by physicians in the future. Virginia's shortage will be primarily among primary care providers and surgeons. The shortage will grow more quickly as the last of the baby-boomers approach retirement age in 2030.

It may take up to ten years to train a physician through residency. It may take even longer to build or expand a medical school and graduate a new class of physicians. Although there may be some differences in extent, all of these models predict a shortfall in the physician workforce. If Virginia is to ensure that the VPSDM *over predicts* the shortfall, it should begin to meet the challenge of a declining supply of FTE patient care physicians now.

Virginia is, in fact, already acting to meet this challenge. The Medical College of Virginia at Virginia Commonwealth University, University of Virginia School of Medicine and the Eastern Virginia Medical School have increased their class sizes. Additionally, Virginia has added two additional medical schools: the Edward Via Virginia College of Osteopathic Medicine and the Virginia Tech Carilion School of Medicine-both near traditionally underserved rural areas. These efforts should combine to increase the number of Virginia medical graduates from about 400 to 425 today to over 600 by 2011 and close to 700 by 2015. Virginia has also been proactive in adding new residency slots. Three Virginia hospitals have added new residency slots in the past two years. Additionally, two other hospitals are developing new residency slots. These efforts alone may not translate into a growth in the number of medical graduates choosing to practice in the state. When combined with efforts in other states however, they go a long way towards meeting the challenges of maintaining the physician workforce through 2030.

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Appendix

Appendix A: Baseline Physician Supply by Specialty, HRSA Model

Source: Bureau of Health Professions. *The Physician Workforce: Projections and Research into Current Issues Affecting Supply and Demand*. US Department of Health and Human Services, Health Resources and Services Administration. December 2008. Exhibit 18, Exhibit 19 and Exhibit 20.

http://bhpr.hrsa.gov/healthworkforce/reports/physicianworkforce/default.htm

Year 2000	**Active**	**Percent of Total**	**Clinical Practice**	**Percent of Total**	**FTEs**	**Percent of Total**
Total	**756,050**	**100.00%**	**597,440**	**100.00%**	**597,430**	**100.00%**
Primary Care	**277,720**	**36.73%**	**214,820**	**35.96%**	**214,810**	**35.96%**
Gen. & Family Practice	110,990	14.68%	89,720	15.02%	89,710	15.02%
General Internal Med.	112,220	14.84%	82,250	13.77%	82,250	13.77%
General Pediatrics	54,520	7.21%	42,850	7.17%	42,850	7.17%
Other Med. Specialties	**107,540**	**14.22%**	**84,460**	**14.14%**	**84,460**	**14.14%**
Allergy	4,020	0.53%	3,320	0.56%	3,320	0.56%
Cardiovascular Disease	21,990	2.91%	18,680	3.13%	18,690	3.13%
Dermatology	9,990	1.32%	8,630	1.44%	8,630	1.44%
Gastroenterology	11,200	1.48%	9,660	1.62%	9,660	1.62%
Internal Med. Sub Spec	36,750	4.86%	27,450	4.59%	27,450	4.59%
Pediatric Cardiology	1,630	0.22%	1,210	0.20%	1,210	0.20%
Pediatrics Sub Spec	12,600	1.67%	8,060	1.35%	8,060	1.35%
Pulmonary Diseases	9,350	1.24%	7,460	1.25%	7,460	1.25%
Surgical Specialties	**163,780**	**21.66%**	**134,470**	**22.51%**	**134,470**	**22.51%**
General Surg Sub Spec	6,370	0.84%	5,780	0.97%	5,780	0.97%
General Surgery	33,980	4.49%	23,620	3.95%	23,610	3.95%
Neurological Surgery	5,290	0.70%	4,230	0.71%	4,220	0.71%
Obstetrics & Gynecology	42,780	5.66%	35,990	6.02%	35,990	6.02%
Ophthalmology	18,830	2.49%	16,810	2.81%	16,820	2.82%
Orthopedic Surgery	24,560	3.25%	20,160	3.37%	20,170	3.38%

Otorhino-laryngology	9,970	1.32%	8,440	1.41%	8,440	1.41%
Plastic Surgery	6,440	0.85%	5,760	0.96%	5,760	0.96%
Thoracic Surgery	4,930	0.65%	4,480	0.75%	4,480	0.75%
Urology	10,630	1.41%	9,200	1.54%	9,200	1.54%
Other Specialties	**207,010**	**27.38%**	**163,690**	**27.40%**	**163,690**	**27.40%**
Anesthesiology	39,090	5.17%	33,560	5.62%	33,560	5.62%
Child Psychiatry	6,650	0.88%	5,550	0.93%	5,550	0.93%
Diagnostic Radiology	23,100	3.06%	18,130	3.03%	18,130	3.03%
Emergency Medicine	27,460	3.63%	21,890	3.66%	21,890	3.66%
Gen. Prevent Medicine	3,670	0.49%	2,160	0.36%	2,160	0.36%
Neurology	13,870	1.83%	10,810	1.81%	10,810	1.81%
Nuclear Medicine	1,530	0.20%	1,230	0.21%	1,230	0.21%
Occupational Medicine	3,130	0.41%	2,320	0.39%	2,320	0.39%
Other Specialties	6,310	0.83%	3,280	0.55%	3,280	0.55%
Pathology	20,200	2.67%	14,240	2.38%	14,240	2.38%
Physical Med. & Rehab.	7,200	0.95%	5,790	0.97%	5,790	0.97%
Psychiatry	41,550	5.50%	33,120	5.54%	33,120	5.54%
Radiation Oncology	4,150	0.55%	3,560	0.60%	3,560	0.60%
Radiology	9,110	1.20%	8,090	1.35%	8,090	1.35%

Appendix B: Virginia's Health Services Areas

Northwestern (HSA I)	North (HSA II)	Southwestern (HSA III)
1. Albemarle County 2. Augusta County 3. Bath County 4. Buena Vista City 5. Caroline County 6. Charlottesville City 7. Clarke County 8. Culpeper County 9. Fauquier County 10. Fluvanna County 11. Frederick County 12. Fredericksburg City 13. Greene County 14. Harrisonburg City 15. Highland County 16. King George County 17. Lexington City 18. Louisa County 19. Madison County 20. Nelson County 21. Orange County 22. Page County 23. Rappahannock County 24. Rockbridge County 25. Rockingham County 26. Shenandoah County 27. Spotsylvania County 28. Stafford County 29. Staunton City 30. Warren County 31. Waynesboro City 32. Winchester City	1) Alexandria City 2) Arlington County 3) Fairfax City 4) Fairfax County 5) Falls Church City 6) Loudoun 7) Manassas City 8) Manassas Park City 9) Prince William County	1. Allegany County 2. Amherst County 3. Appomattox County 4. Bedford City 5. Bedford County 6. Bland County 7. Botetourt County 8. Bristol City 9. Buchanan County 10. Campbell County 11. Carroll County 12. Covington City 13. Craig County 14. Danville City 15. Dickenson County 16. Floyd County 17. Franklin County 18. Galax City 19. Giles County 20. Grayson County 21. Henry County 22. Lee County 23. Lynchburg City 24. Martinsville City 25. Montgomery County 26. Norton City 27. Patrick County 28. Pittsylvania County 29. Pulaski County 30. Radford City 31. Roanoke City 32. Roanoke County 33. Russell County 34. Salem City 35. Scott County 36. Smyth County 37. Tazewell County 38. Washington County 39. Wise County 40. Wythe County
Central (HSA IV) 1) Amelia County 2) Brunswick County 3) Buckingham County 4) Charles City County 5) Charlotte County 6) Chesterfield County 7) Colonial Heights City 8) Cumberland County 9) Dinwiddie County 10) Emporia City 11) Goochland County	**Eastern (HSA V)** 1) Accomack County 2) Chesapeake County 3) Essex County 4) Franklin City 5) Gloucester County 6) Hampton City 7) Isle of Wight County 8) James City County 9) King and Queen County 10) King William County 11) Lancaster County	

12) Greensville County 13) Halifax County 14) Hanover County 15) Henrico County 16) Hopewell City 17) Lunenburg County 18) Mecklenburg County 19) New Kent County 20) Nottoway County 21) Petersburg City 22) Powhatan County 23) Prince Edward County 24) Prince George County 25) Richmond city 26) Surry County 27) Sussex county	12) Mathews County 13) Middlesex County 14) Newport News City 15) Norfolk City 16) Northampton County 17) Northumberland County 18) Poquoson City 19) Portsmouth city 20) Richmond county 21) Southampton County 22) Suffolk City 23) Virginia Beach City 24) Westmoreland County 25) Williamsburg City 26) York County	
Virginia's Health Service Areas		

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