Current and Projected Future Health Care Workforce Demand in Vermont

Final Report

Prepared for:

State of Vermont Agency of Administration

Submitted by:

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Funding for this report was provided by the State of Vermont, Vermont Health Care Innovation Project, under Vermont's State Innovation Model (SIM) grant, awarded by the Center for Medicare and Medicaid Services (CMS) Innovation Center (CFDA Number 93.624) Federal Grant #1G1CMS331181-03-01.

June 16, 2017

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ACRONYMS

ACA	Affordable Care Act
ACO	Accountable Care Organization
ACS	American Community Survey
APRN	advanced practice nurse
BRFSS	Behavioral Risk Factor Surveillance System
CVD	cardiovascular disease
DPMM	Disease Prevention Microsimulation Model
ED	emergency department
FTE	full-time equivalent
HDMM	Healthcare Demand Microsimulation Model
HSA	hospital service area
MEPS	Medical Expenditure Panel Survey
MH/SU	mental health and substance use
NNHS	National Nursing Home Survey
PA	physician assistant
PCP	Primary care provider
SIM	State Innovations Model
VHCURES	Vermont Health Care Uniform Reporting and Evaluation System
VUHDDS	Vermont Uniform Hospital Discharge Data Set

EXECUTIVE SUMMARY

Continuing on the path of health reform, Vermont has demonstrated a commitment to achieving affordable coverage, a strong primary care delivery system, a focus on disease prevention, and creating and sustaining a health care workforce sufficient in size and distribution to achieve these goals. To help support this agenda the Center for Medicare and Medicaid Innovation awarded Vermont a $45 million State Innovation Model (SIM) Testing Grant. The SIM initiative funds development and testing of new payment and service delivery models that have the potential to lower costs for the Medicare, Medicaid and Children's Health Insurance Programs.

Having an accurate picture of future statewide and local population demand for health care services and health professions is an essential enabler to successfully developing innovative and efficient service delivery models. The need to assess the capacity of Vermont's future health workforce is important for both public and private sectors to act and make the investments needed for a health care system that provides high-quality, cost-efficient care while also developing the workforce needed to transform the current system and to maximize population health. The pace of change in the world of health care delivery and finance necessitates an almost constant updating and improvement of workforce projections.

In 2016, the Vermont Health Care Innovation Project Health Care Workforce Work Group commissioned the information services firm IHS Markit (IHS) to develop projections of current and future demand for health workers and to help monitor changes in demand over time. This report describes the data and methods used to develop the demand projections and presents study findings. Working with Vermont stakeholders, IHS identified key trends likely to affect the demand for health care services and workforce over the next fifteen years and projected future statewide and hospital service area level physician and other health profession full-time equivalent (FTE) demand through 2030 under the status quo and multiple scenarios incorporating components of a high performing Vermont health care system.

Synopsis of Study Methods and Data Sources

This study used a microsimulation approach to project the demand for health care services and health professions. The demand projection model has been used for health workforce modeling for federal and state governments, for trade and professional associations, and for health systems such as efforts to model the workforce implications of restructuring care delivery in New York as part of the Delivery System Reform Incentive Payment (DSRIP) Program. The demand projections are based on a representative sample of Vermont's population and first simulated the implications of changing demographics as the population changes and ages, projected changes in disease prevalence, and other population health risk factors. Then, to reflect likely changes over the next fifteen years in care use and delivery patterns, modeled scenarios include assumptions about growth in integrated care delivery models, expanded use of chronic disease management, enhanced care coordination, expanded access to team-based primary care and coordinated mental health and substance use treatment, and improved population health.

Workforce projections are presented under a Status Quo scenario which holds constant current patterns of patient health care use, provider service delivery, and reimbursement policy by payers. Alternative scenarios modeled simulate the implications of potential changes in care use and delivery over time, but modeled assumptions will need to be monitored and updated as reimbursement policy, technology and medical innovation, and care delivery evolve over time. The Status Quo scenario models projected utilization of services and providers (or *demand*) rather than *need* for services and providers (where need is

based on epidemiological considerations regardless of ability to pay for services. The concept of need versus demand is discussed later in greater detail.[a]

The complexity of this modeling effort required the use of data from local, state and national surveys and other data sources. These sources include Vermont data from the Behavioral Risk Factor Surveillance System (BRFSS) and the American Community Survey (ACS), national data from the Medical Expenditure Panel Survey (MEPS) supplemented with data from the Vermont Uniform Hospital Discharge Data Set (VUHDDS) and the Vermont Health Care Uniform Reporting and Evaluation System (VHCURES), population projections from the Vermont Agency of Commerce and Community Development, other national data sources such as the National Nursing Home Survey (NNHS), and published literature on emerging care delivery models and other model parameters. Computer simulations were conducted using IHS's Healthcare Demand Microsimulation Model (HDMM) and Disease Prevention Microsimulation Model (DPMM). Future iterations could potentially use additional data sources.

The study included the contributions of various stakeholders in Vermont, and input from members of the Health Care Workforce Work Group which included representatives from multiple government and private sector entities.

Key Findings: Status Quo Scenario

This study first projected future demand for health care services and providers from 2015 through 2030 under a status quo scenario based on changing demographics in the absence of health care system transformation. These projections provide a baseline for comparison against scenarios (described later) of trends in system transformation. We summarize state-wide findings here, but projections varied across the thirteen hospital service areas modeled.

- **The growing elderly population in Vermont is the primary driver of increasing demand for health care services and the workforce required to meet the projected future demand for services**. Between 2015 and 2030, Vermont is projected to experience a slight overall population decline (-0.9%), but experience 50% growth in the population age sixty-five and older. By comparison, the US population is projected to grow by about 12% with the population age sixty-five and older projected to grow by 46%.[b] This rapid growth in the elderly population suggests that a large portion of the increase in demand for health workers will primarily be among those professions and in care delivery settings that predominantly serve the elderly.
- **Demand for physicians and mid-level providers (physician assistants [PAs] and advanced practice nurses [APRNs]) will grow between 2015 and 2030 by approximately 300 or more FTEs.** The increase in demand will need to be met by a combination of treating clinicians. At the national level, the growth in physician supply will be insufficient to meet the projected growth in demand for

[a] *Demand* for health services is defined as the level and mix of services that consumers are able and willing to purchase at current prices given epidemiological and economic considerations. Current demand, therefore, is equivalent to the quantity of services utilized plus any services not utilized because provider shortages prevented patients from accessing care. Demand for services does not equal *need*, where need is based on a clinical definition taking into account patient epidemiological considerations combined with an assessment of appropriate patient care—regardless of ability to pay for services. For example, there is wide consensus that need for mental health and substance use counselors and clinicians is much larger than demand—but many people needing services will not access such services. Hence, in most cases demand (or utilization) for services will be lower than need.

[b] U.S. Census Bureau. National Population Projections. U S Census Bureau 2014; http://www.census.gov/population/projections/data/national/2014.html.

services; however, the rapidly growing supply of PAs and APRNs will help mitigate future shortfalls of physicians. Projecting future health workforce supply was outside the scope of this project, but over the past few years, Vermont has seen a trend of PAs and APRNs filling in gaps in primary care when there are insufficient doctors to meet the need. This trend will likely continue, with PAs and APRNs increasingly integrated into specialty care. Based on current care delivery models the growth in demand between 2015 and 2030 would be approximately 207 physicians, 60 APRNs, and 30 PAs. There is no consensus on the degree to which PAs and APRNs can substitute for physicians, but the 207 FTE increase in demand for physicians reflects an upper bound that declines to the extent that net growth in Vermont's supply of mid-level providers exceeds the estimated 60 APRNs and 30 PAs required to maintain current levels of care as the population ages.

  - **Physician demand continues to grow in Vermont**. If care delivery patterns remain unchanged, demand for physicians will grow by approximately 207 FTEs (13%). In absolute terms, statewide demand growth is highest for general internal medicine (54 FTEs) and family medicine (29 FTEs). In percentage terms demand growth is highest for specialties serving an older population, including geriatric medicine (63%), hematology and oncology (33%), vascular surgery (33%), and urology (32%). Projected decline in demand for pediatrics and obstetrics & gynecology (-10%) and neonatal-perinatal medicine (-13%) reflects negative population growth among younger age cohorts.
  - **Demand for physician assistants and advanced practice nursing professions will grow at the same rate as physician demand under status quo modeling assumptions, but will grow faster than physician demand under scenarios where mid-level providers play a broader role in care delivery which has been the trend nationally and in Vermont.** A broader role for mid-levels providers is likely, reflecting (a) increased recognition and acceptance of the importance of mid-level providers in providing quality, cost-effective care, and (b) challenges with recruiting and retaining physicians to fill positions. Under the status quo modeling assumptions, demand for APRNs will grow by about 60 FTEs (12%), with the majority of growth taking place among nurse practitioners (44 FTEs). Total PA demand will grow by about 30 FTEs (13%) reaching 267 FTEs, with about 40-45% employed in primary care.

- **Statewide demand for registered nurses will grow by about 1,422 FTEs (22%)**. The highest growth rates are expected in nursing home and residential care settings (69%), and home health (41%). Hospitals will continue to be the largest employer of registered nurses.
- **The rate of growth in demand for other health occupations modeled varies widely**. Slow growth occupations include optometrists, opticians and dentists with about 0-2% cumulative growth between 2015 and 2030. High growth occupations include nurse aides (47% growth) and home health aides (41% growth). High growth in demand for home health aides and other occupations that visit people in their home is linked both to growth in elderly population and statewide efforts to better manage disease and shift care from higher cost to more appropriate and lower cost settings. Vermont has implemented many programs enabling seniors to have choice in home- and community- based services.
- **Data limitations create challenges for modeling new professions such as naturopathic medicine physicians and for modeling need versus demand for services.**
  - Small sample size in various databases analyzed of patients being treated by naturopathic physicians presents challenges for modeling care use and delivery patterns. A conservative projection of growth in naturopathic demand to 2030 might be in the 10-25% range—about the same as the range of projected growth in demand for family medicine and general internal medicine physicians. Given current data limitations, building capacity to model demand for this specialty is an important issue to monitor over time.

- Likewise, the need for some providers (especially substance use counselors and mental health providers) is likely much greater than estimated demand. Removing barriers to receiving care—including removing financial barriers and supply barriers, and improving social determinants of health (e.g., reduced poverty, housing security, and food security issues)—could increase utilization of services and demand for providers. However, there is limited data to quantify need for services.

Key Findings: Modeling Components of a High Performing Vermont Health Care System

After modeling the implications of changing demographics in the absence of system transformation, we modeled the workforce implications of efforts to improve care coordination and delivery.

- **Increased use of integrated care statewide can shift care from specialty to primary care providers**. Greater integration of care is projected to have little impact on overall FTE demand for physicians, PAs and APRNs. However, demand would shift away from medical specialties and towards primary care.
- **An initiative which diverts non-emergent visits from the emergency department into primary care settings shifts demand for health providers**. Reducing avoidable emergency department use among the Medicaid population by 25% could, by 2030, reduce demand for registered nurses based in the emergency departments (-50 FTEs) and emergency physicians and mid-level providers (-12 FTEs), but increase primary care physician and mid-level provider demand by 63 FTEs and RN and LPN demand in ambulatory settings by 18 FTEs by 2030, compared with the status quo scenario.
- **Integrating mental health and substance use services into primary care practices to improve screening and access, reduce care fragmentation, and better manage co-morbid physical and mental health or substance use needs would increase demand for mental health and substance use providers**. The modeled scenario focuses on the Medicaid population, and under conservative assumptions could lead to 4,600 additional patients receiving counseling by 2030 compared to the status quo. To support the additional patients receiving screening, Vermont's workforce would require 31 additional licensed clinical social workers and 3 additional psychiatrists or psychiatric nurses (or some other combination of mental health or substance use counselors).
- **Efforts to better manage disease and achieve population health goals can increase demand for health professions in some settings and decrease demand in others**. Overall demand for providers would likely increase, but would result in reduced mortality and improved quality of life.
    - A cardiovascular disease management program focusing on Vermont's population with cardiovascular conditions could require approximately 42 additional primary care providers, 31 additional registered nurses, and 14 additional cardiologists in ambulatory settings, and would slightly reduce demand for providers in inpatient and emergency settings.
    - Initiatives for improved population health could include targets such as smoking cessation, weight loss among obese and overweight adults, and improved control of blood pressure, cholesterol, and blood sugar for individuals with elevated levels. If such population health improvements were achieved statewide, demand for physicians and other health professions is projected to fall in the short run due to a healthier population and increase in the medium-to-long run as more residents are alive and live into older age groups. Projected growth in demand for physicians in 2030 under these assumptions is 21 FTEs (2%) higher than under status quo assumptions, as the health care system would support an additional 8,900 residents who otherwise would not be alive in 2030.

- New roles for community health workers, health coaches and other care managers, including care coordination, navigation, education and outreach services may positively impact the management of chronic disease and improve access to appropriate care.

Conclusion and Potential Future Directions in Research

Although Vermont's population is projected to decline slightly between 2015 and 2030, the elderly population is projected to grow substantially thus contributing to an overall increase in demand for health care services and providers. Efforts to improve care coordination and delivery under a High Performing Vermont Health Care System will have mixed effects on demand for health workers. Some initiatives likely will shift care to lower cost settings (e.g., from emergency departments to primary care offices), to lower cost providers (e.g., from specialists to primary care providers), or to the future (e.g., by reducing mortality). However, system transformation will likely increase demand for health care providers rather than reduce demand—especially in the longer term by reducing mortality and providing more comprehensive services to patients.

This study focused solely on trends and initiatives that likely will affect demand for health care services and providers. A more complete picture would require supply projections for comparison to determine the projected future adequacy of health workforce supply both at the state level and across hospital services areas and communities. Without supply projections one cannot quantify the magnitude of any future shortages (or surpluses) and identify mitigating strategies or inform Vermont's future decision-making around health workforce. For example, as the population ages there will be increased demand for mental health services for the elderly. However, a better understanding of whether future supply will be sufficient to meet future demand for services could help inform decisions regarding the number and mix of mental health providers to train.

National studies suggest that demand for physicians is growing faster than national supply—suggesting that Vermont will face increasing pressures from other states to attract and retain physicians.[a] On the other hand, the national supply of registered nurses, advanced practice nurses, and physician assistants is growing rapidly, suggesting Vermont might find it easier to attract and retain professionals in these occupations over time. Vermont's historical trends that demonstrate growth in these professionals suggests that Vermont will continue to rely heavily on these professions in the future. Occupations projected to experience rapid growth in demand include nurse aides and home health aides—occupations that have low entry barriers to the profession but also high exit rates.

Tracking Demand Trends over Time

Health workforce demand projections are challenged by the pace and often unpredictable ways in which health care is changing. Uncertainties include shifting policy priorities, emerging care delivery models and changing care practices might affect workforce demand, and how clinicians and care settings will respond to economic and other trends.

- **The pace of care migration from inpatient and institutional to outpatient, community and home-based settings:** Shifts in care settings and modalities spurred by development and expansion of

[a] IHS Markit. 2017 Update: The Complexities of Physician Supply and Demand: Projections from 2015 to 2030. Association of American Medical Colleges 2017; https://aamc-black.global.ssl.fastly.net/production/media/filer_public/a5/c3/a5c3d565-14ec-48fb-974b-99fafaeecb00/aamc_projections_update_2017.pdf.

Accountable Care Organizations, the patient-centered medical home, and other new delivery models will continue to shift health workforce demand from high cost hospitals and emergency departments to other appropriate care settings.

- **More effective management of chronic disease**: Chronic disease management is transitioning to team-based care management and patient education conducted in community and home settings. These activities are likely to increase workforce demand for case managers, social workers, and other health occupations trained in carrying out these activities. Team based care will also support expanding scope of practice for registered nurses, nurse practitioners and physician assistants.
- **Changing health care payment and coverage policies**: These have the potential to significantly influence patterns of demand for health care services and occupations.
- **Economic developments**: National and state trends in unemployment may influence the health occupations and trigger the need to update projections. The last economic downturn (2008-2009) appeared to influence supply and demand by slowing retirements and consumer demand for many discretionary services.
- **Unanticipated and unmet need for mental health and substance use services**: Some trends are difficult to predict into the future—such as trends in substance abuse as new and more potent drugs are developed and make their way into society. An example is the growing opioid crisis where historically used drugs are mixed with fentanyl thus exacerbating the medical and human toll associated with substance abuse.
- **Telemedicine and health information technology**: Currently, there are limited data for modeling the potential impact on health workforce demand associated with telemedicine and health information technology, particularly as these technologies intersect with emerging models of care. This is an important area for future research. While potentially reducing service utilization and demand for providers practicing in some settings (e.g., hospitals), such new technologies might support greater use of providers practicing in other care settings (e.g., physician offices) and has the potential to increase or decrease demand depending upon the specific technologies deployed.

Study Strengths and Limitations

The main strengths of this study include use of recent data sources (including Vermont data) and a sophisticated microsimulation approach that has flexibility for modeling scenarios of potential changes in care use and delivery by individuals or by the health care system. Compared to population-based modeling approaches used historically, this microsimulation model takes into account more detailed information on population characteristics and health risk factors when making state and HSA-level demand projections.

Using individuals as the unit of analysis creates flexibility for incorporating evidence-based research on the implications of changes in technology and care delivery models that disproportionately affect subsets of the population with certain chronic conditions or health-related behaviors and risk factors. This information also leads to more accurate projections at state and local levels. The microsimulation approach also provides added flexibility for modeling the workforce implications of changes in policy and emerging care delivery models under the Affordable Care Act (ACA), which are important areas of ongoing research.

Limitations of the workforce model used largely stem from current data limitations. The main limitation is that historical data provides limited ability to predict how care use and delivery patterns will evolve over time. Hence, we first projected changes in provider demand over time under a status quo scenario

using historical data. Then, we simulated how demand might evolve over time are care use and delivery patterns change. Another limitation is the challenges with modeling need for services (versus utilization based on demand). Given the focus and prioritization for Vermont of addressing mental health and substance use needs of the population, it will be important to update projections in this report as the treatment, utilization, and coverage patterns change. Other data limitations associated with these models include: (1) information on the influence of provider and payer networks on consumer service demand and migration patterns, and (2) information on how care delivery patterns might change over time in response to emerging market factors. These limitations and the uncertainties discussed above underscore the importance of ongoing research on potential implications of the evolving health care system for Vermont's health workforce.

This report provides some information that can support a robust discussion on health care workforce for Vermont, but does not contain all of the information necessary, as discussed above. Efforts to monitor the adequacy of health workforce supply across Vermont will help inform strategies to ensure access to high quality, affordable care.

INTRODUCTION

The use of services and care delivery patterns across Vermont's health care sector continues to evolve based on changing demographics, emerging care delivery models, new technologies, economic circumstances, and policies such as requirements of the federal Affordable Care Act (ACA) or its possible replacement under the new Administration. The ACA, in particular, refocuses program priorities to expand efforts to link the quality and efficiency of health care services to payment for those services through new payment and delivery models and initiatives. These include new health care delivery models such as Accountable Care Organizations (ACOs), and bundled payment initiatives intended to promote better coordination of services and greater efficiency.

Continuing on the path of health reform, Vermont has demonstrated a commitment to achieving affordable coverage, a strong primary care delivery system, a focus on disease prevention, and creating and sustaining a health care workforce sufficient in size and distribution to achieve these goals. To help support this agenda, the Center for Medicare and Medicaid Innovation awarded Vermont a $45 million State Innovation Model (SIM) Testing Grant. The SIM initiative funds development and testing of new payment and service delivery models that have the potential to lower costs for the Medicare, Medicaid and Children's Health Insurance Programs. Having an accurate picture of future statewide and local population demand for health care services and health professions is an essential enabler to successfully developing innovative and efficient service delivery models.

The primary purpose of this project is to help Vermont achieve these goals through the use of a demand-based health workforce microsimulation model. This project provides some, but not all, of the information that can be used by policy makers to make decisions that impact Vermont's health care workforce. This simulation model supports analyses quantifying and assessing current and projected future demand for health care services and the derived demand by medical specialty, health occupation, and care delivery setting. Demand projections include a status quo scenario if patterns of care use and delivery remain unchanged but taking into consideration changing demographics, and alternative scenarios reflecting possible interventions to transform the health care system and improve care management and delivery under an "ideal" high performing Vermont health care system. Scenario modeling assumptions will need to be monitored and updated as new programs and initiatives become implemented and develop over time.

This study examines the demand for health care services and providers at the state and Hospital Service Area (HSA) levels annually from 2015 through 2030. As a policy tool, such projections could help support the State's decisions around recruitment and training strategies to meet identified needs.

The goal of this project was not simply to develop one-time projections, but also to develop a forecasting process that Vermont can use to track developments annually over time and to update projections as new information and data becomes available or as new policies are considered. Study outcomes are intended to inform state policies and influence decisions made by educational institutions and individuals deciding whether to enter a health occupation. Most importantly, it is intended that study outcomes will help the state meet its goal of improved access to high quality affordable care for the people in Vermont.

The complexity of this modeling effort required the use of data from local, state and national surveys and other data sources. These sources include Vermont data from the Behavioral Risk Factor

Surveillance System (BRFSS) and the American Community Survey (ACS), national data from the Medical Expenditure Panel Survey (MEPS) supplemented with data from the Vermont Uniform Hospital Discharge Data Set (VUHDDS) and the Vermont Health Care Uniform Reporting and Evaluation System (VHCURES), population projections from the Vermont Agency of Commerce and Community Development, and published literature. Computer simulations were conducted using IHS's Healthcare Demand Microsimulation Model (HDMM) and Disease Prevention Microsimulation Model (DPMM). This microsimulation approach models *demand* for services rather than *need* for services, as the model's data inputs reflect utilization behavior and have no way of quantifying unmet need.

The remainder of this study is organized to present an overview of demand modeling data and methods (Chapter II), projections of future health services demand (Chapter III), projections of health workforce demand under the status quo scenario (Chapter IV), and the health workforce implications of transformation initiatives that change care use and delivery patterns (Chapter V). Chapter VI discusses key findings and suggests possible directions for refinement and future research. A Technical Appendix provides additional detail on modeling data and methods.

MODELING APPROACH AND DATA

The Healthcare Demand Microsimulation Model (HDMM) used for this analysis is the primary source of workforce projections for the federal Bureau of Health Workforce covering physicians, nurses, mental health and substance use providers, allied health providers, and other health occupations.[3, 4] The model has also been adapted to make supply projections for states, health plans, hospital systems and professional associations.[2, 5, 6] The projections in this report relied on a combination of use of the HDMM, information from state and national sources, published findings in the literature, and data on actual health care utilization in the state from Vermont's VUHDDS and VHCURES databases. Additional documentation of the HDMM is provided in a technical appendix and available in more detail online.[3, 7]

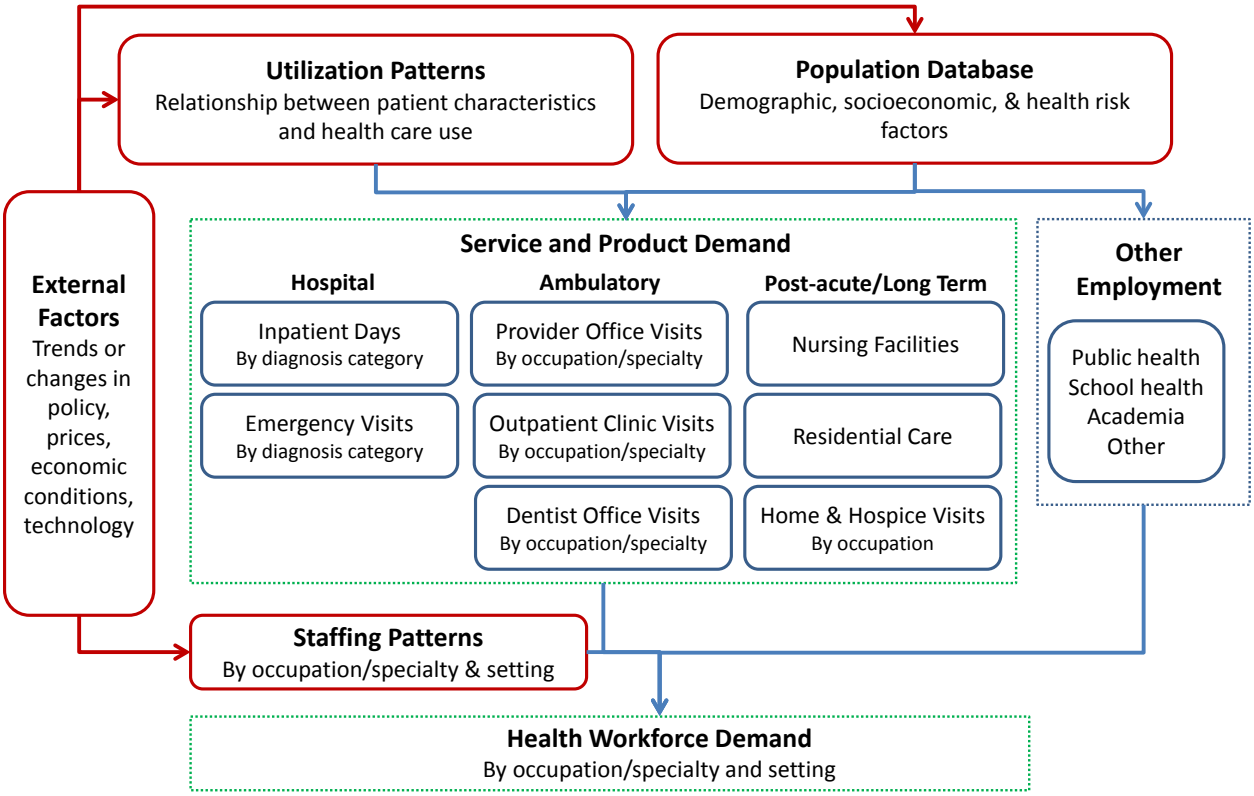
A. Model Overview

The HDMM, as its name implies, models demand for health care services and providers. Demand is defined as the level and mix of health care services (and providers) that are likely to be used based on population characteristics and economic considerations, such as price of services and people's ability and willingness to pay for services. While the nuances of modeling health workforce demand may differ for individual health occupations or medical specialties, the basic framework is the same across health professions. The demand model has three major elements (Exhibit 1).

1. It is built on a **population database** that contains demographic, socioeconomic, and health risk behavior and factors that are correlated with utilization of different types of services. The population database is built at the county level because of data availability, but using market share information the health workforce demand projections are reported at the HSA-level or aggregated to the state level.
2. The model includes **forecasting equations** that relate an individual's characteristics and health risk factors to utilization of services by type of service, care delivery setting, and occupation.
3. The model has input tables and parameters with **staffing patterns** to determine the number and mix of occupations to provide the level and mix of services demanded.

Using the model, different scenarios can be simulated by modifying model inputs or assumptions about how care is used or delivered.

Exhibit 1: Health Care Demand Microsimulation Model Overview



B. Creating the Population Database

The demand model uses a microsimulation framework where a population file constructed for each Vermont county contains demographics, health risk factors, and socioeconomic data on each person in a representative sample of the population in that county. Aggregated data published by the U.S. Census Bureau reports demographics of the population in 2014 by county (i.e., the number of people in each combination by individual age, sex, and race/ethnicity), which are used as the initial step in the population file creation process.

This county-level data was used to draw a representative sample of individuals from a file that merged Vermont data from the 2014 American Community Survey (ACS) and the 2013 & 2014 Behavioral Risk Factor Surveillance System (BRFSS) to provide a more complete profile of the socioeconomic and health characteristics of the population. To create the matched ACS-BRFSS file covering the non-institutionalized population, we statistically matched each Vermont individual in ACS with a Vermont individual in BRFSS with the same gender, age group (15 groups), race/ethnicity, medical insured/uninsured status, and household income level (8 levels). For nursing home residents, information from the 2004 National Nursing Home Survey (NNHS) was used to reflect that residents of

nursing homes have higher prevalence of disease than do people of similar demographic residing in the community (as reflected in BRFSS).

The sampling process generally ensures that the resulting combination of age, sex, and race/ethnicity match the estimates published by the Census. Under this approach, some BRFSS or NNHS individuals might be matched multiple times to similar people in the ACS, while some BRFSS or NNHS individuals might not be matched. In a small number of instances the sample size of Vermont residents in an uncommon demographic group from ACS was too small to generate a reliable sample. In these instances ACS records from nearby states (New Hampshire, Maine, and Massachusetts) that matched the demographic combination in question were used to increase sample size. The metropolitan and non-metropolitan subsamples from this Vermont database were then combined with population data for each county based on demographics.

The population creation process allows us to create a file that is representative of the demographic distribution in Vermont, with a health risk profile for each individual containing the risk factors that will be used to predict health care use. For model calibration we compared predicted prevalence of chronic disease (diabetes, hypertension, cancer, asthma, and arthritis) and other risk factors (smoking, obesity) to county-level published estimates. Estimates for county-level disease prevalence come from data from the Centers for Disease Control and Prevention and Vermont data sources such as the Vermont BRFSS (Exhibit 2).

Exhibit 2: Data Sources for Vermont Disease and Risk Factor Calibration

Condition/Risk Factor	Year	Geography	Source
Arthritis	2012-2013	County-level	Vermont Department of Health Data Atlas [i]
Asthma	2012-2013		
Cancer (any)	2012-2013		
Smoker	2012-2013		
Hypertension	2011, 2013		
Diabetes	2013	County-level	CDC [ii]
Obesity	2013	County-level	CDC [iii]

Notes: [i] http://healthvermont.gov/research/brfss/IA/ChronicConditions/County/atlas.html, http://healthvermont.gov/hv2020/
[ii] www.cdc.gov/diabetes/atlas/countydata/DMPREV/vermont.xlsx [iii] www.cdc.gov/diabetes/atlas/countydata/OBPREV/vermont.xlsx

Projections of Vermont population change and aging come from the Vermont Agency of Commerce and Community Development.[8] This report produced two sets of scenarios projecting population change: a high growth scenario projecting a 7.1% growth rate between 2010 and 2030, and a low growth scenario projecting a -0.8% population decline over the same time period. The low population growth scenario was selected as an input for projecting population change and aging over time since the observed rate of population change to date have more closely reflected this set of projections.

The database prepared for the HDMM contains a representative sample of the population in each Vermont county (with demand projections for HSAs constructed from the counties that map to each HSA). The population profile in this representative sample is inclusive of all insurance types (Medicare,

Medicaid, commercial, and uninsured); population demographics (age, sex, race, and Hispanic ethnicity); household income level; health risk factors including body weight status (normal, overweight, and obese); current smoker status; and presence or history of chronic disease (hypertension, coronary heart disease, diabetes, arthritis, asthma, history of heart attack, history of stroke, and history of cancer); and metropolitan/non-metropolitan residence location.

C. Developing Health Care Use Forecasting Equations

Patterns of health seeking behavior were generated by regression analysis using national data from approximately 169,000 participants in the pooled 2009-2013 files of the Medical Expenditure Panel Survey (MEPS). There are several hundred prediction equations in the simulation model, with separate regressions by care delivery setting, health occupation and/or medical specialty, and children versus adults. Equations were estimated using either Poisson regression to model annual number of office visits, outpatient or clinic visits, or home health visits with a particular provider type; or using logistic regression to model annual probability of hospitalization or emergency department visit for each of 24 diagnosis categories (e.g., hospitalization for a cardiovascular condition).

The dependent variable reflects annual use of health care services, while the explanatory variables consist of the demographic characteristics, health risk factors, medical conditions, and socioeconomic factors described (see Appendix Exhibits A-1 and A-2). We pool multiple years of data to provide a sufficient sample size for regression analysis. Applying the prediction equations to the current and projected future population produced estimates of the growth in demand for health care services by specialty and care delivery setting given the characteristics of the population and community.

The microsimulation model estimates of statewide health care use were calibrated to estimates of health care use derived from Vermont data to reflect that health care use patterns in Vermont can differ from national patterns even after accounting for differences in demographics, disease prevalence and other health risk factors. Counts of hospital discharges and visits with providers came from the Vermont Uniform Healthcare Discharge Dataset (VUHDDS) and Vermont Health Care Uniform Reporting and Evaluation System (VHCURES). VUHDDS data were used to calibrate model estimates of physician visits, inpatient and emergency department settings, by physician specialty.

VHCURES data were used to calibrate the model's estimate of the total number of Vermont office visits. This estimate was then used to scale the model's original estimate of physician office visits to the observed value. As a claims database, VHCURES has limitations, particularly when used to quantify the number of provider interactions in the state. One claim may represent multiple interactions with a provider, or one provider interaction may be represented by more than one claim. Additionally, visits by uninsured Vermonters are not counted in VHCURES given that this population has no insurance to which a claim would be submitted, and federal employees are also excluded. The data were cleaned and subsequently analyzed using an algorithm which was used to estimate the number of physician office visits in the state while also mitigating the effects of these limitations. Given that provider encounters are more easily counted in discharge-level databases, VUHDDS was the preferred source for calibration estimates for the inpatient and emergency settings, and VHCURES was used in the office setting which is not covered in the VUHDDS data.

Both VHCURES and VUHDDS and many of the other input data sources are historical databases; therefore, future changes to patterns in reimbursement or patient service use are not captured. For example, if Medicare does not currently cover a particular substance use treatment but covers the

treatment in the future, the likely change in demand due to that policy change will not be reflected in this modeling effort. Similarly, the effect of such a policy change may also be seen in supply of providers and provider staffing patterns for substance use treatment. These points highlight the importance of regular updates to the workforce projections.

D. Modeling Full Time Equivalent Staffing to Meet Health Services Demand

The number and mix of health professions required to provide the level of health care services demanded is influenced by how the care system is organized and care is reimbursed, provider scope of practice requirements, economic constraints, technology, and other factors. To convert projected demand for services into demand for full-time equivalent (FTE) staffing we determine how each unit of service demanded (e.g., psychiatrist office visits and hospital inpatient days) translates into demand for a partial FTE provider (i.e., the fraction of an FTE provider's time to provide care during that one patient encounter). If there were a major change in how services are organized or reimbursed, then that would change the staffing required to meet future demand.

For example, demand for cardiologists is linked primarily to office visits to a cardiologist, cardiology-related inpatient days (for hospital rounds), outpatient visits to a cardiologist, and cardiology-related emergency visits with a physician consult.

Data on provider productivity to estimate the portion of a staff FTE associated with patient encounters in different care settings come from numerous sources. Examples include the American Medical Association, Medical Group Management Association's Physician Compensation and Production Survey, the American Board of Internal Medicine Practice Characteristics Survey, and surveys and workforce studies conducted for individual health professions. For professions that provide services across a wide array of setting (e.g., nurses and therapists), information on the employment distribution of the care providers in the base year from the Bureau of Labor Statistics was used to determine the number of individuals working in each setting.

Exhibit 3: Workload Metrics for Staffing Ratios

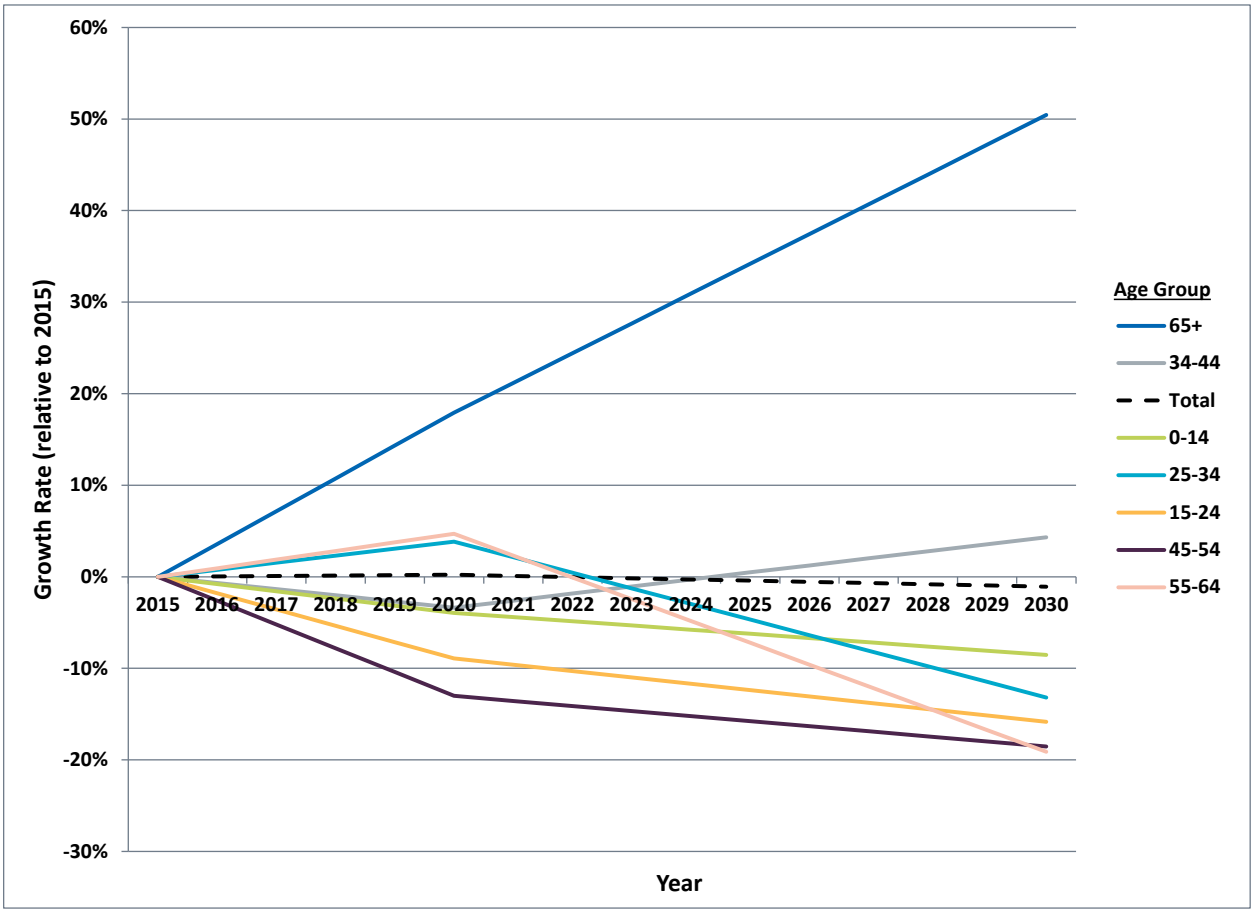
Employment/Care Delivery Setting	Workload Metric
Academia	Annual graduates within that occupation
Home health	Annual home health visits by occupation
Inpatient	Annual inpatient days by primary diagnosis category
Office	Annual visits by occupation and/or medical specialty
Other health care	Total population
Outpatient	Annual visits by occupation and/or medical specialty
Public health	Total population
Residential care	Residential care facility residents
School health	Total population age 6 to 17
Nursing facilities	Nursing home residents

VERMONT POPULATION AND SERVICE DEMAND PROJECTIONS

A key dynamic affecting future service and health workforce demand in general is rapidly shifting population demographics. Nationally, high rates of projected population growth among the elderly "Baby Boomer" population portend rapidly growing demand for health care services with highest growth expected for those specialties that disproportionately serve the elderly. In Vermont, total population size is expected to decrease slightly by 2030, though the elderly population is growing in size.

Between 2015 and 2030, the US population is projected to grow by about 30 million people (9.5%).[1] The population age sixty-five and older is projected to grow by over 20 million (46%) during this period—driving demand for those care settings and services used predominantly by the elderly. This contrasts with state of Vermont population projections which forecast a slight overall population decline (-0.9%) between 2015 and 2030.[8] However, consistent with national projections, Vermont's "Baby Boomer" population age sixty-five and older is projected to grow by about 50% (Exhibit 4) while almost all other age cohorts experience negative growth. These demographic trends portend rapidly growing demand for health care services for those specialties and occupations that disproportionately serve the elderly.

Exhibit 4: Vermont Projected Population Growth by Age Cohort (2015- 2030)



Population growth varies by county, with Rutland County projected to have the largest population decline and Franklin county projected to have the largest population increase (Exhibit 5).

Exhibit 5: Vermont Projected Population Change by County

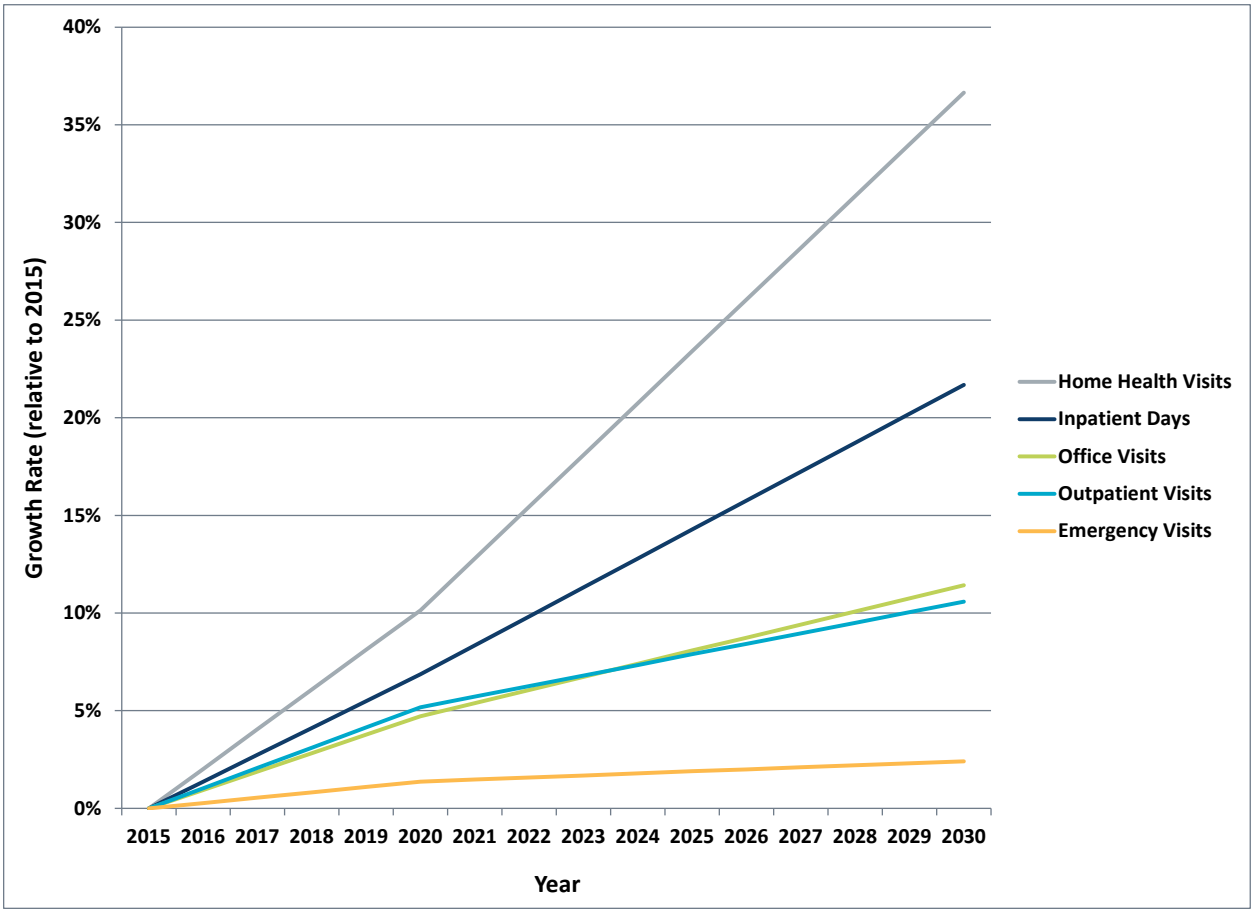
County	2015	2020	2025	2030	Change, 2015-2030	% Change, 2015-2030
Addison	37,000	35,800	35,000	34,100	-2,900	-8%
Bennington	36,300	36,500	35,800	35,000	-1,300	-4%
Caledonia	30,800	32,200	32,400	32,500	1,700	6%
Chittenden	161,400	161,800	162,400	163,000	1,600	1%
Essex	6,200	6,000	5,700	5,500	-700	-11%
Franklin	48,800	49,300	50,000	50,700	1,900	4%
Grand Isle	6,900	6,800	6,600	6,400	-500	-7%
Lamoille	25,200	25,300	25,500	25,600	400	2%
Orange	28,900	28,900	28,700	28,400	-500	-2%
Orleans	27,100	27,400	27,200	27,000	-100	0%
Rutland	59,700	58,500	56,300	54,200	-5,500	-9%
Washington	58,600	60,000	60,000	60,000	1,400	2%
Windham	43,400	44,400	44,000	43,600	200	0%
Windsor	55,700	55,800	55,100	54,400	-1,300	-2%
Vermont Total	**626,000**	**628,700**	**624,700**	**620,400**	**-5,600**	**-1%**

Note: Projections of Vermont's projected population growth and aging are from: Jones and Schwarz (2013).[8]

Demand for health services is defined as the level and mix of services that consumers are able and willing to purchase at current prices given epidemiological and economic considerations. Current demand, therefore, is equivalent to the quantity of services utilized plus any services not utilized because provider shortages prevented patients from accessing care. Demand for services does not equal "need," where need is based on a clinical definition taking into account patient epidemiological considerations combined with an assessment of appropriate patient care—regardless of ability to pay for services. For example, there is wide consensus that need for mental health and substance use counselors and clinicians is much larger than demand, but many people needing services will not access such services. Hence, in most cases demand for services will be lower than need. (An exception might be cosmetic or discretionary care utilization).

Projected service demand growth between 2015 and 2030 varies across delivery settings (Exhibit 6). Demand projections suggest that the effects of changing demographics will have a greater influence on future service demand than will the effects of other known factors and will vary across care settings. For example, based on changing demographics alone, demand for home health services is projected to grow by about 37% with about 22% growth in hospital inpatient days, 11% growth in both physician office visits outpatient visits, and 2% growth in emergency department visits.

Exhibit 6: Projected Growth in Vermont Service Demand by Care Setting



The high percentage growth in hospital inpatient days, relative to ambulatory care, may appear counterintuitive given that hospitalization rates have been declining over the past two decades. However, the burden of disease and rates of hospitalization increase with age. For example, in 2009 the hospitalization rate was 198 hospitalizations per 1,000 diabetes patients under age 45, but 480 hospitalizations per 1,000 diabetes patients age 75 or older (a 142% increase).[9]

Reflecting the rapidly growing elderly Vermont population, the projected percentage increase in demand for services is particularly high for geriatric medicine, nephrology, hematology & oncology and cardiology (Exhibit 7). By comparison, projected demand for services utilized by younger age cohorts will grow much more slowly (e.g., pediatrics, obstetrics & gynecology, and neonatal-perinatal medicine).

Based on changing demographics alone, demand for mental health and substance use services are projected to fall over time. On average, younger populations utilize these services at higher rates than older populations, but the size of these younger populations is projected to decline over the forecast period. Mental health and substance use is an area commonly thought to have a need for services that exceeds demand for services due to underserved populations lacking access to the resources to receive necessary treatment. Given that this analysis quantifies service demand, the status quo projections may not be representative of need for services. As Vermont has made a recent effort to prioritize increasing

access to mental health and substance use services, the gap between need and demand may decrease over time, with unmet need being converted to demand for services. One alternative scenario presented later in this report addresses increased access to these services, but this area is rapidly developing and will need to be monitored over time.

Exhibit 7: Projected Growth in Service Demand by Specialty & Setting, 2015-2030

Specialty	Total Care	Office Visits	Outpatient Visits	Emergency Visits/Consults	Inpatient Days
Allergy & Immunology	-3%	-3%	-3%	-4%	NA
Anesthesiology	18%	18%	6%	NA	NA
Cardiology	30%	30%	17%	17%	36%
Colorectal Surgery	12%	NA	NA	NA	12%
Dermatology	22%	22%	23%	NA	23%
Endocrinology	16%	15%	14%	12%	23%
Gastroenterology	10%	12%	8%	3%	21%
General & Family Practice	14%	10%	9%	NA	22%[i]
General Internal Medicine	23%	22%	15%	NA	24%[i]
General Surgery	14%	18%	9%	-1%	23%
Geriatric Medicine	69%	64%	63%	NA	69%[i]
Hematology & Oncology	41%	47%	38%	17%	33%
Infectious Diseases	16%	NA	NA	-4%	28%
Neonatal-perinatal Medicine	-10%	NA	NA	NA	-10%
Nephrology	28%	26%	20%	NA	43%
Neurological Surgery	9%	NA	NA	-2%	13%
Neurology	11%	13%	-2%	4%	22%
Obstetrics & Gynecology	-9%	-8%	-7%	-7%	-11%
Ophthalmology	24%	24%	28%	-3%	11%
Orthopedic Surgery	12%	12%	8%	4%	32%
Other	17%	18%	4%	-1%	11%
Otolaryngology	8%	10%	-2%	-6%	7%
Pediatrics	-9%	-9%	-9%	NA	-11%[i]
Physical Medicine & Rehab	25%	9%	22%	NA	32%
Plastic Surgery	13%	17%	16%	-7%	-6%
Psychiatry	-4%	-6%	-8%	-1%	-1%
Pulmonology	16%	27%	12%	1%	32%
Radiology	30%	32%	24%	NA	NA
Rheumatology	18%	20%	18%	8%	28%
Thoracic Surgery	6%	28%	10%	5%	NA
Urology	22%	29%	20%	5%	34%
Vascular Surgery	22%	NA	NA	NA	22%
Vermont Total	**15%**	**11%**	**11%**	**2%**	**22%**

Note: [i] Reflects hospital rounds by primary care physicians as well as primary care-trained hospitalists.

VERMONT HEALTH WORKFORCE DEMAND PROJECTIONS

The status quo demand projections presented below take into consideration population change, aging, disease prevalence and health risk factors. The status quo projections, therefore, reflect the continuation of current patterns of care use and delivery in Vermont.

However, care use and delivery patterns will change over time but how they will change is uncertain. For example, efforts to make consumers and providers more cost conscious likely will reduce demand for specialist care. Potential productivity gains from health information technology could reduce demand for providers, but these same technologies could increase demand for providers by removing access barriers (e.g., through telemedicine). Although not covered in this report, over time there also might be shifts in the relative supply of health professions with implications for adequacy of supply. Inadequate supply in one occupation (e.g., physicians) might be partially mitigated by increased use of clinicians in other occupations (e.g., mid-level providers). Historically, this has been the case in Vermont.

The remainder of this chapter discusses current and projected future demand for physician specialties and select clinical and non-clinical health professions and occupations under status quo modeling assumptions. The subsequent chapter models the potential workforce implications of health system transformation or other changes in care delivery.

A. Physicians, Advanced Practice Nurses and Physician Assistants

This section presents state and HSA-level demand projections for physicians, advanced practice registered nurses (APRNs), physician assistants (PAs) from 2015 through 2030. Demand projections reflect the status quo modeling assumption if care delivery continued to be provided as it is today. In Vermont and throughout the U.S. a growing portion of care is being provided by mid-level providers (though physicians continue to provide the majority of diagnostic and treatment services). Although modeling future supply is outside the scope of this report, Vermont likely will reflect national trends that the supply of physicians is growing slower than the demand for services.[2] Hence, over time, APRNs and PAs increasingly will step into roles traditionally filled by physicians. Consequently, one should consider the demand projections for physicians and mid-level providers together—though there is no consensus on the rate that one occupation might substitute for another and any tradeoffs between occupations will differ by medical specialty and care delivery setting.

1. Physicians

Physician demand modeling took place at the specialty level for individual physician specialties and aggregated into four broad categories for reporting: primary care, medical specialties, surgical specialties, and "other" specialties.[a] Based on analyses from the Association of American Medical Colleges on physician billing records, a portion of the primary care physicians are likely working as

[a] **Primary care** consists of general & family practice, general internal medicine, general pediatrics, geriatric medicine, and obstetrics & gynecology. **Medical specialties** consist of allergy & immunology, cardiology, critical care, dermatology, endocrinology, gastroenterology, hematology & oncology, infectious diseases, neonatal-perinatal medicine, nephrology, pulmonology, and rheumatology. **Surgical specialties** consist of general surgery, colorectal surgery, neurological surgery, , ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, urology, and vascular surgery. The **Other specialties** category consists of anesthesiology, emergency medicine, neurology, pathology, physical medicine & rehabilitation, psychiatry, radiology, and all other specialties.

hospitalists—which for Vermont would equate to about 65 primary care physicians (most trained in general internal medicine, but some trained in family medicine or pediatrics).[2]

Statewide projected growth in physician demand to 2030 reflecting changing demographics, disease prevalence, health risk factors, and current state and national patterns of care use and delivery is summarized in Exhibit 8 and Exhibit 9. Statewide physician demand will grow by about 207 FTEs (13%) between 2015 and 2030. However, the impacts of changing demographics and other factors noted above will differ substantially across specialty categories. In absolute terms, demand growth is highest for primary care (69 FTEs) and medical specialties (52 FTEs). In percentage terms, overall demand growth is highest for medical specialties (22%) and surgical specialties (18%). A portion of this FTE growth (especially for primary care) could be met with increased use of PAs and APRNs.

Exhibit 8: Projected Growth in Statewide Physician FTE Demand, 2015-2030

Physician Specialty Category	2015	2020	2025	2030	FTE Growth, 2015-2030	% Growth, 2015-2030
Primary Care	707	734	755	776	69	**10%**
Medical Specialties	238	256	274	290	52	**22%**
Surgical Specialties	257	274	291	303	46	**18%**
Other	412	429	442	452	40	**10%**
Vermont Total	**1,614**	**1,693**	**1,762**	**1,821**	**207**	**13%**

The impacts of changing demographics and other factors also will differ substantially across individual physician specialties. In absolute terms, statewide demand growth is highest for general internal medicine (54 FTEs) and general and family practice (29 FTEs). In percentage terms, overall demand growth is highest for specialties that predominantly serve an older population. Specialties with the highest anticipated growth in demand include geriatric medicine (63%), hematology and oncology (33%), cardiology (27%) and pulmonology (26%). Projected shrinkage in statewide demand for pediatrics (-10%) and OB/GYN (-10%) reflects the expectation that younger age cohorts are projected to shrink more rapidly than the general population.

Exhibit 9: Projected Growth in Statewide Physician FTE Demand by Specialty, 2015-2030

Physician Specialty	2015	2020	2025	2030	FTE Growth, 2015-2030	% Growth, 2015-2030
Primary Care	**707**	**734**	**755**	**776**	**69**	**10%**
Family Medicine	282	295	303	311	29	10%
General Internal Medicine	220	239	256	274	54	25%
Geriatric Medicine	8	9	11	13	5	63%
Obstetrics & Gynecology	113	111	107	102	-11	-10%
Pediatrics	84	80	78	76	-8	-10%
Medical Specialties	**238**	**256**	**274**	**290**	**52**	**22%**
Allergy & Immunology	8	8	8	7	-1	-13%
Cardiology	62	68	74	79	17	27%
Dermatology	26	28	30	32	6	23%
Endocrinology	14	15	15	16	2	14%
Gastroenterology	31	33	34	35	4	13%
Hematology & Oncology	24	26	29	32	8	33%
Infectious Disease	12	13	14	15	3	25%
Neonatal-Perinatal Medicine	8	7	7	7	-1	-13%
Nephrology	18	20	22	23	5	28%
Pulmonology	23	25	27	29	6	26%
Rheumatology	12	13	14	15	3	25%
Surgical Specialties	**257**	**274**	**291**	**303**	**46**	**18%**
Colorectal Surgery	1	1	1	1	0	0%
General Surgery	57	60	63	66	9	16%
Neurological Surgery	10	11	11	12	2	20%
Ophthalmology	54	59	63	67	13	24%
Orthopedic Surgery	64	68	71	73	9	14%
Otolaryngology	24	25	26	26	2	8%
Plastic Surgery	15	16	17	17	2	13%
Thoracic Surgery	7	7	8	8	1	14%
Urology	22	24	27	29	7	32%
Vascular Surgery	3	3	4	4	1	33%
Other Specialties	**412**	**429**	**442**	**452**	**40**	**10%**
Anesthesiology	112	120	126	131	19	17%
Emergency Medicine	85	86	87	87	2	2%
Neurology	41	43	44	46	5	12%
Physical Medicine & Rehab	26	28	30	32	6	23%
Psychiatry	103	102	100	97	-6	-6%
Radiology	45	50	55	59	14	31%
Vermont Total	**1,614**	**1,693**	**1,762**	**1,821**	**207**	**13%**

Exhibit 10 shows that across the state's HSAs there is substantial geographic variation in projected growth in physician demand between 2015 and 2030. Projected growth in physician demand ranges from

3% in Rutland to 18% in St. Albans. Absolute demand growth ranges from 4 FTEs in Randolph to 80 FTEs in Burlington. Compared to other Vermont HSAs, Burlington is a sizable metropolitan area with large concentrations of health care settings, physicians and other health care providers.

Exhibit 10: Projected Physician Demand by Vermont HSA, 2015-2030

Hospital Service Area	2015	2020	2025	2030	Growth, 2015-2030	% Growth, 2015-2030
Barre	164	172	179	186	22	13%
Bennington	103	107	110	113	10	10%
Brattleboro	78	82	85	88	10	13%
Burlington	491	520	546	571	80	16%
Middlebury	67	70	72	74	7	10%
Morrisville	63	67	70	73	10	16%
Newport	73	77	80	83	10	14%
Randolph	36	37	38	40	4	11%
Rutland	155	158	159	160	5	3%
Springfield	69	72	74	75	6	9%
St. Albans	130	138	146	153	23	18%
St. Johnsbury	66	70	73	76	10	15%
White River Jct.	118	123	126	130	12	10%
Vermont Total	**1,614**	**1,693**	**1,762**	**1,821**	**207**	**13%**

Note: Numbers may not sum to Vermont total due to rounding.

Under a status quo scenario, statewide physician demand across care delivery settings is projected to grow at approximately the same rate as growth in demand for health care services. The highest absolute and percent growth in physician demand will likely occur in physician office (154 FTEs and 13%) and hospital inpatient (42 FTEs and 16%) settings; with the lowest growth in emergency departments (4 FTEs and 4%) settings (Exhibit 11).

Exhibit 11: Projected Physician Demand by Vermont Care Setting, 2015-2030

Setting	2015	2020	2025	2030	FTE Growth 2015-2030	% Growth 2015-2030
Office	1,158	1,221	1,266	1,312	154	13%
Outpatient	92	96	99	101	9	10%
Inpatient	262	274	289	304	42	16%
Emergency	102	104	105	106	4	4%
Vermont Total	**1,614**	**1,693**	**1,762**	**1,821**	**207**	**13%**

Note: Numbers may not sum to Vermont total due to rounding.

2. Advanced Practice Registered Nurses

National projections suggest that demand for health care services is projected to grow faster than physician supply, but that the growth in supply of APRNs and PAs will help to blunt a projected growing

shortfall of physicians.[2] Vermont's future likely will follow this national trend. Hence, while the majority of care will continue to be provided by physicians over the foreseeable future, a growing proportion of care will be provided by APRNs and PAs. In addition to projected future shortfalls of physicians in many medical specialties, several trends suggest that the proportion of health care services provided by APRNs will continue to rise: (1) the rapid growth in APRN supply at the national level, (2) states' willingness to expand the legal scope of practice for mid-level providers, and (3) financial pressures to control rising medical costs.

We modeled growth in demand for three categories of APRNs: nurse practitioners (NPs), certified registered nurse anesthetists (CRNAs), and certified nurse midwives (CNWs). NPs comprise about 73% of current total APRN demand in Vermont. Twenty-three states, including Vermont, have enacted into law and implemented full practice authority for NPs.[10] Two emerging models of care delivery—patient-centered medical homes and the nurse-managed health centers—use a provider mix that is richer in NPs and PAs than current models for care delivery.[11]

Vermont statewide projected growth in APRN demand to 2030 under a status quo scenario suggest about 60 FTEs (12% growth) required to maintain current staffing levels (Exhibit 12). This compares to projected demand growth of 17% nationally for these professions. To the extent that APRN supply in Vermont grows faster than 60 FTEs, then such supply growth could help mitigate possible future shortfalls of physicians. Hence, these projections reflect a likely "floor" for future demand growth, with actual growth likely to exceed these levels.

The majority of Vermont's APRN growth will likely take place among NP specialties. NP demand projections for four broad specialty categories are summarized below. Overall, NP demand in Vermont is projected to grow by 44 FTEs (12%) between 2015 and 2030. When looking at the specialty distribution of these NPs, approximately half the growth will be in primary care. The demand growth will be even higher than summarized in this table to the extent that some demand growth for physicians could be shifted to APRNs. By comparison, statewide demand for nurse midwives will likely fall over time (-10%) reflecting population decline among women of child bearing age.

Exhibit 12: Projected Vermont APRN FTE Demand by Profession, 2015-2030

Profession Category	2015	2020	2025	2030	FTE Growth, 2015-2030	% Growth, 2015-2030
Nurse Practitioners	**380**	**395**	**410**	**424**	**44**	**12%**
Primary Care	236	244	252	259	23	10%
Medical Specialties	54	58	62	66	12	22%
Surgical Specialties	19	21	22	23	4	21%
Other	71	72	74	76	5	7%
CRNAs	**109**	**117**	**122**	**128**	**19**	**17%**
Nurse Midwives	**30**	**29**	**28**	**27**	**-3**	**-10%**
Vermont Total	**519**	**541**	**560**	**579**	**60**	**12%**

Note: Future demand and growth will exceed the levels presented here to the extent that additional APRNs are used to help mitigate future shortfalls of physicians.

Demand for virtually all APRN professions modeled, except nurse midwives, is growing at rates faster than projected Vermont population growth between 2015 and 2030. This pattern also holds true across Vermont HSAs (Exhibit 13) and primarily reflects both population growth/decline and aging.

Exhibit 13: Projected Vermont APRN FTE Demand by HSA, 2015-2030

Hospital Service Area	2015	2020	2025	2030	FTE Growth 2015-2030	% Growth 2015-2030
Barre	51	54	56	58	7	14%
Bennington	32	33	34	34	2	6%
Brattleboro	25	26	26	27	2	8%
Burlington	164	173	182	190	26	16%
Middlebury	21	22	22	23	2	10%
Morrisville	20	21	22	23	3	15%
Newport	23	24	25	25	2	9%
Randolph	11	12	12	12	1	9%
Rutland	48	49	49	49	1	2%
Springfield	22	22	23	23	1	5%
St. Albans	44	46	49	51	7	16%
St. Johnsbury	21	22	23	24	3	14%
White River Jct.	37	38	39	40	3	8%
Vermont Total	**519**	**541**	**560**	**579**	**60**	**12%**

Note: Future demand and growth will exceed the levels presented here to the extent that additional APRNs are used to help mitigate future shortfalls of physicians. Numbers may not sum to Vermont total due to rounding.

3. Physician Assistants

Physician Assistants are state-licensed to practice medicine. PAs in primary care obtain medical histories, conduct physical examinations, diagnose and treat illnesses, prescribe medication, order and interpret lab tests, and provide patient education and counseling. PAs are licensed to practice and authorized to prescribe medication in all 50 states and the District of Columbia. Similar to the projections for APRN demand, the PA demand projections presented here reflect demand under a status quo assumption that the portion of care provided by PAs (versus physicians or APRNs) remains unchanged. To the extent that physician shortages develop and that cost considerations and new care delivery models encourage additional use of PAs, future PA demand could be higher than the projections summarized in this report.

Statewide, PA demand will grow by about 30 FTEs (13%) between 2015 and 2030, reaching 267 FTEs (Exhibit 14). Projected growth in PA demand includes 12 FTE primary care providers, with an additional 18 FTEs among the three non-primary care specialties. There is no consensus on the degree to which increased availability of PAs can offset demand for physicians (either by increasing physician productivity or by replacing a portion of the services provided by physicians), and such tradeoffs between physicians and PAs will vary by medical specialty. The degree of substitutability is likely greater in primary care versus medical and surgical specialties.

Despite projected growth in demand, between 2015 and 2030 there will be little change in the distribution of PAs across specialties. By 2030 approximately 45% of PAs will work in primary care; 21% will work in surgical subspecialties; 15% will work in internal medicine subspecialties, and the remainder will work in other practice areas.

Exhibit 14: Projected Vermont Physician Assistant FTE Demand by Specialty, 2015-2030

Specialty Category	2015	2020	2025	2030	FTE Growth, 2015-2030	% Growth, 2015-2030
Primary Care	108	112	116	120	12	11%
Medical Specialties	32	35	37	40	8	25%
Surgical Specialties	49	52	54	56	7	14%
Other	48	49	50	51	3	6%
Vermont Total	**237**	**248**	**257**	**267**	**30**	**13%**

Note: Future demand and growth will exceed the levels presented here to the extent that additional PAs are used to help mitigate future shortfalls of physicians.

Projected PA demand and growth in demand varies geographically based on the size and characteristics of the population in each HSA. Exhibit 15 shows that projected growth in HSA-specific demand between 2015 and 2030 ranges from no growth in Rutland to 11 FTEs in Burlington.

Exhibit 15: Projected Vermont Physician Assistant FTE Demand by HSA, 2015-2030

Hospital Service Area	2015	2020	2025	2030	Growth, 2015-2030	% Growth, 2015-2030
Barre	25	26	27	28	3	12%
Bennington	16	16	17	17	1	6%
Brattleboro	12	13	13	13	1	8%
Burlington	67	71	75	78	11	16%
Middlebury	10	11	11	11	1	10%
Morrisville	10	10	11	11	1	10%
Newport	11	12	12	13	2	18%
Randolph	5	6	6	6	1	20%
Rutland	24	24	24	24	0	0%
Springfield	11	11	11	12	1	9%
St. Albans	18	19	20	21	3	17%
St. Johnsbury	10	11	11	12	2	20%
White River Jct.	18	19	19	20	2	11%
Vermont Total	**237**	**248**	**257**	**267**	**30**	**13%**

Note: Future demand and growth will exceed the levels presented here to the extent that additional PAs are used to help mitigate future shortfalls of physicians. Numbers may not sum to Vermont total due to rounding.

B. Nurses

Registered nurses (RNs) and licensed practical nurses (LPNs) are critical to the effective and efficient delivery of health care services across a wide array of settings, including hospitals, nursing homes, ambulatory care centers, physician offices, hospice programs, home health agencies, schools, and some non-patient care settings such as public health, academia, insurance companies, and government.

1. Registered Nurses

Under a status quo scenario, demand for RNs in Vermont care delivery settings is projected to grow between 2015 and 2030 by 1,422 FTEs (22%) reaching about 7,884 RNs in 2030 (Exhibit 16). The highest RN growth rates are expected to occur in nursing homes and residential care settings (69%) and home health (41%). Absolute growth is highest in hospital inpatient settings (784 FTEs), nursing homes (267 FTEs) and home health (221 FTEs).

Exhibit 16: Projected Vermont RN FTE Demand by Care Setting, 2015-2030

Setting	2015	2020	2025	2030	FTE Growth 2015-2030	% Growth 2015-2030
Office	477	500	516	532	55	12%
Outpatient	228	240	246	252	24	11%
Emergency	540	547	550	553	13	2%
Inpatient	3,614	3,862	4,131	4,398	784	22%
Home Health	534	595	675	755	221	41%
Nursing Home	385	425	539	652	267	69%
Residential Care	119	131	166	201	82	69%
School	158	150	146	141	-17	-11%
All Other	407	408	404	400	-7	-2%
Vermont Total	**6,462**	**6,858**	**7,373**	**7,884**	**1,422**	**22%**

Vermont continues to expand preventive non-medical services that could help the elderly remain in the community rather than institutionalized settings like residential care facilities and nursing homes.[a] To that extent, demand for services could shift from institutional settings to home health and other community-based settings.

Similar to other health professions modeled, projected growth in RN demand between 2015 and 2030 varies by HSA (Exhibit 17). HSAs with the highest absolute in RN demand are Burlington (432 FTEs), Barre (164 FTEs) and St. Albans (111 FTEs).

[a] Interventions to help keep the elderly in the community include improving: nutrition (Meals on Wheels, congregate meal sites, supplemental food programs, senior farmer's market vouchers), exercise (via programs at Senior Centers, such as Tai Chi), social isolation (focus on community integration), preventing falls (which are a leading cause of senior injury and mortality), and preventing elder substance misuse.

Exhibit 17: Projected Vermont FTE RN Demand by HSA, 2015-2030

Hospital Service Area	2015	2020	2025	2030	Growth 2015-2030	% Growth 2015-2030
Barre	692	736	796	856	164	24%
Bennington	455	478	507	536	81	18%
Brattleboro	338	359	386	413	75	22%
Burlington	1,738	1,861	2,016	2,170	432	25%
Middlebury	285	303	328	353	68	24%
Morrisville	265	284	306	329	64	24%
Newport	319	342	368	394	75	24%
Randolph	153	162	174	185	32	21%
Rutland	666	691	724	756	90	14%
Springfield	303	319	339	358	55	18%
St. Albans	447	476	517	558	111	25%
St. Johnsbury	288	307	335	362	74	26%
White River Jct.	512	540	576	611	99	19%
Vermont Total	**6,462**	**6,858**	**7,373**	**7,884**	**1,422**	**22%**

Note: Numbers may not sum to Vermont total due to rounding.

2. Licensed Practical Nurses

A large portion of LPNs work in long term care settings that are projected to experience high rates of demand growth (Exhibit 18). Overall, between 2015 and 2030 demand for LPNs is projected to grow by about 775 FTEs (39%), with most of that growth occurring in nursing homes (428 FTEs), home health (122 FTEs) and residential care facilities (121 FTEs).

Exhibit 18: Projected Vermont LPN FTE Demand by Care Setting, 2015-2030

Setting	2015	2020	2025	2030	FTE Growth 2015-2030	% Growth 2015-2030
Office	264	277	285	294	30	11%
Outpatient	51	54	55	57	6	12%
Inpatient	326	349	373	397	71	22%
Home Health	296	330	374	418	122	41%
Nursing Home	618	683	864	1,046	428	69%
Residential Care	174	192	244	295	121	70%
All Other	229	230	228	226	-3	-1%
Vermont Total	**1,958**	**2,115**	**2,423**	**2,733**	**775**	**39%**

High growth rates in demand are projected across all HSAs. With 215 FTE growth, Burlington HSA alone accounts for over a quarter (28%) of Vermont's projected 775 FTE growth in LPN demand (Exhibit 19).

Exhibit 19: Projected Vermont FTE LPN Demand by HSA, 2015-2030

Hospital Service Area	2015	2020	2025	2030	Growth 2015-2030	% Growth 2015-2030
Barre	211	228	264	300	89	42%
Bennington	148	157	176	195	47	32%
Brattleboro	106	114	132	150	44	42%
Burlington	500	546	631	715	215	43%
Middlebury	86	95	111	128	42	49%
Morrisville	79	86	99	111	32	41%
Newport	100	109	125	141	41	41%
Randolph	47	51	58	66	19	40%
Rutland	208	219	245	271	63	30%
Springfield	97	103	117	131	34	35%
St. Albans	126	135	155	175	49	39%
St. Johnsbury	90	96	113	130	40	44%
White River Jct.	161	172	196	220	59	37%
Vermont Total	**1,958**	**2,115**	**2,423**	**2,733**	**775**	**39%**

Note: Numbers may not sum to Vermont total due to rounding.

Looking to the future, many factors will continue to affect the nurse workforce. These include demand-related trends such as the aging of the population, overall economic conditions, and new models of care. Policies designed to improve access to care and emphasizing disease management and prevention are providing new opportunities and roles for nurses within the health care delivery system.[12] Supply-related issues (outside the scope of this report) include an aging nurse workforce, changes in scope of practice, and economic considerations that might affect occupation choice and practice location.

It is too early to definitively tell whether emerging care delivery models will contribute to a new growth in demand for nurses (e.g., with nurses taking on new roles in preventive care and care coordination), or a net decline in demand for nurses by reducing use of hospital and emergency services. The scenarios modeled later in the report may help inform the staffing implications of some of these emerging care delivery models. Uncertainties regarding how emerging care delivery models might affect demand (and supply) for nurses, uncertainties of how nurses and their employers will respond to economic and other trends and improvements in data collection efforts underscore the importance of ongoing research on the potential implications of the evolving health care system on demand for nurses and other health professionals.

C. Other Health Professions

This section of the report summarizes statewide results for additional health professions modeled that reflect Vermont's interests and data availability. The professions modeled fall under five occupational categories (Exhibit 20):

- Select ***pharmacy occupations***: pharmacists, pharmacy technicians, and pharmacy aides
- Select ***diagnostic services***: medical and clinical laboratory technologists and technicians, diagnostic medical sonographers, nuclear medicine technologists, and radiologic technologists

- Select ***direct care occupations***: home health aides and nursing aides
- Select ***vision care occupations***: optometrists and dispensing opticians
- Select ***other occupations***: dentists, dieticians, podiatrists, and psychologists

In addition, we briefly discuss naturopathic medicine—which was identified as an occupation of interest for this study.

The occupations summarized in Exhibit 20 provide services across the spectrum of care delivery settings. For example, the demand for many technician, technologist and aide occupations is tied to patient use of hospital services (inpatient, outpatient, and emergency department), physicians' offices, nursing home and residential care, home health, and the receipt of diagnostic tests and procedures across care settings. Demand for home health aides and other occupations that visit people in their home is tied to demand for different types of home health services. Demand for pharmacy-related occupations is tied to the number of prescriptions filled, which in turn is influenced by patient visits to provider offices, outpatient clinics, hospitals and emergency departments. Additional detail on the HDMM models demand for these occupations is provided online.[7]

Exhibit 20: Projected FTE Demand for Select Health Professions, 2015-2030

Profession	2015	2020	2025	2030	FTE Growth, 2015-2030	% Growth, 2015-2030
Pharmacy Services						
Pharmacists	397	416	429	441	44	11%
Pharmacy technicians	484	509	526	543	59	12%
Pharmacy aides	57	61	63	65	8	14%
Diagnostic Services						
Medical & clinical lab technicians	355	377	399	422	67	19%
Medical & clinical lab technologists	358	380	403	425	67	19%
Medical sonographers	129	137	145	153	24	19%
Nuclear medicine technologists	26	29	31	34	8	31%
Radiologic Technologists	96	106	115	124	28	29%
Direct Care Services						
Home health aides	1,549	1,728	1,958	2,187	638	41%
Nurse aides	2,710	2,942	3,467	3,991	1,281	47%
Vision Services						
Optometrists	98	99	99	98	0	0%
Opticians	153	155	154	154	1	1%
Other Professions						
Dentists	323	329	330	330	7	2%
Dietitians	146	153	163	173	27	18%
Podiatrists	20	22	24	27	7	35%
Psychologists [i]	215	207	203	198	(17)	-8%

Note: [i] The projected decline in demand for psychologists reflects that the highest users of psychologist services (children and young adults) are projected to experience population decline.

Demand for most of the occupations modeled is growing at rates faster than projected Vermont population growth between 2015 and 2030. For most of the health professions modeled, FTE demand is projected to grow by 11-35% over this period. However, projected growth for home health aides and nurse aides is higher, at 41% and 47%, respectively. The demand for vision service providers is projected to experience virtually no growth. Demand for psychologists is projected to decline slightly based on changing demographics—as the population of youth and young adults who are the primary users of psychologist services is projected to decline. (However, to the extent that there is unmet need for mental health services, then health care system transformation initiatives to remove barriers to receiving care could cause demand to rise—as discussed in the next Chapter).

Projections of FTE demand under the status quo scenario assume that the current national ratio of providers-to-workload drivers remains unchanged over time. Therefore, projected growth in FTE demand mirrors the projected growth in demand for health care services—taking into account the distribution of each occupation across care delivery settings and different rates of growth in demand for services in each setting. Because growth in demand for some occupations (e.g., pharmacists and pharmacy technicians) is tied to the same growth drivers, these occupations will have similar growth in demand. Growth rates may differ, however, if related occupations have different employment distributions across care delivery settings, as demand for some care delivery settings is projected to increase more rapidly than in others.

Naturopathic Medicine Physicians

Naturopathic medicine is a distinct primary health care profession, emphasizing prevention, treatment, and optimal health through the use of therapeutic methods and substances that encourage individuals' inherent self-healing process.[13] Naturopathic physicians are becoming more widespread and popular in Vermont. Since 1996, they have been licensed to practice in Vermont and are trained as primary care practitioners at accredited naturopathic medical schools. Four-year doctoral programs provide training in the basic medical sciences and in conventional diagnostic and treatment methods. Extensive coursework in naturopathic therapeutic approaches combined with supervised training in comprehensive integrated health care are also provided. With the exception of Medicare, out-of-state plans and certain self-insured employers, due to a law passed by the Vermont Legislature in 2007, all insurance companies regulated by the state must reimburse for the services of a naturopathic physician.

Currently, the ability to project statewide or sub-state FTE demand for this specialty is challenged by data limitations. These include small sample sizes for naturopaths reported in the Medical Expenditure Panel Survey (MEPS) and small numbers of providers and patients due, in part, to the relatively short period of time since the specialty was licensed to practice in Vermont. However, given their level of training, looking to the future naturopaths are likely to be part of the solution in meeting growing statewide demand for primary care providers. Therefore, a conservative projection of growth in naturopathic FTE demand to 2030 might be in the 10-25% range—about the same as the range of projected growth in demand for family medicine and general internal medicine physicians. Given current data limitations building capacity to model demand for this specialty is an important issue to monitor over time.

MODELING COMPONENTS OF A HIGH PERFORMING VERMONT HEALTH CARE SYSTEM

The focus of this chapter is the potential workforce demand implications of changing care use and delivery patterns consistent with an "ideal" high-performing Vermont health care system. Modeled scenarios reflect both changing demographics and assumptions and inputs of how care delivery might change over time. Scenarios modeled feature:

- Greater integration of care delivery
- Enhanced care transitions to reduce avoidable emergency department use
- Improved integration of mental health and substance use services with primary care
- Improved evidence-based chronic disease management
- Improved population health

In addition, we quantify differences in health care use patterns between the Medicaid population and a comparison group of similar patients who are commercially insured. We describe each scenario, modeling inputs and assumptions, and the workforce implications.

A. Integrated Care Delivery Model

A variety of integrated care delivery models are being implemented for use with both publicly and privately insured populations. Integrated care delivery goals include: improving the coordination and quality of patient care across delivery settings, reducing inefficiencies and eliminating redundancy, shifting care to lower cost settings and providers as appropriate, improving preventive care efforts, and better controlling medical expenditures.

Looking historically at the effect of these delivery models on use of services provides insights on what might happen if other integrated care models gain greater prominence in Vermont. This scenario models the current and future implications for FTE physician demand if 100% of the Vermont population were enrolled in integrated care entities compared to the status quo. To model this scenario we simulate if patients in a fee-for-service type arrangement had care use patterns of similar patients in a managed care plan.

Under this scenario, shifting the state population to an integrated care model is associated with a slight increase in total physician demand compared to the status quo (Exhibit 21). However, shifts among specialty categories are projected compared to the status quo. These include increased demand for primary care physicians and select surgical specialties and decreased demand for medical and other specialties. Demand would also shift slightly for APRNs and PAs, and to the extent that integrated systems used more mid-level providers in primary care the 40 FTE increase in primary care demand could be partially filled by APRNs and PAs.

Exhibit 21: Integrated Care Scenario: Projected Impact on VT Physician Demand

Workforce FTE Impacts	2015	2020	2025	2030
Total Physicians	**21**	**20**	**20**	**20**
Primary care	38	39	40	40
Medical specialties	-8	-9	-10	-10
Surgical specialties	8	9	9	10
Other specialties	-17	-19	-19	-20

B. Improved Care Transitions: Emergency Department Care Triage for At-Risk Populations

Many patients visit the emergency department (ED) with non-urgent conditions treatable in an ambulatory setting. Under this scenario, patients presenting with non-urgent conditions in the ED would be identified and linked to care managers and community PCPs for follow up. The assumed statewide target in this scenario is to reduce avoidable ED use among the Medicaid population by 25% by 2030. The target patient population is Medicaid patients with one or more ED visits potentially appropriate for diversion. This includes patients with chronic conditions and at-risk patients requiring more intensive ED care management services post discharge.

The general modeling approach for this scenario involves identifying emergency room diagnoses that could be considered potentially preventable, calculating the percentage of visits for each category of emergency visit (cardiology, gastroenterology, etc.) that are potentially preventable, and scaling down the status quo modeling projections by 25% of this number of visits.

Researchers at New York University have categorized ICD-9 diagnosis codes into four categories: non-emergent, emergent – primary care treatable, emergent – ED care needed- preventable/avoidable and emergent – ED care needed – not preventable/avoidable. For each diagnosis code, the proportion of ED cases with the diagnosis falling into each category is reported. For example, ED headache diagnoses are categorized as follows: 78% non-emergent, 9% emergent but primary care treatable, 0% emergent with ED care needed but preventable, and 13% emergent with ED care needed but not preventable. The Lewin Group expanded on the NYU algorithm, using the NYU proportions for each diagnosis to create three categories for each diagnosis: ED Avoidable, ED Questionable, and ED Required.[14] The state of Vermont has indicated that the Lewin methodology is preferred to the NYU methodology for the purposes of classifying ED visits, so the Lewin methodology was used for modeling this scenario.[a]

By 2030, the net projected statewide impact associated with a 25% reduction in avoidable ED use among Medicaid patients is an increase in primary care providers by about 81 FTEs and a decrease in emergency department providers by about 62 FTEs compared to the status quo (Exhibit 22). Most notably, the shift from the ED to primary care settings would result in a need for about 38 additional

[a] **ED Required**: Sum of the probability that each claims was (Emergent - ED Care Needed - Preventable/Avoidable) and (Emergent - ED Care Needed - Not Preventable/Avoidable) was greater than or equal to 50%.

ED Avoidable: Sum of the probability of (Non-emergent) and (Emergent/Primary Care Treatable) is greater than or equal to 80%.

ED Potentially Avoidable: Sum of the probability of (Non-emergent) and (Emergent/Primary Care) Treatable is greater than 50% but less than 80%.

primary care physicians and 50 fewer ED RNs by 2030. While interventions to divert avoidable ED use to a primary care setting might increase overall demand for health workers, the shift would be from higher cost to lower cost settings and would place patients in a situation where more extensive counseling and follow-up care could be provided.

Exhibit 22: ED Triage Scenario: Projected Vermont FTE Staffing Impact

Ambulatory Care (FTEs)	2015	2020	2025	2030
Primary Care Offices	**74**	**77**	**79**	**81**
Primary care physicians	35	36	37	38
Nurse practitioners	14	15	15	15
Physician assistants	9	9	9	10
RN or LPN	16	17	18	18
Emergency Department	**-61**	**-61**	**-62**	**-62**
Emergency physicians	-8	-8	-8	-8
Nurse practitioners	-1	-1	-1	-1
Physician assistants	-3	-3	-3	-3
Registered nurses	-49	-49	-50	-50

C. Integrating Mental Health/Substance Use Services into Primary Care

Integrating mental health/substance use services into primary care clinics can be done under different care delivery models—ranging from improved training of primary care providers to diagnosis and treat patient with MH/SU disorders, to using a team-based approach where MH/SU co-locate with primary care providers, to co-locating primary care providers into clinics that specialize in treating patients with MH/SU disorders. The goal of such integration is diagnosis, prevention, and treatment of individuals with co-morbid physical and mental health/substance use health needs.

Previous discussion of the differences between "demand" versus "need" for health care services is reiterated here because of the importance of this topic for addressing MH/SU needs. Many patients with MH/SU disorders might not seek treatment and thus their need for services might not translate into demand for services. Similarly, patients with mild-to-moderate depressive/anxiety disorders or substance use might be undiagnosed—thus needed care might not result in utilization of services (or demand). The demand estimates presented here are estimates of what could occur in terms of increased utilization of services, which will under represent need for such services. Given the focus and prioritization for Vermont in this area, it will be important to update these numbers with data as the treatment, utilization, and coverage patterns change.

The scenario analyzed for this report is modeled after interventions that some health plans in New York State are attempting as part of their state's Medicaid waiver for system reform. There are two components: (1) primary care providers receive training to better diagnosis patients with MH/SU disorders, and (2) using a team-based approach MH/SU providers co-locate with primary care providers in locations that provide primary care services to Medicaid, uninsured, and other traditionally under-served populations. (The demand implications would be larger than modeled here if the target

population were the entire population of Vermont, but a source of funding for such a broad integration is unclear).

Modeling assumptions were selected from tested and published examples of primary care integration with MH/SU services. The following assumptions and inputs were used to model the workforce effects of integration of primary care and mental health and substance use services:

- The target population modeled is Medicaid and uninsured primary care patients with mild-to-moderate depressive/anxiety disorders or substance use who are not currently receiving specialty MH/SU services. (The assumption is that patients with severe MH/SU needs are unlikely to be first diagnosed in a primary care setting but instead have other venues for diagnosis and treatment).
- Approximately 15% of the Medicaid and uninsured population has undiagnosed MH/SU needs, and these needs largely consist of mild-to-moderate depressive/anxiety disorders or substance use.[a]
- Approximately 80% of the Medicaid population with undiagnosed MH/SU needs visits a primary care provider annually.[b]
- Absent the integration initiative, approximately 50% of patients with undiagnosed MH/SU needs would have been successfully diagnosed by a primary care provider and referred to a MH/SU provider.[15] As a result of the initiative impacts, primary care providers will receive additional training and it is assumed that 80% of patients with undiagnosed MH/SU needs will be diagnosed and referred.
- Absent the initiative, 25% of referred patients will complete the referral.[16] As a result of the initiative, it is assumed that referral completion rates will double to 50%.[17]
- Mental health and substance use services will be provided by a Licensed Clinical Social Worker (or a MH/SU provider of equivalent training) and each provider will manage approximately 75 active patients for approximately 6 months (or approximately 150 patients annually).[c,16]
- MH/SU-related inpatient days are reduced by 0.14 days per person that receives MH/SU services as a result of the integration.[d]

Based on modeling assumptions developed from the literature, between present and 2030 the target population would be approximately 21,000 to 24,000 Vermonters. Of these individuals, approximately 4,600 to 5,200 additional individuals would seek MH/SU counseling who would otherwise not receive such counseling. (Many patients in the target population likely would already be receiving MH/SU

[a] Modeling assumption: For modeling purposes, an estimated percentage of the Medicaid population that may have undiagnosed behavioral health needs was required. Data from the literature around this metric is scarce, but indicates that 15% may be conservative, as some estimate that 60% to 70% of patients with MH/SU issues leave medical settings without receiving behavioral health treatment http://www.commonwealthfund.org/publications/newsletters/quality-matters/2014/august-september/in-focus#/#4. Thus, 15% was chosen in order to avoid overestimating the effects of the initiative.

[b] Nationwide, 86.5% of adult and 93.5% of child Medicaid beneficiaries had contact with a health care professional in the past year. This information is used to guide the assumption that 80% of the Medicaid population with undiagnosed behavioral health needs will visit a primary care provider. http://ftp.cdc.gov/pub/Health_Statistics/NCHS/NHIS/SHS/2014_SHS_Table_A-18.pdf

[c] Source indicates caseloads of 100 – 150 patients. For modeling, the higher caseload was used as the project focuses on population without serious mental health issues, and in that case, presumably, providers are able to see more patients. https://aims.uw.edu/collaborative-care/team-structure/care-manager

[d] Co-location and navigator services have helped the Genesee Health System health center and Hope Network achieve drops in psychiatric inpatient admissions (pre intervention average: 1.95 per person, post intervention average: 0.48 per person) http://kff.org/report-section/integrating-physical-and-behavioral-health-care-promising-medicaid-models-issue-brief/

counseling; it is unclear whether their level of MH/SU counsel utilization would remain the same or increase). Diagnosis and treatment of patients with mild-to-moderate mental health and substance use disorders likely will not dramatically decrease demand for hospital-based services. Hence, the projected decrease in use of such services and health workforce implications for hospital-based care is small.

The workforce implications of health care use impacts indicate a corresponding rise in mental health/substance use care providers in primary care settings, which in 2030 includes an additional 31 FTE clinical social workers and 3 FTE psychiatrists or psychiatric nurses (or some other combination of similarly trained MH/SU providers), and additional support staff (Exhibit 23). While this scenario anticipates a reduction in workforce FTEs in the ED and inpatient settings, the projected impact in these settings is small, as is the overall impact of the initiative. This is due primarily to the modest increase in numbers of patients receiving counseling even after full project implementation. More intensive efforts to address undiagnosed needs would have a larger impact on demand for health workers.

Exhibit 23: Integration of Primary Care and Mental Health & Substance Use Services: Projected Workforce Impact

Population modeled	2015	2020	2025	2030
Population modeled				
Population with undiagnosed MH/SU needs (15% of Vermont Uninsured/Medicaid Pop)	23,700	23,000	22,000	21,100
Population with undiagnosed MH/SU needs who visit PCP (80%)	19,000	18,400	17,600	16,900
Population with undiagnosed MH/SU screening positive for MH/SU needs absent Integration (50%)	9,500	9,200	8,800	8,400
Population with undiagnosed MH/SU screening positive for MH/SU needs with Integration (80%)	15,200	14,700	14,100	13,500
Screened population completing MH/SU referral absent Integration	2,400	2,300	2,200	2,100
Screened population completing MH/SU referral with Integration	7,600	7,400	7,100	6,700
Change in population receiving MH/SU counseling	5,200	5,100	4,900	4,600
Health care use impact of Integration				
Encounters with MH/SU care manager	14,600	14,200	13,600	13,000
Primary care visits	1,800	1,700	1,600	1,600
MH/SU-related emergency department visits	-240	-230	-220	-210
MH/SU-related inpatient days	-390	-370	-360	-340
Workforce FTE implications				
Office setting				
Licensed clinical social worker	35.0	33.5	32.5	31.0
Psychiatrists/psych nurses	3.5	3.5	3.5	3.0
Primary care providers	1.0	0.5	0.5	0.5
Direct medical support	2.0	1.0	1.0	1.0
Direct admin support	15.5	14.5	14.0	13.5
Staff registered nurses	0.5	0.5	0.5	0.5
Emergency Department				
Emergency physicians	<-0.5	<-0.5	<-0.5	<-0.5
Nurse practitioners or physician assistants	-2.0	-2.0	-2.0	-1.5
Staff registered nurses	-0.5	-0.5	-0.5	-0.5
Inpatient				
Hospitalists	<-0.5	<-0.5	<-0.5	<-0.5
Staff registered nurses	-2.5	-2.0	-2.0	-2.0
Licensed practical nurses	<-0.5	<-0.5	<-0.5	<-0.5
Nurse aides/assistants	-0.5	-0.5	-0.5	-0.5

D. Evidence-Based Strategies to Improve Management of Cardiovascular Disease

The Cardiovascular disease (CVD) management scenario assumes adults with CVD become better at self-managing their condition with assistance from health coaches and primary care providers. Better self-management includes: improving prescribing and adherence to aspirin prophylaxis among eligible patients, improving blood pressure control by updating and strengthening implementation of hypertension guidelines, improving cholesterol control by updating current cholesterol management, supporting adherence to current treatment guidelines, and increasing smoking cessation by enabling PCPs to support adherence to standard counseling and treatment for tobacco use disorder.

The following assumptions and inputs are used in this analysis:

- 50% of Vermonters age 18 or older with cardiovascular conditions participate in the program
- Quality improvement in primary care management will decrease CVD-related emergency visits by 20%[18]
- Quality improvement in primary care management will decrease CVD-related inpatient hospital days by 39%[19]
- Quality improvement in primary care management will increase visits to PCPs by 1 and cardiologists by 0.5 annually[17]
- Health coaches in this program will be used in a ratio of 1:2000 patients

Exhibit 24 summarizes statewide modeling results and projected impacts. By 2030 the net projected annual utilization impact associated with this disease management initiative is the following:

- 1,000 fewer emergency department visits
- 2,000 fewer inpatient days
- 92,000 additional primary care visits
- 46,000 additional visits to cardiologists

The projected 2030 workforce impact includes:

- An increase of about 46 FTE CVD educators or health coaches
- **In office/outpatient settings:** an increase of about 42 additional primary care FTEs, 167 direct medical and administrative support staff FTEs, 31 additional staff RN FTEs, and 14 additional cardiologist FTEs
- **In ED settings**: a slight decrease in emergency department staff
- **In inpatient settings:** a decrease in demand for hospital inpatient staff—including approximately 12 fewer RN and 3 fewer nurse aides/assistants FTEs

In terms of workforce implications, the analysis suggests that the greatest impact of this project on the health care workforce will be in ambulatory settings. When the additional FTE requirements associated with primary care providers, cardiologists, direct medical and administrative support staff and staff RNs are combined, approximately 254 FTEs may be needed in 2030. The project also has impact in the inpatient setting, with staff RN FTEs decreasing by approximately 12. There is minimal projected impact in the ED and hospital inpatient settings. This scenario reflects an example where improved access to care may improve patient quality of life, but have minimal impact on reducing use of hospital-based care.

Exhibit 24: CVD Chronic Disease Management Initiative Workforce Impacts

	2015	2020	2025	2030
Number of actively engaged patients	73,400	81,100	86,600	92,000
Projected Care Use Impacts				
Emergency visits	-900	-1,000	-1,000	-1,000
Inpatient days	-1,700	-1,900	-2,000	-2,000
Additional visits to primary care provider	73,400	81,100	86,600	92,000
Additional visits to cardiologists	36,700	40,600	43,300	46,000
Workforce FTE implications				
Office/Outpatient setting				
Primary care providers	33.5	37	39.5	42
Direct medical support	77.5	86	91.5	97.5
Direct admin support	55.5	61.5	65.5	69.5
Staff registered nurses	24.5	27	29	31
Specialists (cardiologists)	11	12	13	13.5
Emergency Department				
Emergency physicians	-0.5	-0.5	-0.5	-0.5
Staff registered nurses	-1.5	-1.5	-1.5	-1.5
Inpatient				
Hospitalists	-1	-1	-1	-1
Staff registered nurses	-10.5	-11	-11.5	-12
Licensed practical nurses	-0.5	-0.5	-0.5	-0.5
Nurse aides/assistants	-2.5	-3	-3	-3
Health Coaches 1:2,000 patients	**36.5**	**40.5**	**43.5**	**46.0**

E. Physician Demand Implications of Achieving Population Health Goals

Population health goals and many care delivery and reimbursement practices support the provision of timely and appropriate preventive care. Among the nation's Healthy People 2020 Goals are (1) improving the percentage of adults with hypertension whose blood pressure is under control, (2) improving blood glucose control of people with diabetes, (3) improving cholesterol levels for adults with hypercholesterolemia, (4) reducing prevalence of obesity by encouraging improved nutritional intake and increased physical activity, (5) reducing the prevalence of smoking, and (6) many other goals related to receiving preventive care and improving health-related behavior.[20] Progress towards achieving many of these goals has been strengthened by changes in policy and treatment guidelines.

Examples of policies designed to help meet these goals include US Preventive Services Task Force (USPSTF) recommendations for intensive lifestyle counseling to individuals who are obese or who are at

high risk for developing cardiovascular disease or diabetes to promote a healthful diet and physical activity[21, 22]; Medicare reimbursement for intensive lifestyle counseling to reduce diabetes and cardiovascular disease prevalence[23]; and provisions in the Affordable Care Act to cover counseling and treatment related to smoking cessation and improving clinical metrics such as blood pressure, cholesterol levels, and hemoglobin A1c levels.[24]

We modeled a hypothetical, but achievable, scenario of the potential impact on patient health and the resulting statewide demand for health care services and providers of achieving the following population health improvements:

- **Sustained 5% body weight loss for overweight and obese adults**: The recommendation is for obese patients to lose 10% body weight or more, and numerous studies have shown that 5% or more weight loss is achievable.[25, 26] However, sustaining weight loss is a challenge but could be achieved using a medical home model where patients continue to receive counseling and support over time.
- **Improved blood pressure, cholesterol, and blood glucose levels for adults with elevated levels**: Clinical trials have shown that appropriate adherence to medicine and counseling can help patients with hyperlipidemia reduce total blood cholesterol by 34.42 mg/dL[27]; patients with uncontrolled hypertension can reduce systolic blood pressure by 14.5 mm Hg and diastolic blood pressure by 10.7 mm Hg[28]; and patients with elevated hemoglobin A1c levels can reduce A1c (modeled as 1 percentage point decline annually until diabetes control is reached at A1c of 7.5%).[29]
- **Smoking cessation**: Patients who stop smoking can, over time, reduce risk for various cancers and other medical conditions.[30]

This modeled scenario is identical to analysis covering the national physician workforce published by IHS Markit and sponsored by the Association of American Medical Colleges.[2]

The Disease Prevention Microsimulation Model (DPMM) used for modeling this scenario simulates onset of disease and other risk factors between 2015 and 2030 under a status quo scenario which assumes the continuation of current patterns of patient health outcomes under normal care, and compares outcomes to simulation results if the above lifestyle and clinical outcomes were achieved. These modeling results from the DPMM were then used as inputs into the Healthcare Demand Microsimulation Model to project levels of health care use and provider FTE demand under both the status quo and intervention modeling assumptions. The difference in health care use and FTE demand between the sets of assumptions reflects the impact of the intervention.

The DPMM uses a Markov-based microsimulation approach that is described in detail in other documents and online.[25, 26, 31, 32] DPMM prediction equations came from clinical trials and published studies. The simulation used a representative sample of Vermont adults constructed using the 2013-2014 National Health and Nutrition Examination Survey (NHANES) combined with Vermont population projections. The modeled intervention focused on adults who are overweight or obese; have elevated blood pressure, cholesterol, or blood glucose levels; or who smoke.

Modeling outcomes for Vermont suggest that achieving these lifestyle and clinical goals would (cumulatively between 2015 and 2030) result in 13,900 fewer cases of heart disease, 7,200 fewer strokes, 4,200 fewer heart attacks, and reduced incidence of cancer and other diseases. On a per capita basis, demand for health care services and physicians would decline by about 1-2% with the impact differing by care delivery setting and medical specialty.

Achieving these population health goals would reduce mortality such that in the future more people would be alive and require care. Achieving modeled outcomes could raise the 2030 population by 8,900 adults (+1.8%)—most of whom would be elderly. As a result, by 2030 statewide demand for physicians would be approximately 21 FTEs *higher* because the number of physicians needed to support these additional 8,900 adults more than offsets the reduced demand associated with a healthier population (Exhibit 25). In addition, more providers would be required in other occupations.

The demand impact varies by physician specialty category (Exhibit 26). The specialty projected to experience the largest percentage increase in demand by 2030 attributed to achieving these population health goals is geriatricians (8% increase in demand associated with more elderly still living), while the specialty projected to experience the largest percentage decrease in demand is endocrinologists (9% decrease associated with fewer patients with diabetes and diabetes-related complications).

Exhibit 25: Projected Scenario Impact on Size of Vermont Adult Population, 2015-2030

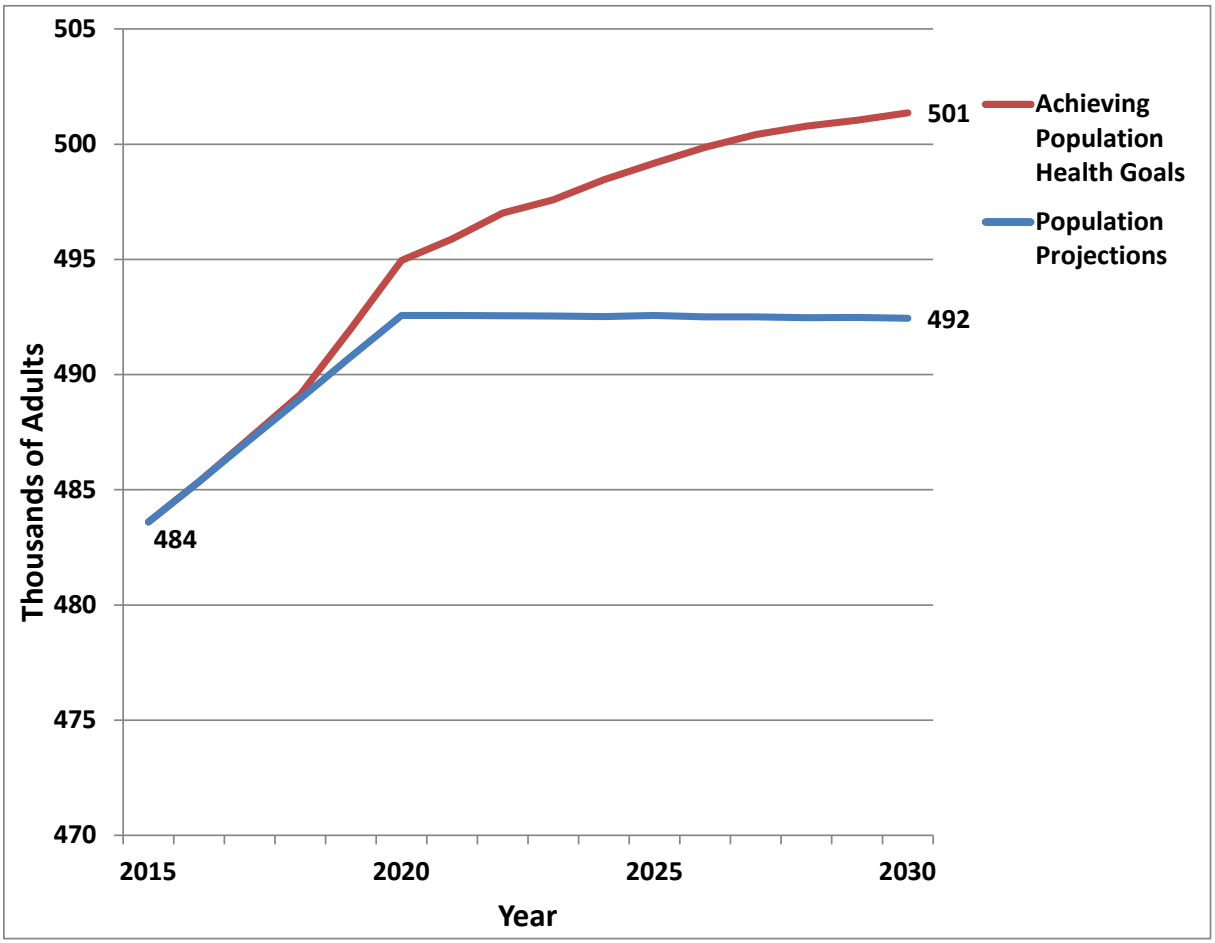
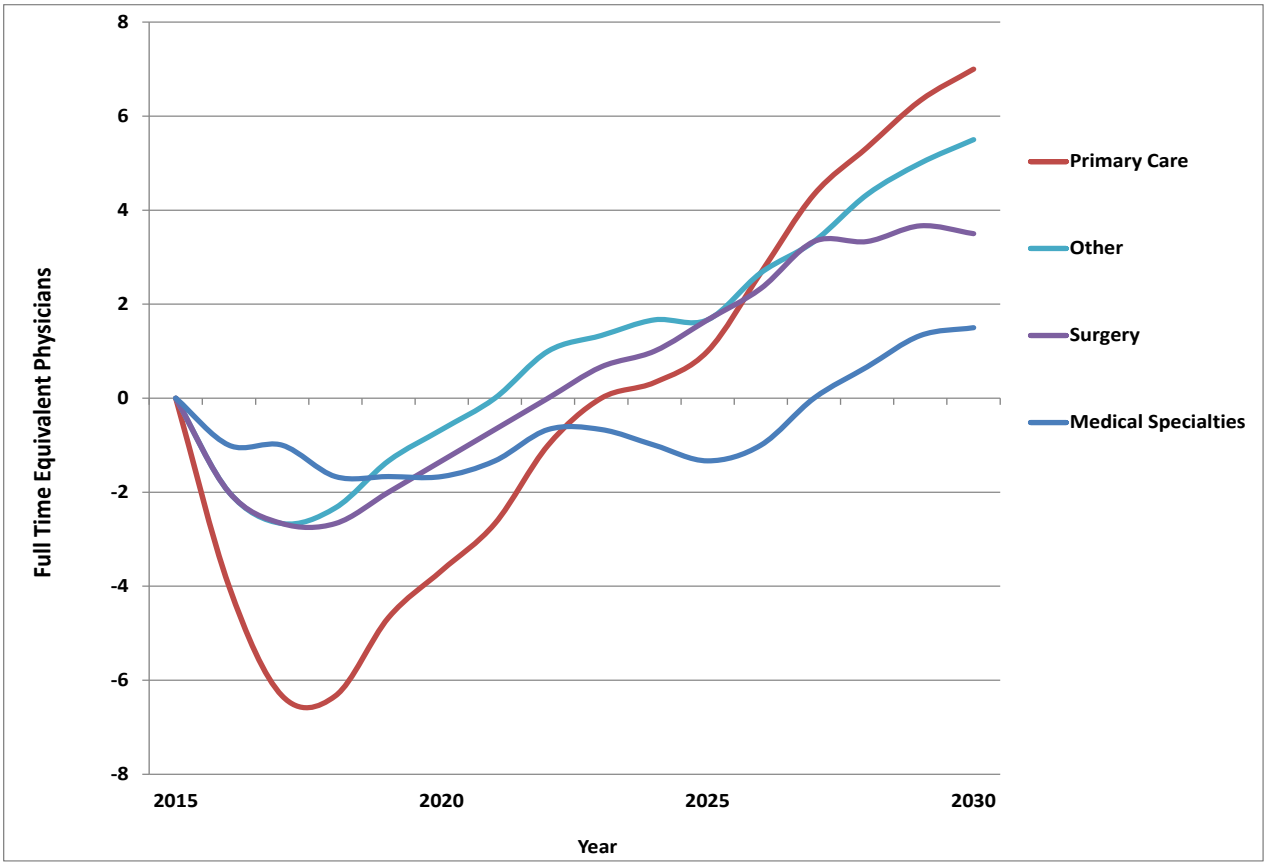


Exhibit 26: Physician Net Demand Implications of Achieving Modeled Population Health Goals



Note: This chart compares projections of Vermont physician demand if the modeled population health goals are achieved versus demand under a continuation of the status quo.

The main conclusion to draw from this scenario is that in the long run achieving select population health goals will not necessarily decrease total physician demand—although it might decrease demand for select physician specialties and shift care across delivery settings. Achieving population health goals reduces morbidity and increases longevity and quality of life, but the demand for health services associated with increased longevity appears to more than offset the declines in service use associated with improved health under the scenario modeled.

The net effect is a slight (1%) decline in physician demand in the initial years after achieving these goals and a slight (2%) increase in physician demand by 2030. Similar results are found for nurses and many other health occupations resulting in higher demand for health workers to support a larger and older population when mortality is reduced. We modeled only a subset of the state's population health goals, but meeting goals related to improved cancer screening, reduced alcohol use, and other population health goals would likely achieve similar implications of increased physician demand to care for a larger population partially offset by decreased demand associated with a healthier population.

F. Alternative Payer Scenario: Examining the Workforce Impact of a Medicaid Population with Use Patterns of the Privately Insured Population

This scenario models the workforce impacts of a change in the health care use patterns of the Medicaid population to match the health care use patterns of those insured by private insurance (controlling for demographics and other risk factors such as disease prevalence). For modeling purposes, outcomes for the Vermont Medicaid population were simulated in the model as if this Medicaid population had care use patterns of a similar population that was commercially insured. Given that the Medicaid population uses health care services at higher rates than those with private insurance, these modeling assumptions result in lower utilization and FTE demand projections compared to the status quo.

This scenario highlights the differences in health care use between the Medicaid and the privately insured populations that are unexplained after controlling for differences in observable health risk factors such as demographics, disease prevalence and lifestyle choices, and other social determinants of health (e.g., eliminate poverty, housing security, and food security issues). This scenario does not necessarily suggest that the population of Vermonters would reduce their health care use by these levels if they were covered by private insurers as the state's Medicaid population may have characteristics that are associated with higher health care use but not captured in the model's prediction equations. Thus, caution should be exercised when interpreting the results of this scenario.

Exhibit 27: Alternative Payer Scenario Workforce Impacts

Workforce FTE Impacts	2015	2020	2025	2030
Total Physicians	-103	-101	-96	-90
Primary care	-24	-24	-23	-21
Medical specialties	-13	-13	-12	-11
Surgical specialties	-5	-5	-5	-4
Other specialties	-61	-60	-57	-53
Advanced practice nurses	-40	-40	-37	-35
Physician assistants	-10	-9	-9	-8
Registered nurses	-539	-529	-498	-467

The projected 2030 workforce impact of the state's Medicaid population having health care use patterns similar to the state's privately insured population includes:

- Lower demand for physicians (90 FTE), including 21 primary care physicians and 53 from the "other specialties" category—of which half are psychiatrists (likely representing systematic differences between the Medicaid and commercially insured populations in mental health conditions not controlled for in our simulation model
- Overall reduced demand for registered nurses (-467 FTEs)

Conclusion

This study combined data on the demographics, socioeconomics, and health risk factors of the population in Vermont, data from national sources on patient care use and delivery patterns, and health workforce simulation models of demand to estimate the current and future demand of physicians and other health professions in Vermont through 2030. In this section we discuss the key findings and their implications. We also discuss study strengths and limitations.

A. Key Findings and Implications

This study first projected future demand for health care services and providers from 2015 through 2030 under a status quo scenario based on changing demographics in the absence of health care system transformation.

- **The growing elderly population in Vermont is the primary driver of increasing demand for health care services and the workforce required to meet the projected future demand for services**. Between 2015 and 2030, Vermont is projected to experience a slight overall population decline (-0.9%), but experience 50% growth in the population age sixty-five and older. By comparison, the US population is projected to grow by about 12% with the population age sixty-five and older projected to grow by 46%.[1] This rapid growth in the older adult population suggests that a large portion of the increase in demand for health workers will primarily be among those professions and in care delivery settings that predominantly serve older adults.
- **Demand for physicians and mid-level providers (physician assistants [PAs] and advanced practice nurses [APRNs]) will grow between 2015 and 2030 by approximately 300 or more FTEs.** The increase in demand will need to be met by a combination of treating clinicians. At the national level, the growth in physician supply will be insufficient to meet the projected growth in demand for services; however, the rapidly growing supply of mid-level providers will help mitigate future shortfalls of physicians. Projecting future health workforce supply was outside the scope of this project, but over the past few years, Vermont has seen a trend of mid-level health care professionals filling in gaps in primary care when there are insufficient doctors to meet the need. This trend will likely continue, with APRNs and PAs increasingly integrated into specialty care. Based on current care delivery models the growth in demand between 2015 and 2030 would be approximately 207 physicians, 60 APRNs, and 30 PAs. There is no consensus on the degree to which mid-level providers can substitute for physicians, but the 207 FTE increase in demand for physicians reflects an upper bound that declines to the extent that net growth in Vermont's supply of mid-level providers exceeds the estimated 60 APRNs and 30 PAs required to maintain current levels of care as the population ages.
    - **Physician demand continues to grow in Vermont**. If care delivery patterns remain unchanged, demand for physicians will grow by approximately 207 FTEs (13%). In absolute terms, statewide demand growth is highest for general internal medicine (54 FTEs) and family medicine (29 FTEs). In percentage terms demand growth is highest for specialties serving an older population, including geriatric medicine (63%), hematology and oncology (33%), vascular surgery (33%), and urology (32%). Projected decline in demand for pediatrics and obstetrics & gynecology (-10%) and neonatal-perinatal medicine (-13%) reflects negative population growth among younger age cohorts.
    - **Demand for physician assistants and nursing professions will grow at the same rate as physician demand under status quo modeling assumptions, but will grow faster than physician demand under scenarios where mid-level providers play a broader role in care**

delivery. A broader role for mid-levels providers is likely, reflecting (a) increased recognition and acceptance of the importance of mid-level providers in providing quality, cost-effective care, and (b) challenges with recruiting and retaining physicians to fill positions. Under the status quo modeling assumptions, demand for advanced practice nurses will grow by about 60 FTEs (12%), with the majority of growth taking place among nurse practitioners (44 FTEs). Total physician assistant demand will grow by about 30 FTEs (13%) reaching 267 FTEs, with about 40-45% employed in primary care.

- **Statewide demand for registered nurses will grow by about 1,422 FTEs (22%)**. The highest growth rates are expected in nursing home and residential care settings (69%), and home health (41%). Hospitals will continue to be the largest employer of registered nurses.
- **The rate of growth in demand for other health occupations modeled varies widely**. Slow growth occupations include optometrists, opticians and dentists with about 0-2% cumulative growth between 2015 and 2030. High growth occupations include nurse aides (47% growth) and home health aides (41% growth). High growth in demand for home health aides and other occupations that visit people in their home is linked both to growth in elderly population and statewide efforts to better manage disease and shift care from higher cost to more appropriate and lower cost settings. Vermont has reportedly implemented many programs enabling seniors to have choice in home- and community- based services.
- **Data limitations create challenges for modeling new professions such as naturopathic medicine physicians and for modeling need versus demand for services.**
    - Small sample size in various databases analyzed of patients being treated by naturopathic physicians presents challenges for modeling care use and delivery patterns. A conservative projection of growth in naturopathic demand to 2030 might be in the 10-25% range—about the same as the range of projected growth in demand for family medicine and general internal medicine physicians. Given current data limitations building capacity to model demand for this specialty is an important issue to monitor over time.
    - Likewise, the need for some providers (especially substance use counselors and mental health providers is likely much greater than estimated demand. Removing barriers to receiving care—including removing financial barriers, supply barriers, and social determinants of health (e.g., reduced poverty, housing security, and food security issues)—could increase utilization of services and demand for providers. However, there is limited data to quantify need for services.

After modeling the implications of changing demographics in the absence of system transformation, we modeled the workforce implications of efforts to improve care coordination and delivery and found the following:

- **Increased use of integrated care statewide can shift care to lower cost settings**. Greater integration of care is projected to have little impact on overall FTE demand for physicians and mid-level providers. However, demand would shift away from medical specialties and towards primary care.
- **An initiative which diverts non-emergent visits to the emergency department into primary care settings shifts demand for health providers**. Reducing avoidable emergency department use among the Medicaid population by 25% could, by 2030, reduce demand for registered nurses based in the emergency departments (-50 FTEs) and emergency physicians and mid-level providers (-12 FTEs), but increase primary care physician and mid-level provider demand by 63 FTEs and RN and LPN demand in ambulatory settings by 18 FTEs by 2030, compared with the status quo scenario.
- **Integrating mental health and substance use services into primary care practices to improve screening and access, reduce care fragmentation, and better manage co-morbid physical and**

mental health or substance use needs would increase demand for mental health and substance use providers. The modeled scenario focuses on the Medicaid population, and could lead to 4,600 additional patients receiving counseling by 2030 compared to the status quo. To support the additional patients receiving screening, Vermont's workforce would require 31 additional licensed clinical social workers and 3 additional psychiatrists or psychiatric nurses (or some other combination of mental health or substance use counselors).

- **Efforts to better manage disease and achieve population health goals can increase demand for health professions in some settings and decrease demand in others**. Overall demand for providers would likely increase, but would result in reduced mortality and improved quality of life.
    - A cardiovascular disease management program focusing on Vermont's population with cardiovascular conditions could require 42 additional primary care providers, 31 additional registered nurses, and 14 additional cardiologists in ambulatory settings, and would slightly reduce demand for providers in inpatient and emergency settings.
    - Initiatives for improved population health could include targets such as smoking cessation, weight loss among obese and overweight adults, and improved control of blood pressure, cholesterol, and blood sugar for individuals with elevated levels. If such population health improvements were achieved statewide, demand for physicians and other health professions is projected to fall in the short run due to a healthier population and increase in the medium-to-long run as more residents are alive and live into older age groups. Projected growth in demand for physicians in 2030 under these assumptions is 21 FTEs (2%) higher than under status quo assumptions, as the health care system would support an additional 8,900 residents who otherwise would not be alive in 2030.
    - New roles for community health workers, health coaches and other care managers, including care coordination, navigation, education and outreach services may positively impact the management of chronic disease and improve access to appropriate care.

The scenarios modeled suggest that system transformation might likely increase demand for health care providers rather than reduce demand—especially in the longer term by reducing mortality and providing more comprehensive services to patients. System transformation likely will shift services from higher cost to lower cost settings.

B. Strengths, Limitations and Potential Areas for Future Research

The primary strengths of this study are the use of the latest data and modeling methods for health workforce analysis. The study reflects the most recent population projections published by the State of Vermont, and recent data on the health risk characteristics of the population and the relationship between these risk characteristics and use of health care services. To the extent possible national patterns of care use and delivery were calibrated to reflect use and delivery patterns in Vermont through analysis of the VUHDDS and VHCURES data. Compared to population-based modeling approaches used historically, this microsimulation model takes into account more detailed information on population characteristics and health risk factors when making state and HSA-level demand projections.

Using individuals as the unit of analysis creates flexibility for incorporating evidence-based research on the implications of changes in technology and care delivery models that disproportionately affect subsets of the population with certain chronic conditions or health-related behaviors and risk factors. This information also leads to more accurate projections at state and local levels. The microsimulation

approach also provides added flexibility for modeling the workforce implications of changes in policy and emerging care delivery models under ACA, which are important areas of ongoing research.

Limitations of the workforce model used largely stem from current data limitations. The main limitation is that historical data provides limited ability to predict how care use and delivery patterns will evolve over time. Hence, we first projected changes in provider demand over time under a status quo scenario using historical data. Then, we simulated how demand might evolve over time as care use and delivery patterns change. Another limitation is the challenges with modeling need for services (versus utilization based on demand). Given the focus and prioritization for Vermont of addressing mental health and substance use needs of the population, it will be important to update projections in this report as the treatment, utilization, and coverage patterns change. Other data limitations associated with these models include: (1) information on the influence of provider and payer networks on consumer service demand and migration patterns, and (2) information on how care delivery patterns might change over time in response to emerging market factors. These limitations and the uncertainties discussed above underscore the importance of ongoing research on potential implications of the evolving health care system for Vermont's health workforce.

This study focused solely on trends and initiatives that likely will affect demand for health care services and providers. A more complete picture would require supply projections for comparison to determine the projected future adequacy of health workforce supply both at the state level and across hospital services areas and communities. Without supply projections one cannot quantify the magnitude of any future shortages (or surpluses) and identify mitigating strategies or inform Vermont's future decision-making around health workforce. For example, as the population ages there will be increased demand for mental health services for the elderly. However, a better understanding of whether future supply will be sufficient to meet future demand for services could help inform decisions regarding the number and mix of mental health providers to train.

National studies suggest that demand for physicians is growing faster than national supply—suggesting that Vermont will face increasing pressures from other states to attract and retain physicians.[2] On the other hand, the national supply of registered nurses, advanced practice nurses, and physician assistants is growing rapidly suggesting that Vermont might find it easier to attract and retain professionals in these occupations over time. Vermont's historical trends that demonstrate growth in these professionals suggests that Vermont will continue to rely heavily on these professions in the future. Occupations projected to experience rapid growth in demand include nurse aides and home health aides—occupations that have low entry barriers to the profession but also high exit rates.

Vermont might consider developing a warning system for adequacy of health workforce supply similar to the Pharmacist Demand Indicator (PDI) index developed by the Pharmacy Workforce Center[a] or the Sentinel System developed by the Washington State Health Workforce Board.[b] Such an indicator/system employs a panel of health worker employers (e.g., hospitals, physician groups) that rate the difficulty filling positions on a scale of 1-5: (5) Demand is much less than the provider supply available, (4) Demand is less than the provider supply available, (3) Demand in balance with supply, (2) Moderate demand; some difficulty filling open positions, (1) High demand; difficult to fill open positions. For pharmacists, Vermont's Quarter 1, 2017 PDI was 3.25 suggesting that at the state level supply and demand were roughly in balance. Between 2007 and 2017, Vermont's value has ranged from a high of 4

[a] https://pharmacymanpower.com/index.php

[b] http://www.wtb.wa.gov/HealthSentinel/

(suggesting supply exceeded demand) in early 2008, to a low of 2.75 (suggesting a slight tightening of the labor market for pharmacists) in 2012 and 2016. Such an index could be constructed for other health occupations to assess how supply adequacy varies across Vermont and over time.

Health workforce demand projections are challenged by the pace and often unpredictable ways in which health care is changing. Uncertainties include shifting policy priorities, emerging care delivery models, how changing care practices might affect workforce demand, and how clinicians and care settings will respond to economic and other trends.

- **The pace of care migration from inpatient and institutional to outpatient, community and home-based settings:** Shifts in care settings and modalities spurred by development and expansion of Accountable Care Organizations, the patient-centered medical home, and other new delivery models will continue to shift health workforce demand from high cost hospitals and emergency departments to other appropriate care settings.
- **More effective management of chronic disease**: Chronic disease management is transitioning to team-based care management and patient education conducted in community and home settings. These activities are likely to increase workforce demand for case managers, social workers and other health occupations trained in carrying out these activities. Team based care will also support expanding scope of practice for registered nurses, nurse practitioners and physician assistants.
- **Changing health care payment and coverage policies**: Increased focus on value-based payment models of care, payment bundling, and risk bearing under Accountable Care Organizations have the potential to influence care use and delivery patterns.
- **Economic developments**: National and state trends in unemployment may influence the health occupations and trigger the need to update projections. The last economic downturn (2008-2009) appeared to influence supply and demand by slowing retirements and consumer demand for many discretionary services.
- **Unanticipated and unmet need for mental health and substance use services**: Some trends are difficult to predict into the future—such as trends in substance abuse as new and more potent drugs are developed and make their way into society. An example is the growing opioid crisis where historically used drugs are mixed with fentanyl thus exacerbating the medical and human toll associated with substance use.
- **Telemedicine and health information technology**: Currently, there are limited data for modeling the potential impact on health workforce demand associated with telemedicine and health information technology, particularly as these technologies intersect with emerging models of care. This is an important area for future research. While potentially reducing service utilization and demand for providers practicing in some settings (e.g., hospitals), such new technologies might support greater use of providers practicing in other care settings (e.g., physician offices) and has the potential to increase or decrease demand depending upon the specific technologies deployed.

These uncertainties underscore the importance of ongoing research on potential implications of the evolving health care system for Vermont's health workforce.

Efforts to monitor the adequacy of health workforce supply across Vermont will help inform strategies to ensure access to high quality, affordable care. Such research might include a heightened focus on modeling workforce supply and overall adequacy of supply, as an adequate supply of health professionals is essential to meeting Vermont's goal of providing access to high quality, affordable care for an aging population. Supply projections would consider the demographics of the current workforce, numbers of health professionals being trained, retirement patterns and numbers of hours worked in patient care. One

area for future research is given the negative projected population growth among adults of working age in Vermont, will there be a sufficient supply of health workers to meet future demand?

Integrating supply and demand projections at state and HSA-levels would present an accurate picture of the current and projected future size, specialty mix and characteristics of Vermont's health workforce and an accurate profile of future demand for services and FTE health professionals. Integrating supply and demand projections is important to identify disparities in access to care and to inform health care policy making.

In addition to evolving care delivery models and reimbursement, each year new data become available on population characteristics, risk factors, and care use patterns. Key data sources used in the model are summarized in Exhibit 28. Since the commencement of this study, 2015 data for many of the sources has now become available.

Exhibit 28: Health Workforce Demand Data Sources and Uses

Data Source	Use in HWSM	Data Used
Population Database		
American Community Survey	Create state and national population files; also potential to model at sub-state level using 5-year file	2014
Behavioral Risk Factor Surveillance System	Health risk factors and other data used to create state and national population files	2013,2014
National Nursing Home Survey	BRFSS-type data, but for residents of nursing homes	2004
U.S. Census Population Projections	National population projections (by demographic)	2014
State Population Projections	Individual state and county-level population projections (by demographic)	Various
Health Care Use		
Medical Expenditure Panel Survey	Estimate health seeking behavior	2009-2013
Nationwide Inpatient Sample	Estimate hospital length of stay; model calibration for annual hospital visits	2013
National Ambulatory Medical Care Survey	Model use of non-physician services during office visits; model calibration for annual office visits	2012
National Hospital Ambulatory Medical Care Survey	Model use of non-physician services and physician consults during ED visits; model calibration for annual ED visits	2011
Health Care Provider Staffing		
Bureau of Labor Statistics, Occupational Employment Statistics	Estimate provider staffing ratios by health occupation (excluding physicians)	2014
American Medical Association Masterfile	Estimate physician staffing ratios by specialty	2014
Health profession surveys	From various professional and trade associations such as MGMA	Various

TECHNICAL APPENDIX

This appendix provides additional technical documentation of the Health Care Demand Microsimulation Model (HDMM) developed by IHS Markit. Detailed documentation is available online.[3, 7]

Exhibit A-1 summarizes the population characteristics in the final population database created for each county. This detailed information for each person captures systematic geographic variation in demographics, insurance and socioeconomic characteristics, health risk factors, and disease prevalence.

Exhibit A-1: Summary of Population Characteristics

Race-Ethnicity: Hispanic, Non-Hispanic black, Non-Hispanic white, Non-Hispanic other race
Gender
Age Group: 0-2, 3-5, 6-12, 13-17, 18-34, 35-44, 45-64, 65-74, 75+ years
Current smoker
Diagnosed with or history of:
Arthritis
Asthma
Coronary heart disease
Diabetes
History of cancer
History of heart attack
History of stroke
Hypertension
Insured (from any source)
Medicaid (insured through Medicaid)
Managed care (insurance plan type)
Family Income: <$10,000, $10,000 to <$15,000, $15,000 to < $20,000, $20,000 to < $25,000, $25,000 to < $35,000, $35,000 to < $50,000, $50,000 to < $75,000, $75,000 or higher
Body Weight: Normal, Overweight, Obese
Metro area

Exhibit A-2 is provided as an example of the regression specifications, with this example showing how patient characteristics are correlated with use of cardiology-related health care services by care delivery setting. The numbers in this table reflect rate ratios (for office and outpatient visits, or inpatient days) or odds ratios (for ED visits and hospitalizations). For all types of cardiology-related care there is a strong correlation with patient age (controlling for other patient characteristics modeled) and being in Medicaid. Having any medical insurance is associated with much greater use of ambulatory care, and if the insurance is Medicaid then there is even greater use of cardiology services across all care delivery settings.

For example, compared to their commercially insured counterparts with similar demographics and health risk factors, patients with Medicaid average 35% more office visits to a cardiologist annually, 42% more cardiology-related outpatient visits, 64% higher odds of a cardiology-related emergency visit, and have 71% higher odds of a cardiology-related hospitalization. These estimates for the Medicaid population are statistically different from 1 (where a ratio of 1 would indicate no statistical difference with the comparison category).

Obesity increases use of cardiology-related services. Smoking is associated with fewer office and outpatient visits to a cardiologist but higher rates of ED visits (likely reflecting correlation rather than causality in the case of ambulatory care, as smoking is a risk factor for heart disease but could be correlated with aversion to visit a doctor). Reflecting access issues, lower income is associated with less use of ambulatory care and more use of ED visits and hospitalization.

The presence of chronic medical conditions—and especially heart disease, hypertension, and history of heart attack—are associated with much greater use of cardiology services across care delivery settings. When modeling the Medicaid population in each county the HDMM takes into consideration that the Medicaid population often has much greater prevalence of a host of chronic conditions and risk factors relative to their non-Medicaid peer group.

To model hospital inpatient service demand we analyzed the 2013 National Inpatient Sample (NIS) which contains discharges from short-term general acute care hospitals and specialty hospitals. Logistic regression quantifies the probability of a person with given characteristics experiencing hospitalization during the year for a wide range of medical conditions, including mental health and substance use conditions based on ICD-9 primary diagnosis code groupings (Exhibit A-3).

To model inpatient length of stay the 2013 NIS discharge records were analyzed. Because of the large sample size (over 8 million hospital stays) estimates derived from the NIS are stable. Estimated Poisson regressions generated the expected number of days spent in the hospital conditional on a hospitalization. Explanatory variables consisted of patient age group, sex, race/ethnicity, insurance type, presence of chronic diseases and risk factors among the diagnosis codes, and residence in a metropolitan area. Separate regressions were estimated for each of the mental health and substance use condition categories. Combining information on condition specific hospitalization risk and length of stay per hospitalization, HDMM computed each person's expected number of inpatient days during the year for different types of medical conditions.

Exhibit A-2: Sample Regressions: Adult Use of Cardiology Services

	Parameter	Office Visits	Outpatient Visits	Emergency Visits	Hospitalization
Race-Ethnicity	Hispanic	0.81**	0.73**	1.03	0.87**
	Non-Hispanic Black	0.78**	0.98	1.45**	1.41**
	Non-Hispanic White	1.0	1.0	1.0	1.0
	Non-Hispanic Other race	0.92**	0.82**	1.09	1.06
	Male	1.11**	1.48**	0.97*	1.07
Age	18-34 years	0.12**	0.13**	0.63**	0.37**
	35-44 years	0.23**	0.52**	0.98	0.80**
	45-64 years	0.52**	0.74**	1.10	1.14*
	65-74 years	0.87**	0.95*	1.12	1.57**
	75+ years	1.0	1.0	1.0	1.0
	Smoker	0.74**	0.75**	1.11	1.06
Diagnosed with	Hypertension	1.56**	1.15**	3.85**	2.71**
	Coronary heart disease	8.54**	9.60**	2.93**	3.96**
	History of heart attack	1.69**	1.63**	2.41**	2.59**
	History of stroke	1.11**	1.18**	3.11**	2.97**
	Diabetes	1.11**	1.37**	1.01	1.16**
	Arthritis	1.09**	1.23**	1.02	0.99
	Asthma	1.08**	1.10**	0.95	18
	History of cancer	1.08**	0.98	0.99	0.93
	Insured	2.48**	1.88**	0.89	1.02
	Medicaid	1.35**	1.42**	1.64**	1.71**
	Managed Care	0.97**	1.06**	1.01	0.99
Household Income	<$10,000	0.84**	15	1.20**	1.16**
	$10,000 to <$15,000	0.89**	0.72**	1.10	1.11
	$15,000 to < $20,000	0.90**	1.06	0.86	1.02
	$20,000 to < $25,000	0.84**	0.72**	1.15	1.09
	$25,000 to < $35,000	0.89**	1.08**	1.18**	1.05
	$35,000 to < $50,000	0.89**	0.96**	0.92	0.94
	$50,000 to < $75,000	0.93**	1.24**	0.89	0.82**
	$75,000 or higher	1.0	1.0	1.0	1.0
Body Weight	Normal	1.0	1.0	1.0	1.0
	Overweight	1.06**	1.02	1.16**	1.22**
	Obese	1.11**	1.08**	1.13**	1.26**
	Metro Area	1.31**	1.02	1.04	0.89

Note: Analysis of the 2009-2013 files of the Medical Expenditure Panel Survey. Estimates for office and outpatient visits reflect rate ratios from Poisson regression. Emergency and hospitalization reflect odds ratios from logistic regression. ** indicates statistically different from 1 at the 01 level, and * indicates statistically significant at the 05 level.

Exhibit A-3: Hospital Inpatient Demand Drivers by Condition Code and Specialty

Medical condition codes (ICD-9 CM)		**Specialty/NPC Profession**
Allergy & immunology	001-139, 477, 995.3	Allergy & immunology
Diseases of the circulatory system	390-459; 745-747; 785	Cardiology
Diseases of the circulatory system	426, 427, 780, 785; 3726 <= pr02 <=3734	Clinical Cardiac Electrophysiology
Diseases of the circulatory system	pr02 IN (0060, 3600, 3950)	Interventional Cardiology
Colon & rectal surgery	17.31-17.36, 17.39, 453, 45.26, 45.41, 45.49, 45.52, 45.71-45.76, 45.79, 45.81-45.83, 45.92-45.95, 463, 464, 46.10, 46.11, 46.13, 46.14, 46.43, 46.52, 46.75, 46.11, 46.13, 46.14, 46.43, 46.52, 46.75, 46.76, 46.94, 153-154	Colon & rectal surgery
Diseases of the skin and subcutaneous tissue	680-709; 757; 782	Dermatology
Endocrine, nutritional and metabolic diseases, and immunity disorders	240-279; 783	Endocrinology
Diseases of the digestive system	520-538; 555-579; 751; 787; 42-54	Gastroenterology
General surgery	860-869; 870-904; 925-939; 958-959; 996-999	General surgery
Neoplasms, diseases of the blood and blood-forming organs	140-239, 280-289; 790	Hematology & oncology
Neoplasms, diseases of the blood and blood-forming organs	195.2, 188.9, 174.9, 156, 164.1, 209.24, 155, 162.9, 183; 92.2 (http://www.donself.com/documents/ICD-10-for-Radiation-Oncology.pdf)	Radiation Oncology
Infectious and parasitic diseases	001-139, 477, 40.11, 40.3, 40.9	Infectious diseases
Nephrology	580-589; 55.2-55.8	Nephrology
Conditions originating in perinatal period	760-779	Neonatal-perinatal medicine
Neurological surgery	850-854; 950-957; 01-05; 89.13	Neurological surgery
Diseases of the nervous system and sense organs	320-359; 742; 781; 784; 800-804	Neurology
Complications of pregnancy, childbirth, and the puerperium	614-679, V22,V23,V24, 72-75	Obstetrics & gynecology 72-75
Ophthalmology	360-379; 8-16; 95-95.4	Ophthalmology
Diseases of the musculoskeletal system and connective tissue; injury and poisoning	710-719; 720-724; 730-739; 805-848; 754-756; 76-84	Orthopedic surgery
Otolaryngology	380-389; 744; 18-29	Otolaryngology
Plastic surgery	904-949; 749; 18.7, 21.8, 25.59, 26.49, 27.5, 27.69, 29.4, 31.7,	Plastic surgery

Medical condition codes (ICD-9 CM)		Specialty/NPC Profession
	33.4, 46.4, 64.4, 78.4, 81-81.99, 82.7, 82.8, 83.8, 85.8, 86.84	
Mental disorders	290-319; 94.1-.59	Psychiatry
Diseases of the respiratory system	460-519; 748; 786; 35-39	Pulmonology
Diseases of the musculoskeletal system and connective tissue	725-729	Rheumatology
Thoracic surgery	426, 427, 780, 785); 32.6, 34.9, 40.6, 90.4, 35-37	Thoracic surgery
Diseases of the genitourinary system	590-608; 753; 788; 789; 791; 55-64	Urology
Vascular surgery	440-448; 0.4-00.5, 17.5, 35-39	Vascular surgery
Physical Medicine/Rehabilitation	0.4-00.5, 17.5, 35-39; 93	Physical Medicine/Rehabilitation

Source: Analysis of the 2013 National Inpatient Sample.

HDMM VALIDATION

Model validation activities continue on an ongoing basis as a long term process evaluating the accuracy of the model and making refinements as needed. For each of four primary types of validation deployed, key short term and long term activities include the following:

- **Conceptual validation**: Through reports, presentations at professional conferences and publication of peer-reviewed manuscripts the models described here continue to undergo a peer-review evaluation of its theoretical framework. Contributors to these models include health economists, statisticians and others with substantial modeling experience; physicians, nurses, behavioral health providers and other clinicians; health policy experts; and professionals in management positions with health systems. Conceptual validation requires transparency of the data and methods to allow health workforce researchers and modelers to critique the model. This report is an attempt to increase the transparency of these complex workforce projection models where work is ongoing to improve the theoretical underpinnings, methods, assumptions, and other model inputs.
- **Internal validation**: The model runs using SAS software. As new capabilities are added to the model and data sources updated, substantial effort is made to ensure the integrity of the programming code. Internal validation activities include generating results for comparison to published statistics used to generate the model (e.g., ensuring that population statistics for the input files are consistent with published statistics).
- **External validation**: Presenting findings to subject matter experts for their critique is one approach to externally validate the model. Intermediate outputs from the model also can be validated. For example, the HDMM has been used to project demand for health care services for comparison to external sources not used to generate model inputs. Results of such comparisons across geographic areas indicate that more geographic variation in use of health care services occurs than is reflected geographic variation in demographics, presence of chronic disease, and health risk factors such as obesity and smoking.

- **Data validation**: Extensive analyses and quality review have been conducted to ensure data accuracy as model data inputs were prepared. Most of the model inputs come from publically available sources (e.g., MEPS, BRFSS, and ACS).

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