Health Program

Better Health Care Worker Demand Projections:

A Twenty-First Century Approach

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BIPARTISAN POLICY CENTER

ABOUT BPC

Founded in 2007 by former Senate Majority Leaders Howard Baker, Tom Daschle, Bob Dole and George Mitchell, the Bipartisan Policy Center (BPC) is a non-profit organization that drives principled solutions through rigorous analysis, reasoned negotiation and respectful dialogue. With projects in multiple issue areas, BPC combines politically balanced policymaking with strong, proactive advocacy and outreach.

THIS REPORT

The Bipartisan Policy Center's (BPC) Health Professional Workforce Initiative is investigating the current and future workforce landscape of the American health care system. The Deloitte Center for Health Solutions, working with BPC's Health Professional Workforce Expert Advisory Panel, recently conducted a review of current data and methodologies utilized in national health care workforce planning. The ensuing report, *The Complexities of National Workforce Planning: Background Paper February 2013*, reveals supply-side workforce issues. This Executive Summary and Background Report analyze current demand projection approaches and propose a new demand projection methodology that integrates existing and future data sources pertaining to multiple health professional groups.

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Executive Summary

How many nurse practitioners will be needed in 2025, and how does this impact the demand for primary care physicians? How do private market solutions like retail care clinics address access to and the demand for preventive care services? Accurate and timely demand projections are critical to effective health professional workforce analysis and future planning.

Health professional workforce forecasting has traditionally focused on the demand for physicians. More recently, policy attention and research is increasingly being devoted to the demand for non-physician health professionals, including nurses, physician assistants, chiropractors, pharmacists, dentists, therapists, allied health and direct care providers, and others. Each group favors its own methodology for projecting its future demand, with two main results. One, there is little opportunity to compare projections across the health professional spectrum. Two, individual group methods of assessing demand are commonly based on current utilization rates, leading to a "business as usual" viewpoint of health care provision. Accordingly, to date, demand projections for the health professions have been largely inaccurate. Nevertheless, these projections help drive policy, academic and market decisions that alter the health professional landscape.

This report examines the demand-side of the workforce equation, and suggests that methods and analytical tools to project health care workforce demand should be integrated into a comprehensive national health professional workforce planning model.

The American health care system is on the cusp of transformation: changing demands on the health care system will inevitably alter who, how and where health care services are provided. It is critical that a more comprehensive and dynamic workforce projection model that can capture dramatic shifts in the health care marketplace and more accurately inform future demands is developed. In so doing, policymakers and academic and industry leaders will have information to help develop more effective policies, as well as education and business models that will help meet the future demand for health care services.

An Overview

It is difficult to navigate the distinction between "patient demand" and true "health care need." Demand for health care services may be simplified as a function of three components: 1) population size and geographical distribution; 2) the incidence and prevalence of all diseases and illnesses, and the skill mix and intensity of health services required; and 3) the factors that affect actual utilization rates.

These key variables may be useful in determining the demand implications of new models of care, changes in the payer environment, economic trends, policy changes, the shifting composition of the workforce, and other macro-simulation factors. Additionally, it is important to understand the impact these variables may have in different circumstances and across diverse geographic areas. For example, what is the impact at the state level, or in a particular local care delivery system? Specific health professional groups require more refined data elements and analytical tools to answer these and many other critical questions. These tools should be customizable to suit the unique needs of various professional groups, while preserving the broad measures that capture comparable trends and general interchangeability between health professions.

A Modernized Conceptual Framework

In conceptualizing a new methodological framework that captures health professional workforce planning across all professions, it is important to examine both the historical lessons learned and the methodological possibilities created by new statistical approaches and computational technologies. A modernized methodological approach ideally should facilitate comparability and shared analysis across all health care workers and provide value to multiple, often competing, health professional constituencies. A new method must include a number of important features:

- A minimum dataset to allow comparability across health professions projections;
- Integration of historical and cross-sectional data from existing health professional workforce data sources, as well as forecasting data, to provide a baseline static model to project demand;
- A broad range of iterative validation and adjustment strategies to continuously provide feedback to the static model and its demand projections;
- Dynamic modeling to capture changes in assumptions and data flows as they occur; and
- A national reference database that provides customizable templates and reports for geographic localities and/or specific health professional groups, a core set of measures and outputs, and growing precision as the reference database expands.

Figure 1 compares the capabilities of the traditional approach to demand modeling to a new "enhanced" methodological framework.

Figure 1: Approaches to Demand Modeling

OLD DEMAND MODELS	NEW DEMAND MODELS
Static modeling	Dynamic modeling
Model specifications fixed in time	Self-learning and self-correcting
Usually health-profession specific	Integrated for all health workers
Limited variables included	Inclusive of all complex variables
Limited feedback on projections	Continuous validation processes
No national database	National reference database
Analysis of lagging indicators	Real-time data integration
No minimum dataset	Minimum dataset for all workers
No core measure sets	National core measure sets
May ignore economic realities	Integrates economic realities
May be subject to expert bias	Does not rely on expert opinions
May perpetuate current inequalities	Relies on multiple perspectives
Sensitive to missing data	Manages missing data
Fixed purpose for given model	Flexible uses for model outputs

Developing a Modernized Demand Project Approach

Dynamic modeling is sometimes described as frequent updates of data into a model with the same variables and specifications; hence, while the numbers are updated, the understanding of the underlying workforce dynamics remains unaltered. An enhanced approach, which is proposed in this paper, allows the outputs of the model (e.g., comparisons of estimated results versus actual results) to change the adjustment factors themselves, to add or remove new variables, or to change the weights or importance of different variables. As a result, the accuracy of the projections is improved over time and through an iterative process as the model is modified to reflect underlying changes in workforce dynamics and market trends.

This more modern approach to dynamic modeling envisions taking multiple and constantly varying perspectives on the underlying workforce dynamics, based on the integration of complex datasets, computational algorithms that can identify trends and complex relationships, and statistical techniques that allow for a highly sophisticated understanding of correlations and estimated changes. Many sources of data will be constantly integrated, different model specifications tried and optimized, and the iterative validation process constant, occurring in real-time. In this type of model, order is imposed on chaotic, disordered data flows.

Concluding Steps and Recommendations

Progress toward a modernized health professional demand projection model may be made in the near term. Some recommendations and implementation steps include:

- Increase funding for the National Center for Health Workforce Analysis (NCHWA) and provide funding for the National Health Care Workforce Commission;
- Build a modernized workforce planning model;
- Establish a national data repository/reference database;
- Develop a minimum dataset applicable to all health professional groups;
- Improve data collection efforts;
- Support research priorities around outcomes of care, new models of care and integration, technology and innovation, and other key areas of uncertainty;
- Develop more sophisticated validation and adjustment strategies;
- Establish a core measures development process;
- Build multiple information dissemination channels; and
- Continuously explore new possibilities for model improvement.

The Challenges Ahead

Successful implementation of a modernized demand projection model will face continuing challenges across a number of fronts. New demand projection methodologies may disrupt the current workforce planning strategies of various groups. This disruption is likely to highlight the different perspectives and priorities of many professional groups along both clinical and economic dimensions.

There will be a need to integrate new health care workers, public health professionals, and international workforce dynamics in areas where existing data sources may be very limited. The growth of telehealth, clinical informatics, and decision support systems – as well as broad structural changes to the health system and traditional care delivery settings – may dramatically alter the need for health professionals in certain geographical areas.

The implementation steps required to successfully build a modernized, comprehensive workforce planning model are ambitious and challenging, especially in times of fiscal austerity. Yet the potential benefits to policymakers, health administrators, educators, providers, payers, and patients may far outweigh the likely costs. The American health care system is in a moment of profound transformation, and thus it is an opportune time to engage in this vital work.

Better Health Care Worker Demand Projections: A Twenty-First Century Approach – Background Report

Background

The U.S. government has a long history of forecasting the future supply of and demand for physician services. While more in-depth forecasting has been devoted to physician supply and demand, over time, workforce policy and research has extended to a range of other health professional spaces, to include physician specialties, nursing, physician assistants, chiropractors, pharmacy, dentistry, therapy, allied health, Direct Care Workers,[1] and others. For example:

PROFESSION	WORKFORCE PROJECTIONS
Physicians	• In 1959, the Surgeon General's Consultant Group on Medical Education published the Bane Report predicting a physician shortage of 40,000 by 1975. • In 1980, the Graduate Medical Education National Advisory Committee (GMENAC) predicted a physician surplus of 145,000 by 2000. • In 1994, the Council on Graduate Medical Education (COGME) predicted a physician surplus of 80,000 by 2000 and excessive growth of specialists. • Cooper and colleagues (2002) predicted a physician shortage, suggesting that demand for physician services is tied to economic expansion and population growth.
Registered Nurses	• The National Center for Health Workforce Analysis in 2000 estimated the supply of registered nurses at 1.89 million while the demand was estimated at 2 million, a shortage of 110,000 or six percent.
Physician Assistants	• The Bureau of Labor Statistics (BLS) projected a 39 percent increase in demand for physician assistants from 2008 to 2018.

Pharmacists	• The BLS reported that 269,900 pharmacists were employed in 2000. By 2018, 315,800 pharmacists are expected to be employed, a 10-year demand increase of 17 percent.
Direct Care Workers	• The BLS projected in 2000 that an increase of 1.2 million Direct Care Workers would be needed between 2002 and 2014 in both institutional and community based care settings.
Mental Health, Allied Health, Chiropractors, Dentists, and others	• Other health professional societies and organizations have issued workforce reports and studies, with BLS projections playing a significant role as their primary data source, but most have relied on a methodology with a limited number of adjustment factors.

By their very nature as forecasts, both supply and demand projections have been largely imprecise. It is also true that these projections have been driven by or have resulted in significant policy and market reactions that alter the health professional landscape. Moreover, because each health professional group has developed its own methodological approach for projecting supply and demand, there is limited ability to compare projections across the health professional spectrum and an incomplete capture of opportunities to use professionals to the full extent of their training and within professions scopes of licensure.

The implementation of the Patient Protection and Affordable Care Act (PPACA) and other recent legislation may create additional challenges. Insurance market reform, subsidies for the purchase of insurance, and delivery system transformation will significantly alter who, how and where health care services are provided. Team-based models of care, currently under evaluation in pilot programs through the Center for Medicare and Medicaid Innovation (CMMI), may well identify opportunities to improve value and change the skill mix and intensity required of health professional groups in such care models.

Health professional supply projection methodologies are better developed, and data on workforce supply is better defined and more available than data for workforce demand. This report examines the demand-side of the workforce equation, and suggests that methods and analytical tools to project demand must be integrated into a comprehensive national health professional workforce planning model.

Demand Projection Methodologies

Workforce demand projections are varied, are designed to be estimates, and are limited to individual health professional groups. Thus far, demand estimates have relied on expert consensus opinion and/or current utilization rates, resulting from a "business as usual" viewpoint of health care provision. Neither of these mechanisms provides precision or accuracy in estimating demand. For example, utilization rates fail to correct for overuse or misuse of health services and cannot account for the unmet health care needs in a given population.

Furthermore, it is difficult to identify the impact on demand of such factors as barriers to access, potential patterns of supplier-induced demand, and health care industry factors like major policy shifts and market changes. Variables in current demand models that are difficult to capture include the adequacy of service levels required to meet health care needs, the certainty of the relationships between these health care requirements and the key variables used in demand projection models, and the stability of these key variables over time and into the future.

Many current methodologies fail to adequately capture economic demand. Economic demand, which is associated with ability and/or willingness to pay for health care services, assesses current and future circumstances and possible behaviors of consumers, health care providers, payers, and employers. Assessing economic demand requires analysis of the availability of government funding, the levels of private sector investment, the types of technology available, the organization of the health care system, and the influences of price and income.

The following workforce projection models fall short of a complete picture of the economic demand for health care services for the reasons described below.

NEEDS-BASED OR ADJUSTED NEEDS MODELS

- Needs models rely on estimated burden of illness (health deficits associated with disease patterns and disability) and appropriate levels of health care services to meet a normative standard (which may be adjusted down to account for economic realities, allowing for unmet health care "needs" to persist). They are based on expert panels and consensus opinion and do not rely on historical utilization rates.
- Such models, however, may not accurately reflect the ability and willingness of those who purchase health care to pay, may be subject to the biases of expert panels, and often may not account for new developments, such as technological advances.
- An example of this approach was the 1980 study by the Graduate Medical Education National Advisory Committee (GMENAC), which reported an expected surplus of physicians by 2000.

DEMAND-UTILIZATION MODELS

- Nationwide utilization models apply current patterns of utilization (and often insurance status) to changing demographics and other key determinants of demand.
- Such models may project existing inequalities and inadequacies into the future. It may be difficult to integrate changes in factors including consumer preferences, practice patterns, technological advances, organization and delivery of care, policies and payment systems, and interchangeability among health professional groups.
- An example of this approach includes the Health Resources and Services Administration's Bureau of Health Professions' 2008 report on the supply and demand of pharmacists; the report indicated a shortage of pharmacists continuing into 2030.
- Requirements models are a type of demand-utilization model that rely on health services utilization and staffing patterns within existing health systems. These models apply easily measurable factors and provide quantitative estimates of health professional requirements within health delivery systems. These models have similar shortfalls as demand-utilization models, particularly with their difficulty to take into account interchangeability among health professional groups.
- An example includes the Council on Graduate Medical Education (COGME).

SOCIO-DEMOGRAPHIC OR TRENDS MODELS

- Socio-demographic models correlate historical demographic trends to project population growth and demographic changes. Historical supply patterns form a proxy for demand estimates, and aggregate economic growth is used to set a cap on otherwise unlimited demand.
- Such models demonstrate no clear causal relationships and assume that individual members of a group being measured have the "average" characteristics of the group to which those individuals belong (i.e., ecological fallacy). Further, it is not clear that historical supply patterns reflect future demand estimates.
- Cooper et al. (2002) used the trends model to correlate macro-economic population variables with physician demand, finding a projected shortage when other studies reported a surplus.

BENCHMARKING MODELS

- Benchmarking models rely on identifying a standard of care within an existing care delivery system that is deemed to provide appropriate, affordable, and sustainable care, and applying that standard to a comparable population.
- Such models assume the benchmark is optimal and applicable to meet the health care needs of the new population and rely on the comparability of populations.

- Weiner (2004) utilized a benchmarking model in a comparison study of specific health systems to analyze physician staffing patterns as a function of demand. He concluded that staffing within these systems was below current U.S. rates yet sufficient to meet patient demand.

These demand models continue the "business as usual" approach to estimating health care workforce requirements; better approaches to estimate the evolving demand for health care services need to be developed.

Issues and Challenges Across All Skilled Health Professional Groups

Due to the difficulty of collecting data that accurately reflects the demand for health care services, workforce planners are ill equipped to determine how the availability of certain categories of health care professionals affects access, cost, and outcomes. Moreover, it is unclear how payment systems impact workforce participation rates, health care demand, or health care need, nor is it clear how technology and innovation may affect health professional productivity.

Profession-specific datasets are available – particularly for physicians and nursing professionals – but they tend to focus on demographics and utilization of health professionals. Different health professional groups tend to utilize different methodological approaches for their demand projections, and their interests often conflict. As such, comparisons across geographical localities and across health professional groups are often not possible. It is likewise difficult to measure the impacts of workforce policy changes and to track interchangeability across health professional groups. Steps are currently being taken by the Bureau of Health Professions in the Health Resources and Services Administration (HRSA), U.S. Department of Health and Human Services (HHS), to move towards developing more integrated data collection for a number of professions.

Yet, there are valuable sources of data, which include current estimates of utilization rates for health care services (often specific to certain health professional groups). There are sources of historical trends data and multiple cross-sectional workforce studies, and there are estimates and forecasts of future state impacts and scenarios that outline contingencies and key drivers. Because of these unaffiliated groups assessing demand for services as separate entities, there is a great need to coordinate and assess demand across the health care system, particularly in the light of new and evolving service delivery models that emphasize care-coordination and the use of an interdisciplinary workforce.

The approach to health workforce analysis would benefit from being a collaborative effort incorporating federal agencies, state governments, professional associations, public and private research institutions, trade, industry and business groups, consumer groups, and other organizations. The National Center for Health Workforce Analysis

(NCHWA), established by the PPACA within the Bureau of Health Professions in the Health Resources and Services Administration (HRSA), HHS, will play a critical role in collecting national health professional workforce data and analyses, developing standardized data definitions and data collection guidelines, projecting national supply and demand and analyzing comparative state data, and providing resources and analysis to inform federal and state workforce policies and workforce development programs. The NCHWA will complement the work of such bodies as the National Health Care Workforce Commission and the Bureau of Labor Statistics (BLS), especially its projections of future job growth inclusive of the health professions.

A Modernized Health Care Workforce Planning Framework

In conceptualizing a new methodological framework that captures health professional workforce planning across all professions, it is important to examine both the historical lessons learned and the methodological possibilities created by new statistical approaches and computational technologies. The methodological framework proposed in this report is detailed in Appendix A.

It is beyond the scope of the analysis performed related to this report to (1) conduct a feasibility analysis integrating all likely data sources; (2) to design and test a dynamic model of a shared demand projection approach (defined as an iterative system that changes over time in response to inputs, has internal feedback loops, and interlocking relationships that impact upon outcomes over time) using emerging data and/or real-time policy or market events; or (3) to evaluate the financial and technological resources required to establish and maintain a national reference database.

Model Design Principles

Given the limitations of the available data, the challenges of reaching consensus across multiple health professional groups, the emergence of significant policy and market shifts in the health care system, and the need to create a useful workforce planning model that may lead to actionable findings, the proposed conceptual framework aligns with the following principles:

- **Data Sources**: Use existing/available data sources (where feasible) and allow flexible integration of new and emerging data sources; integrate a common dataset but also include health profession specific data; allow for management of missing data and excluded variables.
- **Key Variables**: Establish common core variables and outputs for comparability and usefulness but allow customization for local geographies and/or specific health professional groups; adjust key variables based on ongoing, continuous validation and fine-tuning.
- **Dynamic Modeling**: An iterative dynamic modeling platform to model the effects of system change over time capturing such factors as substantive market

shifts, policy changes, new data availability, and interchangeability among health professional groups; adjusting the model as technology innovations, market levers, and business models emerge.

- **Analysis Tools**: Offer customizable templates that may include such factors as trends over time useful for all health professional groups, health system leaders, policymakers, and public consumers; allow customization for localized uses, but establish a core measure set for comparability.
- **Actionable Findings**: Make the findings understandable and actionable for policymakers, professionals, and the public; capture levels of uncertainty but make the findings clear.
- **Growing Precision**: Allow for multivariable scenario testing; create a reference database that allows for growing precision with longitudinal and ongoing real-time validation and adjustment strategies; a learning system where more data over time will move the approach toward greater precision.

Data Inputs and Key Drivers

A national, uniform minimum dataset is needed with standard data definitions and data collection guidelines and formats. This will require the establishment of a national data repository to collect and maintain data across all health professional groups. The National Center for Health Workforce Analysis, within HRSA, is creating a Uniform Health Workforce Minimum Dataset that includes standard demographic, educational, and practice characteristics of health professionals to support consistent data collection across states, professional groups, and associations, among others. The initial effort is focused on physicians, registered nurses, advanced practice nurses (nurse practitioners, clinical nurse specialists, and nurse midwives), physician assistants, dentists, dental hygienists, licensed practice nurses, pharmacists, and physical therapists.

After establishing a minimum data set, data to be included in the integrated planning model to develop workforce demand projections must be determined. As a starting point, it may be necessary to utilize existing data sources where feasible, given that the development of new data collection requirements will likely face significant funding and implementation challenges. It will be necessary to initially accept and work with the imperfections of existing demand data.

The key drivers for demand are complex, with many interdependencies and uncertainties, and are generally less developed than supply projection drivers. The distinctions between consumer and provider perspectives – and "patient demand" and "health care need" – are difficult to distinguish. Data collection instruments are imprecise, the data sources are fragmented with limited comparability, there are time lags in data availability and many substantive data gaps, and there is great geographical and longitudinal variation in data quality across the U.S. and across different professional groups. Data inputs into a projection model come from four general

sources: historical utilization trends, current cross-sectional data, model assumptions, and conceptualization of future states.

Demand may be simplified as a function of three components: population size and geographical distribution; the incidence and prevalence of all diseases and illnesses, and the skill mix and intensity of health services required; and factors that affect actual utilization rates.

These key variables may be useful in determining the demand implications of new models of care, changes in the payer environment, economic trends, the shifting composition of the workforce, and other macro-simulation factors. Impacts across the diverse needs and circumstances of specific geographical locations (e.g., states, local delivery systems, etc.) and specific health professional groups will require more refined data elements and analytical tools that can be customized to their needs while preserving the broad measures that capture comparable trends and general interchangeability between health professions.

Table 1, Appendix B contains recommendations for domains to be included in the common minimum dataset, across multiple health professional groups, along with suggested data sources. Specific data definitions and data collection guidelines and formats are beyond the scope of this report, and the list of data sources is representative only and does not include all potential sources by all health professional groups.

Key Variables and Adjustment Factors

Demand projection models combine a number of variables and factors: (1) input databases and projection equations to derive future estimates for population size, demographics, and geographical distribution; (2) incidence and prevalence of diseases and current utilization patterns to derive anticipated disease burden and estimated skill mix and intensity requirements; and (3) various determinant domains that may impact utilization rates. It should be noted that approaches to measure many of these key variables (particularly disease burdens) are currently imprecise and require further research and development. The key variables to be specified include:

- **Population size** by demographic data (e.g., age, gender, race/ethnicity, household income) and by geographic location (rural/urban), along with relevant adjustment factors (an area for future research).
- **Disease burdens** as a reflection of health care need, to include incidence and prevalence of diseases and illnesses; estimates of intensity or per capita usage of health care services required; skill mix or competencies of health care providers required; and influence of supplier-induced demand and/or workforce shortages, along with relevant adjustment factors.
- **Utilization rates** as a reflection of health care demand:

    - Across all health professional groups (e.g., physicians to include surgical specialties, non-surgical specialties, and primary care; nursing professionals to include advanced practice nurses; physician assistants; allied health professionals; mental health professionals; dentists; pharmacists; chiropractors; and others).
    - By care delivery setting (e.g., inpatient hospital, outpatient hospital, emergency visits, long-term hospitals, nursing facilities, physician offices, home health visits, etc.) and geographic location (where available).

Adjustment factors for these key determinants that assess the demand for health care services must have a logical relationship to the variables listed above based on theory, prior empirical evidence, and future state conceptualization.

Recommended adjustment factors include:

- Current and projected availability of **health professional workforce supply** across all health professional groups and care delivery settings and its interactions with demand estimates and utilization patterns.
- **Scientific advances and technological innovations** to include use of improved diagnostics, settings of technology use, and impact on health outcomes.
- **Consumer care preferences and consumer perceptions** of disease burdens to include differences across demographic variables, geographic workforce supply, preferences and traditions of self-care, and ability/willingness to pay as measured by income elasticity.
- **Financial incentives for providers** to factor in potential impact of provider behavior responding to income-related incentives or behavioral factors on estimated utilization rates.
- **Access to the health care system** to include insurance status, wait times, and travel distances; may adjust for other barriers to access like cultural competency and linguistic barriers.
- **New service delivery patterns** to include degree of health system integration, use of telemedicine modalities, home-based and self-care, and other care delivery models.
- **Changes to payment and reimbursement systems** to include impacts of changing payment systems such as bundled payments, provider behaviors with payment changes, and consumer behaviors with cost sharing.
- **Evolving practice patterns** to include health professional productivity, care delivery settings, shifts toward team-based service delivery and use of clinicians to the fullest extent of their licensures and training.
- **Education, regulation, and licensing impacts** to include changes to scope of

practice, impacts of tort reform, quality measurement, public reporting, and transparency.

- **Macroeconomic and policy impacts** to include adjustments for per capita income and gross domestic product, substantive policy changes (like the PPACA), and other macro variables.
- **Mobility patterns** to include market conditions and employment trends that affect health care worker opportunities and immigration and visa policies affecting the availability of foreign medical graduates.

Time Horizons, Relative Weights, and Growth Factors

Some data sources may have 10+ -year time lags, and the impact of some policy changes may only become apparent in the longer term. The workforce demand model will need to factor in different time horizons with near-term projections expected to be more precise than those with a longer-term horizon.

It is anticipated that relative weights and growth factors take on less importance in dynamic and iterative models than in static models (Appendix C outlines some potential variables). The underlying key variables and adjustment factors will have both historical and future projected growth patterns that will affect their relative assumptions and impacts in the model: for example, population shifts and demographic changes, disease treatment trends seen through existing utilization patterns, and/or technology impacts such as trends data or anecdotal data.

Moreover, the validation strategies are intended to adjust growth rates for each key variable and adjustment factor in a dynamic manner based on ongoing data flows. Assignment of relative weights in a baseline model would be continuously validated as well, and the weights will constantly change as new data flows are analyzed and integrated into the dynamic model. Changes to the model weights applied to each key variable and adjustment factor should be derived by using a ratio of observed measurement to expected impact. Hence, the growth factors are derived through an ongoing, iterative process.

Developing a Core Measure Set

Similar to the need for a supply-side uniform minimum dataset across all health professional groups, there must be a minimum set of outputs that all health professional groups will agree upon and use for demand projections. The model should include the capabilities to produce both analyses and outputs that cover a common or shared set of core measures (similar in concept to the minimum data set) applicable across most or all health professions, as well as allow greater detail and granularity through profession specific core measures.

Policymakers and health systems leaders should reach consensus on a defined set of measurement domains that are most likely to impact decision making.

- A dynamic model will offer multiple perspectives on those measurement domains and offer a variety of tools for interpreting and understanding measurement domains.
- A core measure set should be developed through a national planning process to ensure that user-friendly and comparable measures across all health care workers are in agreement.
- The minimum datasets required to populate these core measure sets across most health care workers should be integrated into a national reporting requirement for all health care professions.

An optimal strategy for building consensus around a core measure sets will need to be determined. An example of an effective committee is the Standards and Technology Committee around Meaningful Use (Office of the National Coordinator). Ideally, the dynamic demand projection model would encompass the diversity required by the industry, coupled with a commitment by stakeholders to endorse and utilize the agreed minimum core measures. The technical capabilities of a dynamic modeling platform must be combined with the institutional infrastructure to make use of its outputs.

Analytical Requirements

The desired outcomes of analytical frameworks for the health care workforce are evidence-based findings that provide actionable and easy-to-understand information to policymakers, planners, and the public. The model must ultimately form part of a broader and more comprehensive national workforce planning model that integrates supply projection methods (which are not addressed in this discussion).

Analytical frameworks need to be able to incorporate national trends, including interchangeability across different health professional groups, and allow valid comparisons across states and within local health systems. They must provide the capacity for longitudinal analyses that identify improvements and areas requiring further research, and provide the capability to disseminate customizable information outputs at varying levels of aggregation. Given the inherent uncertainties and limitations in the data and assumptions, the analytical frameworks must incorporate rigorous quality standards to achieve a viable database and have the capabilities for scenario planning and modeling incorporating a range of techniques, including approaches such as sensitivity analyses, predictive modeling, and propensity scoring. Increased communication about workforce planning among national and state policymakers, health professional education and training institutions, health care provider networks and professional associations, payers and employers, industry and trade groups, and patient or consumer groups is necessary. Opportunities for dissemination and comments through entities including “user communities” and blogs must be encouraged.

A Shared Demand Projection Model

Each health professional group/subgroup included in a comprehensive demand projection model relies on a series of demand functions, tied together and analyzed using more advanced statistical methods.

Suggested Analytical Steps

STEP 1: PROJECTED POPULATION = EXPECTED POPULATION X ADJUSTMENT FACTORS

The projected population may be derived at the local, state, regional, or national level using data sources such as the U.S. Census Bureau or the National Survey of Family Growth. Both resources provide information about population size and demographic information. Geographic locations may be derived by integrating population mailing addresses with geographic information systems or data from the Office of Management and Budget, the Department of Agriculture, the HRSA, and the Bureau of Economic Analysis, among other sources. Adjustment factors may be derived by taking the proportion of actual population over expected population for each set of given conditions.

STEP 2: PROJECTED DISEASE BURDEN = EXPECTED DISEASE BURDEN X ADJUSTMENT FACTORS

Step 2 will achieve a geospatial mapping of the projected disease burden by taking the expected disease burden of the projected population and applying appropriate adjustment factors. The disease burden for the projected population may be sourced from such data resources as the Medical Expenditure and Panel Survey, the BLS, administrative claims data from the Centers for Medicare and Medicaid Services and other payers, the Behavioral Risk Factor Surveillance System, surveys like the National Hospital Discharge Summary and the National Health and Nutrition Examination Survey, the National Natality Survey, the National Vital Statistics System, and others.

Adjustment factors will be necessary to model and account for the impacts of such programs or activities as disease prevention, health promotion, early detection, and other services, such as corporate wellness programs as well as science and technology (e.g., home-based self-testing, bio-monitoring capabilities, early detection of disease, increases in longevity, expanded uses of telemedicine, new pharmaceuticals and medical devices, new diagnostic and interventional technologies, genetic testing, and personalized medicine). Changes in consumer perceptions of the disease burden and/or

the impacts of available workforce supply on consumer perceptions of the disease burden should also be adjusted for. Adjustment factors may be derived by taking the proportion of actual disease burden over expected disease burden for each set of given conditions.

STEP 3: EXPECTED UTILIZATION = PROJECTED POPULATION X PROJECTED DISEASE BURDEN

The projected skill mix and intensity of services required may be used to translate disease burden and population characteristics into expected utilization. Various data sources may include per capita usage in the Health Cost Utilization Project or various data based on care setting such as the National Ambulatory Medical Care Survey, the National Hospital Ambulatory Medical Care Survey, the National Inpatient Sample, the National Survey of Ambulatory Surgery, the National Nursing Home Survey, the National Home and Hospice Care Survey, and others.

For each health professional group, the available data will yield an estimate of expected utilization that may be assigned to a specific location, time, and care setting using the consumer's perspective. This constitutes the expected demand function based on population and disease burden.

STEP 4: PROJECTED UTILIZATION (LOCATION, TIME, CARE SETTING) = EXPECTED UTILIZATION X ADJUSTMENT FACTORS

Projected utilization or predictors of future utilization must incorporate many broad determinants. There are many sources of current and historical utilization rates, but the adjustment factors will need to account for such factors as the availability of workforce supply by care setting, location, and time; access to the health care system; evolving service delivery models, changing payment systems, the impact of financial incentives on provider behaviors; changes in practice patterns, consumer preferences or ability/willingness to pay; the impact of education, training, and licensing changes; and macroeconomic and public policy shifts. Each of these categories has multiple sub-domains and associated data sources that can be factored into the demand projection model. Adjustment factors may be derived by taking the proportion of actual utilization over expected utilization for each set of given conditions.

STEP 5: INCLUDE INTERCHANGEABILITY ACROSS ALL HEALTH PROFESSIONAL GROUPS

Once projected utilization for each health professional group is defined, the utilization of health professional groups to the full extent of their training and licensure may be projected based on available market data and/or skill mix estimates.

Adjustment factors may be derived by taking the proportion of actual use over expected use for each set of given conditions. Multiple regression analyses will provide estimates of the relationship between utilization rates and its major determinants (after adjustment for demographic and geographic composition). More sophisticated and analytical techniques are needed to incorporate multiple adjustment factors and interchangeability effects.

Suggested Analytical Approaches

It will be important to establish multiple analytical approaches that meet the needs of different stakeholders. Analytical approaches include:

- **Workload indicators of health professional staffing needs**: Demand projections converted to required health professional staffing requirements or ratios of health professionals to population counts. This traditional approach simplifies the message to all stakeholders.
- **Trend analysis**: An assumption that observed trends may be most predictive of the future and establishing staffing requirements based on varying scenarios with changes in key assumptions (scenario analyses) will offer stakeholders a way to focus on the directional impacts of a few factors.
- **Regression analysis**: A technique for identifying multiple explanatory (independent) variables that have statistically significant impacts on the response (dependent) variable. This helps identify the most salient correlations and measures the strength of those relationships.
- **Econometric analysis**: Forecasting population demand based on a number of market factors, including health service utilization, access to services, and consumer health preferences. Econometric analyses are increasingly being applied to modern massive datasets.
- **Meta-analysis**: Reconciling potential variances in coverage, classification, and reporting of data by amalgamating all available information along a specific dimension and measuring outcomes on a common scale. This can extend into more advanced statistical techniques (e.g., multidimensional matrix algebra/calculus, non-parametric statistics, and Bayesian inferences).

Dynamic Modeling Approaches

Traditional approaches to dynamic modeling involve frequent updates to static data structures and data flows. Most often these data flows are restricted to a defined number of discrete variables and factors only. This may be the "bare minimum" approach to a dynamic workforce projection model, where the model is unchanging, and static data definitions form the input into the model at multiple points in time. This model is unable to incorporate newly emerging relationships or patterns between variables. The means of adjusting the model is to change the weights assigned to various adjustment factors.

An "enhanced approach" may introduce more precision over time through iterative data cycles. This approach could use statistical estimations based on assumed correlations, which may then be validated as new data confirm the predictive forecasts and/or inform future assumptions and weighting schemes. This may involve multiple data flows that inform a baseline static model. Validation of model predictions will lead to new and more

precise models that integrate the knowledge from that round of validation inputs (i.e., confirms accuracy of forecasts); multiple, iterative validation rounds will lead to more precision.

An "envisioned approach" may extend this even further and leverage the emerging tools of modern analytical science. Given the availability of new and powerful computational technologies, sophisticated algorithmic and statistical techniques, and strategies for dealing with modern massive datasets, the "self-learning" principle can be used to develop a highly dynamic model that occurs in real-time and is inclusive of all sources of available data. The modeling system itself can identify multiple conceptualizations of how health care need and health care demand are changing in time and space. It can take new sources of data and lessons learned from each validation cycle (identifying the strengths of relationships among variables and among adjustment factors) to optimize new model specifications and weights, create new pattern recognition algorithms, and begin to provide order to a complex and ever-changing health care landscape. It imposes order on various chaotic, disordered sets of data flows.

This envisioned approach deals with missing and ambiguous data inputs in the same way that analytic tradecraft, artificial neural networks, and predictive analytics in other fields deal with imperfect data: acceptance of imperfect data, continuous adaptation of the analytical approaches, and ongoing validation of its outputs. This creates a learning system that continues to improve over time, which is the ultimate objective of a dynamic model.

Introducing New Models to Health Professional Stakeholders

Beyond the technical aspects of the demand model itself, it is important to validate the approach and feedback mechanisms with stakeholder groups. The process used to validate the efficacy and efficiency of the dynamic model will require a set of guiding principles to help ensure relevancy, accuracy, and acceptance by health professional groups:

- The process must be transparent to the stakeholders supplying data and using the model.
- There must be a commitment to apply state and local information needs to national assumptions of key variables and adjustment factors.
- There must be universal acceptance of the minimum data set (MDS) and the shared demand projection methodology as the baseline requirement and starting point of the validation process.
- The development of analytic competencies into health care workforce usage must be time-sensitive. The option of waiting until health professionals are comfortable with the science that is available today is not viable. A cohort of experts needs to be educated in the state-of-the-science field of analytics now and be provided with the necessary tools to move the process forward.

The validation process would consist of assessment of accuracy of baseline requirements, verification of shared data collected in minimum datasets, acceptance of shared demand projection methodology assumptions, and acceptance of the demand projections.

Also, a variety of market indicators may be used to assess whether there are imbalances or inconsistencies in the demand projection models and the realities of the market. For example, trends in health professional average earnings, the price of health care services, time from education to employment, patient wait times for appointments, numbers of patients seen (compared to baseline norms), length of time between visits, and other factors may all indicate workforce surpluses or shortages. These may be used as iterative feedback on the overall model and used to adjust demand projections and assumptions as well.

Challenges and Implementation Steps

Progress toward a shared workforce projection model faces challenges across a number of fronts. There are important near-term implementation steps that would help encourage acceptance of the envisioned approach.

Challenges

- **Health professional group interests**: It is a challenge to develop a group of key variables for national and state-based health care workforce modeling. Creating a uniform workforce data set may threaten existing methodological approaches by individual health professional groups and/or highlight conflicting interests.
- **Public health professionals and international health workforce**: The model does not address the role of public health professionals and the migrations of international health professionals into the U.S. workforce. When a U.S.-based demand projection methodology is better developed, it must integrate these important workforce dynamics.
- **Differing perspectives**: Demand can be defined according to clinical and economic dimensions, insurers and employer groups, health professionals, and consumers. A shared demand projection methodology should account for these different perspectives and allow for customized views.
- **Telemedicine expansion**: The evolution and expansion of telehealth, clinical informatics, and decision support systems may dramatically alter the need for health professionals in certain geographical areas. This growth may also prompt the emergence of new business models, create the need for new health professional competencies, and alter the demand for health professionals in unexpected ways. Simple adjustments to a static demand projection model are unlikely to capture the dynamic nature of these changes.
- **Data availability and time lags**: Data availability is the cornerstone of building a shared demand projection methodology. Some key data sources have considerable time lags (e.g., 10 years) and continue to present significant analytical challenges.
- **Decreasing degrees of freedom**: Capturing the complexity of the U.S. health system will require greater granularity and the inclusion of more key variables

and sublevels of data. The inclusion of more variables, however, will decrease the analytical degrees of freedom and limit the ability to draw valid conclusions from the consolidated datasets.

- **Budgetary constraints**: In an era of significant budgetary constraints, the development of a national, comprehensive data repository and reference workforce database may be difficult to support. Health care analytics requires investment in analytics R&D and expert resources to begin to address the "time-sensitive" demand projection problem.
- **Alignment with and links to educational and vocational planning cycles**: Health professional education and training cycles vary in duration, quality, and geographical distribution. Additionally, the scope of practice for various health professionals is continually evolving. An effective workforce planning model must be able to integrate these factors.
- **Links with other occupational data collection cycles such as BLS and census cycles**: The initial linkages for a national reference database for workforce data must focus on key data collection systems, such as the U.S. Census and the BLS, and account for the data collection cycles of these systems. The national reference database should ultimately be inclusive of all available data sources, both public and private.

Implementation Steps

When comparing existing workforce demand models (which use current technologies and techniques) with the possibility of more modernized demand projection models, the direction is clear: it is critical we develop a shared, iterative and more advanced approach.[2] Progress requires a number of important first steps:

- **Provide funding for the National Health Care Workforce Commission**: A 15-member committee (as yet unfunded) appointed by the U.S. Government Accountability Office (GAO), the National Health Care Workforce Commission,[3] is intended to review health care workforce supply and demand and make recommendations regarding national priorities and policy. Other areas of focus will involve review of the implementation of state health workforce development grant programs and workforce development actions including career pathways, policies and practices regarding recruitment, retention and training of the health care workforce.
- **Increase funding for the National Center for Health Workforce Analysis (NCHWA)**: The NCHWA includes leadership and staff with the expertise and experience to bring about many of the ambitious goals set forth in this report with limited resources. Investments in a comprehensive, national shared workforce planning model are expected to generate a considerable return on investment, in terms of both financial resources and improved care.

- **Propose a modernized workforce planning model and build consensus among stakeholders**: This report outlines a number of general principles, a conceptual framework, potential data sources, and a preliminary approach for the national shared workforce planning model; however, much work remains to be done. Despite the challenges and controversies, proponents of a shared planning model should strive to build stakeholder consensus around their approach. A diverse array of health professional groups must be included in this consensus-building process.
- **Establish national data repository/reference database**: A comprehensive workforce planning model relies on a national data repository. Continual improvements to this repository (and the growing precision that this report advocates) require a well-managed national reference database that consolidates existing data sources and integrates emerging data sources. The workforce database must be developed and designed with stakeholder involvement and technical expertise that leverages the best analytical approaches from all industry sectors.
- **Develop a minimum dataset applicable to all health professional groups**: A standardized minimum dataset applicable to workforce projections across all health professional groups will allow comparability across workforce measures and an ability to capture interchangeability across all health professional groups. Work focused on this supply-side minimum dataset should not preclude continued work across a broader framework.
- **Improve data collection efforts**: Improved data definitions and collection guidelines are required to strengthen data collection efforts. Unique provider IDs to help link datasets, more detailed provider characteristics (e.g., type, specialty, workload), more information about organizational characteristics (e.g., size, payer mix, bed capacity, specialty mix, team composition), and more detailed patient data (e.g., procedures, diagnoses, risk adjustment variables such as socioeconomic and geographic data) would also improve data collection. These guidelines must be broadly disseminated.
- **Support research priorities**: The National Health Care Workforce Commission and NCHWA could lead efforts to improve research and data to measure the impacts of workforce changes on outcomes of care; new models of care and integration; technology and innovation; reimbursement and payment systems; consumer care preferences; and other key areas of uncertainty. Setting the research agenda and determining the priority uses of the health professional workforce projection model will drive methodological and analytical approaches.
- **Develop more sophisticated validation and adjustment strategies**: NCHWA should bring together computer scientists, statisticians, mathematicians, health professional groups, and data analysis practitioners to develop a dynamic modeling process that integrates more sophisticated algorithmic and statistical

techniques, as well as better validation strategies to provide real-time feedback to the model.

- **Establish core measures development process**: There should be an inclusive and comprehensive measures development process implemented to leverage the value and new capabilities of a shared workforce model. Health professional schools, health systems and employer groups that employ providers and patients, consumer groups and patient advocates, health professional industry groups and specialty societies, policymakers and political leaders, and others must have a stake in effective core measures development.
- **Build multiple information dissemination channels**: Technological advances and analytical techniques are tools to support national goals. Health professional groups and policy leaders must be active participants in the development, refinement, and deployment of a national health professional workforce planning model and its broad dissemination and use among all stakeholder groups. This dissemination of knowledge will require a strategic communication plan and the utilization of multiple distribution channels.
- **Continuously explore new possibilities**: Stakeholders must be open to harnessing new technologies and capabilities in data management. In the future, cloud computing platforms and sophisticated data crawl technologies may automate the consolidation of existing data sources across multiple systems. Artificial intelligence algorithms may improve the capability of a national workforce planning model to be self-testing and self-learning by constantly optimizing its model specifications and weighting factors, applying advanced statistical techniques, and pushing outputs to new decision support tools.

The implementation steps required to successfully build a modernized, comprehensive workforce planning model are ambitious and challenging, especially in times of fiscal austerity. Yet the potential benefits to policymakers, health administrators, educators, providers, payers, and patients may far outweigh the likely costs.

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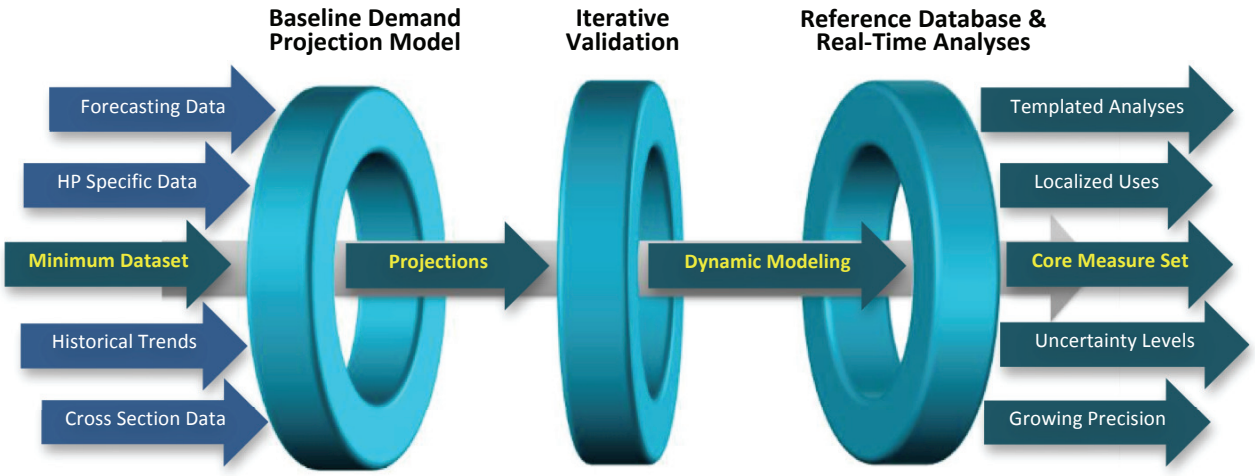
Appendix A – Developing a Modernized Demand Projection Approach

A comprehensive and modernized demand projection model begins with an initial specification of health care worker demand, integrating historical trends and cross-sectional data from existing sources. To the extent possible, it should create a minimum dataset applicable to all included health professional groups. The initial or baseline specification will establish health care worker demand across the entire health care worker spectrum.

The demand projections or estimates will be iterative, undergoing multiple and continuous rounds of projected versus actual demand comparisons, using updated data flows for the same data elements that went into the baseline demand projection model. This process will operate continuously, produce a variety of outputs (including a core measure set), and add to a reference database. The reference database will support ongoing analyses and optimize the iterative validation process in the dynamic model. This operates continuously (Figure 1).

Such a model requires management of very large and sometimes imperfect datasets, but parallels can be found in other industries that utilize modern, massive datasets (MMDS). Advances in computational and statistical approaches further enhance the value of this approach.

Figure 1. Demand Projection Conceptual Framework



Health care worker demand may be conceptualized by starting with a population. The size, distribution, and composition of that population across geography and time constitute the base of potential consumers of health care services. The individuals within the population have a disease burden, defined as the incidence and prevalence of illnesses and diseases. Other factors will include the impact of such things as disease prevention and health promotion, population health factors, pent-up demand and unmet need. Cultural perceptions of disease, the availability of health care workers within a local geography, and the availability of self-testing or self-monitoring tools and technologies will all affect the perceptions of the disease burden. The final driver of health care demand is how perceived disease burden translates into actual utilization of health care services. Utilization is driven by a broad array of determining factors including access and availability, financial constraints and incentives, evolving delivery models and practice patterns, consumer preferences, regulatory and licensing issues, and the interplay of economics, policies, and societal changes.

POPULATION SIZE AND LOCATION

Population growth and demographic shifts over time are important drivers of demand:

- The size and age distribution of the U.S. population (e.g., the aging of the baby boomers, population growth more generally)
- Demographic trends and associated risk profiles (e.g., variations across gender, race, ethnicity, lifestyles)
- Geographical distribution of the population (e.g., environmental factors, access to care delivery systems, urban/rural cultural differences)
- The capacity and willingness to pay for services (e.g., by the consumer and government)
- The propensity of a population to seek care (e.g., elderly, those with chronic diseases)

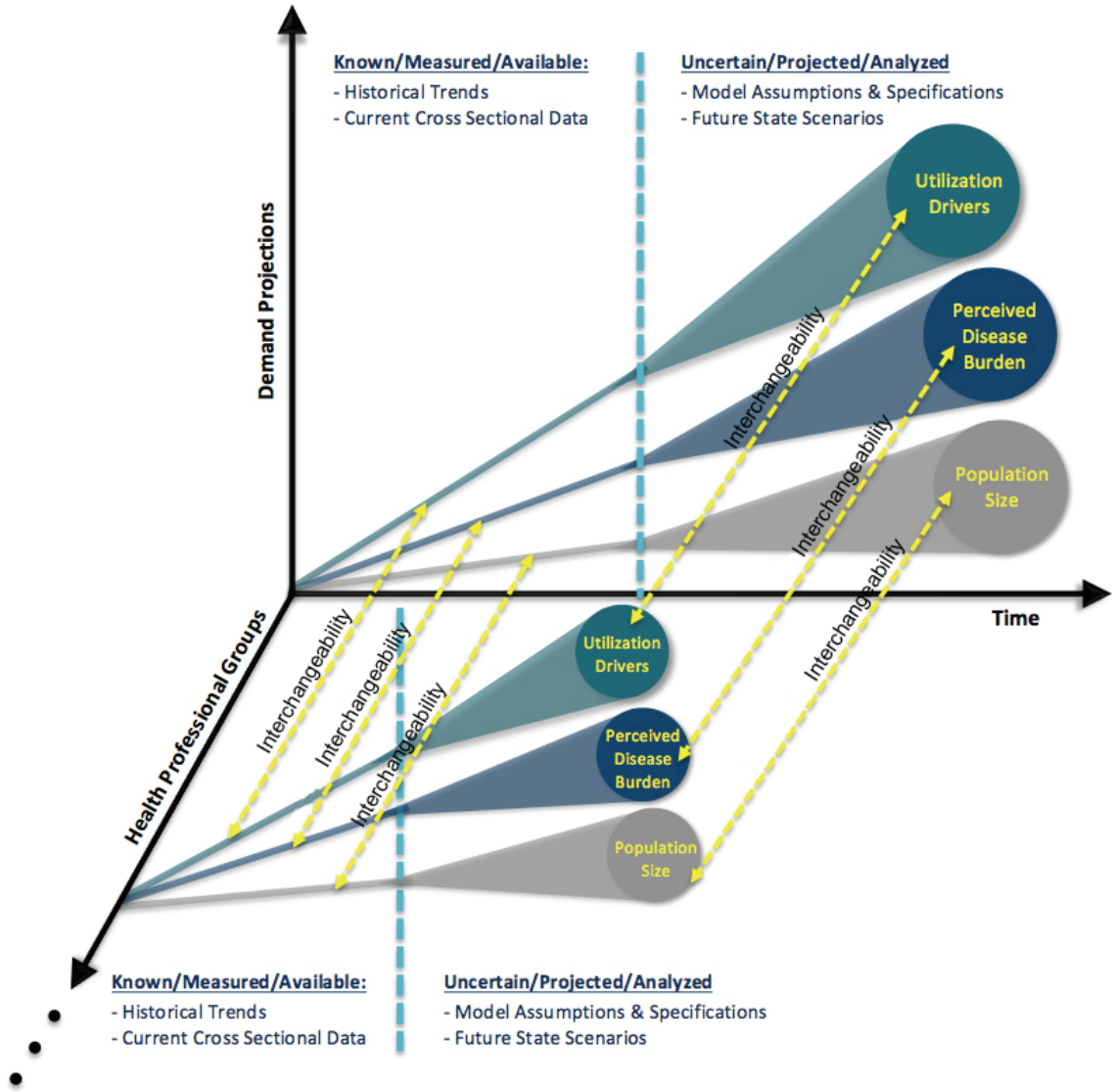
DISEASE BURDENS	The evidence base and knowledge of disease burdens also shift over time and drive demand: • The incidence and prevalence of all diseases (e.g., chronic diseases, infectious diseases and public health issues, diseases and illnesses requiring acute and emergency care) • Health promotion and disease prevention • Scientific advances and technology innovations (e.g., improved diagnostics and self-testing, interventional imaging capabilities, new pharmaceuticals and devices) • Skill mix and intensity required (e.g., what level of workforce competencies are required, how do shifts in workforce characteristics and scope of practice impact requirements) • Consumer perceptions of disease burden (e.g., impacts of income, socioeconomic class, environment, lifestyle, employer engagement, policy initiatives, health education) • Supply impacts on perceived disease burden (e.g., impact of workforce shortages on skill mix and intensity of services; supplier-induced demand)
UTILIZATION RATES	Broad determinants impact upon both historical and future state utilization rates: • Access to health care system (e.g., insurance status, cost sharing, travel distances, socioeconomic class, cultural/linguistic challenges, other barriers to access) • Availability of workforce supply (e.g., primary care providers, specialists, non-physician clinicians, safety net providers, participation levels, entry/exit and aging, gender) • Financial incentives for providers (e.g., health professional income-related interests, specialty selections, geographic choices, supplier-induced demand) • Evolving delivery models (e.g., accountable care organizations, medical homes, telemedicine, home-based care, personalized medicine, retail clinics, prevention) • Payment and incentives for certain health services (e.g., bundled payments, long-term care supports, pay-for-reporting, pay-for-performance, value-based purchasing) • Practice patterns (e.g., team-based delivery models, integration of family caregivers and non-skilled professionals, complementary medicine, self-care and bio-monitoring) • Consumer preferences (e.g., consumer competencies, experience with retail clinics and other value adding processes, health information on internet/mobile devices) • Education, regulations, and licensing (e.g., professional liability, scope of practice, error reporting, clinical quality measures, public transparency) • Economic and policy shifts (e.g., economic recession, per capita income, passage of the Patient Protection and Affordable Care Act, health insurance exchange implementation) • Mobility patterns (e.g., market conditions that affect health care worker employment opportunities, immigration and visa policies affecting foreign medical graduates)

Each of these key demand drivers and underlying data domains may be measured to formulate estimated health care worker demand, and these may then be projected into the future as well through scenario modeling. Current workforce demand projection approaches tend to estimate demand for individual health professional groups in isolation. A more comprehensive approach would be to measure and project across the entire spectrum of health care workers. This comprehensive approach could model potential workforce responses to the underlying health care demand, however, different health care conditions will require different skills and intensities by individual groups.

The value of existing approaches can be retained by establishing a separate demand curve for each health professional group. Each demand curve over time (based on known, measured, and available data) may be assumed to consist of the key drivers outlined above, namely, population characteristics, perceived disease burdens, and the broad determinants of utilization. These separate demand curves for every health professional group or subgroup will enable projection of potential demand (relying on model assumptions and specifications or using future state scenarios). The uncertainties associated with these demand projections will increase the farther the projections extend into the future.

Combining the demand curves (both known and projected) from each health professional group into an integrated demand model will provide the opportunity to more accurately assess the interchangeability effects across various health professional groups. Current demand projection models do not readily deal with interchangeability, but advances in computational and statistical approaches open up the possibility of establishing a better, more integrated demand projection model that captures and manages all relevant components (Figure 2).

Figure 2. Visual Conceptualization of Shared Demand Projection Methodology



A modern, integrated demand projection model would receive data inputs from existing health professional groups and data sources. The proposed model would simply aggregate and amalgamate data flows that are currently in use. Cross-sectional and longitudinal data will be derived from existing and available data sources, and projections will be driven by specifying model(s) assumptions and future state scenarios.

Future demand projections start with the main domains or key drivers of demand. Population characteristics (size, distribution, composition, location, etc.) may be assumed to change in predictable ways and, as time passes and estimated changes are compared to actual changes, adjustment factors based on those predictable changes can

be applied. This approach holds for both perceived disease burdens and the broad determinants of utilization rates.

Dynamic modeling may be seen by some as simply repeated updates of data into an unchanging model (with the same variables and model specifications); hence, the numbers are updated, but the understanding of the underlying workforce dynamics remains unaltered. An enhanced approach allows the outputs of the model (e.g., comparisons of estimated results versus actual results) to change the adjustment factors themselves, to add or remove new variables, or to change the weights or importance of different variables; hence, understanding of the underlying workforce dynamics is improved, and the model is modified somewhat to reflect this.

A more modern approach to dynamic modeling envisions taking multiple and constantly varying perspectives on the underlying workforce dynamics, based on the availability of MMDS, computational algorithms that can help identify trends and complex relationships in both linear and non-linear ways, and statistical techniques that allow very sophisticated methods of understanding correlations and estimated changes. Many sources of data are constantly integrated and tested for computational value, different model specifications are tried and optimized, and the iterative validation process is constant and in real-time.

Lessons learned from other fields that use the analytical power of MMDS to optimize predictive abilities and modernize health care worker demand methodologies will also be helpful.

The progression to a more modern health care worker demand projection methodology will yield many benefits to decision makers and stakeholders. Figure 3 provides a comparison between existing models and future demand models.

Figure 3. Comparison of Existing and Future Demand Models

OLD DEMAND MODELS	NEW DEMAND MODELS
Static modeling	Dynamic modeling
Model specifications fixed in time	Self-learning and self-correcting
Usually health profession specific	Integrated for all health workers
Limited variables included	Inclusive of all complex variables
Limited feedback on projections	Continuous validation processes
No national database	National reference database
Analysis of lagging indicators	Real-time data integration
No minimum dataset	Minimum dataset for all workers
No core measure sets	National core measure sets

May ignore economic realities	Integrates economic realities
May be subject to expert bias	Does not rely on expert opinions
May perpetuate current inequalities	Relies on multiple perspectives
Sensitive to missing data	Manages missing data
Fixed purpose for given model	Flexible uses for model outputs

Appendix B – Existing Data Sources for Health Care Demand Projections

There are many existing sources for data to populate an integrated health care demand projection model. The following table outlines some of these sources, categorized by the key drivers of health care demand.

Table 1. Recommendations for Domains to be Included in the Minimum Dataset

POPULATION SIZE AND LOCATION	
Population size, gender, ethnicity/race, and age distribution	• **U.S. Census Bureau** population projections (by age, gender, and race/ethnicity) • **National Survey of Family Growth** (NSFG) provides information on family life, fertility, and health • Studies in the literature speak to consumer preferences and propensity to seek care by demographic factors, willingness to pay by economic class, and other considerations that are impacted by population characteristics and geography
Geographic distribution	• **Office of Management and Budget** (OMB) metropolitan statistical areas (MSAs) • **Department of Agriculture** (USDA) metropolitan and non-metropolitan counties • **Dartmouth Health Atlas** hospital service areas and hospital referral regions • **National Center for Health Statistics** (NCHS) health care service areas • **Health Resources and Services Administration** (HRSA) health professional shortage areas and medically underserved areas • **Bureau of Economic Analysis** (BEA) economic areas • Broad geographic information systems (GIS) provide the ability to map individual patients to specific geospatial locations, e.g., the Department of Veterans Affairs (VA) geocodes all enrollees in their health system; the expansion of this capability may not require new data collection efforts

DISEASE BURDENS	
Incidence and prevalence of diseases	• **Medical Expenditure Panel Survey** (MEPS) for health status • **Bureau of Labor Statistics** (BLS) Survey of Occupational Injuries and Illnesses • **Administrative claims data** from the Centers for Medicare and Medicaid Services (CMS), private insurance plans, group/staff model health maintenance organizations, and other managed care plans • **Centers for Disease Control and Prevention** (CDC) surveys to include the **Behavioral Risk Factor Surveillance System** (BRFSS) and **National Hospital Discharge Survey** (NHDS) • **National Health and Nutrition Examination Survey** (NHANES) includes interviews and physical examinations • **Agency for Healthcare Research and Quality** (AHRQ) surveys • **National Natality Survey** for obstetric care by physicians and midwives • **National Vital Statistics System** (NVSS) provides mortality data

Skill mix and intensity required	• **Health Cost Utilization Project** (HCUP) may be used to estimate per capita use of health care services
	• Estimates of intensity of services and skill mix required are available for many conditions and care settings (e.g., per capita utilization of services by delivery setting estimated as FTEs required) and may be derived from:
	  ○ **National Ambulatory Medical Care Survey** (NAMCS)
	  ○ **National Hospital Ambulatory Medical Care Survey** (NHAMCS)
	  ○ **National Inpatient Sample** (NIS)
	  ○ **National Survey of Ambulatory Surgery** (NSAS)
	  ○ **National Nursing Home Survey** (NNHS)
	  ○ **National Home and Hospice Care Survey** (NHHCS)

Estimated impacts for scientific advances and technology innovations	• Science and technology may, for example, improve access to home-based self-testing and bio-monitoring capabilities, promote early detection of disease and increase longevity, and expand use of telemedicine and electronic health records – all of which will impact perceived disease burdens • New pharmaceuticals and devices and new diagnostic and interventional technologies may lead to better health outcomes and reduced disease burdens; genetic testing and personalized medicine may lead to long-term improvements in treatment options
Consumer perceptions of disease burden	• **Deloitte Center for Health Solutions' Survey of Health Care Consumers** • Economic indicators; empirical evidence suggests a positive correlation between economic well-being and demand for health care services
Availability of workforce supply	• Bureau of Health Professions, Health Resources and Services Administration, Department of Health and Human Services • **Bureau of Labor Statistics** (BLS) projects employment levels across many health professional groups, especially noting the rise in non-physician clinicians, to include BLS **Occupational Employment Statistics** (OES), the **Current Population Survey** (CPS) Supplement, and the **National Employment Matrix Occupational**

	Employment Projections • **Centers for Medicare and Medicaid Services** (CMS) **Online Survey Certification and Registration (OSCAR)** datasets for staffing and facility characteristics • **American Medical Association** (AMA), **American Osteopathic Association** (AOA), and **American Academy of Physician Assistants** (AAPA) master files; other datasets from **American Association of Medical Colleges** (AAMC), **American Dental Association** (ADA), **American Association of Colleges of Nursing** (AACN), **American Academy of Nurse Practitioners** (AANP), **American Association of Community Psychiatrists** (AACP), **American Society of Health System Pharmacists** (ASHP), **American Association of Colleges of Pharmacy** (AACP), HRSA National Sample Survey of Registered Nurses, and other professional associations • **State medical licensure boards** and **specialty certifying boards** • **Workforce Investment Boards** (WI) Analyses • **National Residency Match Program** (NRMP) • Many health professional groups have current supply projection models
UTILIZATION RATES	
Current utilization rates	• **National Ambulatory Medical Care Survey** (NAMCS) provides data on office visits, medical specialty, and estimates of demographic distribution • **National Hospital Ambulatory Medical Care Survey** (NHAMCS) provides data on emergency and outpatient visits, medical specialties, and demographic distribution • **National Survey of Ambulatory Surgery** (NSAS) provides data on ambulatory surgical care in hospital-based and freestanding ambulatory surgical centers • **National Hospital Care Survey** (NHCS) and **National Hospital Discharge Survey** (NHDS) provide data on utilization of hospital-based care • **National Inpatient Sample** (NIS) provides data on physician services in hospital inpatient settings, likely medical specialties, and demographic distribution • **National Nursing Home Survey** (NNHS) and **National Survey of Residential Care Facilities** (NSRCF) provide nursing home data • **National Home and Hospice Care Survey** (NHHCS) and **National Home Health Aide Survey** (NHHAS) provide home health data • **National Immunization Survey** (NIS) provides immunization data • **American Hospital Association** (AHA) provides state-level estimates of inpatient days, outpatient visits, and emergency visits • **American Health Care Association** (AHCA) provides state-level estimates of nursing facility residents • **Uniform Data System** (UDS) collects community health center data for Federally Qualified Health Centers, and the NACHC's **REACH** provides county-level demographic information for community health centers • **Center for Medicare and Medicaid Services** (CMS) data on home health visits • **Health Cost Utilization Project** (HCUP) provides estimates for hospital nationwide inpatient services (NIS), nationwide emergency department services (NEDS), and state-level data on inpatient, ambulatory surgery, and emergency department cost and utilization • **Medical Expenditure Panel Survey** (MEPS) on cost, utilization, and insurance coverage and other information about families, individuals, providers, and employers • **National Alliance of Caregiving** (NAC) and AARP Caregiving in the U.S. provide in-depth surveys of caregivers

Availability of workforce supply	• **National Center for Health Workforce Analysis** (NCHWA) analyses from the Bureau of Health Professions, Health Resources and Services Administration, Department of Health and Human Services • **Bureau of Labor Statistics** (BLS) projects employment levels across many health professional groups, especially noting the rise in non-physician clinicians, to include BLS **Occupational Employment Statistics** (OES), the **Current Population Survey** (CPS) Supplement, and the **National Employment Matrix Occupational Employment Projections** • Centers for Medicare and Medicaid Services (CMS) **Online Survey Certification and Registration (OSCAR)** datasets for staffing and facility characteristics • **American Medical Association** (AMA), **American Osteopathic Association** (AOA)**,** and **American Academy of Physician Assistants** (AAPA) master files; other datasets from **American Association of Medical Colleges** (AAMC), **American Dental Association** (ADA), **American Association of Colleges of Nursing** (AACN), **American Academy of Nurse Practitioners** (AANP), **American Association of Community Psychiatrists** (AACP), **American Society of Health System Pharmacists** (ASHP), **American Association of Colleges of Pharmacy** (AACP), HRSA National Sample Survey of Registered Nurses, and other professional associations • **State medical licensure boards** and **specialty certifying boards** • **Workforce Investment Boards** (WI) Analyses • **National Residency Match Program** (NRMP) • Many health professional groups have current supply projections, using a variety of approaches and models
Financial incentives for providers	• Bureau of Labor Statistics (BLS) **National Compensation Survey** • **Centers for Medicare and Medicaid Services** (CMS) datasets, private insurance plans and managed care plans datasets
Access to health care system	• Medical Expenditure Panel Survey (MEPS) **Household Component** for person and family-level insurance coverage and **Insurance Component** for employer-sponsored insurance • Census Bureau's **American Community Survey** (ACS) and the **Puerto Rican Community Survey** (PRCS) for population profiles and health insurance coverage estimates • **National Health Interview Survey** (NHIS) models the probability of having medical insurance by age, gender, and race/ethnicity • **AMA's annual Physician Socioeconomic Statistics** collects data on wait times for appointments by new patients or wait times for patients upon arrival for scheduled appointments
Evolving service delivery models	• Model assumptions and adjustments regarding anticipated impacts of evolving service delivery models
Payment and incentives for health services	• Bureau of Labor Statistics (BLS) National Compensation Survey • Centers for Medicare and Medicaid Services (CMS) datasets, private insurance plans and managed care plans datasets
Practice patterns	• **AMA Physician Socioeconomic Statistics** provides survey information on how physicians distribute their time by care delivery setting and the average number of

	patients seen by week • **Medical Group Management Association** (MGMA) Physician Compensation-Production Surveys of group practices • **American Group Practice Association** (AGPA) Group Practice Physician Compensation Trends and Productivity Correlations surveys • **American Association of Health Plans** (AHIP) survey of HMO members • **American Association of Medical Colleges** (AAMC) Faculty Practices Activities Survey • Health professional association surveys that measure shifts in practice patterns toward more use of non-physician clinicians, varying shifts toward or away from group practice or affiliation with hospitals or health systems, health professional productivity, health and technology impacts, and changes in health services offered at different care delivery settings
Consumer preferences and ability/ willingness to pay	• **Consumer Assessment of Healthcare Providers and Systems** (CAHPS) surveys patients and consumers about their experience with health care • **National Health Interview Survey** include surveys of provider utilization • Extrapolations from NAMCS, NHAMCS, NIS, etc. suggest that women and different racial/ethnicity groups have different care preferences; various studies have examined care preferences across demographic variables • Various studies have examined income elasticity estimates to correlate per capita income or per capita GDP with physician or health care services demand variables
Economic and policy shifts	• Gross Domestic Product (GDP) and federal government spending changes (e.g., Medicare and Medicaid funding levels, workforce development initiatives, etc.) • Model assumptions and adjustments regarding anticipated impacts of market changes and policy initiatives • Immigration policies and J-1 visa processes may impact migration patterns of foreign medical graduates, and regional economic conditions may impact domestic migration patterns of U.S. health care workers • Surge in demand as a result of policy changes such as PPACA and increased access to insurance coverage

Appendix C – Key Variables

Table 1 (below) suggests key variables that might form a core set of adjustment factors. An extensive search of the literature and demand models for relative weighting systems and/or literature that explores how different data domains (and/or underlying variables within each domain) might compare to each other was undertaken, but no close fit was identified. The relative weights assigned in the initial baseline demand model will need to be developed through considerable research. An initial list of potential variables is suggested in Table 1. Relative weights may be necessary to set up the initial baseline model, however, it is important to emphasize that the accuracy of the relative weights is not as important in an iterative validation model as it is in a static model. Relative weights for all of the variables would be continuously tested and validated in the proposed iterative model, and revised once projections and actuals are compared. Over time, this strategy is designed to produce greater accuracy and precision.

Table 1: Key Demand Variables

DEMOGRAPHICS
U.S. population size and growth trends
Age of population
Demographic information (race, ethnicity, gender, lifestyle)
Geographical distribution (county, zip code, metropolitan statistical area)
Income/socioeconomic class (ability to pay for health services)
Propensity to seek care (cultural factors)
DISEASE: INCIDENCE, PREVALENCE, BURDEN
Incidence and prevalence of diseases (morbidity, mortality, longevity)
Scientific advances and technology innovations
Improved diagnostics and self-testing
Interventional imaging capabilities
New pharmaceuticals and devices

Skill mix and intensity required for disease burden
Consumer perceptions of disease burden
Workforce supply impacts on perceived disease burden
ACCESS TO HEALTH CARE DELIVERY SYSTEM
Insurance status
Cost-sharing (deductibles, copays, coinsurance)
Travel distances to usual sites of care
Cultural/linguistic/other barriers to care
WORKFORCE
Availability of workforce
Vacancies, turnover rates, shortages
Availability of interchangeable professions
Mobility patterns
Market conditions affecting worker employment opportunities
Immigration and visa policies
SERVICE DELIVERY
Evolving models of care
Accountable care organizations
Patient-centered medical homes
Telemedicine and telehealth modalities
Home-based care
Personalized medicine
Retail clinics
Prevention and wellness programs
Inpatient and outpatient care models
Practice patterns
Interdisciplinary team-based delivery models
Integration of family caregivers and non-skilled professionals
Complementary medicine
Self-care and self-monitoring

Financial incentives for providers

- Income-related interests (induced demand)
- Specialty selections and impacts on skill mix availability

Payment and incentives for health services

- Bundled payments
- Long-term care supports
- Pay-for-reporting
- Pay-for-performance
- Pay-for-outcomes (value-based purchasing)

Consumer preferences

- Raising consumer competencies about health
- Health information availability on internet/mobile devices

EDUCATION, REGULATIONS, AND LICENSING

- Professional liability (defensive medicine, torts)
- Scope of practice changes
- Mandatory error reporting
- More standardized clinical quality measures
- Public transparency

ECONOMIC AND POLICY SHIFTS

- Economic growth (e.g., impacts of recession)
- Per capita income levels
- Patient Protection and Affordable Care Act (PPACA) provisions (various impacts)
- Health insurance exchange implementation

Endnotes

[1] 42 U.S.C. §294P(16). The term "direct care worker" has the meaning given that term in the 2010 Standard Occupational Classifications of the Department of Labor for Home Health Aides [31–1011], Psychiatric Aides [31–1013], Nursing Assistants [31–1014], and Personal Care Aides [39–9021].

[2] See Figure 3, Appendix A.

[3] National Health Care Workforce Commission. The Patient Protection and Affordable Care Act. Mar. 23, 2010 85 SEC. 411.