Developing a Multi-Regional Statewide Nursing Workforce Forecast Model Requires Innovation and Collaboration

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A key message from the Institute of Medicine's report, *The Future of Nursing: Leading Change, Advancing Health,* addresses the need for better health care workforce data collection and information infrastructure, which is a prerequisite for effective workforce planning and policy making. Health care workforce forecasting models provide a mechanism for making future projections, which can be valuable in quantifying supply and demand and identifying the most appropriate strategies to prevent future shortages. Forecasts or predictions about future nursing supply and demand at the state level, although becoming more prevalent, are limited to a minority of states using a variety of methodologies. The Louisiana Multi-Regional Statewide Nursing Workforce Forecasting Model offers a unique and powerful tool to both monitor and forecast changes in the supply of, and demand for nurses at both the state and regional levels relative to specific health care settings. Development of such a model requires collaboration with agencies and/or entities having access to state-level data as well as the support of stakeholders interested in using the model in strategic planning and policy development.

Nurses have been, and will continue to be at the center of health care in the United States. Therefore, collecting and analyzing high-quality and timely data will be needed to assess how the nursing workforce is and will be adjusting to the transformation that the health care system is expected to undergo over the next decade (Buerhaus, 2012; Institute of Medicine, 2010). A health care system that functions appropriately has a workforce that directly impacts quality, cost, and access to health care. Yet, because the health care needs of each state as well as the regions within those states (i.e., urban vs. rural) are unique, it is almost impossible to determine the size and composition of the health care workforce needed using national data and trends. Health policies designed to expand access, improve quality, and control costs must take into account the supply, distribution, education, and utilization of the health care workforce at the state and regional levels in order for these policies to succeed (Martiniano, McGinnis, & Moore, 2010; McEllistrem-Evenson, 2009).

Knowledge of the supply and demand for registered nurses (RNs), advanced practice registered nurses (APRNs), and licensed practical nurses (LPNs) is the first step in determining the nursing workforce that will be needed to provide care to over 300 million American citizens (U.S. Census Bureau, 2012). To ensure that there is a sufficient supply of nurses to meet the future demand for health care, it is essential that workforce planners, policy makers, health care providers, and nursing educators have a means of predicting the future demand for all types of nurses. Having the ability to predict future nursing supply and demand using forecasting models that incorporate state- and regional-level data will assist these groups in the allocation of resources needed for nursing education, program development, and recruitment efforts in both the health care system and education sectors (Budden, Zhong, Moulton, & Cimiotti, 2013).

Forecast studies for RNs, APRNs, and LPNs can be valuable in quantifying supply and demand, as well as gaps in supply and demand, and identifying the most appropriate strategies to prevent future shortages. To quantify RN, APRN, and LPN supply/demand gaps now and in the future, it will be important to have accurate data, including the number of active RNs, APRNs, and LPNs as well as their demographic, education, and practice characteristics, and work locations. A lack of relevant and timely data on the nursing workforce is a significant barrier to identifying where nursing shortages currently exist, where they may exist in the future, and where they may be most severe. The absence of this information impedes the development of effective health workforce programs and policies to alleviate shortages and the ability to evaluate these programs and policies for effectiveness (Martiniano et al., 2010).

Using Forecasting Models to Predict Nursing Supply and Demand

In the past, states have relied on national projections for nursing supply and demand reported by the Health Resources and Services Administration (HRSA) to address nursing workforce supply and demand issues (Biviano, Tise, Fritz, & Spencer, 2004). Although

the HRSA model was seen as the best available source for state-level workforce projections, there were limitations related to the model. Many at the state level did not find the HRSA model to be user friendly and some of the state-level projections were found to be inaccurate (Health Policy Institute of Ohio, 2009). Over the last decade, states have been playing a more significant role in collecting data required to study nursing workforce supply and demand. Many states have created state nursing workforce centers for the purposes of collecting and analyzing workforce data and improving nurse recruitment and retention. At present, approximately 33 states have nursing workforce centers, and each of these states is either actively collecting state-level nursing workforce data or in collaboration with other state entities in collecting and/or reporting on the nursing workforce at the state level (The National Forum of State Nursing Workforce Centers, 2013).

In December 2014, HRSA released projections extending through 2025 using the new Health Workforce Simulation Model (HWSM). "The HWSM is an integrated microsimulation model that estimates the future demand for and supply of health care workers in multiple professions and care settings" (Health Resources and Services Administration [HRSA], 2014, p. 1). Although the HWSM can provide national benchmarks for comparison, and may be the best available resource, the assumptions on which the HWSM is based may not hold true for all states. For example, the HWSM is based on the assumption that RN demand in 2012 equaled RN supply (HRSA, 2014). Yet in 2012, the RN nursing supply in Louisiana was 39,016 full-time equivalents (FTEs) and nurse demand was 42,995 FTEs (Louisiana Center for Nursing [LCN], 2013). The HWSM also is based on the assumption that RNs will continue to train at the current levels. Over the last 5 years, enrollment in Louisiana's pre-RN licensure programs has decreased by 5%. There has only been an overall 2% increase in the number of graduates from Louisiana's pre-RN licensure programs over the past 5 years; in fact, between 2012 and 2013 there was actually a 0.3% decrease in the number of graduates (Louisiana State Board of Nursing [LSBN], 2013a). These findings illustrate how important it is to use state-level data, when available, to determine the future supply and demand for nurses at the state and regional level.

The Collection of Nursing Workforce Data in Louisiana

The Louisiana State Board of Nursing (LSBN) and the Louisiana State Board of Practical Nurse Examiners (LSBPNE) have been collecting data about Louisiana's nursing workforce for over 20 years through the annual licensure renewal process and annual reports submitted by schools of nursing. The Louisiana Center for Nursing (LCN [Louisiana's Nursing Workforce Center]) was established through a Senate Resolution in 2008 as a division of LSBN. The charge to the LCN was to collect, analyze, and report on Louisiana's RN workforce. Although the LSBN and LSBPNE are the repositories for RN and APRN data and LPN licensure data, respectively, the work that has come out of the LCN reflects a community of collaborators with a vested interest in maintaining an adequate nursing workforce in Louisiana. The LCN worked closely with The National Forum of State Nursing Workforce Centers to ensure that the elements contained in The Forum's minimum datasets for nursing supply, education capacity, and demand were collected in Louisiana. The Nurse Demand Project (LCN, 2012), a first for Louisiana, represented a collaborative effort among the Nursing Supply and Demand Council (NSDC), the Department of Health and Hospitals Department of Health Standards, the Louisiana Hospital Association (LHA), the Louisiana State Nurses Association (LSNA), the Louisiana Organization of Nurse Executives (LONE), Louisiana's Long Term Care Association, and the Home Care Association of Louisiana. The work that has come out of the LCN has supported the mission of LSBN by ensuring access to a nursing workforce that not only administers safe, effective, patient-centered care but also is adequate in number. In 2012, LSBN revised its vision statement to include nursing workforce: "LSBN will be a leader in regulatory excellence that advances nursing workforce, education, and practice" (LSBN, 2013b).

Creating a Statewide Multi-Regional Forecast Model: A Collaborative Process

In September 2012, LCN received funding from the Louisiana Health Works Commission (LHWC) and LSBN to develop a nursing workforce forecasting model that could be used to predict supply and demand for RNs, APRNs, and LPNs through 2020 at both the regional and statewide level. The Northeast Ohio Nursing Initiative (NEONI) Forecasting Model (The Center for Health Affairs, 2015) was used as a template for Louisiana's Multi-Regional Statewide Nursing Workforce Forecasting Model. The NEONI Forecaster, although a very dynamic forecasting tool, was limited to 17 counties within Northeast Ohio, whereas Louisiana's Multi-Regional Statewide Nursing Workforce Forecasting Model is believed to be the only nursing workforce forecasting model that has the ability to predict supply and demand for RNs, APRNs, and LPNs at both the regional and statewide level, and identify gaps (either a shortage or a surplus) through the year 2020. The NEONI group, composed of Craig Moore, PhD, economist and private consultant; Patricia Cirillo, PhD, statistician and president of Cypress Research Group in Northeast Ohio; and Lisa Anderson, MSN, RN, vice president with the Center for Health Affairs in Cleveland, Ohio, in collaboration with Cynthia Bienemy, PhD, Director for the LCN, developed Louisiana's Multi-Regional Statewide Nursing Workforce Forecasting Model.

Collaboration Between the RN and LPN Boards

Louisiana is one of three states that have both an RN Board and an LPN Board. Although the LCN falls under the RN Board and its major focus is on the RN and APRN workforce, because of prior collaborative efforts between the RN and LPN Boards by way of the NSDC (an advisory council to the LHWC whose charge is to study all aspects of the supply and demand for all types of nurses in Louisiana, including nursing assistants [Louisiana State Legislature, 2008]), collaboration on the development of the forecast model was an expected and welcomed next step by both boards of nursing. Before developing the forecasting model, the LCN worked closely with the executive director of the LPN Board to ensure that items on the LPN licensure renewal application reflected The Forum's nursing supply minimum dataset.

Forecast Model Design Meeting With Stakeholders

In November 2012, the research team held a forecast model design meeting with stakeholder groups, which included, but were not limited to, members of LSBN, LSBPNE, NSDC, LHWC, LHA, LSNA, and LONE. The purpose of the design meeting was multifaceted. The research team wanted to share with stakeholders what a forecast model looks like, what it could do in terms of predicting future nurse workforce supply and demand, the type of data that would be needed to populate a forecast model, and how a forecast model could be used in workforce planning and policy making. The research team also needed to hear from stakeholders about what they wanted to see in a nursing workforce forecasting model, how they visualized using such a model, their suggestions and rationale for the best regional breakdown for the state and future trends for health care in Louisiana in light of the merging of health care facilities, the building of new health care facilities, and economic development within the state. The current political environment and its impact on health care was also a focus of discussion. All of these were factors that could potentially impact the demand for health care in Louisiana.

It was important for the research team to understand the landscape of Louisiana and to engage stakeholders in the process from the beginning to the end of development of the forecasting model. Stakeholders were instrumental in providing Louisiana-specific data related to the nursing workforce, patient utilization, and nurse staff ratios in various health care settings. If they did not have access to the data, they connected the research team with the person and/or entity that did have access to the data. The LCN was the member of the research team that served not only as the gatekeeper for Louisiana's nursing workforce data but also as the state liaison or communicator between the research team and the stakeholders (Keckley, Coughlin, Gupta, Korenda, & Stanley, 2011).

Model Development

Model development began immediately after the stakeholder engagement meeting and occurred over approximately 9 months.

Working remotely always presents a challenge but having consultants who are vested in the project (such as the NEONI group) makes a tremendous difference in terms of the success of the project. Each member of the research team played a significant role in the overall development of the model. The LCN was responsible for acquiring the data needed to build the model; the NEONI group was responsible for analyzing the data, formatting the data for placement in the model, and building the model. The entire research team was involved in ongoing testing, quality control, and validation of the model.

The forecast model operates on a series of Excel spreadsheets connected by specific mathematical relationships incorporating multiple databases of information related to nurse licensure, demographics, and patient care utilization across multiple settings. Sixteen adjustable settings are embedded within each regional model, which allows hypothetical testing situations based on specific variables. Each model has two components: the demand for health care provided by nurses and the supply of nurses available to provide the care. Each regional model stands alone, while the state model is dynamic with each of the regional models. This means that when changes are made in a regional model (e.g., a 20% decrease in the number of graduates from pre-RN licensure programs in a specific region), these changes are also reflected in the state model, showing the impact that the change will have on the statewide supply and demand for nurses.

Louisiana's Multi-Regional Statewide Nursing Workforce Forecasting Model

In June 2013, the forecast model was presented at a second stakeholder meeting in Louisiana. Louisiana's Multi-Regional Statewide Nursing Workforce Forecasting Model offers a unique and powerful tool for both monitoring and forecasting changes in the supply of and demand for nursing, region by region and health care setting by health care setting, across the state. It provides a mechanism for employing the annual nurse registration data in the state and, over time, will establish trends in nurse utilization, career development, and nurse education. The HRSA supply and demand structure is well established and has been applied in many states. But, unlike the old HRSA model (Biviano et al., 2004) that projected national figures and then allocated a share to each state, the Louisiana model begins with eight regional models, representing the eight regional labor market areas in Louisiana, for each type of nurse, and aggregates them to a statewide model. This bottom up approach is more accurate and allows each region to have an independent model for its nurse workforce analysis. Louisiana's Multi-Regional Statewide Nursing Workforce Forecasting Model may be the only nursing workforce forecasting model to date that has the ability to predict the supply and demand for RNs, APRNs, and LPNs at both the regional and state levels, and identify gaps (shortages or surpluses) at each level. Because of the flexibility in the design, the model can be updated with new data at any time. Assumptions in the

model can also be adjusted based on additional data that become available, such as an increase or a decrease in nurse-patient ratios, changes in staffing patterns, changes in the regional or statewide health care delivery systems, advances in medical technology, and importation or exportation of health care in and out of the region or state.

Unlike many workforce models that just forecasts of the demand and supply of nursing, the Louisiana model allows the user to manipulate the basic assumptions in each regional model with regard to utilization of nurses in each health care setting and the expected change in that utilization going forward. It allows for "what if" analysis that can be a policy tool when discussing different approaches to meeting the nursing needs of each region and of the state as a whole. It has the capacity to include export sales of health care resulting from serving out-of-state patients. And, it allows the user to look at various changes in demand due to migration of the population in and out of the state.

Components of the Model: Nurse Demand, Nurse Supply, and Health Care Settings

Although referred to as a model, the Louisiana Multi-Regional Statewide Nursing Workforce Forecasting Model is actually a tool designed to allow for adjustments of the assumptions within the model that reflect nursing supply and demand. The overall model for each nurse type (RN, APRN, and LPN) comprises nine separate Excel spreadsheets. Each regional model stands alone (the data that drive the model's components are contained within each file). The state model is dynamic with each of the regional models, which means that changes to a regional model's assumptions are reflected in the state model for each nurse type. The supply side of the model is based on the number of nurses working in each region by their age and includes information about (1) the number of newly licensed nurses (RNs, APRNs, and LPNs), (2) the demographics of the nurse workforce (in particular, age), and (3) the work patterns of the nurse workforce (in particular, the number of hours worked) in each region. The demand side of the model marries three general pieces of information: (1) population demographics, (2) the amount of health care (by setting) required by the population, and (3) the number of nurses required to provide each "unit" of health care. (See Table 1.)

A core piece of the model relies on the number of nurses required to care for patients within various settings (also known as the "intensity factor"). The intensity factor is defined as the nurse-to-health care–unit ratio where the number of nurses is expressed as an FTE and the health care unit is measured for each health care setting (e.g., inpatient days for acute settings) (LCN, 2013). Because the intensity factor varies tremendously by health care setting, the model separates the demand for nurses by setting. The various settings delineated in the model are hospital inpatient care, emergency department, ambulatory care, nursing homes/facilities, home health, community health, public health, nursing education, and others, including health care–related set-

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TABLE 1

Components of the Louisiana Forecasting Model

The Supply Model

Components of the supply side of the model include:

- Number of newly licensed nurses (registered nurses, advanced practice registered nurses, and licensed practical nurses)
- Demographics of the nurse workforce (e.g., age)
- Work patterns of the nurse workforce (e.g., number of hours worked).

The Demand Model

Components of the demand side of the model include:

- Population demographics
  - Age
  - Gender
  - Degree of urbanization
- Amount of health care by setting required by the population
  - Inpatient care (inpatient days)
  - Emergency department visits
  - Ambulatory visits
  - Long-term care (resident days)
  - Home health visits
  - Community health (nurses per 10,000 population)
  - Public health (nurses per 10,000 population)
  - Nursing education
  - Other (health care settings other than the ones listed)
- Number of nurses required to provide each "unit" of health care
  - Nurse-to-health care–unit-ratio expressed in full-time equivalents
  - Ratio of nurses working in each health care setting to the estimated demand
- Adjustments that can be made to the demand side of the model
  - Percent of patients coming from outside the region for treatment
  - Migration of older households moving into the region

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tings other than the eight listed here (e.g., free-standing dialysis centers).

Sensitivity Analysis

Sensitivity analysis, the ability to determine how sensitive a change in supply or demand for FTE nurses is, can also be tested with the model. For example, the number of newly licensed nurses can be changed in the model to show how the change affects the supply and demand for nurses through 2020. By running the Louisiana Multi-Regional Statewide Nursing Workforce Forecasting Model with different numbers of newly licensed nurses but keeping all other numbers unchanged, the number of FTE newly licensed nurses who will need to be employed to positively affect a change in the yearly supply of FTE nurses can

be determined. This information could be useful as a strategy to increase the overall supply of FTE nurses in Louisiana.

Ongoing Validation of the Model

The Louisiana Multi-Regional Statewide Nursing Workforce Forecasting Model was thoroughly vetted, documented, debugged, tested, and verified throughout the development process, and a thorough quality-control check was performed by the researcher team after development. Throughout the development phase, model performance was continually compared to the study data and was reviewed with the quality-control team, who gave feedback on the accuracy of the results. This iterative development process, although time consuming, helped establish credibility with the stakeholders and trust in computer-generated analyses.

Outcomes

Nursing Workforce Forecasts

The Louisiana Multi-Regional Statewide Nursing Workforce Forecasting Model was updated for the first time since its development in 2013 with the 2014 licensure renewal data from both LSBN and LSBPNE. This was also the first year LSBPNE conducted online licensure renewal, which allowed for the capture of data reflecting where LPNs were working (zip code), thus enhancing the accuracy of the regional forecasts for LPNs.

Key findings from the updated model indicate the following:

- Although a statewide shortage will exist through 2020 for RNs, APRNs, and LPNs based on current conditions, there will be large regional differences in shortages and surpluses across Louisiana.
- By 2020, the demand for RNs will exceed the supply, resulting in more than 1,700 unfilled FTEs statewide.
- Based on the current intensity factor for APRNs in Louisiana and a growth rate of 4% annually for APRNs in both the inpatient and ambulatory care settings, the demand for APRNs will exceed supply by more than 1,400 FTEs by 2020.
- The demand for LPNs will continue through 2020 in five of the eight regional labor market areas: Baton Rouge, Houma, Lake Charles, New Orleans, and Shreveport.

Implications and Conclusions

The Louisiana Multi-Regional Statewide Nursing Workforce Forecasting Model can serve as a important policy tool that can be used to simulate "what if" scenarios. These scenarios can be employed to help identify the most effective strategies to manage anticipated nurse shortages in Louisiana.

The key to replication of Louisiana's forecasting model is having good state-level data and collaborating partners who see the benefit of such a model. Boards of nursing and nursing

workforce centers play essential roles in achieving accurate and meaningful forecasts through the collection of comprehensive nursing workforce data. One of the major limitations associated with the forecast model is that no national norms were available concerning intensity factors for APRNs and LPNs for comparison with state-level intensity factors. National norms for intensity factors for RNs were available and served as benchmarks for the state and regional intensity factors.

Louisiana's forecasting model is an ever-evolving entity. Because it is based on assumptions relative to the changes taking place in the regional, state, and national health care system, it will be important for all stakeholders to stay abreast of changes occurring in health care, such as those involving health care technology, the nursing workforce, population demographics, and economic development.

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