Working Paper #90

Washington State's Pharmacist Workforce through 2020: Influential Factors and Available Data

February 2004

by

Davis G. Patterson, MA
Susan M. Skillman, MS
L. Gary Hart, PhD

This research was funded by Grant #1 U79 HP 00007-01 from the HRSA Bureau of Health Professions, National Center for Health Workforce Analysis. The authors thank Alice Porter for her superb editing and Seth Blades for valuable research assistance.

WWAMI CENTER FOR HEALTH WORKFORCE STUDIES

UNIVERSITY OF WASHINGTON • SCHOOL OF MEDICINE • DEPARTMENT OF FAMILY MEDICINE

ABOUT THE WORKFORCE CENTER

The WWAMI Center for Health Workforce Studies at the University of Washington Department of Family Medicine is one of six regional centers funded by the National Center for Health Workforce Analysis (NCHWA) of the federal Bureau of Health Professions (BHPr), Health Resources and Services Administration (HRSA). Major goals are to conduct high-quality health workforce research in collaboration with the BHPr and state agencies in Washington, Wyoming, Alaska, Montana, and Idaho (WWAMI); to provide methodological expertise to local, state, regional, and national policy makers; to build an accessible knowledge base on workforce methodology, issues, and findings; and to provide wide dissemination of project results in easily understood and practical form to facilitate appropriate state and federal workforce policies.

The Center brings together researchers from medicine, nursing, dentistry, public health, the allied health professions, pharmacy, and social work to perform applied research on the distribution, supply, and requirements of health care providers, with emphasis on state workforce issues in underserved rural and urban areas of the WWAMI region. Workforce issues related to provider and patient diversity, provider clinical care and competence, and the cost and effectiveness of practice in the rapidly changing managed care environment are emphasized.

The University of Washington Rural Health and Health Workforce Research Center Working Paper Series is a means of distributing prepublication articles and other working papers to colleagues in the field. Your comments on these papers are welcome and should be addressed directly to the authors. Questions about the WWAMI Center for Health Workforce Studies should be addressed to:

L. Gary Hart, PhD, Director and Principal Investigator
Susan Skillman, MS, Deputy Director
Roger Rosenblatt, MD, MPH, Co-Investigator
Laura-Mae Baldwin, MD, MPH, Co-Investigator
Denise Lishner, MSW, Center Research Coordinator
Eric Larson, PhD, Senior Researcher
Heather Deacon, Program Coordinator
Martha Reeves, working paper layout and production
University of Washington
Department of Family Medicine
Box 354982
Seattle, WA 98195-4982
Phone: (206) 685-6679
Fax: (206) 616-4768
E-mail: deac@fammed.washington.edu
Web Site: http://www.fammed.washington.edu/CHWS/

The WWAMI Center for Health Workforce Studies is supported by the Bureau of Health Professions' National Center for Health Workforce Information and Analysis. Grant No. 1U76-MB-10006-03; $250,000; 100%.

ABOUT THE AUTHORS

DAVIS G. PATTERSON, MA, is a Graduate Research Assistant in the WWAMI Center for Health Workforce Studies, Department of Family Medicine, University of Washington School of Medicine.

SUSAN M. SKILLMAN, MS, is the Deputy Director of the WWAMI Center for Health Workforce Studies, Department of Family Medicine, University of Washington School of Medicine.

L. GARY HART, PhD, is Director of the WWAMI Center for Health Workforce Studies and Professor in the Department of Family Medicine, University of Washington School of Medicine.

Washington State's Pharmacist Workforce through 2020: Influential Factors and Available Data

DAVIS G. PATTERSON, MA
SUSAN M. SKILLMAN, MS
L. GARY HART, PhD

EXECUTIVE SUMMARY AND QUESTIONS FOR REVIEW

This report describes the efforts of the University of Washington Center for Health Workforce Studies to identify trends in Washington's pharmacist workforce. We based our analysis state licensing data, hospital staffing data, educational completions data, and population census data. From these sources, we developed models to project supply and demand for pharmacists through the end of the next decade.

In common with other states, Washington is experiencing a shortage of pharmacists. Our models suggest that the current shortage of pharmacists is likely to continue until at least 2008, at which time the projections diverge. One model projects a growing surplus; the other projects a worsening shortage. The model projections, however, should be considered in light of the limitations both in reliable data and readily available supporting literature. We offer these projections for discussion and critique as an opportunity to explore possibilities for improving data sources and our understanding of this issue.

IMPORTANT FACTORS AFFECTING THE PHARMACY WORKFORCE

Several factors may affect the future supply and demand of pharmacy services, including the following:

- Both pharmacy school applicants and graduates declined in the late 1990s, but increased state funding has recently expanded enrollment capacity.
- Improvements in information technology and automation of prescription fulfillment will increase the productivity of dispensing pharmacists, effectively increasing supply.
- The recent transition to the required Doctor of Pharmacy degree requires more existing pharmacists to educate new ones, reducing the supply of pharmacists providing patient services. The longer training time may also reduce supply by making entry into the profession more difficult.
- A chronic shortage is likely to increase job dissatisfaction and exits from the profession as working conditions become more stressful and less flexible.
- Women represent an increasing proportion of the pharmacist workforce. Women's professional lives tend to be shorter than men's, reducing the average supply of services provided per pharmacist.
- An aging workforce, combined with an aging population needing more services, could create a shortage of pharmacists.
- Pharmacist roles are expanding from dispensing of prescriptions to increasing involvement in activities to improve patient care, increasing total pharmacist demand.
- New and increasingly complex drug therapies increase the demand for pharmacist services in dispensing, patient education, and monitoring.
- Insurance coverage of prescription drugs is expanding, leading to increased demand.

RESEARCH APPROACH AND LIMITATIONS

To model pharmacist supply and demand in Washington State, we used four principal data sources: (1) 1998-1999 state licensing data and a supplementary licensing survey from the Washington State Department of Health Office of Health Professions Quality Assurance, (2) a 2002 study of staffing in nonfederal acute care hospitals by the University of Washington Center for Health Workforce Studies and the Washington State Hospital Association, (3) educational completions data for pharmacy programs in the state from 1996 to 2003, and (4) U.S. Census Bureau state population data.

These are the best data available for Washington, but they are missing critical information needed for making accurate workforce projections. For example,

data are not available on job turnover, provider migration in or out of the state, and exits from the profession. We had to model total supply and demand for all sectors by extrapolating from hospital data because nonhospital data on pharmacists were not available. Our assumptions about changes in Washington's total population and educational capacity are probably oversimplified. We are not able to predict or quantify future changes in the state's health services delivery system and health policy. Our analysis of aggregate state supply and demand could mask critical shortages in specific regions and communities of Washington State. In addition, projections of the relatively small pharmacist workforce are more volatile than are projections for larger workforces (pharmacists number in the 4,000s, compared with nursing, for example, in the 50,000s).

RESULTS

This report shows one method of projecting pharmacist workforce demand and two alternative methods of projecting supply. The same demand model is compared with each supply model to generate two scenarios assessing the balance between supply and demand. All values reported represent persons, not positions or FTEs. Following are descriptions of these models and their projections:

Demand Model: We used state total population projections from the U.S. Census Bureau and hospital-sector vacancies to model demand. We extrapolated from hospital employment and vacancies to estimate total state employment and vacancies (both hospital and nonhospital sectors). There were 514 vacancies in 2003, a 10.7 percent shortfall of pharmacists in the state. The model projects an annual increase in demand, based on population growth, ranging from 59 to 63 providers through 2020.

Supply Model I: This model estimates future supply as a function of recent trends in state licensing of pharmacists, supplemented by data from two surveys. Supply Model I projects increases of 164 employed pharmacists per year. Supply increases relative to demand, with equilibrium around 2008, and eventually outstrips demand by 20.8 percent in 2020.

Supply Model II: This model estimates future supply as a function of educational completions and provider retirements, also supplemented by data from two surveys. Model II assumes that recent expansions of educational capacity will be sustained, yielding 154 to 155 new graduates annually beginning in 2007. But projected retirements and increased demand caused by population growth more than offset this expansion. Unlike Supply Model I, Supply Model II projects decreases in supply relative to demand. The shortage of pharmacists increases to 30.2 percent in 2020.

QUESTIONS FOR REVIEW

Our models project two divergent trends in the supply of Washington State's pharmacists—a future surplus or a shortage. These models were developed with very limited data. Before such projections can be used to inform policy, they must be reviewed by stakeholders familiar with the environment in which this workforce operates. These stakeholders can provide subjective assessments of how the profession is likely to change where quantifiable data do not exist currently, and they can generate estimates about how these changes may affect workforce supply and demand. Below are some questions for which we seek stakeholder input. This list is not exhaustive, and we welcome additional insights regarding influential factors and useful trend data.

(1) Is Washington heading for a shortage or a surplus of pharmacists after 2008? How realistic are the future demand estimates in this report, which are based solely on state population growth?

(2) What are the pressures facing the educational pipeline to pharmacy in Washington State?

(3) How many of Washington's pharmacists were trained out of state? How many of those trained in Washington stay here to work? What is the net impact on supply?

(4) This report makes no distinctions between different types of pharmacy services. How do the prospects for different areas of pharmacy practice (e.g., order fulfillment, primary care, secondary and tertiary services) differ?

(5) How do the hospital and nonhospital sectors compare? When only hospital vacancy rates are available and these are used to estimate nonhospital vacancies, what kind of error (if any) is introduced?

(6) How equitably are pharmacists distributed throughout the state? Are there area shortages or surpluses? What are differences by sector or facility type?

(7) How will new pharmacy technology and new drug therapies affect supply and demand?

(8) How can we obtain more recent and accurate data to assess the current pharmacist workforce? What are practical long-term strategies for creating the data needed to monitor pharmacist supply and demand on an ongoing basis?

(9) What new state and federal policies may change pharmacist supply and demand?

(10) Will economic changes (e.g., recession) cause population demand for care to increase or decrease substantially during the next decade?

Washington State's Pharmacist Workforce through 2020: Influential Factors and Available Data

INTRODUCTION

The Bureau of Health Professions forecasts a 14.5 percent increase in the number of pharmacists nationally from 2000 to 2010 (Bureau of Health Professions, 2000). Applications and enrollments in pharmacy schools declined in the late 1990s, while the demand for pharmacists continues to rise with an aging population, new drug therapies, and changing pharmacist roles (Bureau of Health Professions, 2000). The supply of pharmacists varies widely from state to state, but there is evidence for a shortage currently nationally and locally (Bureau of Health Professions, 2000; Knapp, 2002; Skillman et al., 2003).

How will the supply and demand of pharmacists change in the state of Washington, and what factors will affect the pharmacist workforce? We reviewed literature on the pharmacist workforce and analyzed existing data in an attempt to answer these questions. We were able to identify numerous trends in pharmacy practice and health care, but because of serious limitations in the availability of data for Washington State, we are able to offer only rudimentary and tentative answers to these questions. The overriding message of this exercise is that we need much more data just to understand the current state of affairs, and projections of future supply and demand should be viewed as exploratory rather than predictive, subject to a number of influential trends that we have few or no data to quantify.

FACTORS AFFECTING SUPPLY AND DEMAND OF PHARMACISTS

Supply refers to the number of pharmacy services that can be provided. Supply is affected over time either by changes in the number of providers or changes in the conditions of service provision. For example, an aging workforce decreases the supply of providers—and therefore the supply of services—through deaths and retirements. Increases in productivity—the unit of output per unit of input—increase the supply. An increase in the supply of services does not necessarily mean an increase in the number of persons providing those services. For example, new technology that allows more prescriptions to be dispensed per full-time equivalent provider, or FTE, causes an increase in the total supply of services.

Demand refers to the actual number of pharmacy services that the population is willing and able to pay for, regardless of financing or whether services are necessary. Population growth and population aging, all other things being equal, lead to a higher total burden of disease and thus a higher demand for health care services.

The pharmacy profession is undergoing rapid changes that make predicting the future difficult even if data were available for a perfect reading of the current situation. A recent state study showed that pharmacists are one of the most difficult kinds of personnel for hospitals to recruit (Skillman et al., 2003), echoing increasing vacancy rates nationally (Bureau of Health Professions, 2000).

Table 1 shows the most likely factors that will affect the future supply and demand of pharmacists.

It is evident from this table that there are countervailing forces acting on supply levels. At the same time, all signs point to increasing demand for pharmacist services. A brief explanation of these forces follows:

Increases in Educational Capacity: Both pharmacy school applicants and graduates declined nationally in the late 1990s (Bureau of Health Professions, 2000), but increased state funding has recently expanded enrollment capacity (Health Care Personnel Shortage Task Force, 2004).

Increased Productivity: Improvements in information technology and automation of prescription fulfillment will increase the productivity of dispensing pharmacists, effectively increasing supply (Knapp, 2002).

Increased Length of Training: The baccalaureate degree in pharmacy has been phased out nationally, and all new pharmacists are now required to obtain the Doctor of Pharmacy degree. This change requires more existing pharmacists to educate new ones,

reducing the supply of pharmacists providing patient services. The longer training time may also reduce supply by making entry into the profession more difficult (Bureau of Health Professions, 2000).

Declining Job Satisfaction: A chronic shortage of pharmacists is likely to decrease job satisfaction as working conditions become more stressful and less flexible. These changes could in turn lead some to abandon the profession (Bureau of Health Professions, 2000).

Table 1. Factors Affecting Supply and Demand of Pharmacists

Factor	Effect on Supply	Effect on Demand
Increases in educational capacity	Increase	
Increased productivity	Increase	
Increased length of training	Decrease	
Declining job satisfaction	Decrease	
Increasing proportion of women pharmacists	Decrease	
Aging workforce and population	Decrease	Increase
Expanded professional roles		Increase
New drug therapies		Increase
Expanded insurance coverage		Increase

Increasing Proportion of Women Pharmacists: Women represent an increasing proportion of the pharmacist workforce (Bureau of Health Professions, 2000). Overall, women's professional lives in pharmacy tend to be shorter than men's (Bureau of Health Professions, 2000). This shift in the gender composition of the workforce reduces the total per capita level of services provided when compared with the historically male-dominated workforce.

Aging Workforce and Population: An aging workforce, combined with an aging population needing more services, could create a shortage of personnel or exacerbate current shortages (Levenson, 2002). In Washington, from 1995 to 2025, the proportion of the population age 65 and over will nearly double from 11.6 percent to 20.2 percent (U.S. Census Bureau).

Expanded Professional Roles: Pharmacist roles are expanding from dispensing of prescriptions to increasing involvement in activities to improve patient care, increasing total demand for pharmacists (Bureau of Health Professions, 2000; Knapp, 2002).

New Drug Therapies: New drugs are appearing at a faster rate, and the complexity of drug therapies is increasing. These trends increase the demand for pharmacist services in dispensing, patient education, and monitoring (Bureau of Health Professions, 2000; Knapp, 2002).

Expanded Insurance Coverage: Insurance coverage of prescription drugs is expanding, leading to increased demand (Bureau of Health Professions, 2000).

DATA AND METHODOLOGICAL LIMITATIONS

The data and methods used in this analysis suffer from several drawbacks:

Scarcity of Data: Few data relate to the state's pharmacist workforce. The only trend data that exist provide gross numbers of licenses and educational completions. We were able to extrapolate estimates of a few limited aspects of supply and demand using four unrelated sources: a survey of licensees that accompanied the 1998-99 professional licensing and license renewal process, a 2002 survey of hospital administrators, educational program completions data from 1996-2003, and U.S. Census state population data.[1]

We used state licensing data from the Washington State Department of Health Office of Health Professions Quality Assurance. The Department of Health also conducted a supplementary survey during the 1998-99 licensing and renewal process. This provides the most recent survey data available on Washington's credentialed health care professionals. (Note: we are currently in the process of analyzing a 2003 survey of retail pharmacies.)

Another key source of data for this report is a 2002 study of staffing in nonfederal acute care hospitals conducted by the Washington State Hospital Association and the University of Washington Center for Health Workforce Studies (Skillman et al., 2003).

Educational completions data come from the National Center for Education Statistics Integrated Postsecondary Education Data System (NCES IPEDS) and directly from educational program directors in the state from 1996 through 2003.

We could find no data on job turnover, provider migration in or out of the state, or exits from the profession; these and other critical individual variables are not factored into any estimates in this report. In addition, we have not incorporated system-level changes in health care and economic trends into our analysis. In effect, we treated all of these factors as constants, with no net effects on future supply or demand. We know that they will change, but available data do not allow us to take account of their influences at the state level. The limited analysis presented here relies on an extensive set of assumptions that are open to question and revision. For example, our demand model extrapolates from hospital sector vacancies to project demand for the entire state pharmacist workforce. Are vacancy rates the same in the hospital and nonhospital sectors? Projections may be highly sensitive to variations in assumptions and factors external to our analysis. In addition, it must be noted that our demand model is rather simple, based on vacancies. A more sophisticated multivariate economic model that simultaneously includes changes in supply and demand (and accompanying price changes) is even farther beyond present data capability.

Exclusion of Geographic Variation: Pharmacists are unlikely to be perfectly distributed according to local population needs. Adequate data do not exist to analyze regional differences in the pharmacy workforce over time. An analysis of state supply and demand in the aggregate showing an apparent equilibrium or surplus of providers can still mask critical shortages in substate areas.

Size of the Workforce: The pharmacist workforce is small compared to the largest health occupations in the state. It is in the 4,000s, as compared, for example, to nursing, which is in the 50,000s. This smaller size makes projections more volatile. Small annual changes in educational completions, retirement rates, demand for services, etc., can cause much larger fluctuations over time in the balance between demand and supply.

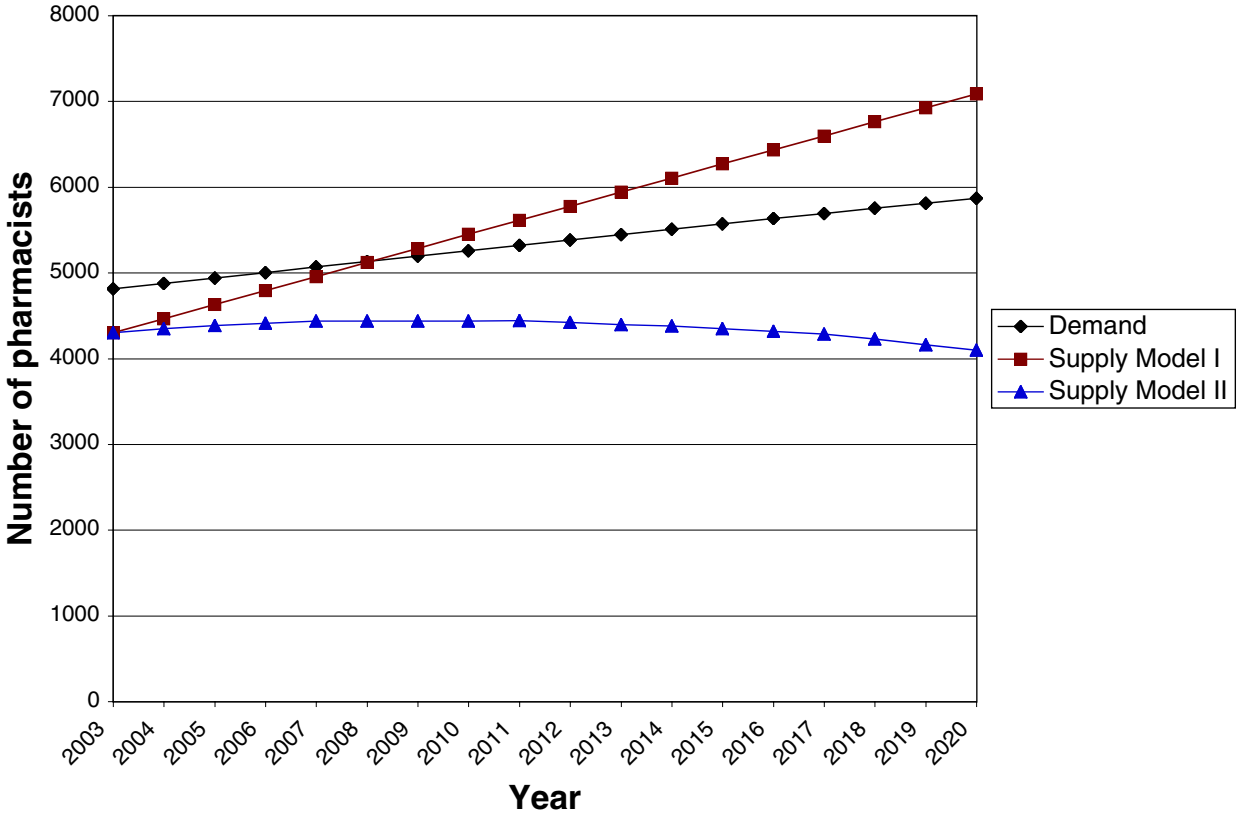
RESULTS

Our analysis of available data on pharmacists in Washington yielded the following results:

Demographics: According to Washington State licensing data in 1998-99, 79 percent of pharmacists in current practice were non-Hispanic white. By comparison, 62 percent of 1999-2000 pharmacy graduates were non-Hispanic white, and 22 percent were Asian or Pacific Islander (Patterson & Skillman, 2002). Sixty-four percent of new graduates in Washington were women in 1999-2000 (Patterson & Skillman, 2002).[2]

Present Shortage of Pharmacists Likely to Continue Until at Least 2008: We created two projection scenarios for this report, shown in Figure 1 (see Appendix for a detailed explanation of methods). Both scenarios assume that demand for services and rates of increase in supply of providers (adjusted for population growth) will continue at current levels. Both scenarios, based on the 2002 hospital vacancy rate of 10.7 percent, suggest that the current statewide shortage is likely to continue until at least 2008. But the two scenarios show divergent trends. One scenario, using licensing trends, projects a steady increase in supply, erasing the shortage around 2008 and producing a 20.8 percent surplus of pharmacists by 2020. An alternative scenario projects declining supply as retirements and increasing demand outstrip educational output, leading to a 30.2 percent shortage by 2020.

Figure 1. Pharmacists in Washington State 2003-2020: A Demand Model and Two Alternative Supply Models



Projections include the following state-level data:

- Total active professional licenses.
- Hospital pharmacist employees and vacancies.
- Total general population projections.
- Pharmacist program completions.
- Retirement projections.

Unavailable data that would improve projections:

- Need and distribution of professionals in substate areas.
- Trend data on vacancies/turnover.
- Practice characteristics (e.g., full- v. part-time, career length, specialty practice).
- Job satisfaction and compensation.
- Nonhospital employees/vacancies.
- Demand differentials by demographic group (burden of disease by age, ethnicity, urban/rural, etc.).
- Migration in and out of state.
- Regulation and credentialing changes.
- Scope of practice changes.
- Educational trends (e.g., cost, availability, demand for training).
- Technological change (e.g., productivity, new therapies).
- Macroeconomic trends affecting health care (e.g., total economic growth, trends in insurance coverage).
- Other health care systems/organizational trends.

QUESTIONS RAISED BY THIS REPORT

Our models project two divergent trends in the supply of Washington State's pharmacists—a future surplus or a shortage. These models were developed with very limited data. Before such projections can be used to inform policy, they must be reviewed by stakeholders familiar with the environment in which this workforce operates. These stakeholders can provide subjective assessments of how the profession is likely to change where quantifiable data do not exist currently, and they can generate estimates about how these changes may affect workforce supply and demand. Below are some questions for which we seek stakeholder input. This list is not exhaustive, and we welcome additional insights regarding influential factors and useful trend data.

(1) Is Washington heading for a shortage or a surplus of pharmacists after 2008? How realistic are the future demand estimates in this report, which are based solely on state population growth?

(2) What are the pressures facing the educational pipeline to pharmacy in Washington State?

(3) How many of Washington's pharmacists were trained out of state? How many of those trained in Washington stay here to work? What is the net impact on supply?

(4) This report makes no distinctions between different types of pharmacy services. How do the prospects for different areas of pharmacy practice (order fulfillment, primary care, secondary and tertiary services) differ?

(5) How do the hospital and nonhospital sectors compare? When only hospital vacancy rates are available and these are used to estimate nonhospital vacancies, what kind of error (if any) is introduced?

(6) How equitably are pharmacists distributed throughout the state? Are there area shortages or surpluses? What are differences by sector or facility type?

(7) How will new pharmacy technology and new drug therapies affect supply and demand?

(8) How can we obtain more recent and accurate data to assess the current pharmacist workforce? What are practical long-term strategies for creating the data needed to monitor pharmacist supply and demand?

(9) What new state and federal policies may change pharmacist supply and demand?

(10) Will economic changes (e.g., recession) cause population demand for care to increase or decrease substantially during the next decade?

APPENDIX: A DEMAND MODEL AND TWO ALTERNATIVE SUPPLY MODELS

This report shows one method of projecting pharmacist workforce demand and two alternative methods of projecting pharmacist supply. These models were developed using the best data available for Washington. The same demand model is compared with each supply model to generate two scenarios assessing the balance between supply and demand. All values reported represent persons, not positions or FTEs. The shaded rows in the accompanying tables are the raw numbers representing the principal components of provider supply and demand that add up to each year's projected total surplus or shortage (covered under the Results section of each analysis).

DEMAND MODEL

This model uses state population projections and data on hospital pharmacist employees and vacancies. We extrapolated from hospital employment and vacancies to estimate total state employment and vacancies (hospital and nonhospital sectors). This current total demand value was then adjusted to take account of increasing demand resulting from population growth in each subsequent year.

The following detailed explanations refer to the Demand Model in Tables A1 and A2 where rows are numbered D1-D3:

(D1) We obtained state population projections for 2000, 2005, 2015, and 2025 from the U.S. Census Bureau. We assumed that population would grow at a constant rate in each of the years between these estimates.

(D2) We calculated the total demand in 2003 as the sum of currently practicing (S3, explained below), 4,300, and vacancies (results row 1, explained below), 514. This yields a demand of 79 providers per 100,000 population. We assumed this rate of demand through 2020. Thus demand grows in constant proportion to population growth.

(D3) The net annual increase in demand due to population growth, maintaining a ratio of 79 providers per 100,000, ranges from 59 to 63 providers per year through 2020.

SUPPLY MODEL I: LICENSING TRENDS

This model uses recent trends in state licensing of pharmacists to project future supply. We did not have information about the specific components that led to yearly changes in the number of licenses. Therefore, we assumed (recognizing this is likely an oversimplification) that whatever combination of forces driving these increases historically would continue at about the same rate.

The following detailed explanations refer to Supply Model I in Table A1, rows S1-S5:

(S1) 1996-2001 figures are derived from the Washington State Department of Health's biennial reports summarizing total active licenses as of July 30 in odd years. Summary data were available from 1993 through 2001, inclusive. We estimated even years as the midpoints between numbers of licenses in odd years. We derived figures for 2002 and 2003 by adding the mean yearly increase for this five-year period of available data. Based on our analysis of 1999 licensing data, we know that total active licenses overestimate supply because these numbers include licensees not in practice and some duplicate records.

(S2) Yearly net increases in active licensees for 1996 through 2000 inclusive are based on actual licensing data as reported in (S1). We used the mean yearly increase for this five-year period, 276, as the estimate for increases from 2001 to 2020.

(S3) Data come from two sources, for two years only: a survey of licensees that accompanied the 1999 professional licensing and license renewal process, and a 2002 survey of hospitals in Washington State (Skillman et al., 2003).

The 1999 value was derived from the licensing data as follows:

— We based all estimates on only active licensees working or living in Washington who were currently practicing, up to age 65, inclusive. All others were excluded from our analysis.

— 3,787 licensees of 4,090 responding to the survey indicated that they were currently engaged in nonvolunteer practice (92.9%).

— 326 active licensees (fitting all other criteria) did not respond to the survey. We assumed that they were in current practice at the same rate as respondents, 92.9 percent, yielding an additional 303 providers.

— Currently practicing survey respondents (3,787) and imputation for missing responses (303) total 4,090. Since nonpracticing licensees may have been more likely not to respond to the survey, this total is likely to be an overestimate.

The 2003 value was derived from hospital survey data as follows:

— The proportion of 1999 licensees indicating employment in hospital inpatient or emergency departments (excluding outpatient care) was 21.0 percent. We assumed that the same proportion of pharmacists in 2003 were employed in hospitals to derive the size of the total pharmacist workforce as follows:

— There were an estimated 931 pharmacist positions in nonfederal acute care hospitals in 2003. To adjust for possible overcounting of persons occupying multiple positions in different locations (or more than one type of pharmacist position at the same location), we adjusted this value downward based on the fact that 3.1 percent of 1999 licensees giving a work location indicated two different hospital sites. Performing this adjustment yields 903 hospital providers. Assuming they constitute 21.0 percent of the total state workforce, as hospital providers did in 1999, the total number of providers is 4,300.

We estimated that the number of licensees in the intervening years (2000-2002) increased at a constant rate based on the 1999 to 2003 average yearly change. Using this method, note that the number of providers per 100,000 appears to have remained almost constant from 70.8 in 1999 to about 70.5 in 2003.

(S4) We estimated the proportion of active licensees (S1) who are currently practicing (S3) from 1999 through 2003 by dividing (S1) by (S3). This proportion declines from 64.8 percent to 55.6 percent, averaging 59.4 percent during the period. This change over time may be the result of differences in the data sources used to estimate currently practicing providers for 1999 and 2003 or some other source of error. Alternatively, these numbers may reflect a real decline.

(S5) For the years 1999 through 2002, the increase in the number of licensees in current practice is derived from the annual increase in total employment estimated in (S3). As explained above, the values in (S3) were based on two different sources of data, one yielding an estimate of employment for 1999, the other for 2003. The average annual increase in currently practicing licensees between these two time points was 52.

To project future growth in currently practicing licensees from 2003 through 2020, the model begins by looking at the growth trend in total licensees from 1996 through 2001. During this period, total licensees grew at a mean annual rate of 276 (S2). We used this historical mean annual growth rate in total licenses to estimate the future annual rate of increase. To obtain estimates of only those pharmacists currently practicing, total licensees (which include both pharmacists in practice and those not in practice who continue to maintain their licenses) must be adjusted downward. We adjusted the annual increase in licensees of 276 to reflect that on average, only 59.4 percent of active licensees (estimated in S4 above) were employed as pharmacists from 1999 through 2003. This adjustment yields an annual increase of 164 providers from 2003 to 2020.

Results: The following detailed explanations refer to the Results Section of Table A1, rows 1 and 2:

(1) Hospital administrators surveyed in 2002-2003 (Skillman et al., 2003) reported an estimated 108 vacancies. We adjusted this value to account for possible coverage of more than one position by a single provider and then estimated vacancies in all settings (hospital and nonhospital sectors), as in (S3) above. These adjustments yielded 514 total vacancies. We projected vacancies in each subsequent year by adding the annual increase in demand (D3) and subtracting new providers (S5).

(2) Vacancies are expressed as a percentage of total demand in each year. A positive number represents a shortfall of providers; a negative number represents a surplus.

Summary of Supply Model I: The number of pharmacist licensees increased during the years for which we have data (1995 to 2001) at an average rate of 276 per year. We were able to derive estimates of the proportion of active licensees in practice during each year from 1999 to 2003. From analysis of state health professions licensing data, we know that an average of 59.4 percent of active licensees were in practice during each year of this period. We applied this proportion to our estimates of future annual increases in licenses. Using this method, we projected increases in employed pharmacists of 164 per year. The annual increase in demand, based on population growth, ranges from 59 to 63 through 2020. Beginning with 514 vacancies in 2003, a 10.7 percent shortfall of pharmacists in the state, Supply Model I shows increases in supply relative to demand, with

equilibrium around 2008. In this model, supply eventually outstrips demand by 20.8 percent in 2020. Policy interventions would probably ensure that an impending surplus of this magnitude would never come to pass.

SUPPLY MODEL II: EDUCATIONAL OUTPUT AND RETIREMENTS

This model uses data on educational completions and provider ages to project future supply. We attempted to estimate net change in supply by taking account of newly educated entrants to the profession and exits due to retirement.

The following detailed explanations refer to Supply Model II in Table A2, rows S1-S8:

(S1) Same as Supply Model I, (S1).

(S2) Same as Supply Model I, (S3).

(S3) Same as Supply Model I, (S4).

(S4) Same as Supply Model I, (S5), years 1999 through 2002, for comparison purposes only. Supply increases based on actual employment estimates are similar to what would be expected based merely on educational completions net of retirements, the method we employed in this model.

(S5) We obtained completions data from two sources. NCES IPEDS data for Washington's two pharmacy programs are publicly available for the years 1996-98 and 2000. We obtained data for 1999 and 2001-03 directly from the programs.

A shortage of pharmacists in Washington has resulted in the appropriation of funds to increase enrollment capacity in pharmacy programs (Health Care Personnel Shortage Task Force, 2004). This increase will result in 16 additional graduates annually beginning in 2007 (William E. Fassett, Ph.D., Dean, Washington State University College of Pharmacy, personal communication, February 17, 2004). We projected educational completions to continue at the higher rate beginning in 2007 to take account of this capacity increase. The imputed value of 138.5 completions per year from 2004 through 2006 is the annual mean of the completions for the eight prior years of available data (1996-2003). We assumed that all program completers sit for and pass the licensing exam.

(S6) At any given time, some proportion of program completers will not be in practice. Our estimates, based on available licensing and practice data, suggest that about 59.4 percent of current license holders are in active practice (as in Supply Model I, row S4). We adjusted values downward by this proportion to yield active providers resulting from yearly program completions.

(S7) The 1998-99 state licensing survey asked licensees their age. We had no data on exits from the profession due to death, outmigration, change in occupation, etc., and therefore attrition in our model is captured exclusively through aging out providers surveyed in 1998-99 as they reach age 65.[3]

(S8) The net annual increase in supply is simply the difference between the gain from completions (S6) less retirements (S7).

Results: The following detailed explanations refer to the Results Section of Table A1, rows 1 and 2. These methods are the same as those used to derive the results for Supply Model I:

(1) Hospital administrators surveyed in 2002-03 (Skillman et al., 2003) reported an estimated 108 vacancies. We adjusted this value to account for possible coverage of more than one position by a single provider and then estimated vacancies in all settings (hospital and nonhospital sectors), as in (S3) above. These adjustments yielded 514 total vacancies. We projected vacancies in each subsequent year by adding the annual increase in demand (D3) and subtracting new providers (S5).

(2) Vacancies are expressed as a percentage of total demand in each year. A positive number represents a shortfall of providers; a negative number represents a surplus.

Summary of Supply Model II: The number of educational completions from 1996 to 2003 averaged 138.5 pharmacists per year. Recent expansion of capacity will add 16 graduates annually beginning in 2007. For purposes of this projection, we assumed that all completers of pharmacy programs would obtain a license to practice. From analysis of the state health professions licensing data we know that an estimated 59.4 percent of active pharmacist licensees are in practice at any given time. We adjusted educational output in each year using this percentage, which resulted in increases to supply of 82 to 92 providers per year. Our projections of retirements, based on ages of licensed providers, result in annual reductions to supply that grow from 45 in 2003 to 161 in 2020. Our estimates of the annual increase in demand, based on population growth, range from 59 to 63 through 2020. Beginning with 514 vacancies in 2003, a 10.7 percent shortfall of pharmacists in the state, Supply Model II shows steady decreases in supply relative to demand. The shortage of pharmacists increases to 30.2 percent in 2020.

Table A1. Projections Using Supply Model I: Pharmacist Licensing Trends

Supply Model I	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(S1) Active licensees	5,803	5,855	6,084	6,313	6,748	7,183	7,459	7,735																	
(S2) Net increase in active licensees	52	229	229	435	435	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276	276
(S3) Total currently practicing (per 100,000)				4,090 (70.8)	4,142 (70.7)	4,195 (70.6)	4,247 (70.6)	4,300 (70.5)																	
(S4) Proportion of active licensees currently practicing				64.8%	61.4%	58.4%	56.9%	55.6%																	
(S5) Net increase in currently practicing				52	52	52	52	164	164	164	164	164	164	164	164	164	164	164	164	164	164	164	164	164	164

Demand Model	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(D1) State population (in 1000s)	5,516	5,602	5,687	5,773	5,858	5,938	6,018	6,098	6,178	6,258	6,338	6,418	6,498	6,578	6,658	6,738	6,818	6,898	6,978	7,058	7,133	7,208	7,283	7,358	7,433
(D2) Total demand (79 per 100,000)								4,814	4,877	4,940	5,003	5,066	5,129	5,192	5,255	5,318	5,381	5,444	5,507	5,570	5,633	5,692	5,751	5,810	5,869
(D3) Annual increase in demand								63	63	63	63	63	63	63	63	63	63	63	63	63	59	59	59	59	59

Results	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(1) Total vacancies								514	413	312	211	110	9	-92	-193	-294	-395	-496	-597	-698	-799	-904	-1,009	-1,114	-1,219
(2) Vacancies / total demand (%)								10.7	8.5	6.3	4.2	2.2	.2	-1.8	-3.7	-5.5	-7.3	-9.1	-10.8	-12.5	-14.2	-15.9	-17.5	-19.2	-20.8

Table A2. Projections Using Supply Model II: Pharmacist Educational Output and Retirements

Supply Model II	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(S1) Active licensees	5,803	5,855	6,084	6,313	6,748	7,183	7,459	7,735																	
(S2) Total currently practicing (per 100,000)				4,090 (70.8)	4,142 (70.7)	4,195 (70.6)	4,247 (70.6)	4,300 (70.5)																	
(S3) Proportion of active licensees currently practicing				64.8%	61.4%	58.4%	56.9%	55.6%																	
(S4) Net increase in currently practicing in Model I row (S5)				52	52	52	52																		
(S5) Educational completions	161	164	68	136	150	137	138	154	138	139	138	155	154	155	154	155	154	155	154	155	154	155	154	155	154
(S6) New completers currently practicing				81	89	81	82	91	82	82	82	92	91	91	92	91	91	92	91	91	92	91	91	92	91
(S7) Retirements				26	38	36	53	45	45	54	57	93	92	91	87	108	120	105	123	121	127	149	157	156	161
(S8) Net increase in currently practicing				55	51	45	29	46	37	28	25	-1	-1	0	5	-17	-29	-13	-32	-30	-35	-58	-66	-64	-70

Demand Model	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(D1) State population (in 1000s)	5,516	5,602	5,687	5,773	5,858	5,938	6,018	6,098	6,178	6,258	6,338	6,418	6,498	6,578	6,658	6,738	6,818	6,898	6,978	7,058	7,133	7,208	7,283	7,358	7,433
(D2) Total demand (79 per 100,000)								4,814	4,877	4,940	5,003	5,066	5,129	5,192	5,255	5,318	5,381	5,444	5,507	5,570	5,633	5,692	5,751	5,810	5,869
(D3) Annual increase in demand								63	63	63	63	63	63	63	63	63	63	63	63	63	59	59	59	59	59

Results	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(1) Total vacancies								514	531	557	592	630	694	758	821	879	959	1,051	1,127	1,222	1,315	1,409	1,526	1,651	1,774
(2) Vacancies / total demand (%)								10.7	10.9	11.3	11.8	12.4	13.5	14.6	15.6	16.5	17.8	19.3	20.5	21.9	23.3	24.8	26.5	28.4	30.2

NOTES

[1] The Labor Market and Economic Analysis Branch of the Washington State Employment Security Department has produced projections and job vacancy estimates, but because their estimates of employment are significantly higher than those suggested by any other data source, we did not incorporate its estimates into this analysis.

[2] Sex is missing for 72 percent of pharmacists in Washington State 1999 licensing data, and not reported here.

[3] Substituting a 2.6 percent retirement rate every year from 2003 through 2020, suggested by William E. Fassett, Ph.D., Dean, Washington State University College of Pharmacy (personal communication, March 19, 2004), changes the supply projection very little. This rate of retirement yields a total of 1,873 vacancies by 2020, a 31.9 percent shortage, compared to this model's estimated vacancy rate of 20.2 percent.

REFERENCES

Bureau of Health Professions (2000). *The pharmacist workforce: a study of the supply and demand for pharmacists*. Rockville, MD: U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions.

Health Care Personnel Shortage Task Force (2004). *Progress 2003: a report of the Health Care Personnel Shortage Task Force*. Olympia, WA: Workforce Training and Education Coordinating Board.

Knapp, D. A. (2002). *Professionally determined need for pharmacy services in 2020*. Retrieved February 17, 2004, from http://aacp.org/site/pdf.asp?TP=/Docs/MainNavigation/Resources/4634_needsconferencefinalreport.pdf.

Levenson, D. (2002). *Hospitals struggling to fill pharmacy, radiological technology staff positions*. Retrieved September 18, 2003, from http://www.hospitalconnect.com:80/jsp/article.jsp?dcrpath=AHA/NewsStory_Article/data/AHANEWS2B241&domain=AHANEWS.

Patterson, D. G., Skillman, S. M. (2002). *Health professions education in Washington State: 1996-2000 program completions statistics*. Working Paper #73. Seattle, WA: Center for Health Workforce Studies, University of Washington.

Skillman, S. M., Hutson, T., Andrilla, C. H. A. (2003). *Washington State hospitals: results of 2003 staffing survey*. Working Paper #79. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

RELATED RESOURCES FROM THE WWAMI CENTER FOR HEALTH WORKFORCE STUDIES AND THE RURAL HEALTH RESEARCH CENTER

PUBLISHED ARTICLES

Benedetti, T. J., Baldwin, L. M., Andrilla, C. H., Hart, L. G. (2004). The productivity of Washington State's obstetrician-gynecologist workforce: does gender make a difference? *Obstetrics and Gynecology*, 103(3), 499-505.

Larson, E. H., Hart, L. G., Ballweg, R. (2001). National estimates of physician assistant productivity. *Journal of Allied Health*, 30(3), 146-152.

Larson, E. H., Palazzo, L., Berkowitz, B., Pirani, M. J., Hart, L. G. (2003). The contribution of nurse practitioners and physician assistants to generalist care in Washington State. *Health Services Research*, 38(4), 1033-1050.

WORKING PAPERS

Baldwin, L.-M., Fay, M. M., Larson, E. H., Lishner, D. M., Mauksch, L. B., Katon, W. J., Walker, E., Hart, L. G. (2003). *Modeling the mental health workforce in Washington State: using state licensing data to examine provider supply in rural and urban areas*. Working Paper #80. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Benedetti, T. J., Baldwin, L.-M., Andrilla, C. H. A., Hart, L. G. (2003). *The productivity of Washington State's obstetrician-gynecologist workforce: does gender make a difference?* Working Paper #82. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Larson, E. H., Palazzo, L., Berkowitz, B., Pirani, M. J., Hart, L. G. (2001). *The contribution of nurse practitioners and physician assistants to generalist care in underserved areas of Washington State*. Working Paper #64. Seattle, WA: WWAMI Rural Health Research Center, University of Washington.

Patterson, D., Skillman, S. M. (2002). *Health professions education in Washington State: 1996-2000 program completion statistics*. Working Paper #73. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Patterson, D. G., Skillman, S. M., Hart, L. G. (2004). *Washington State's dental hygienist workforce through 2020: influential factors and available data*. Working Paper #92. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Patterson, D. G., Skillman, S. M., Hart, L. G. (2004). *Washington State's radiographer workforce through 2020: influential factors and available data*. Working Paper #89. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Skillman, S. M., Hutson, T., Andrilla, C. H. A. (2003). *Washington State hospitals: results of 2002 workforce survey*. Working Paper #79. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Skillman, S. M., Hutson, T., Andrilla, C. H. A., Berkowitz, B., Hart, L. G. (2002). *How are Washington State hospitals affected by the nursing shortage? Results of a 2001 survey*. Working Paper #68. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

Wright, G. E., Paschane, D. M., Baldwin, L. M., Domoto, P., Cantrell, D., Hart, L. G. (2001). *Distribution of the dental workforce in Washington State: patterns and consequences*. Working Paper #60. Seattle, WA: WWAMI Center for Health Workforce Studies, University of Washington.

DATA SNAPSHOTS

WWAMI Center for Health Workforce Studies, University of Washington (2000). *Data snapshot: race and ethnicity of Washington State health professionals compared with state population*. Seattle, WA: Author.

WWAMI Center for Health Workforce Studies, University of Washington (2001). *Data snapshot: licensed practical nurses (LPNs) in Washington: demographics and employment characteristics*. Seattle, WA: Author.

WWAMI Center for Health Workforce Studies, University of Washington (2001). *Data snapshot: registered nurses (RNs) in Washington: demographics and employment characteristics*. Seattle, WA: Author.

WWAMI Center for Health Workforce Studies, University of Washington (2002). *Data snapshot: pharmacists in Washington: demographic and employment characteristics*. Seattle, WA: Author.

For a complete list of publications by the Center for Health Workforce Studies, visit http://www.fammed.washington.edu/CHWS/.