New pharmacist supply projections: Lower separation rates and increased graduates boost supply estimates

Katherine K. Knapp and James M. Cultice

Abstract

Objective: To revise the 2000 Bureau of Health Professions Pharmacist Supply Model based on new data.

Design: Stock-flow model.

Setting: United States.

Participants: A 2004 estimate of active pharmacists reported by the Bureau of Labor Statistics was used to derive the base count for the 2007 supply model.

Interventions: Starting with a 2004 base of active pharmacists, new graduates are added to the supply annually and losses resulting from death and retirement are subtracted.

Main outcome measures: Age- and gender-based pharmacist supply estimates, 2004–2020

Results: Increased U.S. pharmacist supply estimates (236,227 in 2007 to 304,986 in 2020) indicate that pharmacists will remain the third largest professional health group behind nurses and physicians. Increases were driven by longer persistence in the workforce (59%), increased numbers of U.S. graduates (35%), and increases from international pharmacy graduates (IPGs) achieving U.S. licensure (6%). Since more pharmacists are expected to be working part time the full-time equivalent (FTE) supply will be reduced by about 15%. The mean age of pharmacists was projected to decline from 47 to 43 by 2020. Because of unequal distribution across age groups, large pharmacist cohorts approaching retirement age will result in fewer pharmacists available to replace them. The ratio of pharmacists to the over-65 population is expected to decrease after 2011 and continue to fall beyond 2020; this is likely a reflection of baby boomers passing through older age cohorts.

Conclusion: The revised estimated active U.S. pharmacist head count in 2006 is 232,597, with equivalent FTEs totaling approximately 198,000. The substantial increase over the 2000 pharmacist supply model estimates is primarily attributable to pharmacists remaining in the workforce longer and educational expansion. U.S. licensed IPGs account for less than 6% of overall increases. The pharmacist workforce is projected to become younger on average by about 4 years by 2020. Coincident demands for more physicians and nurses over the same period and shortages in all three professions stipulate that active steps be taken, including continued monitoring of work trends among pharmacists and other health professionals.

Keywords: Pharmacists, workforce, supply model, baby boomers, physicians, retired pharmacists, gender.


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The federal government’s 2000 National Pharmacist Workforce Survey of the supply and demand for pharmacists found clear evidence of a shortage of pharmacists and an increase in prescription volume that outpaced the growth in supply of pharmacists. Since then, while the shortage appears to have been moderated by declines in the ambulatory prescription growth rate and changes in pharmacy practice involving wider use of pharmacist technicians and technology, concern remains over the adequacy of the future supply to meet expected demand. The numbers of pharmacists working part time has been increasing, even while pharmacists appear to be staying in the workforce longer. The workload on the individual pharmacist continues to increase, with more time spent in dispensing and administrative duties, usurping the time available for counseling and clinical activities. In addition, while the vacancy rate in community pharmacies has declined since the government’s 2000 study, the downward trend appears to have reversed in the past year toward a more severe national shortage level.

With more than 230,000 pharmacists currently in practice, pharmacy is the third largest health profession in the United States behind nurses (2.4 million) and physicians (830,000). All three of these health professions have reported a supply shortage relative to the demand for services. Unless key factors affecting the balance between supply and demand change considerably, the continued aging of the baby boomer cohort in the U.S. population is likely to sustain or exacerbate existing health care personnel shortages in the near future.

The Bureau of Health Professions (BHPr) Pharmacist Supply Model estimates the size, age, and gender distribution of the active pharmacist workforce in the United States. The model is revised periodically to reflect new or changed source data and has been expanded to estimate the full-time equivalent (FTE) supply, as well as head counts. The present study examines the current and future supply of pharmacists through trends in numbers of new graduates entering the workforce, new schools being built and expansion of existing programs, annual hours worked, age and gender distribution of the pharmacist population, and losses through death and retirement.

Model revision at this time is relevant because events related to the pharmacist shortage could affect key variables used to project the supply of pharmacists. A prime example is age-related separation rates, which reflect the proportion of men and women pharmacists who stop working as pharmacists at each year of age. Under shortage conditions, job-related stress, which tends to increase the likelihood of leaving pharmacy work, and rising salaries, which tend to decrease the likelihood of leaving pharmacy work, were coexistent and may have resulted in new work participation patterns and intrinsically related separation rates. The 2000 Census, which included an expanded work-related sample survey, provided an opportunity to tap into pharmacist work patterns during the peak of the shortage. The current study uses these data to calculate a new set of separation rates.

Another reason for revision is the post-2000 expansion of pharmacy’s educational enterprise through the formation of new schools and the expansion of existing programs—a trend that was not adequately foreseen in the 2000 supply model. The 2000 supply model assumed the addition of three new schools and the expansion of existing programs—a trend to the pharmacist workforce will become increasingly younger (by about 4 years by 2020) and female (more than 62% women pharmacists by 2020). Reductions in ratios of pharmacists per 100,000 over-65 population from 2011 onward and continuing past 2020 are expected as the large baby boomer population cohort moves into retirement age.

At a Glance

**Synopsis:** U.S. pharmacist supply estimates of 236,227 in 2007 and 304,986 in 2020 were determined using a stock-flow model based on a 2004 estimate of active pharmacists reported by the Bureau of Labor Statistics. Pharmacists will remain the third largest professional health group behind nurses and physicians. The increase over a previous supply model estimate was attributed to pharmacists remaining in the workforce longer and educational expansion. The model predicted that the pharmacist workforce will become increasingly younger (by about 4 years by 2020) and female (more than 62% women pharmacists by 2020). Reductions in ratios of pharmacists per 100,000 over-65 population from 2011 onward and continuing past 2020 are expected as the large baby boomer population cohort moves into retirement age.

**Analysis:** Factors affecting pharmacist supply include new graduates entering the workforce, the creation of new schools of pharmacy and expansion of existing programs, annual hours of employment, the age and gender distribution, and losses through death and retirement. The increasing age of the U.S. baby boomer cohort is likely to further exacerbate existing health care personnel shortages in the near future. The loss of experienced pharmacists could accelerate the rate at which younger pharmacists are moved into positions that demand greater responsibility. Ongoing monitoring of work patterns and maintaining pharmacist supply with attention to leadership issues are of utmost importance.
2007 supply model reflects updated U.S. graduate projections. International pharmacy graduates (IPGs) who achieve U.S. pharmacist licensure are another source of supply. The 2007 supply model includes new IPG estimates based on recent data from the Foreign Pharmacy Graduate Equivalency Examination (FPGEE) and the North American Pharmacist Licensure Examination (NAPLEX).

Modeling the pharmacist supply has been critically important to the pharmacist workforce research effort because no strategies for dynamic supply determination currently exist. The most recent past pharmacist census, which was based on state licensure data and reported in 1994, produced supply estimates that closely matched those of the BHPrel at that time. Annual estimates from the Bureau of Labor Statistics (BLS) have, on the other hand, varied significantly from year to year, probably as a result of the small numbers of pharmacists in randomly selected population samples. The BHPrel supply model is therefore an important touchstone for pharmacist workforce research and planning.

**Objective**

Our objective was to elucidate key findings from the 2007 supply model. Based on new data, we sought to further refine the head count estimates generated by the 2007 supply model using FTE participation rates by gender to project estimates of the available pharmacist workforce over time.

**Methods**

The base count for the 2007 supply model is drawn from a 2004 estimate of active pharmacists reported by BLS. The total count is distributed into 50 age groups by gender using data from the 2004 National Pharmacist Workforce Survey. The model projects these numbers forward in time by (1) adding, each year, the projected number of new entrants and (2) subtracting, each year, the projected number of both base-year pharmacists and new entrants who will die or retire. At any point in time, the composite of base-year pharmacists and new entrants who have neither died nor retired constitutes the active pharmacist supply. The 2004 National Pharmacist Workforce Survey found that men worked 91% and women 81% of a 40-hour workweek, together averaging 84% of an FTE workweek. We applied these factors by gender to estimate the projected FTE pharmacist supply.

Separation factors for men and women, composed of estimated deaths and retirements for ages 24 through 74 years, are based on Current Population Survey (CPS) data collected in a 5% sample of the 2000 Census population (approximately 10,000 surveys). The rates are based on the experiences of pharmacists in the sample. By comparison, separation rates in the 2000 supply model were based on 5-year averages of pharmacist work participation. The model was constructed to “retire” all pharmacists by age 75; therefore, we excluded all pharmacists 75 or older when making the projections.

The model includes estimates of IPGs and U.S. graduates. The National Association of Boards of Pharmacy provided data on pharmacists educated outside the United States who achieved U.S. licensure, specifically the number of pharmacists who had successfully completed both the FPGE and the NAPLEX. National Association of Boards of Pharmacy data were available only for 2003 through August 2006. IPGs achieving U.S. licensure numbered 470 in 2003, 875 in 2004, 763 in 2005, and 883 in 2006. Data for 2006 were prorated to a full year based on actual data through August 2006. The mean for the 4 years was 738 new U.S. licensees per year. The U.S.-licensed IPG variable was modeled as a constant, as in the 2000 supply model, with the conservative estimate of 600 IPGs per year based on the limited global resource of eligible IPGs and shortages in countries other than the United States providing competition for these pharmacists. U.S. graduate estimates were based on the assumption that the maturation of new schools and the expansion of existing U.S. PharmD programs would result in an additional 100 graduates each year; this is roughly equivalent to one new school starting to graduate pharmacists each year.

The relative contributions of separation rates, U.S. graduates, and IPGs toward the increase in predicted numbers of pharmacists in 2020 were calculated by using the updated model while first substituting the separation rates used in the earlier model and then substituting both the earlier separation rates and earlier U.S. and IPG graduate trends with the new separation rates and updated post-2004 graduates. Differences in year-to-year projections resulting from the new separation rates and updated trends in U.S. graduates and IPGs were then calculated for each year from 2005 through 2020 and the relative contributions averaged across the projection period.

We developed two alternative supply projections based on different retirement patterns. A basic series used the same separation rates as the 2007 Supply Model. We developed a low series that reflects retirement 2 years earlier and a high series that reflects retirement 2 years later.

To investigate the impact of supply changes in the 2007 supply model relative to population, we calculated pharmacist-to-population ratios for the total U.S. population and the population older than 65 years. The rationale for investigating the over-65 ratio is that the elderly are the largest per capita consumers of prescription medications, which have been shown to be a significant predictor of demand as reflected by pharmacy positions.

**Results**

The supply model projected about 236,000 active pharmacists by 2007, and this increases to almost 305,000 by 2020 (Table 1). The projected supply of active pharmacists for the years 2010, 2015, and 2020 is 14%, 20%, and 27% higher, respectively, than estimates from the 2000 supply model. The model predicts that men and women pharmacists will be equal in number sometime during 2006 or 2007 and that the work-
force will become increasingly female, with more than 62% women pharmacists by 2020. Projections of U.S. graduates exceed 2000 supply model estimates by 546 (7%) in 2005, 2,323 (29%) in 2010, 2,662 (32%) in 2015, and 3,003 (36%) in 2020. IPG estimates exceed 2000 supply model estimates by 286 (91%) each year.

Table 2 shows a partial list of the relative contributions of the three variables to increased supply estimates. Revised separation rates had the largest impact, accounting for 59.5% on average (range, 81.2% in 2005 to 46.6% in 2020). The increase in U.S. graduates had the next largest impact, accounting for 34.8% on average (range, 12.3%–47.6%). IPGs, based on an estimated 600 achieving licensure annually, accounted for 5.7% (range, 6.5%–5.8%).

Based on the dominance of revised separation rates in increasing workforce estimates, we modeled the two rate sets. Figure 1 depicts the rate of workforce depletion over time using a hypothetical 100,000-person workforce and the two sets of separation rates: the BLS-derived rates used in the 2000 supply model and the CPS rates used in the 2007 supply model. By design, all pharmacists were considered retired by age 75. Figure 1 illustrates that the newer rates used in the 2007 supply model result in a slower depletion of the active workforce. The greatest differences in persistence patterns were among older cohorts of pharmacists. The age at which 50% of the

Table 1. Estimated number of men, women, and total pharmacists, 2004–2020

<table>
<thead>
<tr>
<th>Years</th>
<th>U.S. pharmacy graduates</th>
<th>U.S.-licensed IPGs</th>
<th>Total active men pharmacists</th>
<th>Total active women pharmacists</th>
<th>Women pharmacists</th>
<th>Total active pharmacists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>125,199</td>
<td>101,201</td>
<td>226,400</td>
<td>45</td>
<td>226,400</td>
<td></td>
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<tr>
<td>2005</td>
<td>123,998</td>
<td>105,923</td>
<td>229,921</td>
<td>46</td>
<td>229,921</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>121,142</td>
<td>111,455</td>
<td>232,597</td>
<td>48</td>
<td>232,597</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>118,953</td>
<td>117,274</td>
<td>236,227</td>
<td>50</td>
<td>236,227</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>117,448</td>
<td>123,098</td>
<td>240,546</td>
<td>51</td>
<td>240,546</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>116,201</td>
<td>128,891</td>
<td>245,092</td>
<td>53</td>
<td>245,092</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>115,322</td>
<td>134,633</td>
<td>249,955</td>
<td>54</td>
<td>249,955</td>
<td></td>
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<tr>
<td>2011</td>
<td>114,626</td>
<td>140,375</td>
<td>255,001</td>
<td>55</td>
<td>255,001</td>
<td></td>
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<tr>
<td>2012</td>
<td>114,133</td>
<td>146,042</td>
<td>260,175</td>
<td>56</td>
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<tr>
<td>2013</td>
<td>113,748</td>
<td>151,668</td>
<td>265,416</td>
<td>57</td>
<td>265,416</td>
<td></td>
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<tr>
<td>2014</td>
<td>113,498</td>
<td>157,236</td>
<td>270,734</td>
<td>58</td>
<td>270,734</td>
<td></td>
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<tr>
<td>2015</td>
<td>113,411</td>
<td>162,746</td>
<td>276,157</td>
<td>59</td>
<td>276,157</td>
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<tr>
<td>2016</td>
<td>113,465</td>
<td>168,262</td>
<td>281,727</td>
<td>60</td>
<td>281,727</td>
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<tr>
<td>2017</td>
<td>113,716</td>
<td>173,723</td>
<td>287,439</td>
<td>60</td>
<td>287,439</td>
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<tr>
<td>2018</td>
<td>114,048</td>
<td>179,156</td>
<td>293,204</td>
<td>61</td>
<td>293,204</td>
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<tr>
<td>2019</td>
<td>114,581</td>
<td>184,504</td>
<td>299,085</td>
<td>62</td>
<td>299,085</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>115,206</td>
<td>189,780</td>
<td>304,986</td>
<td>62</td>
<td>304,986</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation used: IPGs, international pharmacy graduates.

Table 2. Relative contributions of the supply model’s source data in accounting for the increase in projections

<table>
<thead>
<tr>
<th>Years</th>
<th>U.S. graduates</th>
<th>IPGs</th>
<th>Separation rates</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>12.3</td>
<td>6.5</td>
<td>81.2</td>
<td>100.0</td>
</tr>
<tr>
<td>2010</td>
<td>32.7</td>
<td>5.5</td>
<td>61.8</td>
<td>100.0</td>
</tr>
<tr>
<td>2015</td>
<td>34.4</td>
<td>5.5</td>
<td>60.1</td>
<td>100.0</td>
</tr>
<tr>
<td>2020</td>
<td>47.6</td>
<td>5.8</td>
<td>46.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Means, 2005–2020</td>
<td>34.8</td>
<td>5.7</td>
<td>59.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Abbreviation used: IPGs, international pharmacy graduates.

Figure 1. Separation rate–driven models of percent pharmacists remaining in the workforce from 25 to 75 years of age: Comparison of 2007 supply model versus 2000 supply model

workforce was no longer active increased from 62 years in the
2000 supply model to 64 years in the 2007 supply model. Among
older pharmacists, the rate of leaving the workforce was very
similar for men and women pharmacists, suggesting that both
men and women pharmacists were working more in their later
years (data not shown). As noted earlier, these changes in the
workforce depletion rate (or reciprocally participation) were
the primary reason for increased supply estimates, accounting
for about 59% of supply estimate increases in the 2007 supply
model. Their effect on overall increase in supply decreases sub-
stantially over time (from 81% to 47%).

Figure 2 shows mean pharmacist age by gender to 2020. Larger-sized cohorts in younger age groups exert a downward
influence on the mean age of the overall workforce and on men
pharmacists through 2020—despite both men and women
pharmacists remaining in the workforce for more years. The
model portrays an overall drop in the mean age of all pharma-
cists from 47 to 43 years and for men pharmacists from 52 to
46 years from 2004 to 2020. Over the same period, the mean
age for women pharmacists remains at 42 years.

Figure 3 shows the age distribution of pharmacists in 2006. The
distribution is irregular. We note relatively higher counts from
ages 48 to 55, which correlate with a period of educational
expansion in the late 1970s and early 1980s. Lower counts are
observed from ages 39 to 47, corresponding approximately to
the decline in graduates in the mid-1980s.1 Graduate counts
grew again in the 1990s, but the national implementation of
an entry-level PharmD program in the early 2000s caused a
reduction in graduates. The youngest age cohorts have been
increasing as a result of a new phase of educational expansion
beginning in 2000.

Figure 4 shows the comparison of head counts and FTEs. As
noted earlier, gender-based differences in work patterns result
in an increasing gap between head count projections and FTE
projections as the ratio of women to men pharmacists increases.
The gap between head count and FTE is 34,489 in 2005 and
increases to 45,748 by 2020. The overall head count–to–FTE
supply reduction is approximately 15%.

Figure 5 depicts alternative series for supply estimates. The
basic series was drawn from CPS data as reported earlier. The
maximum impact is an increase or decrease in head count of
about 10,000 pharmacists in 2020.

Figure 6 illustrates ratios of pharmacists to population
groups. The pharmacist–to–100,000-population ratio rises
from 77 in 2004 to 91 in 2020. The pharmacist–to–100,000-
over-65-population, however, starts at 625 in 2004, remains
steady through 2011, decreases to 575 by 2020, and contin-
ues to decrease to 508 in 2030, rebounding slowly thereafter
despite the sizable growth in the pharmacist supply shown by
the model.

Discussion
The principal finding of the 2007 supply model was an unex-
pected supply estimate increase. Increased work participation,
particularly by older pharmacists, accounted for, on average,
59% of the head count increase. Corroborative data from the
2000 and 2004 National Pharmacist Workforce Surveys also
found that more near-elderly pharmacists have continued to
remain active in the workforce, albeit on a part-time basis.10
The same report observed that their remaining active may have
mitigated the severity of the pharmacist shortage. Historical
events that could have encouraged increased persistence in the
workforce over the last decade include the rise in wages that
occurred in the late 1990s as the pharmacist shortage became
severe; the 2000 stock market downturn that affected retirement savings significantly; the rise in demand for pharmacists that made jobs plentiful, including part-time work, which is often attractive to older pharmacists; and increased opportunities for clinical involvement and technology advances during the 1990s that resulted in professional job satisfaction and the motivation to continue working.

Whether these new work patterns will persist or be adopted by younger pharmacists as they move closer to retirement age is impossible to predict. For this reason, frequent reassessment of work patterns will continue to be an important adjunct to supply modeling.

The educational expansion in pharmacy that began in the 1990s and continues unabated, accounting for about 35% of the increased supply, has resulted in a workforce that is projected to grow younger on average despite older pharmacists remaining employed. Generally, physician and nursing workforces are assumed to be growing older on average. Recently, however, a call for educational expansion in the medical profession could result in a similar downward age trend for physicians.

The effect of a younger pharmacist workforce has not been determined; however, in the face of shortages in other health professions, the presence of a growing, young workforce trained using today’s more clinically oriented practice standards and technology advances is a positive factor for the prospect of meeting health care delivery needs through the end of the baby boomer era.

The fall in ratios of pharmacists per 100,000 over-65 population, beginning in 2011 and falling to 575 by 2020 and 508 in 2030 before rebounding slowly thereafter, despite the sizable growth in the pharmacist supply shown by the model, illustrates the challenge to pharmacy as the large baby boomer population moves through the senior age cohorts. This effect is likely to occur with other health care workers as well, compounding the difficulty in providing health care services during this era. An equally important question for future research is how the balance between supply and demand will shift once the size of the baby boomer cohort begins to decrease.

A 2002 study suggested the need for additional pharmacists by the second and third decade of the 21st century. The study did not anticipate the increased work participation of older pharmacists and educational expansion that have occurred. The new supply projections considerably lessen but do not eliminate the 157,000-pharmacist deficit projected for 2020, especially when reductions related to FTE participation are taken into account.

The unevenness of age distribution (Figure 3) poses a potential problem in the near future as the pharmacists currently in the 48- to 55-year age group, a relatively large cohort, begin to retire and turn over responsibilities to the current 39- to 47-year age group, which is much smaller in number. Sufficiency, not only in terms of numbers but also in terms of leadership and management potential and experience, may be questionable. Younger pharmacists may need to be moved more quickly into positions with higher levels of responsibility. This potential problem should draw the attention of pharmacist employers early enough to plan for its eventuality.

**Limitations**

The substantial change in workforce participation behavior over a retrospective 10-year period, as reflected by separation rate changes, suggests using caution when making longer-term supply predictions. Future changes in the economy and other factors could result in new shifts in workforce behaviors. In addition, the supply model assumes that the trend toward a predominantly female workforce will continue based on the current preponderance of women among student pharmacists. This dis-
Figure 5. Alternative supply projections: 2005–2020

Figure 6. Ratios of pharmacists to U.S. population groups
troduction could possibly shift in the opposite direction. Finally, educational expansion has not proven to be predictable and is therefore difficult to model. The uncertainties in these three areas argue for continued research on work patterns and other supply issues to monitor whether model revision is indicated.

Conclusion

The revised estimated active U.S. pharmacist head count in 2006 is 232,597, with equivalent FTEs totaling approximately 198,000. The substantial increase over the 2000 pharmacist supply model estimates is primarily attributable to pharmacists remaining in the workforce longer and educational expansion. U.S.-licensed IPGs account for fewer than 6% of overall increases. The pharmacist workforce is projected to become younger on average by about 4 years by 2020. A trend toward part-time work reduces the effective pharmacist workforce by about 15%. Although the ratio of pharmacists to the general population will increase through 2020, the ratio of pharmacists to the over-65 population will decrease after 2011 and continue to do so past 2020 as the baby boomers move through their senior years. Historical fluctuations in graduates could create a shortfall of experienced, senior pharmacists during the early phase of the baby boomer retirement era. Coincident demands for more physicians and nurses over the same period and shortages in all three professions stipulate that active steps be taken, including continued monitoring of work trends among pharmacists and other health professionals.

References