HPI Health Policy Institute
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State-Level Dentist Workforce Projections Data and Methods

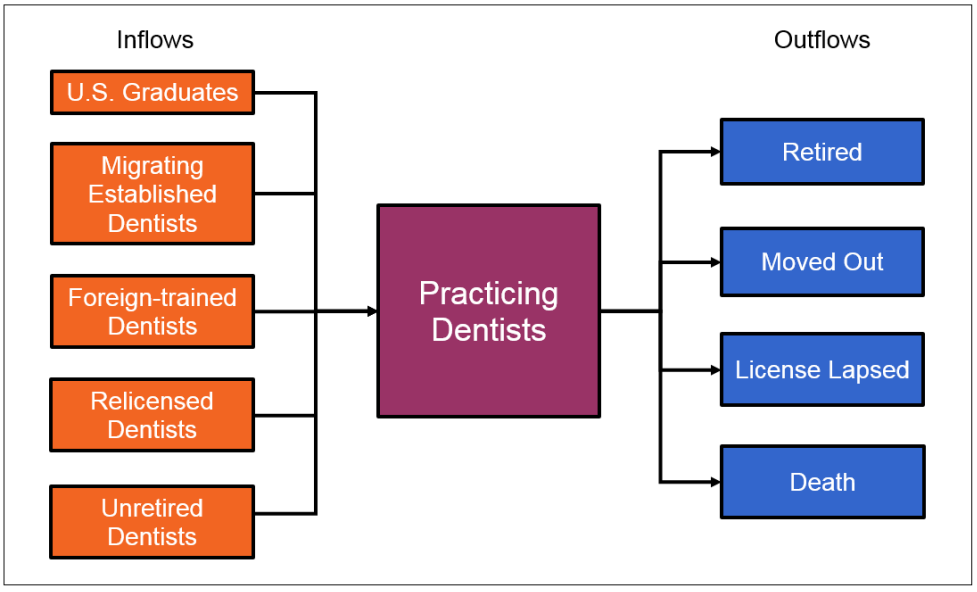
Introduction

This document summarizes our methodology for our state-level dentist workforce projection model. The methodology summarizes California as an illustrative example. The methodology is the same when applied to other states, though specific data parameters vary state to state. In addition, any state is liable to have special circumstances that require customized approaches not detailed in this paper.

Conceptual Framework

Our conceptual framework is illustrated in Figure 1 below. Our analysis requires assumptions on future inflows and outflows of dentists from various sources in a given state. We base these assumptions on actual historical inflows and outflows data and then generate various scenarios on whether inflows and outflows will change in the future. We do this for seven age groups of dentists.

Figure 1: Conceptual Model of State-Level Dentist Workforce Projections



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Data Sources and Methodological Approach

We use five data sources in our analysis. The American Dental Association (ADA) masterfile contains the most up-to-date information on dentists, practicing and non-practicing, in the United States. It is updated through a variety of methods including reconciliation with state licensure databases, death records, and various surveys and censuses of dentists carried out by the ADA. We use the masterfile's archived datasets from December of 2005, 2010, and 2015 to gather historical information on the dentist population profile, including age, graduation year, licensure status, practice location, retirement date and deceased date. This provides us with a "snapshot" for each of our study years. In addition, through various unique identifiers, we are able to track critical information for each dentist over time (e.g., what state they are in, whether they have retired).

As a supplement to the ADA masterfile, we use the ADA Health Policy Institute's Distribution of Dentists (DOD) survey data from 1998 through 2013. This rolling census is sent to all dentists in the United States using a panel methodology. All dentists are assigned to one of three panels. Each year, one panel is surveyed for their location, practice status and demographic information. The survey's response rates for the three most recent years were 75.9 percent, 68.4 percent, and 72.0 percent.

To calculate historical measures of dentists per 100,000 population, we incorporate U.S. Census Bureau population counts.[1] To calculate future estimates of dentists per 100,000 population, we combine our future dentist supply modeling results with population projections based on the most up-to-date, reliable data we could find.

We rely on the ADA's Survey of Dental Education for historical data on the number of graduates of U.S. dental schools.[2]

We adjust our future supply of dentists estimates for annual hours worked and number of patients seen per week. In other words, we estimate the number of full-time equivalent dentists. We base this on historical data on annual hours worked and the number of patients seen per week for different age groups of male and female dentists separately. These data are drawn from the ADA's Survey of Dental Practice results from 2000 through 2014.[3]

The state workforce projection model uses historical trends of inflows of dentists to and outflows of dentists from the state's workforce to inform various assumptions about future inflows and outflows. We define four types of outflows of dentists: (1) those who retired, (2) those who moved out of state, (3) those whose license expired, and (4) those who died before retirement.

We define five types of inflows of dentists: (1) new U.S. dental school graduates who became licensed to practice in the state, (2) established dentists who moved into the state from another state, (3) foreign-trained dentists who became licensed to practice in the state, (4) dentists who reactivated an expired license, and (5) dentists who returned from retirement to the workforce.

We analyze historical inflows and outflows for seven age groups of dentists separately to capture important differences in behaviors across the life cycle (e.g., propensity to graduate or retire). The age groups are: under 35, 35 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 84, and 85 to 99.

Calculation of Historical Outflows

We analyze historical outflow rates across the period 2010 to 2015 and calculate outflow rates for each age group. For example, for dentists in the workforce who were ages 55 to 64 in 2010, we calculate the proportion who were retired in 2015. This provides a retirement rate for the 55 to 64 age group for the period 2010-2015. We also calculate the proportions who moved out of state, who were deceased, or whose license was expired in 2015. Table 1 displays the total outflow rates from all sources for the seven age groups. For example, 14.9 percent of 55 to 64-year-old practicing dentists in California in 2010 were not practicing in California in 2015 either because they had retired, moved to another state, let their California license lapse without practicing in another state, or deceased.

Table 1: Historical Outflow Rates, 2010-2015, California

	2010 – 2015
Age under 35	13.2%
Age 35 - 44	5.5%
Age 45 - 54	5.5%
Age 55 - 64	14.9%
Age 65 - 74	34.3%
Age 75 - 84	48.6%
Age 85 - 99	72.5%

Source: ADA Health Policy Institute analysis of ADA masterfile; ADA Distribution of Dentists. **Note**: Total outflow rates denote the percentage of dentists who had retired, moved out of state, whose license had lapsed, or who were deceased.

The “baseline” scenario in our analysis corresponds to the assumption that future outflow rates are the same as outflow rates for 2010-2015. Our choice to use 2010-15 outflow rates as the baseline scenario is

influenced heavily by analysis we have done at the national level showing increasing average retirement age for dentists.[4] While at the national level, outflow rates from the dentist workforce in 2010-2015 were lower than in 2005-2010, we do not believe outflow rates will return to 2005-2010 levels. Research shows that the dental economy is unlikely to return to pre-recession growth levels. Dentist net incomes are stagnant, making it unlikely retirement patterns will return to pre-recession levels.[5]

Calculation of Inflows, Step 1: Dental School Graduates

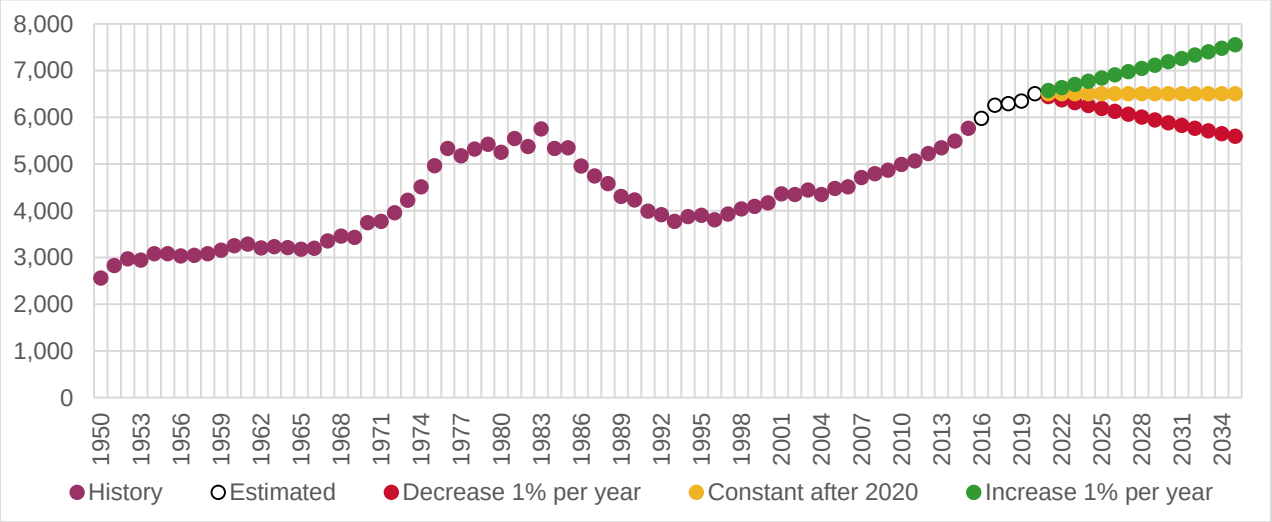
We use a two-step process to calculate inflows of dentists into a state's workforce. The first step is to estimate the number of future dental school graduates who will practice in the state from 2015 to 2035.

We first estimate the number of U.S. dental school graduates from 2016 through 2020 based on existing enrollment and expected attrition of dental school students. The estimates account for the opening of ten dental schools since 2008 and indicate increasing numbers every year through 2020. We then create three scenarios for the annual number of dental school graduates after 2020: that the number of graduates will remain constant, that the number will increase by 1 percent per year, and that the number will decrease by 1 percent per year. [6] (See Figure 2.)

For state-level projections, we assume that the annual number of graduates will remain constant, because while we can reasonably estimate the number of graduates through 2020, uncertainty increases thereafter.

We recognize that the future number of dental school graduates is subject to intense debate and speculation. On the one hand, there are the dental schools that have recently opened with others in the planning stages. On the other hand, the flattening of dentist earnings in recent years[7] combined with increases in educational debt could place downward pressure on the number of dental school applicants, as suggested in previous research.[8,9]

Figure 2: U.S. Dental School Graduates per Year, Historical and Three Projected Scenarios



Sources: ADA Health Policy Institute Survey of Dental Education, ADA Health Policy Institute projected scenarios. **Notes:** Data for years 1950-2015 are historical. Estimates for 2016-2020 assume that all dental schools in operation in 2016 will maintain current or expected levels of graduates per year until 2020. Results after 2020 are projected scenarios.

After establishing the scenario for future U.S. dental school graduates, we estimate the percentage of those graduates who will start practicing in a particular state. We base the percentage for each state on historical data between 2005 and 2015. We apply those percentages to the projected number of future U.S. dental school graduates to estimate the number of new dental school graduates locating in a particular state. For example, 12.8 percent of dental school graduates from the classes of 2005 through 2015 ended up practicing in California in 2015.

For some states, historical data are not sufficient to project where future dental school graduates locate. Some dental schools have opened so recently that they had little or no presence in the historical inflows of graduates we analyze. These schools include Western University of Health Sciences, College of Dental Medicine in California; Midwestern University, College of Dental Medicine in Illinois; LECOM, College of Dental Medicine in Florida; and New York Medical College, Touro College of Dental Medicine in New York.

For states where these dental schools are located, we take additional steps to account for the new schools' effects on the future supply of dentists. We estimate these schools' future numbers of graduates based on either their first graduating classes or by estimating the share of enrollees expected to graduate (based on national historical percentages). We then estimate the share of that school's graduates expected to practice in the state by using the percentage of enrollees who resided in the state at the time of matriculation. Given these numbers, we increase the estimated percentage of U.S. dental school graduates expected to locate in the state accordingly. We make additional assumptions in the cases of New York and Texas.[10,11]

Calculation of Inflows, Step 2: Established and Foreign-Trained Dentists

In recent years, about two-thirds of inflows into the dentist workforce in larger states consisted of new U.S. dental school graduates. The remainder came from established dentists who moved into the state, dentists who reactivated an expired license, foreign-trained dentists entering the state, or dentists who came out of retirement. In order to project the inflow of dentists due to in-migration, license reactivation, and foreign-trained dentists entering the state, we rely on historical inflow rates observed from 2005 to 2015. (In some cases, including for California, we determined that historical percentages from 2010 to 2015 would be a more reliable timeframe.)

Table 2 summarizes the modeling assumptions for inflows used in the California analysis. These are based on historical data. In other words, the analysis assumes that the pattern of new U.S. dental school graduates settling in California, in-migration of practicing dentists into California from other states, license reactivation rates, and entry of foreign-trained dentists into California will remain constant.

Table 2: Assumptions of Inflow Rates into the Dentist Workforce in California

	Share of New U.S. Dental School Graduates Who Locate in California	Share of Dentists from Other Sources Who Locate in California
Age under 35	12.9%	3.9%
Age 35 - 44	15.7%	1.9%
Age 45 - 54	14.8%	1.1%
Age 55 - 64	3.3%	0.5%
Age 65 - 74	0.0%	0.3%
Age 75 - 84	0.0%	0.3%
Age 85 - 99	0.0%	0.3%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: "Share of New U.S. Dental School Graduates Who Locate in California" percentages represent the share of U.S. dental school graduates (per graduate age group) who located in California between 2005 and 2015, adjusted upwards to account for the share of graduates expected to remain in the state from Western University of Health Sciences College of Dental Medicine. "Share of Dentists from Other Sources Who Locate in California" percentages represent the share of "Other Dentists" (per age group) who were not practicing in California in 2010 but who started practicing in the state by the end of 2015. "Other Dentists" are established foreign-trained dentists, relicensed dentists, or dentists returning to the workforce from retirement (i.e. not new U.S. dental school graduates).

Combining Outflows and Inflows in the Model for Estimated Dentist "Head Count"

The model starts with the state's 2015 active licensed dentist workforce broken out into seven age groups. We apply various assumptions for outflows per age group to calculate the number of these dentists still working in 2020. To yield an updated age distribution for 2020, we apply aging logic based on masterfile historical patterns of how these seven age groups move from younger to older groups in a five-year period. To this total, we add the estimated inflows of new dental school graduates, established and foreign-trained dentists moving in state, relicensed dentists, and unretired dentists by age group.

Table 3 summarizes the basic working of the model and shows results for our scenario of the projected dentist workforce head count in 2020. The modeling predicts that there will be 31,985 practicing dentists in California in 2020 compared to 30,180 in 2015. We reiterate the process to calculate projections for 2025, 2030 and 2035.

Table 3: Example of Workforce Model Projection, California, 2015-2020, for Baseline Scenario

	Column A	Column B	Column C	Column D	Column E	Column F	Sum of Columns D, E, F
	Active licensed dentists, 2015	Assumed five-year outflow rate	Apply five-year retention rate	Apply aging logic to Column C to yield 2020 age distribution	Inflow of new U.S. grads	Inflow of established, foreign-trained, relicensed, & unretired dentists	Active licensed dentists, 2020
Age under 35	3,832	13.2%	3,328	932	3,344	324	4,601
Age 35 - 44	7,155	5.5%	6,764	5,711	635	742	7,088
Age 45 - 54	7,796	5.5%	7,370	6,914	46	395	7,354
Age 55 - 64	7,162	14.9%	6,094	7,624	1	191	7,815
Age 65 - 74	3,493	34.3%	2,294	3,982	0	73	4,055
Age 75 - 84	690	48.6%	355	968	0	14	982
Age 85 - 99	52	72.5%	14	89	0	1	90
Total	30,180	13.1%	26,219	26,219	4,026	1,740	31,985

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: Data for 2015 are based on the ADA masterfile. Results after 2015 are projected. Totals in the projection may not appear to match the sum of age groups due to the rounding of fractional numbers produced by the model. Assumes (a.) U.S. total annual dental school graduates will increase until 2020 and then remain constant and (b.) future outflow rates are same as 2010-2015 historical percentages. "Outflow rate" in Column B is the percentage of dentists leaving the workforce after combining assumed percentages for dentists who are retired, moved out of state, deceased, or who have expired licenses.

Female Share of the Dentist Workforce

We examine the historical trends of females as a share of dental school graduates and the dentist workforce. From 1975 to 2015, the female share of U.S. dental school graduates grew dramatically from 3.1 percent to 48.0 percent.[12,13] The increase in female dental school graduates since the 1970s affects the dentist workforce today. Among active dentists ages 35 or younger, the female share grew from 38.6 percent (2005) to 43.6 percent (2010) to 47.9 percent (2015) nationally. In other words, the female share grew by 5.0 percent (2005-2010) and then by 4.3 percent (2010-2015).

For active dentists ages 55 to 64, by comparison, the female share grew from 5.6 percent (2005) to 10.9 percent (2010) to 18.1 percent (2015) nationally.

After analyzing the historical growth of females in all dentist age cohorts, we project the future female share of each age cohort using California as an example (see Table 4). These projections assume that the female share will level off at 50 percent of the workforce within each age cohort. We apply these projected percentages of female dentists in the state's workforce to our state workforce projection, yielding projections of the dentist workforce by gender and age group.

Table 4: Historical and Projected Female Share of California Dentist Workforce

	2005	2010	2015	2020	2025	2030	2035
Age under 35	41.4%	44.7%	49.5%	50.0%	50.0%	50.0%	50.0%
Age 35 – 44	37.5%	40.9%	42.7%	46.8%	50.0%	50.0%	50.0%
Age 45 – 54	23.7%	32.8%	39.9%	41.8%	43.6%	49.4%	50.0%
Age 55 – 64	9.0%	15.6%	24.4%	32.8%	39.9%	41.8%	43.6%
Age 65 – 74	6.3%	7.5%	10.5%	17.5%	25.1%	34.3%	40.2%
Age 75 – 99	4.1%	5.7%	5.9%	6.9%	8.7%	14.3%	22.7%
All ages	25.7%	29.9%	33.9%	37.6%	41.2%	44.2%	46.0%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: Data for 2005, 2010, and 2015 are historical. Results after 2015 are projected and assume that the female share will level off at 50% for each age cohort.

Full-Time Equivalent Adjustments

We adjust the simple head count measure of the supply of dentists to full-time equivalent dentists based on hours worked and patients seen. We calculate the national average annual hours worked for each dentist gender and age group. We then calculate an index of hours worked that compares every gender and age

group to male dentists under age 35 – the group with the highest average and the group we use as the reference group. For example, the "hours worked" index for females under age 35 is 0.875 because their average annual hours worked is 87.5 percent of the average for males under age 35 (see Table 5). We apply these indices for each gender and age group to the head count projection of the dentist workforce for each gender and age group. Thus, we calculate the full-time equivalent supply of dentists per 100,000 population adjusted for hours worked.

Similarly, to adjust the supply of dentists by patient visits, we first calculate the national average number of weekly patient visits for each dentist gender and age group. We then calculate an index of patient visits that compares every dentist gender and age group to male dentists under age 35, the group we use (again) as the reference group. For example, the "patient visits" index for male dentists ages 55 to 64 is 0.893 because their average number of weekly patient visits is 89.3 percent of the average for male dentists under age 35 (See Table 6). We apply these indices for each gender and age group to the head count projection of the dentist workforce for each gender and age group. Thus, we calculate the full-time equivalent supply of dentists per 100,000 population adjusted for patient visits.

Table 5: Dentist Hours Worked by Dentist Gender and Age Group

	Average Annual Hours Worked		Indexed to Male, Age under 35	
	Male	Female	Male	Female
Age under 35	1,818.7	1,591.9	1.000	0.875
Age 35 – 44	1,815.8	1,550.5	0.998	0.853
Age 45 – 54	1,782.1	1,576.3	0.980	0.867
Age 55 – 64	1,672.4	1,555.2	0.920	0.855
Age 65 – 74	1,403.3	1,444.2	0.772	0.794
Age 75 – 99	1,181.3	857.9	0.650	0.472

Source: ADA Health Policy Institute, 2000-2014 results from the Survey of Dental Practice.

Table 6: Patient Visits per Week (Excluding Hygienist Visits) by Dentist Gender and Age Group

	Average Patient Visits Per Week (Excluding Hygienist Visits)		Indexed to Male, Age under 35	
	Male	Female	Male	Female
Age under 35	61.9	51.0	1.000	0.824
Age 35 - 44	63.4	50.6	1.024	0.817
Age 45 - 54	60.7	46.6	0.981	0.753
Age 55 - 64	55.3	46.0	0.893	0.743
Age 65 - 74	46.1	34.8	0.745	0.562
Age 75 - 99	33.9	19.8	0.548	0.320

Source: ADA Health Policy Institute, 2000-2014 results from the Survey of Dental Practice.

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[3] For more information on Survey of Dental Practice methodology, see the Methodology section in the most recent releases available from http://www.ada.org/en/science-research/health-policy-institute/data-center/dental-practice.

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[10] For Touro College in New York, we lacked the percentage of students who were in-state residents at the time of matriculation and assumed 50 percent to remain in state after graduation.

[11] For Texas Tech University Health Sciences Center El Paso which just announced plans to build a dental school, we assumed (a.) that the state and the Commission on Dental Accreditation would approve the school's creation, (b.) 30 enrollees per year starting in 2020, (c.) 29 graduates per year starting in 2024, and (d.) 80 percent of graduates to remain in the state after graduation.

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