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Research Brief

Projected Supply of Dentists in the United States, 2020 – 2040

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Key Messages

- *We update our earlier estimates of the future supply of dentists in the U.S. with the most recent data, namely updated U.S. population projections. After monitoring key dentist labor market and Census population data, we concluded that new data warranted a revised analysis.*
- *Under what we consider to be the most probable scenario, the per capita supply of dentists in the United States is projected to increase through 2040 even after adjusting for expected changes in hours worked and patient visits due to dentist age and gender composition. The projected increase is larger compared to our previous analysis.*
- *Understanding the future supply of dentists only partially contributes to the central policy question of whether the dental workforce will be able to meet population needs. The issue of provider adequacy is far more complex and further research is needed.*

Introduction

With any type of health care service, having a sufficient number and distribution of providers is critical to ensuring population access to needed care. In the dental care sector, there is intense debate at the federal and state level on the adequacy of the dentist workforce in terms of meeting current and future population needs. The Health Resources and Services Administration (HRSA) estimates that there is a current shortage of 10,877 dentists in the United States.[1] Several dental schools that have opened in recent years cite insufficient supply of dentists as a key reason why more dental school graduates are needed.[2,3,4] Alternatively, a recent analysis suggests evidence for a surplus of dentists by 2040.[5]

Assessing the adequacy of the dentist workforce is not simply a supply-side issue. The demand for dental care on the part of the population, the mix of patients in terms

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of payer type and geographic location, and a host of other factors determine whether the current and future dentist workforce is sufficient. For example, the aggregate supply of dentists may be adequate in size when compared to the aggregate demand for dental care. However, there may be an insufficient number of dentists relative to need or demand for dental care among disadvantaged populations or in certain geographic areas. The issue of dentist workforce adequacy is complex and further conceptual and empirical work is needed. This is true not just of dentistry, but other types of health care services.[6]

In this research brief, we project the number of dentists in the United States through 2040 using the most recent data. Specifically, we update our previous analysis by (1) incorporating the Census Bureau's "low immigration" scenario of projected population growth (2) increasing our estimates of future U.S. dental school graduates, and (3) increasing our projected retirement rates for dentists. We do not attempt to make any judgments on the adequacy of the future dentist workforce. This would require further investigation, incorporating demand-side factors and a host of other issues. Nevertheless, we feel our analysis is a major contribution to the evidence base as it leverages unique data and builds modeling scenarios based on empirical analyses of dentist behavior. It also incorporates the effects of shifting dentist demographics in respect to hours worked and volume of patient visits.

Results

In 2020, there were 201,117 practicing dentists in the United States. This translated to 61.0 dentists per 100,000 population.

Our workforce projection model used historical trends in inflows of dentists to and outflows of dentists from the workforce to inform various assumptions about future inflows and outflows. We redefined our "baseline" modeling scenario on assumptions that are most probable based on updated data: (1) the U.S. population's growth rate will remain near its recent comparatively low levels, (2) that the annual number of U.S. dental school graduates will increase through 2026 and then remain constant, and (3) that dentist retirement rates over the next five years will increase as they have in recent years. The most significant change in assumptions in this current update is reduced population growth. Under our baseline scenario, the unadjusted number of dentists per 100,000 population will increase from 60.7 in 2020 to 67.0 in 2040. Our previous analysis projected an increase to 63.7 in 2037. Thus, our new analysis predicts a large increase in the number of dentists relative to the population due to lower population growth estimates.

Dentists vary by gender and age group in the number of hours they work and the number of patients they treat per week. To account for this, we adjusted our projections for hours worked and number of patient visits to create full-time equivalent projections. Our

The Covid-19 Pandemic and the Dentist Workforce Model

Early in the pandemic, HPI research suggested that COVID-19 could result in an increase in retirement rates among older dentists. This is not the case as of May 2021. Dentist retirement rates have been rising steadily since 2013 and there is no change in this trend due to COVID-19, as of our most recent analysis of retirement trends.

baseline modeling scenario seen in Figure 1 indicates that the projected number of dentists per 100,000 population will increase even after adjusting for expected changes in hours worked and patient visits. In other words, the number of full-time-equivalent dentists per capita is expected to grow and the projected increase is larger than our previous estimates.

Figure 2 takes the same data from Figure 1 but summarizes changes over time from 2020 to 2040. The projected growth rate of the number of dentists per capita between 2020 and 2040 is 10.4 percent. Adjusting for expected shifts in hours worked due to the age and gender profile of the future dentist workforce, the growth rate of the supply of full-time equivalent dentists is slightly lower, at 9.7 percent. Replicating the same adjustment for patient visits, the growth rate is 8.2 percent. These growth rates differ due to a projected decline in average hours worked per dentist.

Figure 3 shows the trends behind the "dentists per capita" measure in Figure 1. We calculated, in five-year intervals, historical and projected headcounts of dentists entering and leaving the workforce (inflows and outflows). There was a large cohort of dentists who graduated from U.S. dental schools between 1974 and 1988 (See also Figure 8). When they started to retire, this dramatically increased outflows from the workforce from 2015 through 2020 and we projected their retirements will also account for much of the outflows through 2030. The departure of this cohort from the workforce has kept the dentists per capita measure nearly unchanged from 2015 to 2020 even as inflows into the workforce increased with expanded enrollment in U.S. dental schools.

As our methods section describes, we defined three assumptions about future inflows of dentists into the workforce and three assumptions about future outflows of dentists from the workforce (Table 1). By pairing these assumptions in all possible combinations, we generated nine possible scenarios of workforce projections. Table 2 contains all nine scenarios adjusted for expected shifts in hours worked. Table 3 contains the scenarios adjusted for expected shifts in the number of patient visits per dentist. The baseline scenario denotes what we feel is the most probable scenario.

Taken together, the nine scenarios in Table 2 suggest that the dentist workforce per capita, adjusted for hours worked, will increase in 20 years under all of our modeling scenarios from 54.7 to between 58.0 and 61.9. This range of outcomes is greatly influenced by choice of assumption of the future number of U.S. dental school graduates. If the number of graduates increases or decreases by more than 1 percent per year relative to our baseline scenario (from 2026 through 2040), the future supply of dentists would fall outside the bounds described in Table 2.

The same principle applies to Table 3 where results are adjusted for expected shifts in patient visits. The nine scenarios represented in Table 3 suggest that the full-time equivalent dentist workforce per capita will change in 20 years from 53.9 to between 56.3 and 60.1. If future conditions fall outside the bounds defined by our assumptions, the future dentist supply would fall outside the bounds of these scenarios.

Our baseline scenario also projects that the "de-aging" of the dentist workforce will continue. The share of dentists ages 55 and older increased from 27 percent in 2001 to a peak of 40 percent in 2013-2016.[7] This share decreased to 37 percent in 2020, and we project it will decrease to 33 percent in 2040. This finding originates from the opening of ten new dental schools[8] in recent years, expanded enrollment in established dental schools, and the resulting additional graduates entering the workforce.

Discussion

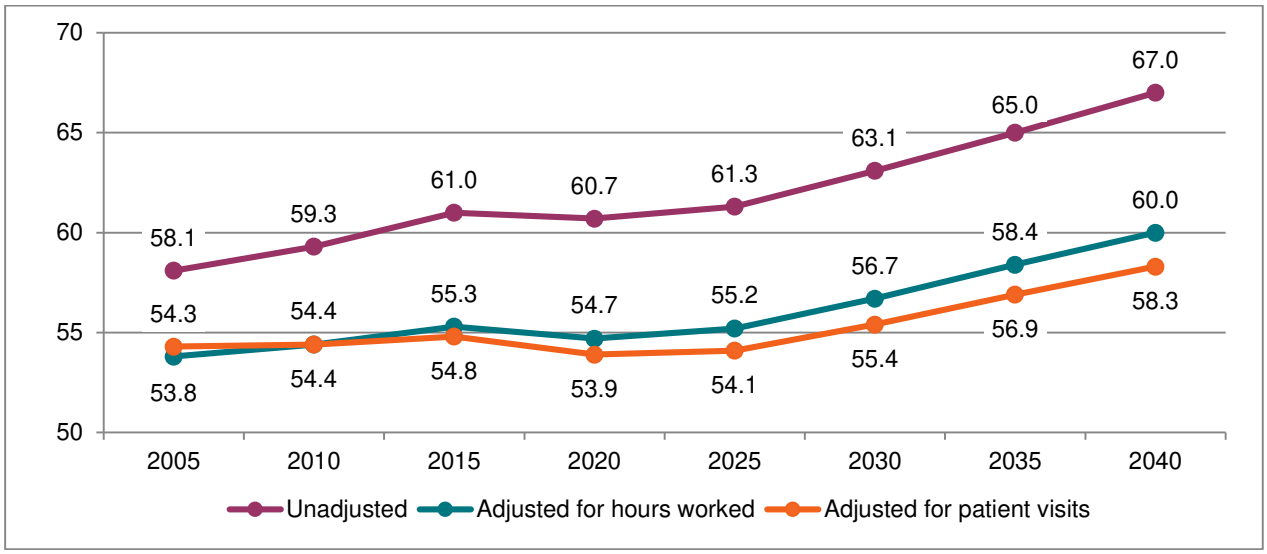
Our dental workforce projection model, while conceptually straightforward, has the potential to generate numerous alternative scenarios based on different assumptions. We took considerable care to focus our analysis on what we believe are the most probable assumptions based on extensive analysis of the best available empirical data. We updated our assumptions as new information became available. We emphasize, however, that different sets of assumptions will yield different results and we will continue updating the model as needed.

Our main finding is that under what we consider to be the most likely scenario, the per capita supply of dentists in the United States is projected to increase through 2040. More importantly, even after adjusting for expected reductions in hours worked and patient visits per dentist resulting from the age and gender profile of the dentist workforce, the full-time equivalent supply of dentists is also expected to increase by 2040. Total inflows to the dentist workforce are expected to exceed total outflows, and this net gain is expected to outpace the projected growth of the U.S. population.

As we noted in the introduction, our analysis needs to be interpreted carefully. Understanding how the total supply of dentists might evolve only partially contributes to the central policy question of whether or not there will be a shortage of dentists in the United States. The issue of provider adequacy is far more complex and even at the most aggregate level requires assessment of the demand for dentists. The future demand for dentists, in turn, will depend on the future demand for dental care among the population, the future evolution of productivity and efficiency of dentists, and potential changes in the workforce mix within dental care delivery models. Recent analysis suggests that the demand for restorative dental care will trend downward.[9] There is strong evidence that dental care use among working-age adults is declining, especially among younger adults. On the other hand, insurance coverage expansions could also lead to increases in demand. For example, if Medicare were to cover dental care services or adult dental coverage in Medicaid was mandatory, this would increase the demand for dental care. While further work is needed, our results suggest that, at the aggregate level, the United States could be entering a period of expanding supply of dentists and flat demand for dental care.

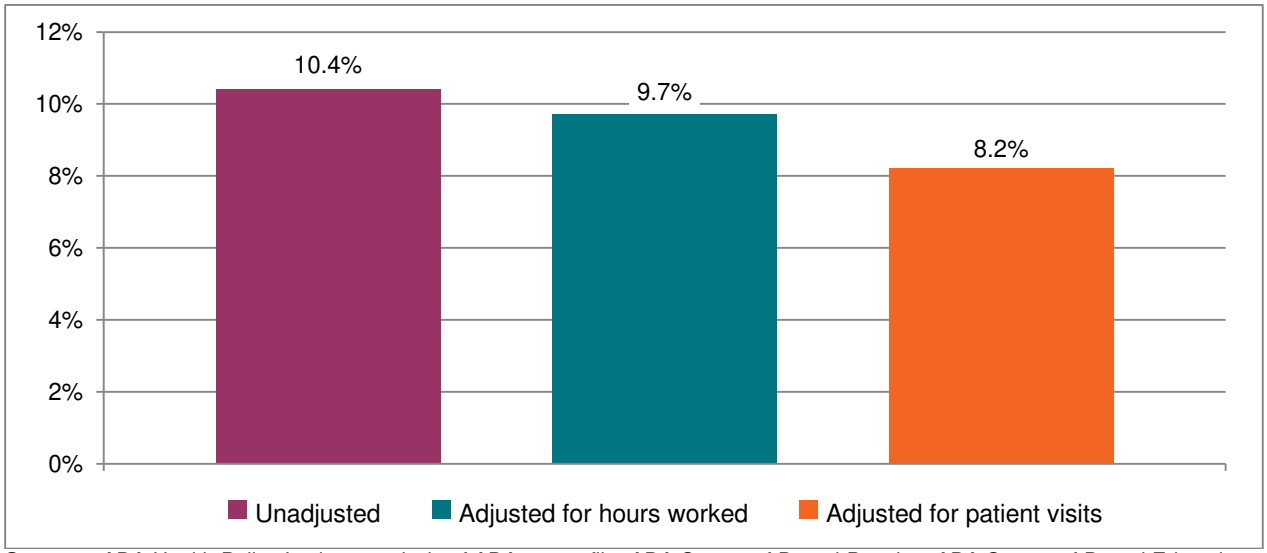
As we noted, highly aggregated national-level analyses like ours do not entirely address a key concern of policymakers: is the supply of providers adequate to meet the needs of key segments of the population? These key segments of the population are typically thought of according to geography (e.g., populations in rural versus urban areas) or by payer type (e.g., populations with Medicaid dental benefits versus commercial dental benefits). Answering this question requires much more sophisticated small-scale geographic analyses and comprehensive data on where Medicaid-accepting dentists are located. The Health Policy Institute has developed methods to study these issues[10] and we look forward to continued collaboration with policymakers in this area.

Figure 1: Historical and Projected Dentists per 100,000 Population in the U.S., Baseline Scenario



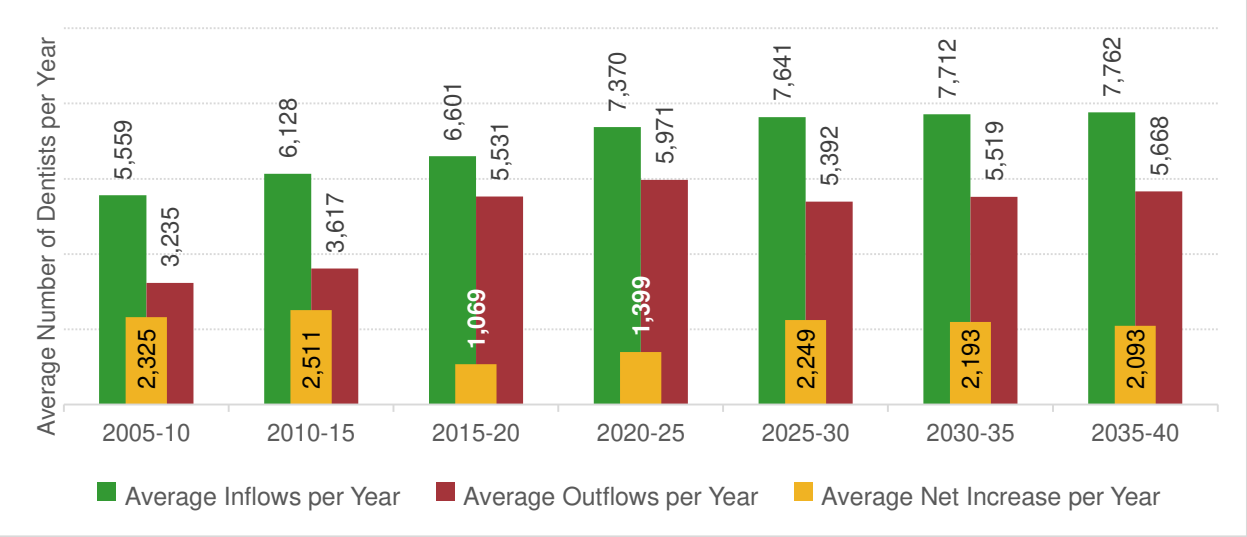
Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, Intercensal Estimates, Postcensal Estimates, National Population Totals, and National Population Projections. **Notes**: Data for 2005-2020 are based on the ADA masterfile. Results after 2020 are projected. Assumes (1) retirement rates will correspond to historical patterns for (a) relatively high outflow rates from 2020 to 2025 and (b) typical U.S. business cycles for 2025 to 2040; (2) the annual number of U.S. dental school graduates will increase through 2026 and then remain constant; (3) U.S. population growth will match the U.S. Census Bureau's "low immigration" scenario released in 2020.

Figure 2: Percentage Increase in Projected Dentists per 100,000 Population in the U.S. from 2020 to 2040, Baseline Scenario



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, National Population Totals, and National Population Projections. **Notes**: Data for 2005-2020 are based on the ADA masterfile. Results after 2020 are projected. Assumes (1) retirement rates will correspond to historical patterns for (a) relatively high outflow rates from 2020 to 2025 and (b) typical U.S. business cycles for 2025 to 2040; (2) the annual number of U.S. dental school graduates will increase through 2026 and then remain constant; (3) U.S. population growth will match the U.S. Census Bureau's "low immigration" scenario released in 2020.

Figure 3: Inflows to and Outflows from U.S. Dentist Workforce (Average per Year), Historical and Projected



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, National Population Totals, and National Population Projections. **Notes**: Data for 2005-2020 are based on the ADA masterfile. Results after 2020 are projected. Assumes (1) retirement rates will correspond to historical patterns for (a) relatively high outflow rates from 2020 to 2025 and (b) typical U.S. business cycles for 2025 to 2040; (2) the annual number of U.S. dental school graduates will increase through 2026 and then remain constant.

Table 1: Assumptions for Inflows and Outflows Used in the Model

Three Inflow Assumptions
U.S. total annual dental school graduates will increase until 2026 and then increase 1% per year.
U.S. total annual dental school graduates will increase until 2026 and then remain constant.
U.S. total annual dental school graduates will increase until 2026 and then decrease 1% per year.
Three Outflow Assumptions
Outflow rates will be relatively low through 2025, comparable to outflows during an economic downturn.
Outflow rates will correspond to long-term averages under typical U.S. business cycles.
Outflow rates will be relatively high through 2025.

Table 2: Summary of Workforce Projection under Nine Scenarios for Dentists per 100,000 Population, Adjusted for Hours Worked

Assumptions			Projections				
Inflow rate	Outflow rate, 2020 - 2025	2020	2025	2030	2035	2040	Description
1% annual growth in graduates per year after 2026	Relatively low	54.7	56.9	57.7	59.5	61.9	Highest outcome
	As for average U.S. business cycles	54.7	55.6	57.0	59.1	61.7	
	Relatively high	54.7	55.2	56.8	59.0	61.7	
Graduates per year remain constant after 2026	Relatively low	54.7	56.9	57.6	58.9	60.3	
	As for average U.S. business cycles	54.7	55.6	56.9	58.4	60.0	
	Relatively high	54.7	55.2	56.7	58.4	60.0	Baseline scenario
1% annual decline in graduates per year after 2026	Relatively low	54.7	56.9	57.4	57.9	58.3	
	As for average U.S. business cycles	54.7	55.6	56.6	57.5	58.0	
	Relatively high	54.7	55.2	56.5	57.4	58.0	Lowest outcome

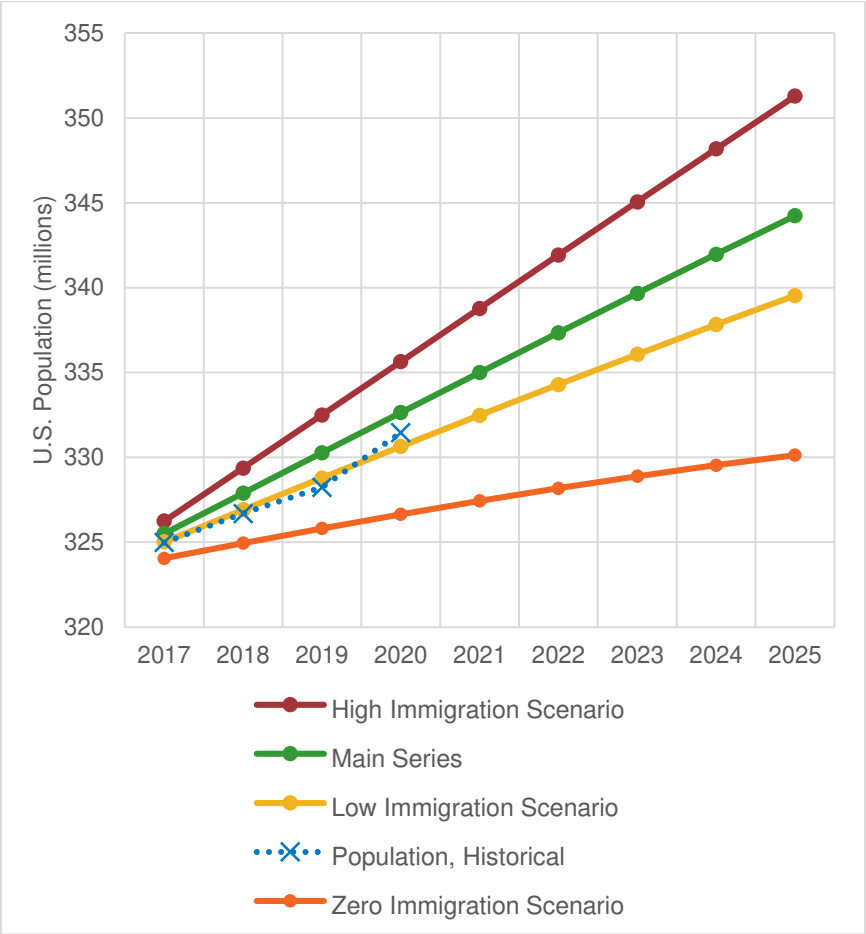
Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, National Population Totals, and National Population Projections. **Notes**: Data for 2020 are based on the ADA masterfile. Results after 2020 are projected. Assumes U.S. population growth will match the U.S. Census Bureau's "low immigration" scenario released in 2020.

Table 3: Summary of Workforce Projection under Nine Scenarios for Dentists per 100,000 Population, Adjusted for Patient Visits

Assumptions			Projections				
Inflow rate	Outflow rate, 2020 - 2025	2020	2025	2030	2035	2040	Description
1% annual growth in graduates per year after 2026	Relatively low	53.9	55.7	56.4	58.0	60.1	Highest outcome
	As for average U.S. business cycles	53.9	54.5	55.7	57.6	59.9	
	Relatively high	53.9	54.1	55.5	57.5	59.9	
Graduates per year remain constant after 2026	Relatively low	53.9	55.7	56.3	57.3	58.5	
	As for average U.S. business cycles	53.9	54.5	55.6	56.9	58.3	
	Relatively high	53.9	54.1	55.4	56.9	58.3	Baseline scenario
1% annual decline in graduates per year after 2026	Relatively low	53.9	55.7	56.0	56.4	56.5	
	As for average U.S. business cycles	53.9	54.5	55.3	56.0	56.3	
	Relatively high	53.9	54.1	55.2	55.9	56.3	Lowest outcome

Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, National Population Totals, and National Population Projections. **Notes**: Data for 2020 are based on the ADA masterfile. Results after 2020 are projected. Assumes U.S. population growth will match the U.S. Census Bureau's "low immigration" scenario released in 2020.

Figure 4: U.S. Census Bureau Population Projections, 2017 - 2025 (Main Series and Alternative Immigration Scenarios) and Historical Population Counts, 2017 - 2020



Source: U.S. Census Bureau, National Population Totals, and National Population Projections. **Notes:** The U.S. Census Bureau's Main Series population projection was released in 2017 and updated in 2018. The alternative scenarios, released in 2020, were based on assumptions of low, high, and zero levels of immigration. The historical population trend, released by the Bureau in 2017-2020, is most similar to the Bureau's low immigration scenario. In this graph, the 2020 historical population is based on the 2020 Census while the 2017-2019 Historical Populations are based on post-censual estimates derived from the 2010 Census.

Table 4a: Outflow Rates

	2002-2007	2003-2008	2004-2009	2005-2010	2006-2011	2007-2012	2008-2013	2009-2014
Age under 35	3.1%	2.8%	2.4%	2.5%	2.1%	2.0%	2.0%	2.1%
Age 35 - 44	3.2%	3.3%	2.9%	2.9%	2.6%	2.5%	2.4%	2.5%
Age 45 - 54	4.8%	4.8%	4.3%	4.4%	3.7%	3.6%	3.5%	3.8%
Age 55 - 64	17.9%	17.5%	16.2%	14.8%	14.0%	13.2%	13.1%	14.1%
Age 65 - 74	44.6%	41.5%	40.0%	38.8%	36.6%	32.7%	32.8%	34.7%
Age 75 - 84	66.9%	63.0%	60.5%	59.4%	53.2%	50.1%	50.3%	52.5%
Age 85 and older	90.0%	82.7%	76.2%	80.5%	74.9%	71.2%	68.1%	72.1%
All ages 65 and older	49.2%	45.6%	43.9%	42.8%	39.8%	36.0%	36.1%	38.1%

Table 4b: Outflow Rates (Continued)

	2010-2015	2011-2016	2012-2017	2013-2018	2014-2019	2015-2020	Hypo-theti-cal*
Age under 35	1.9%	2.3%	2.5%	2.5%	2.4%	2.8%	2.8%
Age 35 - 44	2.0%	2.2%	2.3%	2.3%	2.3%	2.5%	2.5%
Age 45 - 54	3.4%	3.8%	4.0%	3.9%	4.0%	4.1%	4.1%
Age 55 - 64	14.5%	15.3%	15.9%	16.6%	17.4%	18.1%	19.5%
Age 65 - 74	37.0%	39.2%	40.9%	44.3%	45.9%	47.0%	49.8%
Age 75 - 84	53.5%	58.2%	61.4%	73.9%	74.8%	76.6%	79.2%
Age 85 and older	73.4%	77.2%	80.6%	87.5%	87.2%	90.0%	92.6%
All ages 65 and older	40.2%	42.7%	44.6%	49.4%	50.8%	51.9%	54.5%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: Total outflow rates denote the percentage of dentists who had retired, whose license had lapsed, or who were deceased. *The hypothetical outflow rate is extrapolated for ages 55 and older based on the change from 2018 to 2020. N.A. = Not available.

Figure 5: Historical Outflow Rates (Five Years Ending), Dentists Aged Under 55

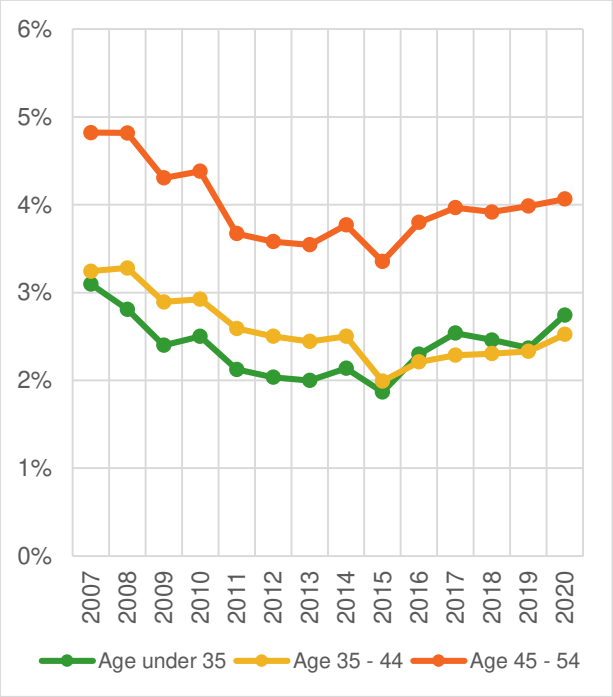
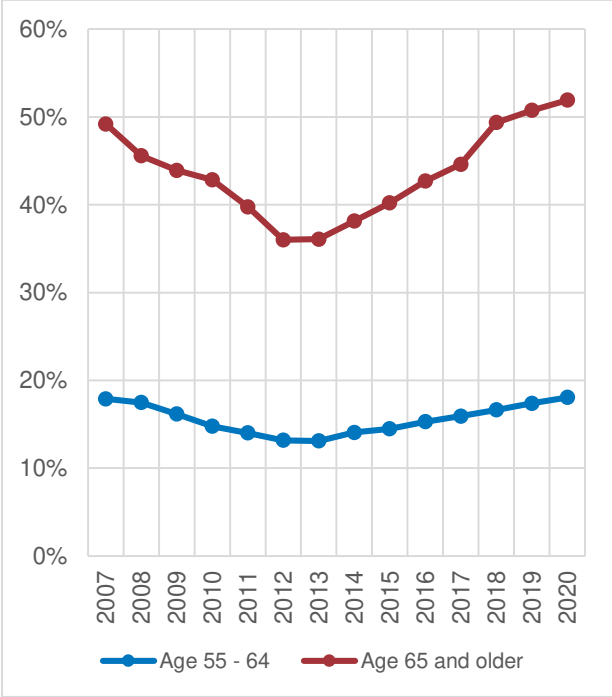


Figure 6: Historical Outflow Rates (Five Years Ending), Dentists Aged 55 and Older



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

Table 5: U.S. Business Cycle Expansions and Contractions

Years	Number of Cycles	Duration of Average Contraction	Duration of Average Expansion	Duration of Average Cycle
1945-2009	11	11.1 months	58.4 months	69.5 months

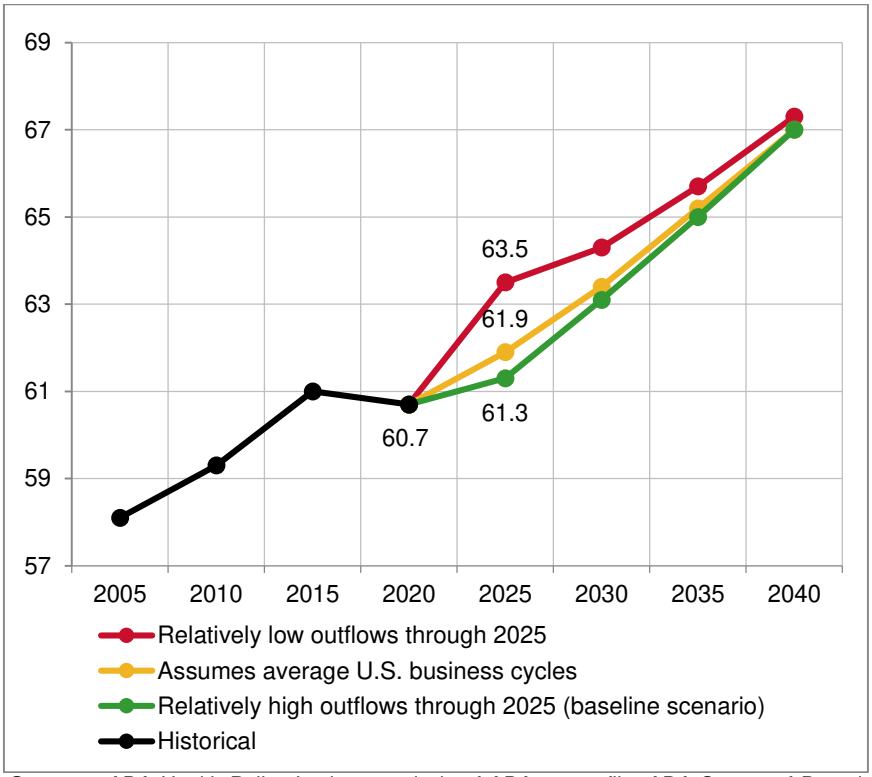
Source: National Bureau of Economic Research.

Table 6: Three Outflow Assumptions

	Relatively low through 2025		Average U.S. business cycles		Relatively high through 2025 (baseline scenario)	
	2020-2025	2025-2040	2020-2025	2025-2040	2020-2025	2025-2040
Age under 35	2.1%	2.8%	2.8%	2.8%	2.8%	2.8%
Age 35 - 44	2.6%	2.8%	2.8%	2.8%	2.5%	2.8%
Age 45 - 54	3.7%	4.3%	4.3%	4.3%	4.1%	4.3%
Age 55 - 64	14.0%	17.9%	17.9%	17.9%	19.5%	17.9%
Age 65 - 74	36.6%	45.5%	45.5%	45.5%	49.8%	45.5%
Age 75 - 84	53.2%	69.9%	69.9%	69.9%	79.2%	69.9%
Age 85 and older	74.9%	88.7%	88.7%	88.7%	92.6%	88.7%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: The three assumptions differ only in their percentages for the years 2020-2025. All three use the "average U.S. business cycles" percentages for the years 2025-2040. Total outflow rates denote the percentage of dentists who had retired, whose license had lapsed, or who were deceased.

Figure 7: Historical and Projected Dentists per 100,000 Population (Unadjusted), Scenarios With High and Low Outflows by End-of-Year 2025



Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Practice; ADA Survey of Dental Education; U.S. Census Bureau, Intercensal Estimates, Postcensal Estimates, National Population Totals, and National Population Projections. **Notes**: Data for 2005-2020 are based on the ADA masterfile. Results after 2020 are projected. Assumes the annual number of U.S. dental school graduates will increase through 2026 and then remain constant; U.S. population growth will match the U.S. Census Bureau's "low immigration" scenario released in 2020.

Table 7: Historical Dentist Inflows, 2010-2015

	U.S. Dental School Graduates	Foreign-trained Dentists	Relicensed Dentists	Dentists Returned from Retirement	Total
Age under 35	22,751	541	0	1	23,293
Age 35 - 44	3,754	1,105	276	12	5,147
Age 45 - 54	271	459	428	42	1,200
Age 55 - 64	17	182	377	88	664
Age 65 - 74	1	62	130	75	268
Age 75 - 84	0	9	26	28	63
Age 85 and older	0	2	2	3	7
Total	26,794	2,360	1,239	249	30,642

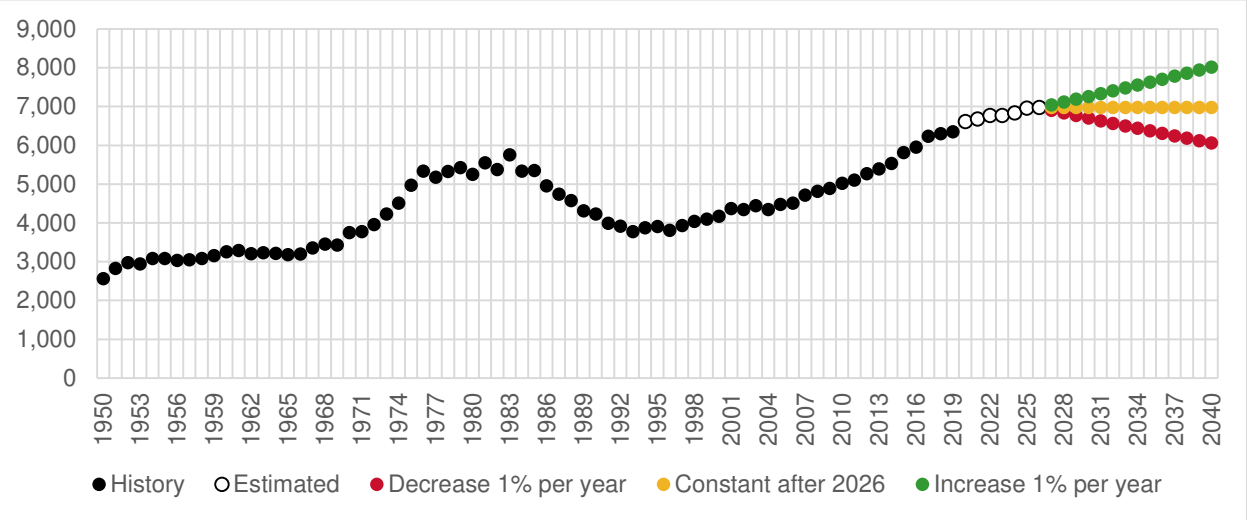
Source: ADA Health Policy Institute analysis of ADA masterfile. **Note:** Dentists counted toward inflow totals when they were on record with a degree in dentistry, a license to practice, a professionally active occupation code, and a location within the 50 states or District of Columbia.

Table 8: Historical Dentist Inflows, 2015-2020

	U.S. Dental School Graduates	Foreign-trained Dentists	Relicensed Dentists	Dentists Returned from Retirement	Total
Age under 35	24,633	827	2	1	25,463
Age 35 - 44	4,261	947	268	7	5,483
Age 45 - 54	335	439	366	8	1,148
Age 55 - 64	20	173	352	27	572
Age 65 - 74	4	83	185	23	295
Age 75 - 84	0	12	21	8	41
Age 85 and older	0	2	0	0	2
Total	29,253	2,483	1,194	74	33,004

Source: ADA Health Policy Institute analysis of ADA masterfile. **Note:** Dentists counted toward inflow totals when they were on record with a degree in dentistry, a license to practice, a professionally active occupation code, and a location within the 50 states or District of Columbia.

Figure 8: U.S. Dental School Graduates per Year, Historical, Estimated, and Three Inflow Assumptions



Sources: ADA Health Policy Institute Survey of Dental Education, ADA Health Policy Institute estimates and assumptions. **Notes:** Data for years 1950-2019 are historical. Estimates for 2020-2026 assume that all dental schools in operation in 2020 will maintain current or expected levels of graduates per year until 2026. Data points after 2026 are assumptions about future numbers of U.S. dental school graduates.

Table 9: Excerpt from Workforce Model Projection, 2020-2025, for Baseline Scenario (Unadjusted)

	Column A	Column B	Column C	Column D	Column E	Column F	Sum of Columns D, E, F
	Profes-sionally active dentists, 2020	Assumed five-year outflow rate	Apply five-year outflow rate	Apply aging logic to Column C to yield 2025 age distribution	Inflow of new U.S. graduates	Inflow of foreign-trained, relicensed, & unretired dentists	Profes-sionally active dentists, 2025
Age under 35	34,254	2.8%	33,314	9,328	27,583	820	37,730
Age 35 - 44	48,216	2.5%	46,999	47,485	4,783	1,445	53,713
Age 45 - 54	43,396	4.1%	41,632	43,483	393	858	44,733
Age 55 - 64	42,395	19.5%	34,144	41,111	0	528	41,638
Age 65 - 74	28,449	49.8%	14,294	25,117	0	381	25,498
Age 75 - 84	4,128	79.2%	857	4,536	0	57	4,593
Age 85 and older	279	92.6%	21	201	0	4	204
Total	201,117		171,260	171,260	32,759	4,091	208,110

Sources: ADA Health Policy Institute analysis of ADA masterfile; ADA Survey of Dental Education. **Notes**: Data for 2020 are based on the ADA masterfile. Results after 2020 are projected. Totals in the projection may not appear to match the sum of subgroups due to the rounding of fractional numbers produced by the model. Assumes (1) retirement rates will correspond to historical patterns for relatively high outflow rates from 2020 to 2025 and (2) the annual number of U.S. dental school graduates will increase through 2026 and then remain constant. Outflow rate in Column B is the percentage of dentists who had retired, whose license had lapsed, or who were deceased.

Table 10: Historical and Projected Female Share of U.S. Dentist Workforce

	2005	2010	2015	2020	2025	2030	2035	2040
Age under 35	38.6%	43.7%	48.0%	50.6%	52.5%	52.5%	52.5%	52.5%
Age 35 - 44	31.5%	36.0%	40.0%	44.8%	48.1%	51.1%	52.5%	52.5%
Age 45 - 54	17.9%	25.6%	32.8%	37.3%	42.0%	47.2%	49.2%	52.2%
Age 55 - 64	5.6%	10.9%	18.1%	26.0%	32.8%	37.3%	42.0%	47.2%
Age 65 - 74	2.7%	3.8%	6.4%	12.1%	19.4%	27.2%	34.0%	38.1%
Age 75 and older	1.9%	2.0%	2.9%	4.9%	9.5%	16.8%	24.3%	31.5%
All ages	20.0%	24.1%	28.9%	34.5%	39.9%	44.2%	47.0%	49.4%

Source: ADA Health Policy Institute analysis of ADA masterfile. **Notes**: Data for 2005-2020 are historical. Results after 2020 are projected and assume that the female share will level off at 52.5% for each age cohort.

Table 11: 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	1,847.3	1,592.0	1.000	0.862
Age 35 – 44	1,845.6	1,576.5	0.999	0.853
Age 45 – 54	1,780.3	1,631.2	0.964	0.883
Age 55 – 64	1,701.8	1,547.5	0.921	0.838
Age 65 – 74	1,485.3	1,513.3	0.804	0.819
Age 75 and older	1,186.5	1,032.4	0.642	0.559

Source: ADA Health Policy Institute, 2010-2019 results from the Survey of Dental Practice.

Table 12: Patient Visits per Week (Including Hygienist Visits) by Dentist Gender and Age Group

	Average Patient Visits Per Week (Including Hygienist Visits)		Indexed to Male, Age under 35	
	Male	Female	Male	Female
Age under 35	80.4	64.5	1.000	0.802
Age 35 – 44	86.4	69.0	1.075	0.858
Age 45 – 54	80.5	64.8	1.001	0.806
Age 55 – 64	74.1	56.6	0.922	0.704
Age 65 – 74	61.3	49.3	0.762	0.613
Age 75 and older	45.7	29.0	0.568	0.361

Source: ADA Health Policy Institute, 2010-2019 results from the Survey of Dental Practice.

Data & Methods

Data Sources and Methodological Approach

We used five data sources in our analysis. The first source is the American Dental Association (ADA) masterfile, a database that 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 used the masterfile's annual archived datasets from 2002 through 2020 to gather historical information on the dentist population profile, including dentist age, dental school 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 were able to track critical information for each dentist over time.

Our second source is the U.S. Census Bureau. To calculate historical measures of dentists per 100,000 population, we used Census population counts.[11,12] To calculate future estimates of dentists per 100,000 population, we combined our future dentist supply modeling results with a particular scenario from the U.S. Census Bureau's national population projections.[13]

The Census projections are released with a main series and three alternative scenarios based on data and assumptions made in 2016 and 2017. After that time, their low immigration scenario has come closer than their main series to matching the actual Census population estimates for 2017-2020, as seen in Figure 4. (This decreased growth rate is due to lower immigration[14] as well as a trend after 2008 for fewer births and more deaths each year.[15]) Therefore, we selected the Census Bureau's low immigration scenario for our projection of the future U.S. population. If we had selected the main series projection, our baseline dentist per 100,000 population estimate for 2040 would have been 64.5 instead of 67.0.

Our third source is the ADA's Survey of Dental Education for historical data on the number of graduates and current enrollment of U.S. dental schools.[16]

Our fourth source, to gauge variation in dentists' working hours and number of patient visits, is the ADA's Survey of Dental Practice results from 2010 through 2019.

Our fifth source, the "U.S. Business Cycle Expansions and Contractions" table[17] from the National Bureau of Economic Research, provided information on recessions and the average duration of business cycles.

The model counts professionally active, licensed dentists in all 50 states and Washington D.C. with these occupation codes in the ADA masterfile: private practice (full or part-time), dental school faculty/staff, armed forces, other federal services (i.e., Veterans Affairs, Public Health Service, Federally Qualified Health Centers), state or local government employee, hospital staff, graduate student/intern/resident, or other health/dental organization staff member.

The workforce projection model uses historical trends in inflows of dentists to and outflows of dentists from the workforce to inform various assumptions about future inflows and outflows. We defined three types of outflows of dentists: (1) those who retired, (2) those whose license expired, and (3) those who died before retirement. We do not have data on dentists who migrate from the United States to other countries, but

we expect most of these cases entail a license expiration that is accounted for in our data.

We defined four types of inflows of dentists: (1) new U.S. dental school graduates who became professionally active in the U.S., (2) foreign-trained dentists who became professionally active in the U.S., (3) dentists who reactivated an expired license, and (4) dentists who returned from retirement to the workforce.

We analyzed 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.

Outflow History and the Business Cycle

The outflows part of the model accounts for a possible relationship between outflows and business cycles, meaning a dentist's decision to retire may be influenced by the presence or absence of an economic downturn.

We calculated outflows as the proportion of dentists per age group who left the workforce over a five-year period. For example, for dentists in the workforce who were aged 55 to 64 in 2015, we calculated the proportion who were retired in 2020. This provided a retirement rate for the 55 to 64 age group for the period 2015-2020. We also calculated the proportions who were deceased or whose license was expired in 2020.

We computed total outflow rates as the combined shares of dentists who had retired, whose license had lapsed, or who were deceased. Table 4 and Figures 5 and 6 display the total five-year outflow rates per age group for years ending 2007-2020.

When examining historical outflow trends, we focused on dentists aged 55 and older; they account for the majority of dentists who leave the workforce in a five-year period. As seen in Table 4 and Figure 6, outflow rates for dentists aged 65 and older declined from 49 percent to 36 percent (2007-2012) and have increased to about 52 percent since then. Outflow rates for ages 55 to 64 fluctuated similarly within a narrower range.

The low outflow rates in 2012 occurred during a period following an economic downturn. The National Bureau of Economic Research determined that an 18-month recession ended in June 2009.[17] The stock market had declined from its 2007 high and was still below its peak in 2012.[18] The gross domestic product per capita (inflation-adjusted) had similarly declined from its 2007 high and had not recovered by 2012.[19] It is reasonable to assume that some dentists postponed retirement after the economic downturn. Retirement funds may have decreased in value and average general dentist income (inflation-adjusted) was declining from a 2005 peak.[19]

By contrast, the recession that began in February 2020[17] has not yet produced evidence of an unusual increase in numbers of dentists postponing retirement. It differs from the 2008 recession in having a shorter but deeper decrease in gross domestic product[20] and a shorter period below peak value for the S&P 500 index.[18]

Estimation of Outflows, 2020-2025

Given the variance of dentists' likelihood to retire before, during and after the 2008 recession, the size of the dentist workforce in 2025 could also vary, depending on whether there is another economic downturn that compels dentists to postpone retirement.

Therefore, we designed one assumption of outflow percentages to simulate the postponement of dentists' retirements. For this, we selected outflow percentages from 2011, a year with decreased outflows but not as extreme as those in 2012 or 2013.

We designed a second assumption of outflow percentages to represent the higher number of retirements that occur if they are not postponed. We calculated hypothetical outflow rates, extrapolated for ages 55 and older based on the change from 2018 to 2020, estimated to be likely continuations of the trends shown in Table 4 and Figure 6.

Estimation of Outflows, 2025-2040

We used a different approach to estimate long-term outflow percentages for the 15 years after 2025. First, to understand how prevalent recessions are over the long term, we consulted the "U.S. Business Cycle Expansions and Contractions" table released by the National Bureau of Economic Research,[17] excerpted in Table 5.

The table states that from 1945 to 2009, there were 11 business cycles, each with a period of expansion and contraction.[21] The average business cycle lasted 69.5 months and included an economic contraction (recession) of 11.1 months average duration, or 16 percent of the business cycle.

We therefore assumed that for the years 2025-2040, 16 percent of the period will be affected by a recession. For this period, we calculated outflow percentages by dentist age group, weighted 16 percent by historical outflow percentages influenced by the 2008 recession and weighted 84 percent by historical outflow percentages that occurred outside of the 2008 recession. We called these the "average business cycle" outflow percentages.

Estimation of Outflows, Baseline Assumption, 2020-2040

As described earlier, for the period 2020-2025, we created two outflow assumptions to represent the presence or absence of dentists' postponed retirements by end-of-year 2025. For a third assumption, we applied the "average business cycle" outflow percentages to 2020-2025.

To summarize our three outflow assumptions for 2020-2040, they all applied "average business cycle" outflow percentages to the years 2025-2040. For the years 2020-2025, however, one assumption is that older dentists will postpone retirement, a second assumption is that dentists' retirement rates will continue to increase, and the third assumption applies the "average business cycle" percentages to the period 2020-2025. For our baseline scenario, we take the second assumption that dentist retirement rates will continue to increase as they have since 2013. We display these three sets of outflow assumptions in Table 6.

Figure 7 compares the effects of our three outflow assumptions while holding our inflow assumption constant. The "low outflow" scenario assumes that an economic downturn (comparable to 2008 with declines in the stock market and gross domestic product) will occur by 2025. In a "low outflow" scenario, we expect older dentists are more likely to stay in the workforce because some "can't afford to retire," thus boosting the number of active dentists per capita. Under the "high outflow" scenario (our baseline), we expect dentists to continue to retire in greater numbers, reducing the growth rate of dentists per capita in the short term. Our third assumption uses the "average business cycle" outflows applied to 2020-2025 as well as beyond 2025 and generates a trend line falling between the first two assumptions.

Estimation of Inflows

We updated the inflows analysis part of the model by recognizing that, on average, 3.7 percent of new U.S. dental school graduates will not achieve "professionally active" status long enough to be counted in the model. This group includes dentists who work in U.S.

territories or the armed forces overseas, those who move to other countries, those who find U.S. employment that does not require a dentist license, and those who retire or die early.

We analyzed historical data on inflows for the periods 2010-2015 and 2015-2020 (Tables 7 and 8). We also estimated the number of U.S. dental school graduates from 2020 through 2026 based on known enrollment, expected attrition of dental school students, and the expected opening of three new dental schools.[22] We incorporated the estimates of 2020-2026 graduates into all scenarios; we assumed that all dental schools in operation this year will maintain current or expected levels of graduates per year at least until 2026.

We developed three scenarios for the future inflows of dentists into the workforce based on three assumptions for the number of future graduates from 2026 to 2040. The medium scenario assumed that after 2026, the annual number of dental school graduates would remain constant at the level estimated for 2026. The high and low scenarios assumed that after 2026, the annual number of graduates would increase or decrease, respectively, at the rate of 1 percent per year. Figure 8 displays both historical and future numbers of graduates per year under these three assumptions.

We generated future assumptions of inflows based on these high, medium and low numbers of new graduates joining the workforce. Our overall baseline scenario assumed that the medium inflow assumption would apply, meaning the annual number of graduates would increase until 2026 and then remain constant. Our baseline choice is based on the assumption that, while we can reasonably estimate the number of graduates through 2026, uncertainty increases thereafter.

We recognize that the future number of dental school graduates is subject to intense debate and speculation. On one hand, there are dental schools that have recently opened. On the other hand, the flattening of dentist earnings in recent years[23] combined with increases in dental educational debt and reduced demand for restorative dental care could place downward pressure on the number of dental school applicants, as suggested in previous research.[5,9,24]

In the last 10 years, about 88 percent of inflows have been new U.S. dental school graduates with remaining inflows coming from foreign-trained dentists, established dentists who reactivated an expired license, and dentists who came out of retirement. Tables 7 and 8 show that these smaller subsets of inflows have been a variable proportion of the total supply of dentists. Therefore, to minimize the number of scenarios under consideration, we designed the model to project this smaller subset of inflows as a constant percentage of active licensed dentists. We believe this is a reasonable assumption and our sensitivity analysis shows alternative assumptions have no relevant impact on overall results.

Combining Outflows and Inflows in the Model for Unadjusted Dentist Estimates

The model started with the 2020 active licensed dentist workforce broken down into seven age groups. We applied various assumptions for outflows per age group to calculate the number of these dentists still working in 2025. We applied 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 yield an updated age distribution for 2025. To this total, we added the estimated inflows of new dental school graduates, foreign-trained dentists, and relicensed and unretired dentists by age group.

Table 9 summarizes the basic working of the model and shows results for our baseline scenario of the projected dentist workforce (unadjusted) in 2025. We repeated the process to calculate projections for 2030, 2035 and 2040.

Female Share of the Dentist Workforce

We examined the historical trends of females as a share of dental school graduates and the dentist workforce. From 1972 to 2019, the female share of U.S. dental school graduates grew dramatically from 1.0 percent to 50.6 percent.[16,25]

The increase in female dental school graduates since the 1970s affects the dentist workforce today. Among active dentists under age 35, the female share grew from 38.6 percent (2005) to 50.6 percent (2020). For active dentists aged 55 to 64, the female share grew from 5.6 percent (2005) to 26.0 percent (2020).

After analyzing the historical growth of females in all dentist age cohorts, we projected the future female share of each cohort, as summarized in Table 10. These projections assume that the female share of U.S. dental school graduates will level off at 52.5 percent, the same percentage as the female share of first-year dental school enrollment in 2019-20.

We applied these projected percentages of women in the dentist workforce to our total workforce projection, yielding projections of the dentist workforce by gender and age group.

Adjusted Projections

For each dentist gender and age group, we calculated the average annual hours worked. We then calculated an index of hours worked that compared every gender and age group to male dentists under age 35: the group that typically has the highest average and the group we used as the reference group. For example, the "hours worked" index for females under age 35 was 0.862 because their average annual hours worked was 86.2 percent of the level for males under age 35 (Table 11).

We performed similar calculations for all dentist gender and age groups based on average patient visits per week, including hygienist visits (Table 12).

Using these indices per gender and age group as multipliers to the projection of the dentist workforce by gender and age group, we calculated the adjusted projections of dentists per 100,000 population seen in Tables 2 and 3. Both tables show the nine scenarios we selected to display a variety of combinations of assumptions of future inflows of dentists to and outflows of dentists from the workforce.

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