# Trends in Cervical Disc Arthroplasty Utilization in the Medicare Population: Projections Through 2040

Paul G. Mastrokostas, Leonidas Mastrokostas, Abigail Kyla Razi, Sean Inzerillo, Jad Bou Monsef, Afshin Razi, Mitchell K Ng

INTRODUCTION:

Cervical disc arthroplasty (CDA) has emerged as a motion-preserving alternative to anterior cervical discectomy and fusion (ACDF), offering the potential to reduce adjacent segment degeneration while maintaining cervical spine mobility. While prior studies have highlighted the increasing adoption of CDA, trends within the Medicare population remain less defined. This study retrospectively analyzed Medicare Part B National Summary data from 2009 to 2022 to assess historical utilization patterns of single- and multi-level CDA and applied statistical modeling to project future procedure volumes through 2040.

METHODS:

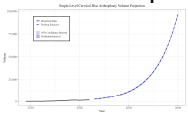
Medicare Part B National Summary data from 2009 to 2022 were analyzed to quantify single- and multi-level CDA procedure volumes. Data adjustments accounted for Medicare Advantage enrollment using established correction factors. Forecasting models—including log-linear, Poisson, negative binomial regression, and ARIMA—were applied to project utilization trends. Model performance was assessed using mean absolute error and root mean square error. The Poisson regression model was selected for final projections due to its optimal balance of predictive accuracy and stability.

RESULTS:

From 2009 to 2022, single-level CDA volume increased by 1,454% (108 to 1,679 cases), while multi-level CDA volume grew by 609.5% from 2015 to 2022 (147 to 1,042 cases). Forecasting projected a 23.5% annual growth rate for single-level CDA and 24.4% for multi-level CDA through 2040. By 2040, single-level CDA is expected to reach 96,430 procedures annually (95% CI: 95,822–97,039), while multi-level CDA will reach 63,362 procedures (95% CI: 62,869–63,856).

DISCUSSION AND CONCLUSION:

CDA utilization in the Medicare population has grown substantially and is projected to continue increasing through 2040. These trends reflect rising demand for motion-preserving cervical spine procedures and highlight the importance of healthcare planning, surgeon training, and equitable reimbursement policies to accommodate future growth.



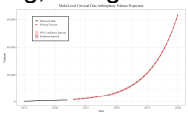




**Table 1.** Updated Historical Procedure Volumes of Single- and Multi-Level Cervical Disc Arthroplasty

| Year Intervals | Single-Level Cervical Disc Arthroplasty | | | Multi-Level Cervical Disc Arthroplasty | | |
|---|---|---|---|---|---|---|
| | Adjusted Volume | Percent Change | | Adjusted Volume | Percent Change | |
| | | YY-PC | 2-Year | | YY-PC | 2-Year |
| 2009 | 108 | - | - | - | - | - |
| 2010 | 139 | - | 18.2 | - | - | - |
| 2011 | 139 | - | 18.4 | - | - | - |
| 2012 | 136 | - | -19.7 | - | - | - |
| 2013 | 267 | - | 72.3 | - | - | - |
| 2014 | 339 | 232.4 | 78.4 | - | - | - |
| 2015 | 438 | 250.3 | 39.2 | 147 | - | - |
| 2016 | 731 | 275.2 | 75.3 | 250 | - | 84.5 |
| 2017 | 1,093 | 317.3 | 34.0 | 490 | - | 111.3 |
| 2018 | 1,094 | 275.4 | 38.0 | 483 | - | 62.4 |
| 2019 | 1,153 | 327.6 | 14.0 | 584 | - | 6.2 |
| 2020 | 1,040 | 213.1 | -12.4 | 882 | 450.0 | 14.1 |
| 2021 | 1,570 | 180.1 | 17.5 | 1,024 | 345.2 | 16.8 |
| 2022 | 1,679 | 67.4 | 8.9 | 1,042 | 114.4 | 1.8 |

**Table 2.** Forecast Model Outputs for Single-Level Cervical Disc Arthroplasty

| Model | Intercept | Trend Estimate | Growth Rate | 95% CI | MAE | RMSE |
|---|---|---|---|---|---|---|
| Log-Linear | -195.970 | 0.249 | 0.310 | 28.2% | (23.8, 32.8) | 766 | 971 |
| Poisson | -18.828 | 0.213 | 0.085 | 23.5% | (20.3, 27.1) | 177 | 233 |
| NegBinom | -180.164 | 0.232 | 0.017 | 25.2% | (21.8, 28.6) | 216 | 334 |
| ARIMA | 159.000 (SE) | ARIMA(1,0,1)(0,0,0)[0] | 47.250 | NA | NA | 180 | 145 |

%= Percentage; CI = confidence interval; MAE = mean absolute error; RMSE = root mean square error; NegBinom = negative binomial; ARIMA = auto-regressive integrated moving average; NA = not applicable.

**Table 3.** Poisson Model Outputs for Multi-Level Cervical Disc Arthroplasty

| Model | Intercept | Trend Estimate | Growth Rate | 95% CI | MAE | RMSE |
|---|---|---|---|---|---|---|
| Log-Linear | -243.750 | 0.274 | 0.047 | 31.4% | (28.5%, 45.7%) | 440 | 511 |
| Poisson | -414.485 | 0.214 | 0.000 | 23.4% | (19.9%, 31.7%) | 167 | 238 |
| NegBinom | -230.017 | 0.266 | 0.039 | 26.6% | (19.0%, 34.2%) | 230 | 249 |
| ARIMA | 123.871 (SE) | ARIMA(1,0,0)(0,0,0)[0] | 20.429 | NA | NA | 48 | 51 |

%= Percentage; CI = confidence interval; MAE = mean absolute error; RMSE = root mean square error; NegBinom = negative binomial; ARIMA = auto-regressive integrated moving average; NA = not applicable.

**Table 4.** Projections of Single- and Multi-Level Cervical Disc Arthroplasty

| Year Intervals | Single-Level Cervical Disc Arthroplasty | | | | Multi-Level Cervical Disc Arthroplasty | | | |
|---|---|---|---|---|---|---|---|---|
| | Projected Volume | 95% CI | | % Rate of Change | Projected Volume | 95% CI | | % Rate of Change |
| | | Lower Limit | Upper Limit | | | Lower Limit | Upper Limit | |
| 2023 | 2,075 | 2,371 | 2,779 | - | 1,451 | 1,651 | 1,935 | - |
| 2024 | 1,346 | 1,646 | 1,814 | 23.5 | 1,804 | 1,839 | 2,011 | 24.4 |
| 2025 | 1,673 | 1,819 | 4,200 | 23.5 | 2,244 | 2,289 | 2,498 | 24.4 |
| 2026 | 2,082 | 2,263 | 5,219 | 23.5 | 2,793 | 2,871 | 3,087 | 24.4 |
| 2027 | 2,589 | 2,814 | 6,488 | 23.5 | 3,750 | 3,296 | 3,835 | 24.4 |
| 2028 | 3,218 | 3,500 | 8,066 | 23.5 | 4,669 | 4,677 | 4,743 | 24.4 |
| 2029 | 4,000 | 4,350 | 10,031 | 23.5 | 5,774 | 5,795 | 5,893 | 24.4 |
| 2030 | 11,699 | 11,407 | 11,912 | 23.5 | 7,174 | 6,949 | 7,200 | 24.4 |
| 2031 | 14,544 | 14,211 | 14,802 | 23.5 | 8,873 | 8,491 | 9,000 | 24.4 |
| 2032 | 17,818 | 17,477 | 18,105 | 23.5 | 11,041 | 10,036 | 11,248 | 24.4 |
| 2033 | 22,017 | 21,737 | 22,319 | 23.5 | 13,736 | 11,947 | 13,987 | 24.4 |
| 2034 | 27,350 | 26,977 | 27,558 | 23.5 | 17,089 | 14,019 | 17,246 | 24.4 |
| 2035 | 33,947 | 33,529 | 33,947 | 23.5 | 21,261 | 20,975 | 21,247 | 24.4 |
| 2036 | 41,475 | 41,076 | 41,874 | 23.5 | 26,430 | 26,152 | 26,705 | 24.4 |
| 2037 | 51,514 | 50,775 | 51,458 | 23.5 | 32,890 | 32,151 | 33,262 | 24.4 |
| 2038 | 64,241 | 62,748 | 65,734 | 23.5 | 40,858 | 40,242 | 41,525 | 24.4 |
| 2039 | 79,802 | 77,244 | 78,608 | 23.5 | 50,830 | 50,409 | 51,273 | 24.4 |
| 2040 | 96,430 | 95,822 | 97,039 | 23.5 | 63,362 | 62,869 | 63,856 | 24.4 |

%= Percentage; CI = confidence interval.