Racial and Socioeconomic Differences in Technology-Assisted Total Knee Arthroplasty Amid National Growth: A 2016 to 2022 Medicare Claims Analysis

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INTRODUCTION:

Technology-assisted total knee arthroplasty (TKA), including both robotic and computer-assisted procedures, has expanded rapidly in recent years. In the context of this growth, differences in utilization across racial and socioeconomic subgroups remain unclear. This study aimed to evaluate trends in the use of technology-assisted TKA from 2016 to 2022 and to assess differences in receipt by race and socioeconomic status in fee-for-service Medicare beneficiaries.

METHODS:

Medicare fee-for-service claims were used to identify patients who underwent elective inpatient primary TKA in 2016-2022. Patients were categorized into six race-socioeconomic subgroups based on race (White, Black, Hispanic) and dual Medicare/Medicaid eligibility (yes/no; proxy for socioeconomic status). Procedures were categorized as technology-assisted or not. Cochran-Armitage trend tests and compound annual growth rate (CAGR) were used to evaluate annual trends for the full sample and race-socioeconomic subgroups. Multivariable logistic regression models examined the association between race-socioeconomic subgroups and receipt of a technology-assisted TKA, adjusting for age, sex, comorbidities, hospital characteristics, and surgery year.

RESULTS:

Of the 1,071,615 patients (White 92.3%, Black 6.4%, Hispanic 1.3%), the receipt of a technology-assisted TKA increased from 6.2% in 2016 to 24.1% in 2022 (P<0.001; CAGR 25.4%). This increase was driven primarily by robotic-assisted TKA from 0.57% to 18.1% (P<0.001; CAGR 78.0%). When stratified by the race-socioeconomic category, the CAGR for technology-assisted procedures in Hispanic dual-eligible patients was 16.0% (5.94% in 2016 to 14.44% in 2022), and the CAGRs for the other race-socioeconomic categories ranged from 24.7% (Hispanic-non-dual-eligible) to 27.1% (Black non-dual-eligible). Across the study period, the odds of receiving a technology-assisted procedure were significantly lower for White dual-eligible (OR 0.84, 95% CI 0.82-0.86), Black non-dual-eligible (OR 0.92, 95% CI 0.89-0.95), Black dual-eligible (OR 0.85, 95% CI 0.81-0.89), and Hispanic dual-eligible patients (OR 0.69, 95% CI 0.64-0.74) compared to White non-dual-eligible patients (all P<0.001).

DISCUSSION AND CONCLUSION:

There was national growth in use of technology assistance, specifically robotics, for TKA in fee-for-service Medicare beneficiaries. While there was growth over time across all race-socioeconomic categories, most categories of minority and lower-income Medicare beneficiaries were less likely to receive these surgical innovations. Differences were primarily driven by dual-eligibility status, with largest differences for Hispanic dual-eligible beneficiaries. These differences in use emphasize the need for equal-access focused policies for advanced orthopaedic technologies.

Table 1. Odds of utilizing any technology assistance (robotic or computer) for race/SES subgroups compared to White non-dual-eligible patients.

	OR	95% CI Lower	95% CI Upper	P-Value
White Non-Dual-Eligible	*Reference*			
White Dual-Eligible	0.841	0.819	0.863	<0.001
Black Non-Dual-Eligible	0.923	0.894	0.952	<0.001
Black Dual-Eligible	0.849	0.808	0.892	<0.001
Hispanic Non-Dual-Eligible	0.954	0.864	1.053	0.3512
Hispanic Dual-Eligible	0.688	0.639	0.741	<0.001

Table 2. Trends of any technology-assistance (robotic or computer) for primary TKA over time for all race and socioeconomic subgroups.

	2016	2017	2018	2019	2020	2021	2022	Total	Cochran-Armitage Trend Test P-Value	Compound Annual Growth Rate
Conventional (% of total)	249216 (93.80)	229208 (92.38)	172998 (89.66)	145990 (86.66)	71944 (82.63)	47523 (78.21)	36834 (75.87)	953713	<.0001	
Technology (% of total)	16486 (6.20)	18913 (7.62)	19943 (10.34)	22479 (13.34)	15126 (17.37)	13242 (21.79)	11713 (24.13)	117902		25.4
Total	265702	248121	192941	168469	87070	60765	48547	1071615		