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The Impact of New Cardiovascular Device Technology on Health Care Costs

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Abstract

Drug-eluting coronary stents (DES) are widely used[1] and entail sizeable Medicare hospital expenditures.[2] However, the overall cost impact of DES has not been well quantified. Clear understanding of how new technologies like DES affect healthcare expenditures can provide insight into national trends in healthcare cost growth, of which new technology is presumably the leading driver.[3] New technology may not only increase costs by being more expensive than previous treatments, but also by changing the patterns of care for chronic disease.[4] Accordingly, we sought to assess the overall impact of DES on Medicare expenditures in a nationally-representative cohort of Medicare beneficiaries with coronary artery disease (CAD).

METHODS

Because DES were introduced in 2003, we calculated average annual payer-perspective costs among CAD patients during 2002–2006 (including 2002 costs as a baseline), in each U.S. Hospital Referral Region (HRR)[6] using a 5% random sample of fee-for-service Medicare beneficiaries, excluding patients younger than 66 and older than 85 (DES use declines markedly at older ages).[5] Calculations were separately performed on each of three CAD sub-cohorts categorized annually by clinical events: patients with acute myocardial infarction (AMI), patients with acute coronary syndrome (ACS) but no AMI, and patients without ACS. We did not assume DES-associated healthcare cost growth was confined solely to DES recipients, thus cohorts included all CAD patients regardless of treatments received. Costs included all facility and provider Medicare payments, including non-cardiovascular costs, inflated to 2006 dollars using the consumer price index. This design captured costs downstream of major cardiovascular procedures and events, as patients were retained in the cohort through 12/31/2006 or until death. Annual DES rates within each HRR and subcohort were also calculated.

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Substantial geographic variation in DES use across HRRs enabled measurement of the relationship between higher DES use and higher healthcare costs. Multivariable regression models were estimated predicting annual HRR-level healthcare costs among CAD patients as a function of the local DES rate, HRR "fixed effects" that controlled for time-invariant differences in costs across HRRs, and time varying controls such as an annual HRR-specific medical cost index (controlling for geographic variability in healthcare inflation), patients' average DxCG Risk Score (predicting comorbidity-associated costs), and general time trend controls. Models were estimated separately for each subcohort.

To fully describe the national expenditure implications of the per-patient DES cost increases estimated by regression models, we computed the total change in national expenditures attributable to DES by multiplying the total number of Medicare beneficiaries nationwide in each CAD subgroup by the per-patient 2002–2006 cost increase predicted by the models.

RESULTS

Calculations were derived from 1,981,088 Medicare beneficiaries with CAD, of whom 4.5% had a recent AMI, 3.4% had a recent non-infarction ACS, and 92% had no recent ACS. Between 2002–2006, DES use increased from 0% in all subcohorts to 23% among AMI, 29% among non-infarction ACS, and 1.1% among non-ACS patients. Inflation-adjusted cost increases during 2002–2006 among CAD subcohorts ranged from 4.7% to 11.7%. Multivariable regressions indicated that each 1% increase in DES use was associated with a $28 average per-patient cost increase ($p=0.009$) among AMI patients, a $35 increase ($p<0.001$) among non-infarct ACS patients, and a $133 increase ($p=0.003$) among non-ACS patients. These estimates implied a DES-attributable increase in annual expenditures on AMI patients of $657, on non-infarct ACS patients of $999, and on non-ACS patients of $146 (Table 1). Because the vast majority of CAD patients were non-ACS, this subgroup comprised the largest portion of DES-attributable national cost growth.

COMMENT

Drug-eluting stents substantially increased costs for Medicare beneficiaries with CAD. The fraction of DES cost growth attributable to non-ACS patients (68%) was much larger than the proportion of DES received by this subcohort (33%), suggesting DES use among non-ACS patients was particularly cost-amplifying (i.e., DES introduction changed patterns of care for non-ACS patients in a more costly manner than for ACS patients). This is troubling, as the limited efficacy of PCI among non-ACS patients, whether or not DES is utilized, would not justify sizeable DES-related cost increases among non-ACS patients.[7, 8]

This analysis contributes to understanding the cost-increasing effects of technology because the cost effects of DES were measured beyond the price of the new technology itself. By measuring "global" costs among stable groups of patients over time, we captured temporal changes in both direct and indirect costs related to changing rates of DES use that occurred among patients who actually received the technology as well as non-recipients.

This observational study could not establish whether the association between increased DES use and cost growth was causal. Use of DES may be appropriate in selected non-ACS patients and could deliver benefits at acceptable cost.[9] Outpatient pharmaceutical costs were not included; these may have amplified or attenuated the DES-associated cost increase.

Drug-eluting stents added $1.57 billion in annual Medicare expenditures among beneficiaries ages 66–85, with the largest cost increase occurring among non-ACS patients.

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References

1. DeFrances CJ, Lucas CA, Buie VC, Golosinsky A. 2006 National Hospital Discharge Survey. Natl Health Stat Report. 2008; 5:1–20. [PubMed: 18841653]
2. Inpatient Hospital Payment Information for Value-Driven Health Care. Centers for Medicare and Medicaid Services; Available at: http://www.cms.hhs.gov/HealthCareConInit/02_Hospital.asp
3. Newhouse JP. Medical care costs: how much welfare loss? J Econ Perspect. 1992; 6(3):3–21. [PubMed: 10128078]
4. Escarce JJ, Bloom BS, Hillman AL, Shea JA, Schwartz JS. Diffusion of laparoscopic cholecystectomy among general surgeons in the United States. Med Care. 1995; 33(3):256–271. [PubMed: 7861828]
5. Groeneveld PW, Heidenreich PA, Garber AM. Racial disparity in cardiac procedures and mortality among long-term survivors of cardiac arrest. Circulation. 2003; 108(3):286–291. [PubMed: 12835222]
6. Center for the Evaluative Clinical Sciences - Dartmouth Medical School. The Dartmouth Atlas of Health Care; Available at: www.dartmouthatlas.org
7. Boden WE, O'Rourke RA, Teo KK, et al. Optimal medical therapy with or without PCI for stable coronary disease. N Engl J Med. 2007; 356(15):1503–1516. [PubMed: 17387127]
8. Katritsis DG, Ioannidis JP. Percutaneous coronary intervention versus conservative therapy in nonacute coronary artery disease: a meta-analysis. Circulation. 2005; 111(22):2906–2912. [PubMed: 15927966]
9. Cohen DJ, Bakhai A, Shi C, et al. Cost-effectiveness of sirolimus-eluting stents for treatment of complex coronary stenoses: results from the Sirolimus-Eluting Balloon Expandable Stent in the Treatment of Patients With De Novo Native Coronary Artery Lesions (SIRIUS) trial. Circulation. 2004; 110(5):508–514. [PubMed: 15262844]

Table

Patient-level and Subgroup-level Costs Attributable to DES

	Per Patient*			Per National CAD Subgroup, Annualized		
Subgroup	**Cost, 2002† ($)**	**Cost, 2006 ($)**	**Cost change attributable to DES ($)**	**National subgroup patients, n (millions)**	**Subgroup patients receiving DES in 2006, n (thousands)**	**Subgroup cost increase attributable to DES ($millions)**
AMI	35,815	37,345	657	0.36	82.9	236
Non-infarct ACS	26,418	28,278	999	0.27	77.8	269
Non-ACS	10,244	11,667	146	7.30	80.3	1,067
TOTAL CAD	11,952	13,398	198	7.93	241.0	1,572

*Costs are inflation-adjusted average per-patient costs, including both DES recipients and non-recipients.

†2002 costs inflated to 2006 dollars using consumer price index.

Abbreviations: CAD—coronary artery disease; DES—drug-eluting stent; AMI—acute myocardial infarction; ACS—acute coronary syndrome.

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