Supplementary Online Content


eAppendix. Validation of NIS Estimates of National Coronary Revascularization Rates

This supplementary material has been provided by the authors to give readers additional information about their work.
TECHNICAL APPENDIX

Validation of NIS Estimates of National Coronary Revascularization Rates

To validate the procedure volume estimates derived from the Nationwide Inpatient Sample (NIS) that were the primary data for this study, we compared the quarterly coronary artery bypass grafting (CABG) and inpatient percutaneous coronary intervention (PCI) procedure volumes estimated by the NIS for Medicare beneficiaries over age 65 to actual CABG and inpatient PCI claims in the 2001-2008 100% Medicare Provider Analysis and Review (MedPAR) national database of inpatient claims. The quarterly count of Medicare fee-for-service claims was inflated by a multiplier to account for CABGs or PCIs occurring among Medicare beneficiaries who were enrolled in Medicare health maintenance organizations, as these data do not appear in the MedPAR database but would have been reported in the NIS. The multiplier was calculated on a quarterly basis using the age, sex, race, and geographic distribution of Medicare fee-for-service beneficiaries and their CABG or PCI rates, applied to the age/sex/race/geographic distribution of HMO-enrolled Medicare beneficiaries (i.e., indirect standardization).

The quarterly counts of procedures using the NIS and Medicare were highly correlated across 2001-2008, with a Spearman correlation coefficient of 0.91 (p<0.001) for CABG (Appendix Figure 1) and a correlation coefficient of 0.78 (p<0.001) for PCI (Appendix Figure 2). The trends in CABG utilization as observed among Medicare beneficiaries in the NIS closely approximated actual Medicare CABG claims (Appendix Figure 3), as did the trends in PCI utilization (Appendix Figure 4). The difference in quarterly CABG counts between Medicare claims and the NIS estimates averaged 0.1% (range: -14% to 13%), while the difference in
quarterly PCI counts between Medicare claims and NIS estimates averaged 0.2% (range, -9% to 9%).

We then calculated the ratio of the number of inpatient drug-eluting-stent procedures to the total number of PCI procedures for each calendar quarter of Medicare claims, and compared these ratios to DES:total PCI ratios estimated from the NIS. We observed extremely high correlation (Spearman correlation coefficient = 0.99, p<0.001) between these two measures (Appendix Figure 5).

We conclude that NIS data provide a close approximation to actual nationwide coronary revascularization rates for both CABG and PCI, as well as for the ratio of drug-eluting stent use to total PCI use.

**Trends in Repeat Percutaneous Coronary Interventions: 2001-2008**

Nationwide Inpatient Sample data do not include patient identifiers, thus it is not possible to determine from NIS data whether the rate of repeat PCI (i.e., PCI occurring within 1 year of a prior PCI procedure) changed during 2001-2008. Therefore, to assess changes over time in the rate of repeat PCI we used Medicare 2000-2008 inpatient and outpatient facility claims, which include patient identifiers, to determine the fraction of PCI procedures in each calendar year among Medicare beneficiaries over age 65 that were repeat procedures, defined as PCI performed in patients who had received a prior PCI within 365 days. The annual percentage of repeat PCI declined slightly from 16.1% of all PCI procedures in 2001 to 12.9% in 2008 (Cochran-Armitage test for trend: p=0.003) (Appendix Figure 6). We conclude that the stability in national PCI rates during 2001-2008 occurred despite declining numbers of patients undergoing repeat PCI procedures during the same time interval.
Appendix Figure 1. Correlation between the observed quarterly count of actual Medicare CABG claims from patients older than age 65 (x-axis), and the projected count of Medicare CABG claims from the same population as predicted by the Nationwide Inpatient Sample (y-axis). The gray diagonal line indicates perfect correlation. Abbreviations: NIS—Nationwide Inpatient Sample; CABG—coronary artery bypass grafting.
Appendix Figure 2. Correlation between the observed quarterly count of actual Medicare PCI claims from patients older than age 65 (x-axis), and the projected count of Medicare PCI claims from the same population as predicted by the Nationwide Inpatient Sample (y-axis). The gray diagonal line indicates perfect correlation. Abbreviations: NIS—Nationwide Inpatient Sample; PCI—percutaneous coronary intervention.
Appendix Figure 3. Trends in the quarterly count of actual Medicare CABG claims from patients older than age 65 (red line), and the projected count of Medicare CABG claims from the same population as predicted by the NIS (blue line). Abbreviations: NIS—Nationwide Inpatient Sample; CABG—coronary artery bypass grafting.
Appendix Figure 4. Trends in the quarterly count of actual Medicare PCI claims from patients older than age 65 (orange line), and the projected count of Medicare PCI claims from the same population as predicted by the NIS (green line). Abbreviations: NIS—Nationwide Inpatient Sample; PCI—percutaneous coronary intervention.
Appendix Figure 5. Trends in the quarterly percentage of PCI procedures utilizing DES as reported on actual Medicare PCI claims from patients older than age 65 (black bars), and the projected quarterly percentage of PCI procedures utilizing DES from the same population as predicted by the NIS (gray bars). Abbreviations: NIS—Nationwide Inpatient Sample; PCI—percutaneous coronary intervention; DES—drug-eluting stents.
Appendix Figure 6: Annual Rates of First PCI and Repeat PCI Among Elderly Medicare Beneficiaries

The graph shows the annual rates of first PCI (gray portion of the bars) and repeat PCI (black portion of the bars) procedures each year from 2001 to 2008. The percentages in white text indicate the fraction of all PCI procedures in the calendar year that were repeat procedures. The source is Medicare institutional claims from 2001-2008 for patients age 65 or older. Abbreviations: PCI—percutaneous coronary intervention.