Supplementary Online Content

Meiri A, Zhang F, Ross-Degnan D, Wharam JF. Trends in insulin out-of-pocket costs and reimbursement price among US patients with private health insurance, 2006-2017. *JAMA Intern Med.* Published online June 1, 2020. doi: 10.1001/jamainternmed.2020.1302

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

eMethods.

We drew our sample of 612,071 patients with diabetes and private health insurance using data from Optum, which includes enrollment information and all medical, pharmacy, and hospitalization claims for commercially-insured members from all 50 US states.[1] Patients with diabetes were those who had diagnosis codes indicating diabetes in medical service claims (1 inpatient claim or 2 outpatient claims within one year), or who had pharmacy claims for insulin or an oral hypoglycemic medication other than metformin alone (excluded because it can also be used to treat prediabetes or polycystic ovary syndrome).[2]

We identified pertinent pharmacy insulin claims for enrolled members with diabetes between January 2006 and June 2017 by insurance benefit type as shown in the CONSORT diagram in eFigure 1. We classified health insurance benefit design into three categories: members in high-deductible health plans with a health savings account (HDHP-HSA), members in health plans with a health reimbursement arrangement (HRA), and members in plans with any deductible level without a savings account ("no account"). HDHP-HSA members must pay the actual price (i.e., the amount negotiated between the pharmacy benefit manager and the health insurer) for medications prior to exceeding their deductible level, permitting inference about insulin prices, while members in HRA and non-account plans pay for medications using a traditional tiered copayment schedule (i.e. certain dollar amount per specific prescription as negotiated by the insurer). Non-account members included patients in HDHPs and those in low-deductible plans (e.g., <$500 per calendar year) but without access to an HSA or HRA. HRAs are similar to HSAs in that they allow employees to use funds towards medical expenses (including medications). However, HRAs are owned by the employer and thus not portable; they might or might not roll over from year to year. HSAs are permitted only when attached to HDHPs that meet qualifying design features set by the Internal Revenue Service (IRS).

We calculated out-of-pocket costs first per 30-day equivalent insulin fill by dividing the days supplied listed on the claim by 30, then dividing the out-of-pocket amount (deductible + copayment) on the claim by the number of 30-day fill equivalents. We also calculated the per member per month (PMPM) out-of-pocket cost for insulin by dividing the sum total monthly out-of-pocket amount spent on insulin by the number of unique patients in a given month to provide a more clinically relevant estimate of patients' monthly burden of insulin out-of-pocket costs. We then calculated the weighted average of these monthly means to arrive at our annual estimate of insulin out-of-pocket costs PMPM.

We excluded zero and negative days' supply values (less than 0.1% of all fills), limited implausibly high values of days' supplies to 180 (<0.01% of fills) and excluded negative out-of-pocket cost values (<0.02% of fills). We also limited implausible out-of-pocket costs per 30-day fill to the federally-mandated individual out-of-pocket maximum amount in the calendar year of the claim based on IRS Form 8889 (<0.001% of fills).[3] We adjusted for inflation using the annual medical care consumer price index and report all values in 2017 US dollars.[4]

We imputed insulin reimbursement prices by calculating the median non-$0 out-of-pocket payment toward the annual deductible per 30-day equivalent insulin fill per calendar year among HSA-HDHP members. These members must pay actual insulin prices until exceeding their annual deductible level so that excluding $0 deductible amounts (i.e., fills occurring after members have exceeded their deductible level) and calculating the annual median 30-day insulin fill payment represents the actual negotiated insulin price to the insurer.

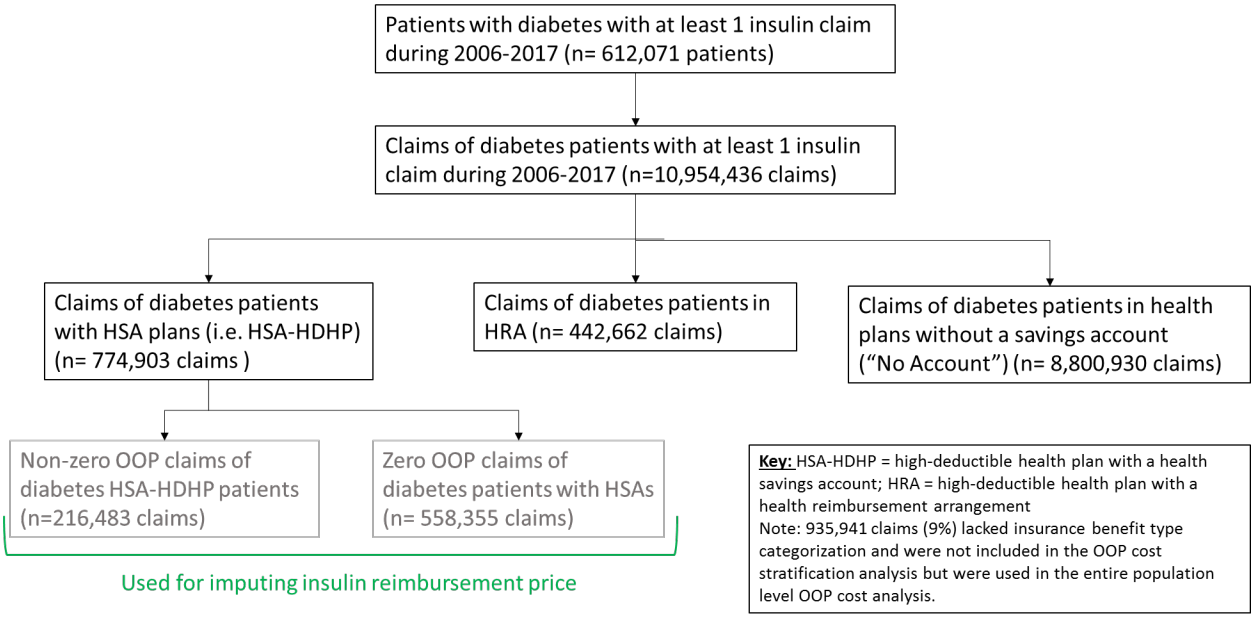
Because we had only six months of 2017 data, we imputed 2017 outcomes (costs and prices) by first estimating the ratio of January-to-June values to January-to-December values in 2017 year (per outcome) based on the 2006-2016 trend in this ratio. We then divided the January-to-June values from 2017 by the estimated 2017 ratio. For out-of-pocket costs, the ratio is based on mean 12-month and 6-

month values while for insulin prices, the ratio is based on non-zero 12-month and 6-month median values. The equation was as follows:

Estimated 2017 full 12 months outcome = (Actual 2017 first 6 months outcome) / (Estimated 2017 first 6 months / estimated 2017 full 12 months ratio from 2006-2016 ratio model)

We calculated inflation-adjusted median annual 30-day insulin prices and mean out-of-pocket costs (per 30-day fill and PMPM) per calendar year. We divided the 30-day mean out-of-pocket costs by the price in each calendar year to approximate the share of the insulin price that patients paid. We then modeled the trend in these annual measures using an annual time-series design and an autoregressive model with intercept, trend, and change in trend ($trend^2$) terms,[5] adjusting standard errors for autocorrelation and removing nonsignificant terms. We stratified patient out-of-pocket PMPM analyses by the previously described insurance benefit design categories.

eFigure. CONSORT Diagram



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3. Internal Revenue Service (IRS) Prior Forms. https://www.irs.gov/downloads/irs-prior. Published 2019. Accessed July 30, 2019.

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5. Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *J Clin Pharm Ther*. 2002;27(4):299-309. doi:10.1046/j.1365-2710.2002.00430.x