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Multiple Drug Cost Containment Policies in Michigan's Medicaid Program Saved Money Overall, Although Some Increased Costs

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Abstract

Michigan's Medicaid program implemented four policies (preferred lists, joint and multi-state purchasing arrangements, and maximum allowable cost) in 2002–2004 for its dual-eligible Medicaid and Medicare beneficiaries, taking antihypertensives and antihyperlipidemics prescriptions. We used interrupted time series analysis to evaluate the impact of each individual policy while holding the effect of all other policies constant. Preferred lists increased preferred and generic market share, and reduced daily cost. In contrast, maximum allowable cost increased daily cost, and is the only policy that did not generate cost savings. The joint and multi-state arrangements did not impact daily cost. Despite policy tradeoffs, the cumulative effect was a 10% decrease in daily cost and an annualized cost savings of $46,195.

INTRODUCTION

Nationwide, Medicaid prescription drug expenditures increased by 18.8% per annum between 2000–2002, a rate that was much higher than any other medical service.(1) Rising Medicaid prescription expenditures have been attributed to increased utilization, a shift in demand for newer and more expensive drugs, and increased prices of existing drugs.(2, 3) During this period, economic activity declined, which affected state budgets due to reduced state tax revenues and increased enrollment in public insurance programs.(4–6) Because of the decline in revenue and increases in Medicaid costs, many states responded by implementing various cost containment policies.

Multiple cost containment strategies are an important feature of state efforts to control Medicaid prescription drug costs. By the start of Fiscal Year 2010, 44 U.S. states had a preferred drug list, 26 states were part of a multi-state purchasing coalition, and 44 states had a maximum allowable cost pricing system.(7) Moreover, 26 states had three or more of these policies in place.(7)

Previous research has primarily focused on the effects of single cost containment policies.(8) For example, Law and colleagues compared the impact of a prior authorization policy implemented by Michigan's and Indiana's Medicaid programs on the use and cost of antihypertensive medications for dual eligible beneficiaries (i.e., individuals enrolled in both

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Medicaid and Medicare). Using data from July 2000 to September 2003, Law and colleagues found that the prior authorization: (a) shifted utilization to preferred drugs without reducing overall prescription drug use; (b) reduced pharmacy reimbursements; and (c) generated cost savings for both Medicaid programs in the first year after the policy was implemented.(9)

Our study expands the work of Law and colleagues to examine multiple cost containment policies implemented by the Michigan Medicaid program to control cardiovascular drug costs among dual-eligible beneficiaries. Cardiovascular agents are among the most expensive and highly-utilized prescription medications among the aged population.(10) In 2003, cardiovascular prescription drugs accounted for 12% of total Medicaid prescription drug expenditures.(11) Cardiovascular drug classes such as antihypertensives are often targeted by cost containment policies because of the wide range of drugs available with comparable therapeutic outcomes and variability in cost.(3, 9) These drugs therefore can serve as a testbed for examining the effectiveness of various cost containment strategies.

Overview of Michigan's Cost Containment Policies

In the early 2000s, Michigan's Medicaid outpatient prescription drug program, like other state Medicaid programs, experienced budget shortfalls due to reduced state revenues, reductions in employer-sponsored health insurance, and increased unemployment.(4, 5, 12) In response, the state implemented a number of Medicaid cost containment strategies to address what was considered an unsustainable increase in expenditures. Within a three-year period, Michigan implemented four cost containment policies: (1) a preferred drug list in February 2002; (2) a joint purchasing arrangement with Vermont in February 2003; (3) a maximum allowable cost system for pharmacy reimbursement in November 2003; and in May 2004 (4) a multi-state pooling supplemental rebate arrangement that increased the number of states covered by the joint purchasing arrangement to include Alaska, New Hampshire, Nevada and Montana.(13–15)

Michigan's preferred drug list was developed by a Pharmacy and Therapeutic Committee of 6 physicians and 5 pharmacists who provide care to Medicaid beneficiaries.(16) This committee identified the "best in class" products in each drug class based on clinical effectiveness and safety, and then conducted an economic analysis to compute the daily cost net of manufacturer rebates for each product.(17, 18) Manufacturers whose products had higher net costs than the "best in class" products were given an opportunity to provide supplemental rebates in addition to those that are federally mandated.(17, 18) A second economic analysis was carried out to determine which products within a class would be granted *preferred* status, and included in the preferred list without prior authorization.(17, 18) Although non-preferred drugs are available to patients, unlike those on the preferred list, they require prior authorization where physicians are required to provide an appropriate medical justification for prescribing them.(17, 18) Preferred Lists are expected to reduce prescription costs by encouraging the use of generic products that are less expensive than chemically-equivalent brand products.(20)

Purchasing pool arrangements--which include joint purchasing arrangements and multi-state pooling supplemental rebate arrangement--are designed to obtain economies of scale in

purchasing and processing of claims by reducing per-unit administrative costs.(15, 19) All states in a purchasing pool contract with the same pharmacy benefits manager to manage their prescription drug benefits and negotiate supplemental manufacturer rebates on a multi-state basis, though each state maintains a separate preferred drug list.(17, 18)

The Maximum Allowable Cost is a ceiling price set for generic and multisource brands that are chemically-equivalent and have the same active ingredients (generic substitutes). Maximum Allowable Cost is similar to reference pricing used in Canada that extends the concept of drug interchangeability to include chemically-related active ingredients that are pharmacologically equivalent (therapeutic substitutes).(21–23) Michigan reviews reimbursements by third party insurers and other state Maximum Allowable Cost Programs before setting a maximum price.(4, 17) Maximum pricing is the only policy designed to directly reduce the cost of generics by limiting the amount Medicaid can reimburse pharmacies. Maximum pricing can also reduce the cost of brands by forcing manufacturers of expensive branded drugs to provide large discounts in order to maintain their market share.

Study Overview

Michigan's cost containment efforts were motivated by the need to reduce prescription drug costs without negatively impacting access to care by encouraging physicians to prescribe products that are cost-effective for taxpayers, and safe and clinically-effective for beneficiaries.(17, 20) However, it is not clear whether multiple policies are needed to address rising prescription drug costs, which policies or combination of policies are most effective in reducing costs, and the mechanisms by which cost containment is achieved (i.e., are cost savings achieved through shifting market share to preferred drugs, or by reducing the price of individual drugs?)

The goals of our study were to examine the extent to which cost containment policies: 1) shifted market share to preferred drugs and generic drugs ("mix effect"); 2) reduced the price of generics and preferred drugs ("price effect"); and 3) reduced the daily cost (a combined price and mix effect). (The daily cost is the cost per day for each prescription provided to a dual-eligible beneficiary.)

METHODS

Study Design and Data

Exhibit 1 illustrates the timeline of Michigan's 4 cost containment policies. The study spanned 57 months and covered 5 policy periods (one 26-month pre-policy period and 4 policy periods of various durations).

Claims data for non-institutionalized, dual-eligible persons aged 65 years and older covering FY 2000–2004 were drawn from Michigan's Medicaid outpatient prescription drug fee-for-service program database. Beneficiaries over 65 years old made up 20% of the Michigan Medicaid dual-eligible population.(9) (We did not include individuals enrolled in Medicaid Managed Care Organizations or institutionalized individuals because detailed and complete histories of prescription-specific utilization and expenditure information were not available

for these persons.(10)) From this database, we extracted socio-demographic information, including age, gender, and race for each beneficiary; prescription drug information including the claim service date, national drug code, product name, days supply; and cost incurred by each payer (i.e., Medicaid, private insurance, and beneficiary).

We selected prescription drugs from 2 therapeutic classes, antihypertensives and antihyperlipidemics using the Micromedex® Healthcare Series database (Thomson Healthcare, Greenwood Village, Colorado). Prescription drugs were categorized along 2 policy-relevant dimensions: generic status and preferred drug status. First, we used Michigan Medicaid's preferred drug list (24) and information from a published report(25) to classify drugs into 3 categories: 1) preferred drugs that did not require prior authorization; 2) non-preferred drugs that required prior authorization; or 3) unlisted drugs. Second, we used information from the FDA website(26) to classify drugs as either brands (i.e., products marketed under a trade name and protected by a patent) or generics (i.e., products that are chemically-equivalent to brands but not protected by a patent). A list of the 108 cardiovascular products reimbursed by Michigan Medicaid is provided in Appendix A. Of the 24 products introduced between FY2000–2004, 13 products were introduced during the policy periods.

Analyses

Prescription drug utilization and expenditure data were aggregated on a monthly basis using the national drug code as the identifying variable. We measured utilization using drug days' supply (i.e., the number of days covered by each prescription) in order to control for prescription size. Prescription drug expenditures were calculated as the sum of amounts paid by Medicaid, private insurance, and beneficiary, but did not include pharmacy dispensing fees. All expenditures were inflated to September 2004 constant dollars using the Consumer Price Index for all urban consumers (CPI-U). (The CPI-U is the index used by Medicaid to analyze manufacturer price increments.)

In order to evaluate the "mix effect", we calculated the generic market share by aggregating days supply for generic drugs and dividing by the total days supply. We used similar methods to calculate the market share of brands, preferred drugs, non-preferred drugs and unlisted drugs.

To evaluate the "price effect", we calculated the generic price by dividing total generic drug expenditures by total generic days supply. Similar methods were used to calculate the price of brands, preferred drugs, non-preferred drugs and unlisted drugs.

To evaluate the "combined price and mix effect", we calculated the daily cost by dividing total expenditures by total days supply. (Of note, the daily cost equals the sum of generic and brand price, weighted by days supply; and is equivalent to the sum of preferred, non-preferred and unlisted price, weighted by days supply.)

In addition, we calculated generic expenditure share by dividing total generic expenditures by total drug expenditures. A similar method was used to calculate preferred expenditure share.

Regression analysis—We used interrupted time series analysis to investigate the mix effect, the price effect, and the combined price and mix effect of the 4 cost containment policies on cardiovascular drugs used by Michigan's dual-eligible beneficiaries. Interrupted time series methods simultaneously controls for pre-policy levels and trends in the variables of interest (e.g., prescription drug expenditures).(9, 16, 22) The changes in market share and price reflect the marginal effect of individual policy by holding the effect of all other policies constant. Because Medicaid allows up to 100 days supply per prescription,(27) we expected days supply to be autocorrelated. We used the Newey-West autocorrelation covariance matrix estimator with optimal lag length to calculate consistent standard errors and to ensure valid hypothesis testing.(22, 28)

For each policy-relevant classification (i.e., generic status and preferred drug status), we evaluated the mix, price, and combined effect of each cost containment policy. For example, we compared the preferred price, the non-preferred price, and the unlisted price in each policy period, in order to evaluate price effects. We used similar methods to evaluate the mix effect and the combined price and mix effect. Lastly, we calculated cost savings for each policy by multiplying the change in price by total days supply.

Regression analyses were conducted using STATA release 10 (College Station, Texas). A *p*-value < .05 was considered statistically significant. The regression equations used in the study are described in Appendix B.

Several limitations of the study should be noted. First, expenditures were not adjusted for the supplemental manufacturer rebates received by Michigan because manufacturer rebate information is proprietary information. Consequently, the estimated cost savings generated by Michigan's policies may be understated, given that 3 of the 4 policies (preferred lists and both purchasing arrangements) have a supplemental manufacturer rebate component. However, this approach is consistent with other studies that have evaluated state Medicaid expenditures.(9) Second, because we concentrated on older, dual eligibles, a population with poorer health status than the general Medicaid population, our study findings may not be generalizable to other Medicaid programs with different beneficiary demographics and prescription drug utilization characteristics. Third, our study did not include a control group. However, we used interrupted time series design--a method considered acceptable for studying intervention effects--that addressed threats to internal validity by controlling for pre-intervention level and trend changes.(30) A limitation of the interrupted time series design is that we could not control for individual level factors (16) such as generic drug entry and brand product patent expiration. For example, we were unable to quantify the impact that the entry of generic drug Lisinopril in 2002 had on the market share of the therapeutically-equivalent drugs Prinivil and Zestril. Finally, it is unclear what role, if any, the sequencing of policy implementation or the mix of policies played in generating the calculated cost savings (i.e., would we have arrived at the same conclusion if both the preferred lists and joint pool had not preceded maximum pricing).

RESULTS

Data Characteristics—The study population included 5,391 dual-eligible beneficiaries enrolled in the Michigan Medicaid outpatient prescription drug program over the 5-year study period from January 2000 to September 2004. The Medicaid recipients were predominantly White (73%), female (70%), and more than half (61%) were 65–79 years old.

50,902 prescription drug claims were included in the study. Antihypertensives accounted for 82% of total market share and 65% of total expenditures; antihyperlipidemics made up 18% of total market share and 35% of total expenditures. Branded drugs made up 61% of total days supply and 82% of total expenditures. Preferred drugs accounted for 62% of total days supply and 54% of total expenditures. Monthly utilization decreased between the pre-policy and post-policy period: prescription claims decreased by 25%, days supply decreased by 23%, and the monthly number of beneficiaries decreased by 37%. The number of products covered by Medicaid also decreased: the number of generic products fell by 3%, brand products by 57%, and total products decreased by 40%. Appendix C contains information on total reimbursements and prescriptions by policy-relevant classification.

Main Findings

Between the pre-policy and post-policy periods, the daily cost fell by $0.14 (10%) generic market share increased from 30% [11,686/38,380 days supply per month] to 54% [15,299/28,593 days supply per month], and preferred market share increased from 50% [19,078/38,380 days supply per month] to 83% [23,645/28,593 days supply per month]. Despite a significant (76%) shift to generic drugs, generic expenditure share increased by only 27% (see Exhibit 2). In contrast, the 63% increase in preferred market share was accompanied by 79% increase in preferred expenditure share (see Exhibit 3).

The preferred drug list had a positive effect on generic market share (which increased by 26%), whereas the other three policies, joint pool, maximum pricing, and multi-state pool decreased generic market share by 16%, 6% and 28%, respectively. Only the preferred list had a statistically significantly reduced the daily cost. The annualized cost savings generated by three policies (preferred lists, joint pool and multi-state pool) was $83,159 (total cost savings of $141,168). These savings were partly offset by cost increase from maximum pricing of $36,964 (total cost increase of $33,883). The cumulative effect of all policies was to increase generic market share by 24 percentage points and preferred market share by 32 percentage points; increase the price of generic and non-preferred drugs; and generate annualized cost savings of $46,195 (total cost savings of $107,285)(see Exhibits 4 & 5).

Below we summarize significant findings of the regression analysis, focusing first on the 4 policies implemented by Michigan's Medicaid program and then on the impact of these policies by therapeutic class, generic status and preferred status.

Findings by Policy

Preferred Drug List [effective 32 months]: The preferred list reduced the daily cost by shifting market share from brands to generic products (by 26%) and from expensive

nonpreferred drugs to less expensive preferred drugs (by 25%), which more than offset the increase in the price of brands and nonpreferred drugs. The preferred list generated the largest cost savings of the four policies, accounting for 94% [$43,205/$46,195] of annualized cost savings and 107% [$115,213/$107,285] of the total cost savings.

Joint Purchasing Arrangement [effective 15 months]: The joint pool shifted market share from generics to brands, and from preferred to nonpreferred drugs. The price of brands, generics and non-preferred drugs decreased, and that of preferred drugs increased. As a result of these tradeoffs, the daily cost was not significantly affected. The joint pool accounted for 24% [$11,171/$46,195] of the annualized cost saving and 13% [$13,963/$107,285] of the total cost savings.

Multi-state Pooling Supplemental Rebate Arrangement [effective 5 months]: The multi-state pool significantly reduced generic market share, and had no significant impact on preferred market share. The price of brands decreased significantly and that of generics declined marginally. The multi-state pool had no effect on daily cost because of tradeoffs: the preferred drug price increased and partly offset the decrease in the price of both non-preferred and unlisted drugs. The multi-state pool accounted for 62% [$28,783/$46,195] of annualized cost savings and 11% [$11,993/$107,285] of total cost savings.

Maximum Allowable Cost [effective 11 months]: Maximum pricing is the only policy that increased the daily cost, though insignificantly. Maximum pricing significantly reduced the price of preferred drugs, but also generated tradeoffs by increasing nonpreferred market share. Even though maximum pricing reduced the generic price, it did not shift market share to generic drugs and therefore did not generate any cost savings. Maximum pricing is the only policy that did not produce cost savings. The cost increase associated with the maximum pricing partly offset cost savings generated by the other 3 policies.

Findings by Drug Class

Therapeutic drugs: The preferred drug list exerted a positive effect by reducing the price of both antihypertensives and antihyperlipidemics. The antihyperlipidemics recorded an annualized cost savings of $100,385 (total savings of $109,906) and the antihypertensives an annualized cost increase of $54,190 (total cost increase of $2,623) over the policy period. Of note, the antihypertensive class was not impacted by cost containment policies because of tradeoffs: preferred list cost savings were significantly offset by cost increase from purchasing arrangements and maximum pricing. In contrast, in the antihyperlipidemics class, generated cost savings from the preferred drug list and purchasing arrangements were partly offset by cost increases associated with the maximum pricing.

Findings by Policy-relevant Classifications

Generic drug status: The preferred list is the only policy that increased generic market share (by 26%), whereas the other policies decreased generic market share by between 6% (maximum pricing) and 28% (multi-state pool). Generic market share increased by 24 percentage points between the pre-policy and post-policy period. However, the preferred list increased the price of brands, whereas the purchasing arrangements reduced the price of

brands. Generics generated annualized cost increase of $151,395 (total cost savings of $5,284), and brand products generated annualized cost increase of $105,200 (total cost savings of $102,001) over the policy period.

Preferred drug status: The preferred list was the only policy that shifted market share to preferred drugs. In contrast, both the joint pool and Maximum pricing significantly reduced preferred drugs' market share. Price effects were significant: the preferred list and maximum pricing reduced the preferred drug price, and both purchasing arrangements reduced the price of non-preferred drugs and increased the price of preferred drugs. Non-preferred drugs generated annualized cost savings of $75,107 (total cost savings of $217,949), while preferred drugs had annualized cost increase of $41,902 (total cost increase of $105,904) and unlisted drugs had annualized cost savings of $12,990 (total cost increase of $4,758).

Discussion

Michigan's cost containment policies streamlined reimbursement for prescription drugs dispensed to dual-eligible Medicaid beneficiaries to fewer products. Utilization as measured by monthly days supply and the number of drug products reimbursed fell significantly over the policy period. The 4 policies collectively changed the mix of drugs dispensed to generic and preferred products. Generic market share increased from one-third in the pre-policy period to more than half in the post-policy period, while preferred market share increased from one half to more than 80 percent over the same period. This significant shift to preferred drugs is in line with the 2003 Inspector General's report, which identified a 80 to 90 percent market shift.(29)

Overall, the 4 policies reduced the daily cost through a combination of price effects (reduction in prices) and mix effects (shifting market share to generic and preferred products that are less expensive). Only the preferred list had a significant effect on the daily cost, by shifting market share towards generic and preferred drugs, and reducing the price of preferred drugs. The joint and multi-state purchasing arrangements did not significantly affect the daily cost due to tradeoffs between preferred drug prices (which increased) and non-preferred drug prices (which decreased), combined with a shift in market share to more expensive non-preferred drugs. However, it is worth noting that despite the shift to more expensive products, purchasing arrangements generated cost savings to the Medicaid program (in addition to supplemental manufacturer rebates).

Different policies had different effects on prices. For example, the preferred list reduced preferred drug price and increased non-preferred drug price. In contrast, the purchasing arrangements caused a shift towards non-preferred drugs that was accompanied by a decrease in the non-preferred drug price. These changes suggest that manufacturers' may have offered price concessions to Medicaid in addition to supplemental rebates, in exchange for increased market share.(20) Second, maximum pricing is the only policy that did not generate cost savings. This finding is contrary to the 2003 Inspector General's report in which 24 states identified their maximum pricing programs as successful cost containment strategies.(29) It is not clear why generic market share decreased during the maximum pricing policy period. We speculate that the preferred list effect--the offer of supplemental

rebates which shifted market share to more expensive brands--dominated the impact of maximum pricing. This finding suggests that maximum pricing in itself lacks a mechanism to encourage generic substitution of brands, and may therefore have limited scope in generating cost savings.

Cost containment policies were most effective in the antihyperlipidemics class, where all the drugs were included in the preferred list either as preferred or non-preferred drugs. This is significant because antihyperlipidemics are the most expensive therapeutic class, and accounted for a third of total drug expenditures. Unlike the study by Law and colleagues,(9) our study found that Michigan's policies generated cost increases in the antihypertensives class due to policy tradeoffs. Specifically, despite preferred list cost savings, the purchasing arrangements encouraged use of expensive nonpreferred products without significantly reducing the nonpreferred drug price.

Policy implications of this study include the following. First, well-coordinated multiple policies can have a positive and significant impact on the daily cost. Second, a significant increase in generic market share was associated with a large reduction in daily cost. However, despite this significant shift to generic drugs, generic expenditure share did not change proportionately between the pre-policy and post-policy periods. This suggests that to generate meaningful cost savings, policies should also target brand products, which account for a substantial proportion of total prescription drug expenditures. Third, the maximum pricing increased the daily cost despite reducing the generic price, because market share shifted to expensive brands. This suggests that reducing generic price is not sufficient to reduce daily cost or generate cost savings, and that it is necessary to shift market share to less expensive products. Fourth, the preferred list and purchasing arrangements generated cost savings but the maximum allowable cost policy--employed by 44 states in FY2010--increased costs. This finding might lead policymakers to conclude that the preferred lists and purchasing arrangement policies should be pursued, but maximum pricing should not be pursued. However, from our analysis it is not clear why the maximum pricing generated cost increase given that generic price decreased. As noted earlier, the preferred list may have adversely affected the product mix and dominated any positive effect of the maximum pricing, so that overall costs increased. More research is needed on the interaction of multiple policies and their impact on overall costs.

In general, a multiple cost containment approach may be justified if: (1) policies have a reinforcing effect on each other (e.g., the joint pool increased the effectiveness of the preferred list); (2) they target different therapeutic sub-classes (e.g., the preferred list--which gives manufacturers an incentive to provide price concessions in exchange for inclusion of their products in the formulary--might work better in a brand dominated sub-class, whereas maximum pricing--which sets the maximum reimbursement rate for therapeutically-equivalent products--may be more effective in classes with many competing generics); or (3) more than one policy is needed to achieve required cost savings. Conversely, multiple policies may be counterproductive because of inherent tradeoffs (e.g., although maximum pricing may reduce generic price, the purchasing arrangements may shift market share to more expensive brands).

Evaluating the impact of policy-induced first-order substitutions (shifts to other prescription drugs) and second-order substitutions (increased use of other health care services such as the emergency room), was beyond the scope of the current study. These substitution effects may offset prescription drug cost savings and increase overall health care costs. Additional policy research is needed to evaluate and quantify these substitution effects.

In summary, Michigan's Medicaid program achieved cost savings on cardiovascular drugs used by dual-eligible beneficiaries through a combination of price and mix effects. However, we found evidence of policy tradeoffs that partly offset overall cost savings. Of particular concern, the maximum pricing generated cost increase despite reducing generic price, perhaps because other policies shifted market share to expensive brands. These findings have implications for evidence-based rational drug reimbursement in the era of multiple cost containment policies, including AIDS Drug Assistance Programs that are struggling to meet growing demand.(31) Study findings suggest that policy makers need to evaluate the impact of multiple policies on the price and mix of both targeted drugs and untargeted drugs with the same therapeutic outcomes. Additional research is needed to evaluate policy tradeoffs, in order to inform public health decision-making, and to ensure that scarce public dollars achieve the greatest value for money spent.

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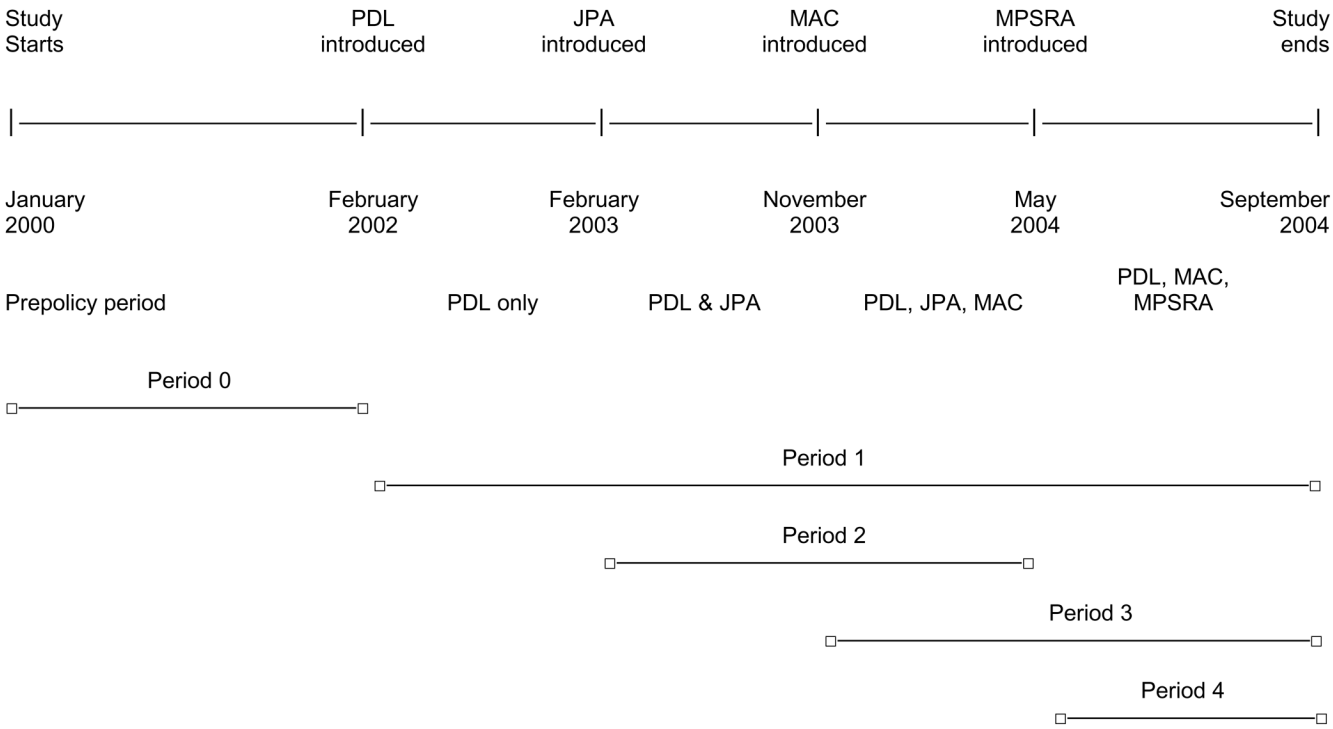

Exhibit 1.

Headline: Timeline for Michigan Medicaid's multiple cost containment policies

SOURCE: Authors' analysis of the timeline of Michigan Medicaid cost containment policies as implemented

Notes: The effective period of each policy is as noted in the legend. Please note that the multi-state pool replaced the joint pool in May 2004

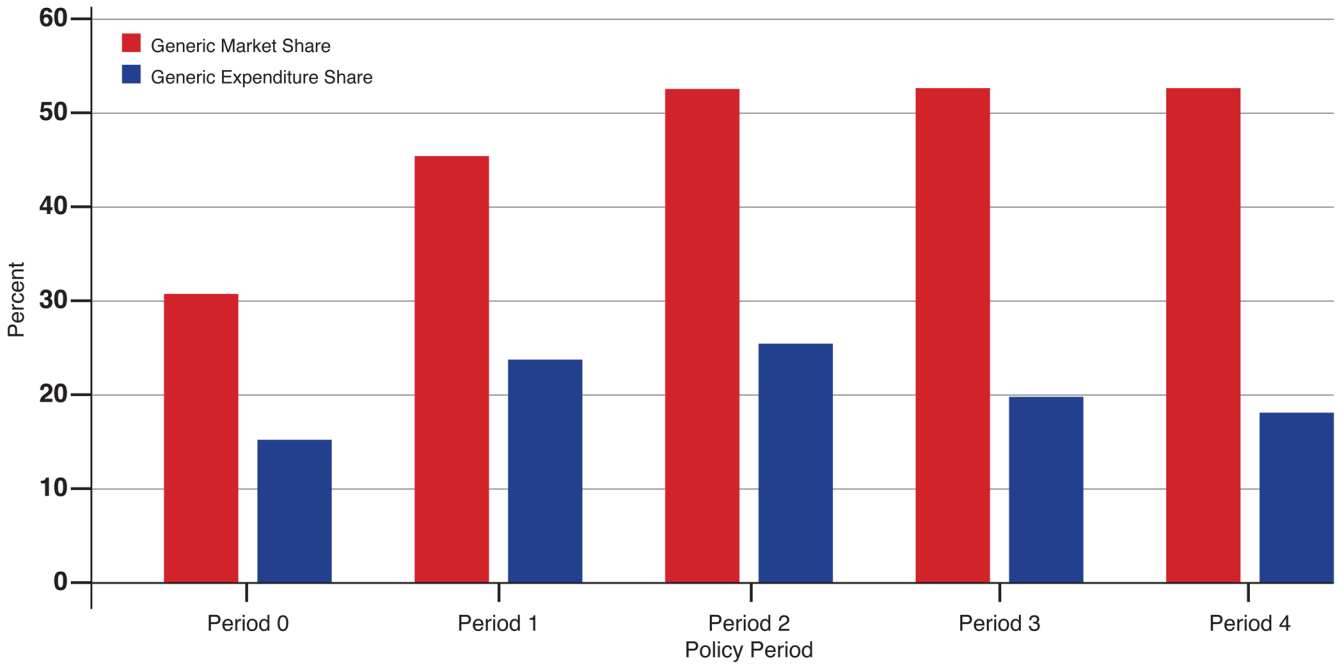

Exhibit 2.

Headline: Generic market share & expenditure share.

SOURCE: Authors' analysis of market share and expenditure share from cardiovascular drug prescription claims data for Michigan Medicaid dual-eligible beneficiaries 65 years and older, between FY 2000–2004.

Notes: Generic market share is the proportion of generic days supply to total days supply. Generic expenditure share is generic drug expenditures as a percentage of total drug expenditures.

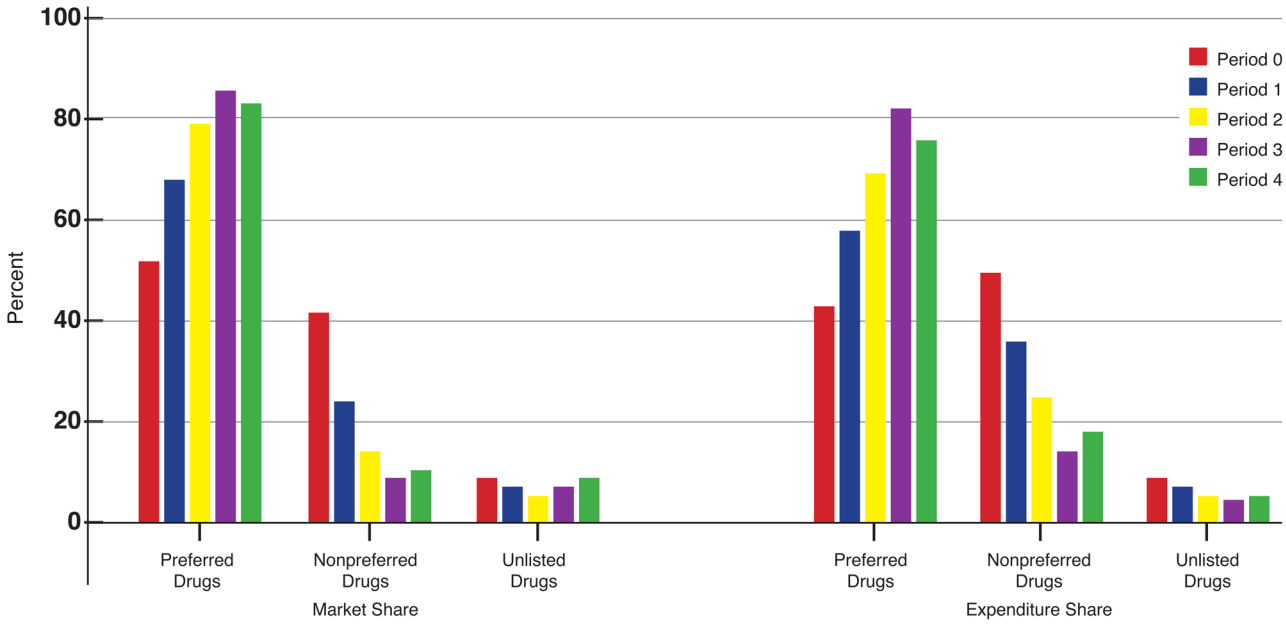

Exhibit 3.

Headline: Preferred/non-preferred/unlisted market share and expenditure share.

SOURCE: Authors' analysis of market share and expenditure share from cardiovascular drug prescription claims data for Michigan Medicaid dual-eligible beneficiaries 65 years and older, between FY 2000–2004.

Notes: Preferred market share is the proportion of preferred drug days supply to total days supply. (Nonpreferred market share and unlisted market share are analogously defined.) Preferred drug expenditure share is the preferred drug expenditures as a percentage of total drug expenditures (nonpreferred drug expenditure share and unlisted drug expenditure share are analogously defined).

Exhibit 4

Price and Market Share Changes due to Cost Containment Strategies**

	Preferred drug list	Joint purchasing agreement	Maximum allowable cost	Multi-state pooling supplemental rebate arrangement	All policies Post-policy less pre-policy value
Antihypertensives price	**−$0.09 (−$0.15, −$0.02)**	$0.03 (−$0.03, $0.09)	**$0.06 ($0, $0.12)**	$0.08 (−$0.06, $0.22)	−$0.04
Antihyperlipidemics price	**−$0.55 (−$0.75, −$0.34)**	−$0.04 (−$0.29, $0.22)	**$0.37 ($0.09, $0.64)**	−$0.39 (−$0.90, $0.11)	−$0.24
Generic market share change	**26% (17%, 33%)**	**−16% (−22%, −10%)**	**−6% (−9%, −4%)**	**−28% (−37%, −19%)**	75%
Generic price change	$0.02 (−$0.22, $0.26)	**−$0.22 (−$0.36, −$0.08)**	**−$0.13 (−$0.20, −$0.06)**	−$0.23 (−$0.48, $0.01)	−$0.24
Brand price change	**$0.31 ($0.19, $0.43)**	**−$0.20 (−$0.34, −$0.06)**	$0.17 (−$0.03, $0.38)	**−$0.60 (−$0.96, −$0.24)**	$0.51
Preferred drug market share change	**25% (15%, 36%)**	**−8% (−15%, −0%)**	**−16% (−23%, −9%)**	−7% (−19%, 6%)	63%
Non-preferred drug market share change	**−28% (−39%, −18%)**	**9% (2%, 15%)**	**15% (7%, 23%)**	8% (−4%, −19%)	−78%
Unlisted drug market share change	**3% (1%, 4%)**	−1% (−3%, −1%)	1% (−1%, 3%)	−1% (−5%, 3%)	1%
Preferred drug price change	**−$0.14 (−$0.27, −$0.01)**	**$0.11 ($0, $0.22)**	**−$0.12 (−$0.17, −$0.07)**	**$0.40 ($0.20, $0.60)**	−$0.01
Non-preferred drug price change	**$0.94 ($0.71, $1.17)**	**−$0.50 (−$0.80, −$0.21)**	−$0.17 (−$0.52, $0.18)	**−$1.06 (−$1.72, −$0.40)**	$0.82
Unlisted drug price change	−$0.24 (−$0.52, $0.03)	−$0.16 (−$0.44, $0.13)	**$0.36 ($0.25, $0.47)**	**−$0.76 (−$1.25, −$0.27)**	−$0.33
Change in daily cost of therapy	**−$0.15 (−$0.22, −$0.08)**	−$0.02 (−$0.09, $0.05)	$0.11 (−$0.01, $0.22)	−$0.08 (−$0.28, $0.11)	−$0.14

SOURCE: Authors' analysis of cardiovascular drug prescription claims data for Michigan Medicaid dual-eligible beneficiaries 65 years and older, between FY 2000–2004.

Notes: Changes in price and market share were predicted from interrupted time series regression analysis with standard errors controlled for autocorrelation. Reported changes in price and market share represent the marginal effect of each policy, controlling for level and trend effects in the other three policy periods. Bold numbers represent values that are statistically significant (p-value < .05).

Exhibit 5

Total and Annualized Cost Savings by Policy-Relevant Classifications

	Preferred drug list	Joint purchasing agreement	Maximum allowable cost	Multi-state pooling supplemental rebate arrangement	All policies
Total Cost Savings					
Antihypertensive drugs	**−$49,714 (−$88,039, −$11,390)**	**$17,797 ($4,668, $30,926)**	$18,562 (−$93, $37,217)	**$15,978 ($1,706, $30,250)**	$2,623
Antihyperlipidemic drugs	**−$65,498 (−$92,981, − $38,016)**	**−$31,760 (−$57,253, −$6,267)**	$15,322 (−$30,452, $61,096)	−$27,970 (−$56,393, $452)	−$109,906
Generic drugs	**$154,257 ($51,091, $257,421)**	**−$79,533 (−$116,955, −$42,111)**	**−$35,448 (−$50,470, −$20,425)**	**−$44,560 (−$69,995, −$19,125)**	−$5,284
Brand drugs	**−$269,469 (−$383,455, − $155,483)**	**$65,570 ($37,900, $93,240)**	**$69,331 ($21,553, $117,109)**	**$32,567 ($7,406, $57,729)**	−$102,001
Preferred drugs	**$159,750 ($10,437, $309,063)**	$4,905 (−$51,072, $60,884)	**−$90,960 (−$128,398, −$53,522)**	$32,209 (−$6,781, $71,198)	$105,904
Non-preferred drugs	**−$286,533 (−$440,009, −$133,056)**	−$10,232 (−$58,260, $37,796)	**$113,536 ($39,773, $187,299)**	−$34,720 (−$78,328, $8,888)	−$217,949
Unlisted drugs	$11,569 (−$9,887, $33,026)	−$8,636 (−$21,335, $4,062)	**$11,307 ($3,832, $18,783)**	−$9,482 (−$19,386, $423)	$4,758
Total cost savings	**−$115,213 ($−165,883, −$64,542)**	−$13,963 (−$42,541, $14,615)	$33,883 (−$2,218, $69,985)	−$11,992 (−$40,021, $16,036)	−$107,285
Annualized Cost Savings					
Antihypertensive drugs	**−$18,643 (−$33,015, −$4,271)**	**$14,238 ($3,734, $24,741)**	$20,249 (−$102, $40,601)	**$38,346 ($4,093, $72,599)**	$54,190
Antihyperlipidemic drugs	**−$24,562 (−$34,868, − $14,256)**	**−$25,409 (−$45,802, −$5,014)**	$16,715 (−$33,221, $66,650)	−$67,129 (−$135,343, $1,085)	−$100,385
Generic drugs	**$57,845 ($19,159, $96,533)**	**−$63,626 (−$93,564, −$33,689)**	**−$38,670 (−$55,058, −$22,282)**	**−$106,944 (−$167,987, −$45,900)**	−$151,395
Brand drugs	**−$101,051 (−$143,796, − $58,306)**	**$52,456 ($30,320, $74,592)**	**$75,634 ($23,512, $127,755)**	**$78,161 ($17,773, $138,549)**	$105,200
Preferred drugs	**$59,906 ($3,914− −$115,899)**	$3,924 (−$40,858, $48,707)	**−$99,229 (−$140,070, −$58,388)**	$77,301 (−$16, 274, $170,876)	$41,902
Non-preferred drugs	**−$107,450 (−$165,003, −$49,896)**	−$8,186 (−$46,608, $30,237)	**$123,857 ($43,388, $204,326)**	−$83,328 ($187,988, $21,332)	−$75,107
Unlisted drugs	$4,339 (−$3,708, $12,385)	−$6,909 (−$17,068, $3,250)	**$12,336 ($4,180, $20,491)**	−$22,756 (−$46,527, $1,016)	−$12,990
Annualized cost savings	**−$43,205 (−$62,206, −$24,203)**	−$11,171 (−$34,032, $11,692)	$36,964 (−$2,419, $76,347)	−$28,783 (−$96,051, $38,486)	−$46,195

SOURCE: Authors' analysis of cardiovascular drug prescription claims data for Michigan Medicaid dual-eligible beneficiaries 65 years and older, between FY 2000–2004.

Notes: Annualized and total cost savings were predicted from interrupted time series regression analysis with standard errors controlled for autocorrelation. Negative values represent cost savings and positive values are cost increases. Bold numbers represent values that are statistically significant (p-value < .05).