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Association between dispensing of low-value oral albuterol and removal from Medicaid preferred drug lists

Anna Volerman^{1,2*}, Alison Pelczar³, Rena Conti⁴, Christina Ciaccio² and Kao-Ping Chua⁵

Abstract

Background: Oral albuterol has worse efficacy and side effects compared with inhaled albuterol, and thus its use has been discouraged for decades. Drug inclusion or exclusion on formularies have been associated with reductions in low-value care. This study examines dispensing of oral albuterol and inclusion of oral albuterol on state Medicaid drug formularies—Preferred Drug Lists (PDLs). It also evaluates the association between removal of oral albuterol from the PDL and dispensing levels.

Methods: This quasi-experimental study determined oral albuterol inclusion on PDLs and dispensing between 2011 and 2018, using Medicaid program websites and the State Drug Utilization Database. Using a difference-in-differences model, we examine the association between removal of oral albuterol from Arkansas' Medicaid PDL in 2014 and dispensing of this drug through Medicaid, with Iowa as a control state. The outcome measure was the percent of all albuterol prescriptions that were for oral albuterol.

Results: A total of 28 state Medicaid PDLs included at least one formulation of oral albuterol in 2018. In 2018, 179,446 oral albuterol prescriptions were dispensed to Medicaid beneficiaries nationally. Medicaid programs paid approximately \$3.0 million for oral albuterol prescriptions in 2018. Removal of oral albuterol syrup from the Arkansas PDL in March 2014 was associated with a more rapid decline in dispensing compared with Iowa which maintained this medication on their PDL.

Conclusions: Findings suggest that removal of low-value medications, such as oral albuterol, from PDLs may be one avenue by which state Medicaid programs can reduce wasteful spending while improving guideline-based care.

Keywords: Albuterol, Low-value care, Preferred drug list, Medicaid

Background

Low-value services are those that fail to improve health or result in small health improvements relative to their cost [1, 2]. Use of low-value services is estimated to cost at least \$75–100 billion annually [3] and is widespread among all populations, including children [4, 5], non-elderly adults [6], and Medicare beneficiaries [7]. Prior

research suggests health insurer coverage and reimbursement policies, including drug inclusion or exclusion on formularies [8], can reduce low-value care and promote high-value care [9, 10]. These findings highlight the importance of carefully designing formularies so that they only include high-value drugs.

Most state Medicaid programs use preferred Drug Lists (PDLs), a type of formulary that lists of medications typically covered by Medicaid without prior authorization. Studies suggest that PDLs can impact prescribing of several types of medications, including cardiovascular drugs

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[11]. Other studies suggest that Medicaid managed care organizations can reduce drug spending by designing formularies that steer members toward drugs with a lower cost than those included in the state PDL, suggesting that effects of PDLs on spending and value may not always be positive [12, 13]. Despite the ability of PDLs to influence prescribing, few studies have examined the effect of removing drugs that are always low-value from PDLs. One study suggested that removal of methadone from PDLs can reduce prescribing of this drug for pain management, but methadone can be used both appropriately and inappropriately for analgesia [10].

One example of a drug that is always low-value is oral albuterol, an asthma quick-relief medication which is available in both tablet and syrup formulations. Compared with inhaled albuterol, oral albuterol has worse efficacy and side effects [14]. Clinical guidelines have explicitly dissuaded healthcare professionals from prescribing oral rescue medications for decades. The original asthma guidelines in the United States, published in 1991, recommend aerosol therapy over oral delivery due to the faster onset of relief, fewer adverse effects, and ability to achieve the same relief with a lower dose [15]. The two guideline updates (1997 and 2007) make no mention of oral beta₂-agonist medications as treatment options [16, 17]. Similarly, international guidelines either explicitly do not recommend oral albuterol or make no mention of it [18, 19].

Despite the absence of oral albuterol in guidelines and calls to cease prescribing of this medication [20], a 2006 study found that this drug was frequently used [21]. In this study, we report more recent data on dispensing of oral albuterol to Medicaid patients, assess the inclusion of oral albuterol in Medicaid PDLs, and evaluate the association between the removal of oral albuterol from Arkansas' PDL and dispensing of this drug.

Methods

This quasi-experimental study examines oral albuterol dispensing and Medicaid PDLs between 2011 and 2018.

Data source for albuterol dispensing

We obtained data on albuterol prescription dispensing to Medicaid enrollees in all states between 2011 and 2018 from the State Drug Utilization Database, which is maintained by the Centers for Medicare & Medicaid Services [22]. This database reports the quarterly number of prescriptions dispensed to Medicaid enrollees by national drug code (NDC). We identified products containing albuterol using a list of NDCs obtained from IBM Microdex RED BOOK (see Table E1 in [Online Supplement](#) for full list) [23]. Our list included all albuterol NDC codes that were active during the study period.

In the State Drug Utilization Database, data are suppressed for any quarterly count less than 11. We imputed suppressed counts in the same manner as prior studies using the same dataset [24]. This method leveraged the discrepancy between the sum of state-level totals and the national total. Imputed counts were weighted inverse to the number of quarters during the year that the count was suppressed, so that counts less frequently suppressed received greater weight (see Methods E1 in [Online Supplement](#) for description of the full methodology). When suppressed cells were dropped instead of imputed, results from difference-in-differences analyses were unchanged (see Table E2 in [Online Supplement](#), which contains the results without imputed counts).

Data source for PDLs

For the analysis of oral albuterol inclusion on 2018 PDLs, data on PDLs were obtained from Medicaid program websites. If PDLs were unavailable on websites, published minutes and notes for the state's Pharmacy and Therapeutics Committee were reviewed for indications of changes. If neither was available, the state's Medicaid office was contacted to clarify coverage or obtain prior PDL versions. When more than one list was published during 2018, all versions were reviewed to evaluate whether changes in coverage occurred. An albuterol formulation was considered preferred if it was included on the PDL; otherwise, it was considered non-preferred.

The analysis was limited to PDLs for FFS plans. Four states (Hawaii, New Jersey, New Mexico, and South Dakota) did not use PDLs for their FFS plans in 2018 [25] and were excluded, leaving 46 states and the District of Columbia (henceforth referred to as "states"). Of the 47 states, 11 had FFS only (no managed care organization (MCO) plans) in 2018, 13 had both FFS and MCO plans and used the same PDL for both (uniform PDL), and 23 had both FFS and MCO plans but used different PDLs [25]. For these 23 states, the PDLs for MCO plans were not examined.

For each of the 47 states using PDLs in 2018, we determined whether at least one formulation of oral albuterol was considered preferred on the state's 2018 FFS PDL. Additionally, we calculated total reimbursement for oral albuterol prescriptions across all state Medicaid programs in 2018. We conducted these analyses to determine the degree to which Medicaid programs continue to include low-value oral albuterol on PDLs and to estimate the direct amount of wasteful spending on this drug by Medicaid programs.

Selection of states for difference-in-differences analysis

Nineteen states did not consider any form of oral albuterol as preferred on their FFS PDL in 2018. For

these states, PDLs from 2011 to 2018 were reviewed to determine whether any oral albuterol formulations had changed from preferred to non-preferred status. Changes were identified in six states (2012: Idaho; 2016: Connecticut, Delaware; 2017: Michigan; 2018: Kentucky, New Jersey, North Carolina). Three states were not considered, because PDL removal occurred too early or late during the study period to have sufficient pre-intervention or post-intervention data. Two states (Connecticut and Delaware) were not considered because dispensing totals of oral albuterol in the quarter before PDL removal were 0.1–0.3%, levels that were too low to measure impact. In contrast, dispensing totals before PDL removal were high enough to measure impact in Arkansas, which changed oral albuterol syrup from preferred to non-preferred in March 2014, midway through the study period.

To identify potential control states for Arkansas, the percentage of dispensed albuterol prescriptions that were for oral albuterol syrup in 2011 was calculated for each state. This percentage was used because it is unaffected by the number of Medicaid enrollees, in contrast to raw prescription counts. States with a similar percentage of dispensed albuterol prescriptions that were for oral albuterol syrup to Arkansas in 2011 were considered. Iowa was chosen as the control state for several reasons. First, the trends for this percentage during the pre-intervention period between 2011 and 2013 were parallel to Arkansas. Second, Iowa did not experience any changes in albuterol coverage on its PDL between 2011 and 2018. Third, while Iowa transitioned from being fee-for-service only to a combination of fee-for-service and managed care organization plans in April 2016, the state utilized a uniform PDL that applied to both types of plans throughout the study period. Finally, Iowa expanded Medicaid under the Affordable Care Act in January 2014, as did Arkansas.

Statistical analysis

To examine the association between removal of oral albuterol syrup from Arkansas' PDL in 2014 and dispensing of this drug, a difference-in-differences analysis was performed using data between 2011 and 2018. The pre-intervention period consisted of 12 quarters between January 2011 and December 2013, and the post-intervention period included 19 quarters between April 2014 and December 2018. The quarter containing March 2014 was excluded. A second difference-in-differences model including only data through 2015 was also estimated, as Iowa started to use MCOs in 2016, while Arkansas had only FFS plans from 2011 to 2018.

The dependent variable was the percentage of albuterol prescriptions dispensed that were for oral albuterol syrup. The model included indicators for quarter to

adjust for seasonal patterns in dispensing. Robust standard errors were used.

To test the parallel trends assumption, a linear regression model was fit using only data from 2011 to 2013. Terms included time as a continuous variable, an indicator for Arkansas, and their interaction.

Results

Oral albuterol dispensing

In 2018, the database indicated that 174,505 oral albuterol prescriptions were dispensed to Medicaid beneficiaries nationally. After imputation, we estimate that the true total was 179,466 (see Table 1 for prescriptions by state). This total included 10,736 prescriptions for immediate-release tablets, 3182 for extended-release tablets, and 165,528 for syrup. Based on reimbursement data for the 174,505 non-imputed prescriptions in the database, Medicaid programs paid \$3.0 million for oral albuterol in 2018. In 2018, the percentage of albuterol prescriptions across all state Medicaid programs that were for oral albuterol was 0.7%, down from 3.2% in 2011.

Inclusion of albuterol on PDLs

In 2018, 28 of the 47 states that used PDLs included at least one oral albuterol formulation on their PDL. Of these 28 states, 26 had preferred status for oral albuterol syrup and 15 had preferred status for at least one formulation of oral albuterol tablet (immediate-release or extended-release) (Table 1).

Removal of albuterol syrup from Arkansas PDL

In Arkansas, oral albuterol syrup comprised an average 0.93% of all albuterol prescriptions dispensed per quarter under Medicaid during 2011–2013, compared to 0.83% in Iowa. This percentage declined over time in both states. Rates of decline were similar ($p = 0.50$), suggesting the parallel trends assumption was met.

After Arkansas removed albuterol syrup from the PDL in March 2014, the percent of dispensed albuterol prescriptions that were for albuterol syrup almost immediately declined to levels near zero, while this percentage declined more slowly in Iowa (Fig. 1). PDL removal was associated with a 0.33 percentage-point greater decline in this percentage in Arkansas compared with Iowa ($p = 0.01$) (Table 2). Restricting the time period to 2011–2015 produced similar results (differential decrease of 0.43 percentage points, $p = 0.02$).

Discussion

We provide an updated snapshot of the prescribing of oral albuterol and report on its inclusion on the majority of state PDLs in 2018 despite its worse efficacy and side effect profile compared with inhaled albuterol. Moreover,

Table 1 Oral albuterol inclusion status on Medicaid fee-for-service preferred drug lists (PDLs) and oral albuterol prescriptions by state in 2018¹

State	Status of albuterol on PDL		Oral albuterol prescriptions	
	Tablet preferred ¹	Syrup preferred	Number	Percent of all prescriptions
Alabama	x	x	3266	1.17
Alaska	x	x	31	0.07
Arizona		x	1381	0.29
Arkansas			0	0.00
California	x	x	43,831	1.54
Colorado			425	0.16
Connecticut		x	428	0.13
Delaware		x	56	0.07
District of Columbia		x	32	0.04
Florida		x	5596	0.47
Georgia			7141	1.03
Hawaii	*	*	2654	2.53
Idaho			20	0.03
Illinois		x	7000	0.77
Indiana		x	2770	0.56
Iowa	x	x	269	0.20
Kansas			250	0.21
Kentucky			2504	0.41
Louisiana		x	5264	1.13
Maine			106	0.13
Maryland		x	2097	0.45
Massachusetts	x	x	673	0.13
Michigan		x	9179	1.01
Minnesota		x	384	0.12
Mississippi	x		3377	1.99
Missouri			940	0.26
Montana			47	0.06
Nebraska		x	122	0.16
Nevada			1025	0.43
New Hampshire			108	0.22
New Jersey	*	*	7251	1.01
New Mexico	*	*	1947	1.06
New York			31,776	1.42
North Carolina ²	x	x	1810	0.34
North Dakota	x	x	56	0.26
Ohio			3235	0.25
Oklahoma			1140	0.48
Oregon			269	0.10
Pennsylvania			2327	0.21
Rhode Island			64	0.06
South Carolina	x	x	1205	0.49
South Dakota	*	*	35	0.17
Tennessee	x	x	2019	0.47
Texas		x	19,356	1.34
Utah	x	x	308	0.51

Table 1 (continued)

State	Status of albuterol on PDL		Oral albuterol prescriptions	
	Tablet preferred ¹	Syrup preferred	Number	Percent of all prescriptions
Vermont	x	x	27	0.06
Virginia			2700	0.69
Washington	x	x	660	0.15
West Virginia	x		1762	0.68
Wisconsin	x	x	416	0.11
Wyoming			97	0.62
National	15	26	179,446	0.78

¹ For albuterol tablets, states may have considered immediate-release and/or extended-release tablets to be preferred. These formulations were categorized separately, as some states considered one to be preferred and the other to be non-preferred. Table shows states that had at least one formulation of tablets as preferred

² Oral albuterol tablets were removed from the PDL in North Carolina in December 2018

*States with no preferred drug lists

we provide quasi-experimental evidence that removal of oral albuterol from the PDL in Arkansas was associated with an immediate near-elimination of dispensing of this drug. In contrast, dispensing of oral albuterol still occurred at the end of the study period in Iowa, which did not remove oral albuterol from its PDL. Findings suggest state Medicaid programs can reduce wasteful spending and potentially improve patient health by excluding low-value drugs from PDLs.

Oral albuterol has not been recommended as part of clinical guidelines for asthma for over three decades. Despite evidence-based recommendations in place, this study demonstrates that it continues to be utilized with over 175,000 prescriptions filled in 2018. Total spending on these prescriptions in 2018 was a modest \$3.0 million, representing a fraction of total Medicaid spending for inhaled albuterol in 2018 (\$1.1 billion for 22,882,125 prescriptions) [26]. However, this amount only represents the direct costs of oral albuterol dispensing. The true cost is likely higher, as the use of oral albuterol over more effective inhaled formulations may lead to avoidable and costly emergency department visits for asthma exacerbations or potentially symptoms related to the side effects of oral albuterol [27]. Consequently, potential savings if Medicaid programs removed oral albuterol from PDLs may be greater than just the direct costs of dispensing.

Formulary placement, including PDL inclusion, can be a tool to promote use of high-value care, as seen with curative hepatitis C treatment [28]. Conversely, PDL removal can be used to contain costs. Although studies have documented decreases in dispensing following

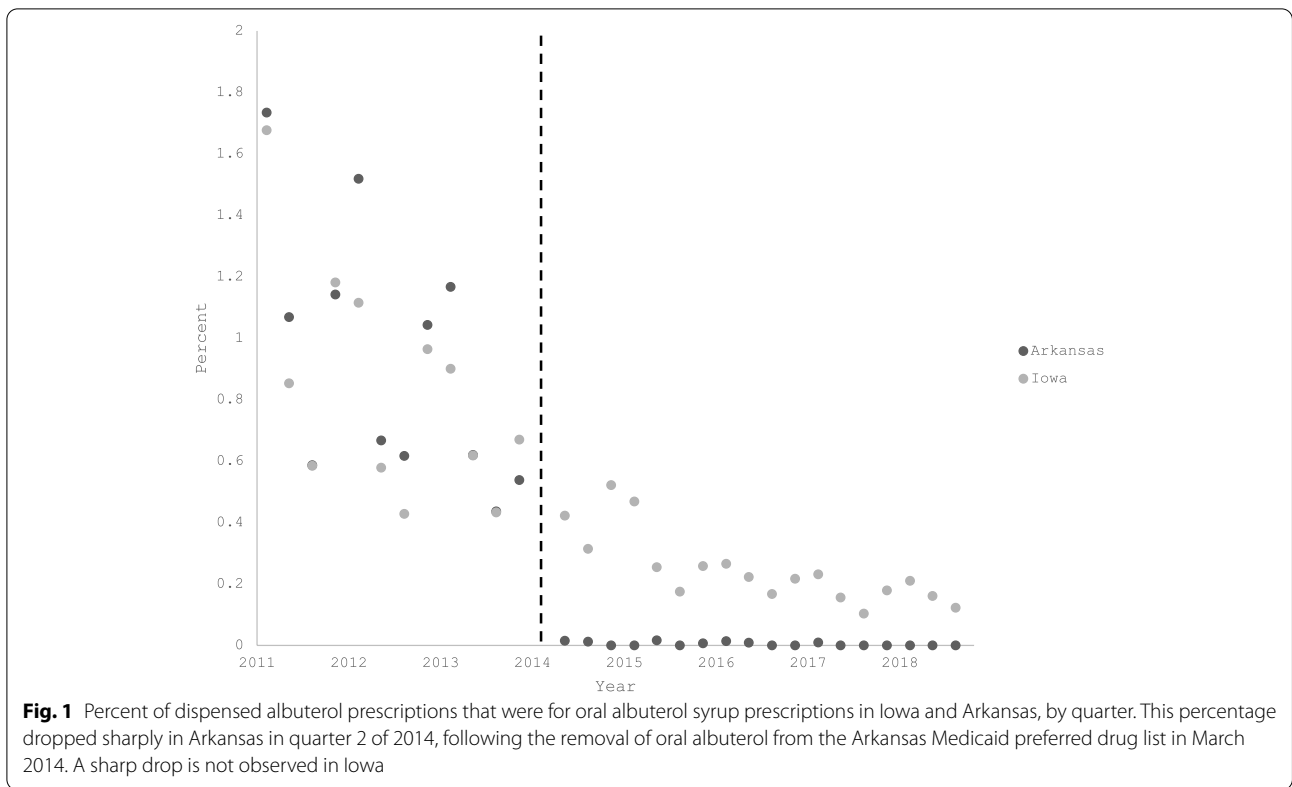


Table 2 Results from difference-in-differences analysis examining association between dispensing and removal of oral albuterol syrup from Arkansas' PDL in March 2014

	2011–2018		2011–2015 (Sensitivity Analysis)	
	Estimate (SE)	p	Estimate (SE)	p
Intercept	1.04 (0.12)	<0.001	1.19 (0.14)	<0.001
Difference in the pre-intervention period	0.09 (0.12)	0.43	0.09 (0.10)	0.37
Change during post-intervention period	−0.58 (0.08)	<0.001	−0.44 (0.09)	<0.001
Additional change during post-intervention period in Arkansas	−0.33 (0.13)	0.01	−0.43 (0.15)	0.01

SE standard error

Dependent variable is percentage of albuterol prescriptions that were for oral albuterol syrup

removal of several expensive drugs from PDLs [9, 10], our study provides some of the first evidence that PDL removal can reduce dispensing of a drug that is universally low-value.

While this study focused on oral albuterol, findings may be applicable to other low-value drugs. An analysis of employer pharmacy benefits demonstrated that reducing the use of high-cost, low-value drugs could lead to an annual savings of 3–24% of the overall pharmacy spending [29]. For example, some formularies include branded combination products that do not necessarily provide

sufficient clinical value to justify their higher cost compared with their individual generic components, such as ibuprofen/famotidine (Duexis) [30].

This study has several limitations. First, in the Medicaid dispensing database, there may be some lag between when a prescription is dispensed and when it was reported. In addition, data sources did not report why Arkansas removed oral albuterol from its PDL. Consequently, it is unclear whether the resulting reductions in dispensing were intended or not. Second, the aggregated nature of the data precluded us from determining

whether oral albuterol prescriptions were replaced with inhaled albuterol prescriptions among Medicaid enrollees in Arkansas. Third, both Arkansas and Iowa adopted Medicaid expansion in January 2014, two months before the PDL change in Arkansas. However, we have no a priori reason to suspect that Medicaid expansion would differentially cause shifts in the percentage of albuterol prescriptions that were for oral albuterol between the two states. Finally, the suppression of small cells in this database meant that imputation was necessary; we show that this did not significantly impact results.

Conclusion

Medicaid PDL removal may be a powerful tool for reducing dispensing of low-value drugs to Medicaid recipients. Moreover, the importance of this tool may only be increasing as a greater number of states carve out prescription drug benefits from managed care organization capitation payments and adopt uniform PDLs that apply both to fee-for-service and managed care organization enrollees [31]. State Medicaid programs and insurers more broadly should consider the removal low-value drugs from formularies and PDLs in order to reduce wasteful spending and potentially improve patient health by decreasing use of medications that have more effective alternatives.

Abbreviations

FFS: Fee for service; MCO: Managed Care Organization; NDC: National Drug Code; PDL: Preferred drug list.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12913-022-07955-x>.

Additional file 1.

Additional file 2.

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Authors' contributions

AV, AP, KC conceptualized and designed the study. AP organized the data and performed analyses. KC assisted with analyses. AP and AV drafted the manuscript. CC, KC, RC critically reviewed and revised the manuscript. All authors interpreted the data and also read and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate

Not applicable. This study utilized state-level data that was publicly available and included not individual information; thus, ethics or human subjects research approval was not required.

Consent for publication

Not applicable.

Competing interests

The authors declare they have no competing interests.

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References

- Baker DW, Qaseem A, Reynolds PP, Gardner LA, Schneider EC. Design and use of performance measures to decrease low-value services and achieve cost-conscious care. *Ann Intern Med*. 2013;158(1):55–9.
- Gruber J, Maclean JC, Wright B, Wilkinson E, Volpp K. The Impact of Increased Cost-Sharing on Utilization of Low Value Services: Evidence from the State of Oregon [Internet]. Rochester: Social Science Research Network; 2017. [cited 2021 Dec 20]. Report No.: ID 2903099. Available from: <https://papers.ssrn.com/abstract=2903099>
- Shrank WH, Rogstad TL, Parekh N. Waste in the US health care system: estimated costs and potential for savings. *JAMA*. 2019;322(15):1501–9.
- Chua K-P, Schwartz AL, Volerman A, Conti RM, Huang ES. Use of low-value pediatric services among the commercially insured. *Pediatrics*. 2016;138(6):e20161809.
- Chua K-P, Schwartz AL, Volerman A, Conti RM, Huang ES. Differences in the receipt of low-value services between publicly and privately insured children. *Pediatrics*. 2020;145(2):e20192325.
- Reid RO, Rabideau B, Sood N. Low-value health Care Services in a Commercially Insured Population. *JAMA Intern Med*. 2016;176(10):1567–71.
- Schwartz AL, Landon BE, Elshaug AG, Chernew ME, McWilliams JM. Measuring low-value care in Medicare. *JAMA Intern Med*. 2014;174(7):1067–76.
- Morgan S, Hanley G, Greyson D. Comparison of tiered formularies and reference pricing policies: a systematic review. *Open Med*. 2009;3(3):e131–9.
- Dillender M. What happens when the insurer can say no? Assessing prior authorization as a tool to prevent high-risk prescriptions and to lower costs. *J Public Econ*. 2018;165:170–200.
- Faul M, Bohm M, Alexander C. Methadone prescribing and overdose and the association with Medicaid preferred drug list policies - United States, 2007–2014. *MMWR Morb Mortal Wkly Rep*. 2017;66(12):320–3.
- Suchin Virabhak P, Judith A, Shinogle P. Physicians' prescribing responses to a restricted formulary: the impact of Medicaid preferred drug lists in Illinois and Louisiana. *Am J Manag Care*. 2005;11(1 SP) [cited 2022 Apr 1]. Available from: <https://www.ajmc.com/view/jan05-1983psp014-sp02>.
- Hernandez I, Gellad WF. Differences between managed care and fee-for-service Medicaid in the use of generics for high-rebate drugs: the cases of insulin Glargine and Glatiramer. *J Manag Care Spec Pharm*. 2020;26(2):154–9.
- Munshi KD, Mager D, Ward KM, Mischel B, Henderson RR. The effect of Florida Medicaid's state-mandated formulary provision on prescription

- drug use and health plan costs in a Medicaid managed care plan. *J Manag Care Spec Pharm*. 2018;24(2):124–31.
14. Price D, Bosnic-Anticevich S, Briggs A, Chrystyn H, Rand C, Scheuch G, et al. Inhaler competence in asthma: common errors, barriers to use and recommended solutions. *Respir Med*. 2013;107(1):37–46.
 15. Expert Panel Report 1. Guidelines for the diagnosis and Management of Asthma. Bethesda: U.S. Department of Health and Human Services; National Institutes of Health; National Heart, Lung, and Blood Institute; National Asthma Education and prevention Program; 1991.
 16. Expert Panel Report 2. Guidelines for the Diagnosis and Management of Asthma. Bethesda: U.S. Department of Health and Human Services; National Institutes of Health; National Heart, Lung, and Blood Institute; National Asthma Education and Prevention Program; 1997. Report No.: NIH Publication No. 97–4051
 17. Expert Panel Report 3. Guidelines for the Diagnosis and Management of Asthma. Bethesda: U.S. Department of Health and Human Services; National Institutes of Health; National Heart, Lung, and Blood Institute; National Asthma Education and Prevention Program; 2007. Report No.: NIH Publication No. 07–4051
 18. Global Initiative for Asthma. GINA Report: Global Strategy for Asthma Management and Prevention. 2021 [cited 2021 Dec 10]. Available from: <https://ginasthma.org/gina-reports/>
 19. British guideline on the management of asthma. *Healthcare Improvement Scotland*; 2019. Report No.: SIGN 158.
 20. Craig S, Tuszynski M, Armstrong D. It is time to stop prescribing oral salbutamol. *Aust Fam Physician*. 2016;45(4):245–7.
 21. Bonner S, Matte T, Rubin M, Fagan JK, Ahern J, Evans D. Oral beta2-agonist use by preschool children with asthma in east and Central Harlem, New York. *J Asthma Off J Assoc Care Asthma*. 2006;43(1):31–5.
 22. State Drug Utilization Data [database online]. Baltimore, MD; 2021.
 23. IBM Micromedex RED BOOK [database online]. Greenwood Village, CO: Truven Health Analytics; 2020.
 24. Clemans-Cope L, Epstein M, Lynch V, Winiski E. Rapid Growth in Medicaid Spending and Prescriptions to Treat Opioid Use Disorder and Opioid Overdose from 2010 to 2017 [Internet]. Washington, DC: The Urban Institute; 2019. p. 20. [cited 2021 Dec 20]. Available from: https://www.urban.org/sites/default/files/publication/99798/rapid_growth_in_medicaid_spending_and_prescriptions_to_treat_opioid_use_disorder_and_opioid_overdose_from_2010_to_2017_1.pdf
 25. State Medicaid Preferred Drug Lists [Internet]. Kaiser Family Foundation; 2020 Jul [cited 2021 Apr 9]. Available from: <https://www.kff.org/other/state-indicator/medicaid-preferred-drug-lists/>.
 26. Congressional Budget Office. Prescription Drugs: Spending, Use, and Prices [Internet]; 2022. p. 30. [cited 2022 Apr 1]. Available from: <https://www.cbo.gov/publication/57050>
 27. Murawski MM, Abdelgawad T. Exploration of the impact of preferred drug lists on hospital and physician visits and the costs to Medicaid. *Am J Manag Care*. 2005;11 Spec No:SP35–42.
 28. Washington State Department of Health. Plan to Eliminate Hepatitis C in Washington State by 2030 [Internet]. Olympia; 2019. [cited 2021 Dec 20]. Available from: <https://www.doh.wa.gov/Portals/1/Documents/Pubs/150nonDOH-HepCFreeWA-PlanJuly2019.pdf>
 29. Vela L. Reducing Wasteful Spending in Employers' Pharmacy Benefit Plans [Internet]. 2019 [cited 2021 Dec 20]. Available from: <https://www.commonwealthfund.org/publications/issue-briefs/2019/aug/reducing-wasteful-spending-employers-pharmacy-benefit-plans>
 30. Hakim A, Ross JS. High prices for drugs with generic alternatives: the curious case of Duexis. *JAMA Intern Med*. 2017;177(3):305–6.
 31. Gifford K, Lashbrook A, Barth S, Nardone M, Hinton E, Stolyar L, et al. States Respond to COVID-19 Challenges but Also Take Advantage of New Opportunities to Address Long-Standing Issues: Results from a 50-State Medicaid Budget Survey for State Fiscal Years 2021 and 2022 - Pharmacy [Internet]. 2021. [cited 2022 Apr 1]. Available from: <https://www.kff.org/report-section/states-respond-to-covid-19-challenges-but-also-take-advantage-of-new-opportunities-to-address-long-standing-issues-pharmacy/>

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