Conflict of Interests

All contributing authors are employees of Walgreen Co, the sponsor of the presented research.

Walgreens funded purchase of MarketScan Commercial Claims and Encounters databases, that meet HIPAA requirements.

This research was approved by Advarra IRB (#Pro00044844).

Inpatient and outpatient medical costs, hospitalizations, and length of stay associated with adherence to non-cycled oral antineoplastics among oncology patients.

Francis Staskon, PhD; Edward A. Witt, PhD; Heather Kirkham, PhD, MPH; Laly Havern, PharmD

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Objectives

Research aims:

- Propose a proportion of days covered (PDC) adherence metric to measure utilization of non-cycled antineoplastic therapies for a variety of cancers provided by pharmacies.
- Examine costs and health outcomes associated with adherent PDC (≥80%).

Methods

- This retrospective cohort study used MarketScan Commercial Claims and Encounters databases from 2017--2019.
- PDC was calculated for 2018 utilizing non-cycled medications ("2018 cohort") and then for 2019 for those who had a 2018 PDC ("2018/2019 cohort").
- Medications were from 14 therapeutic categories per year or across both years (see Table 2; also includes generic product names).
- New therapy/diagnosis indications in 2018 were inferred from a look back into 2017 data. Continuous enrollment was required as were ICD oncology diagnosis codes for those 18—65 years of age.
- Sample exclusion criteria were deaths, hospice care, inpatient transplant services, and females on fertility therapy.

Methods - continued

- Modeled outcomes were medical costs (total net inpatient and outpatient costs), hospitalizations, and length of days stay (LOS) for 2018 and combined 2018-2019 cohorts.
- General Linear and Logistic models' covariates included adherent (PDC≥80% or not), gender (female vs. male), age (mean split of log transform), census region (northeast vs. other), metropolitan location (metro vs. not metro), number therapy classes (2+ therapy classes vs. 1), retail orders (all vs. mix or mail), new to therapy/diagnosis (PDC medications and ICD coding), presence of comorbidity (any non-cancer Charlson comorbidity index category) and changed insurance type (category change). Explored covariate interactions with focus on interactions between adherent and comorbidity indication, or by metro area, or by new to therapy.

Methods - continued

- Finally, for patients meeting 2019 PDC criteria, combined yearly results were modeled for associations for patients matched across years on identifiers, gender, census region and age range. New to therapy in 2018 was retained as a covariate.

Results

- A total of 5,694 patients met the 2018 PDC criteria ('2018 cohort'). Of those, 2,034 also had a 2019 PDC ('2018/2019 cohort'). Average 2018 PDC was 73.2% and average 2019 PDC was 84.7%. Average PDC for 2018/2019 cohort was 67.9%.
- As presented in Table 1. demographics and clinical features have some different rates between patients in 2018 and the subset also having a 2019 PDC measure.

Patient characteristics by Cohort

Table 1: Demographics and clinical characteristics for 2018 and 2018/2019 PDC Cohorts

Characteristic Indicated	2018	2018/2019
Count	5,694	2,034
Female	14.9%	32.9%
North-east region	16.6%	17.8%
South region	27.2%	47.7%
Metropolitan area	47.6%	88.5%
Retail pharmacy only	59.1%	61.1%
Insurance type change	2.6%	4.7%
Single therapy class used	91.3%	96.2%
Non-cancer Comorbidity	22.9%	30.9%

Results - continued

- In combined years, rates for females increased 18%, and south census regions increased 20% in the matched cohort. There is also a larger rate for metropolitan (difference of 40.9%). In 2018, 22.9% had at least 1 Charlson non-cancer index comorbidity category that increased 8% on combined years. Finally, there are somewhat higher rates for single therapy class (increase 4.9%) and insurance type changes (1.9%) on matched years.
- In 2018, 16.2% were hospitalized with LOS=9.5 (s.d.=17.2), and 24.1% were hospitalized in both years with LOS=8.8 (s.d.=12.4).
- The most utilized antineoplastic drug classes were aromatase inhibitors (34.9%) followed by BCR-ABL kinase inhibitors (28%) in this sample (see Table 2).

Aromatase and BCR-ABL Kinase Inhibitors were 62.9% of usage

Table 2: Distribution of Index Therapy Classes for 2018 PDC on Total Fills

Therapy Classes	Generic Products	Patient Count	%
Androgen Biosynthesis Inhibitors	abiraterone	387	6.8
Antiandrogens	apalutamide, enzalutamide	236	4.1
Antiestrogens	tamoxifen	282	5.0
Antileprotics	thalidomide	26	0.5
ALK Inhibitors	alectinib, crizotinib	163	2.8
BCR-ABL Kinase Inhibitors	bosutinib, dasatinib, imatinib, nilotinib	1,588	28.0
BRAF Kinase Inhibitors	dabrafenib, vemurafenib	119	0.7
EGFR Inhibitors	erlotinib	118	2.1
Multikinase Inhibitors	cabozantinib, sorafenib	248	4.4
Tyrone Kinase Inhibitors	trametinib	9	0.2
mTOR Kinase Inhibitors	everolimus	239	4.2
Aromatase Inhibitors	anastrozole, exemestane, letrozole, ribociclib	163	34.9
CDK inhibitors	abemaciclib, palbociclib	75	1.3
JAK inhibitors	ruxolitinib	293	5.2

Results - continued

- Models on the outcome of medication carrier net payments used for PDC calculations indicated higher adjusted medication costs for adherent patients compared to those non-adherent in 2018 by $29,492 ($p<.0001$), and in the 2018/2019 cohort by $68,367 ($p<.0001$) (see Table 3).

- Model for 2018 found significant effects favoring the adherent cohort with reduced medical costs (-$9,600, $p<.0001$) (see Table 3). Other significant covariates indicated higher costs for younger patients ($p<.04$), new to therapy ($p<.0001$), those with a comorbidly ($p<.0001$), and significantly lower costs for metro areas ($p<.0001$) and utilizing retail pharmacies ($p<.05$).

Total Rx and Medical Costs Outcomes by Adherence Cohorts

Table 3: Modeled Adjusted Costs for 2018 and 2018/2019 Outcomes of Prescription and Total Medical by Adherent Levels[1]

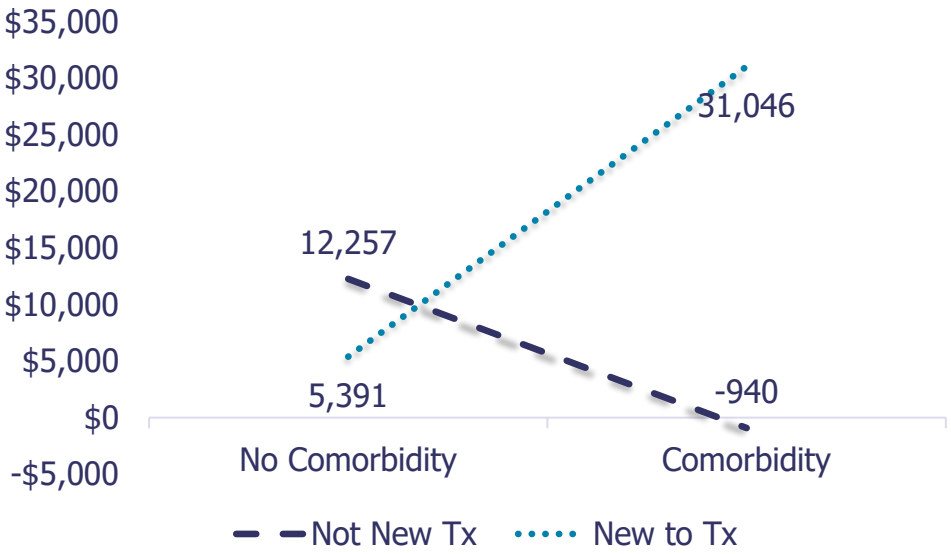
Adherence	2018		2018/2019	
	PDC Rx Costs	Total Medical	PDC Rx Costs	Total Medical
PDC<80	$47,214	$31,684	$108,740	$39,779
PDC 80+	$76,706	$22,084	$177,107	$30,423
delta	$29,492	-$9,600	$68,367	-$9,356

[1] Those adherent in both years appear as PDC80+ in table

Results - continued

- There was a significant interaction between adherence, comorbidity and new to therapy ($p<.04$; Figure 1). The cost difference between adherent and non-adherent is greatest for those new to therapy and with a comorbidity (a $31,046 difference), but for those not new therapy with a comorbidity there is a slight cost increase with adherence (-$940).

Figure 1. Difference in Adjusted Medical Cost Between Adherent and non-Adherent 2018 by New to Therapy (Tx) and Comorbidity Indications.



Results - continued

- Model results on combined years indicated an adherence effect for reduced adjusted medical costs (-$9,356, $p<.05$) (see Table 3). Other significant covariates were increased cost for new to therapy ($p<.003$), having a comorbidity in either year ($p<.0001$), and northeast region ($p<.02$). Interactions between adherence groups and comorbidity was not significant.

Results - continued

- As reported in Table 4, 2018 logistic model indicated significant effects favoring the adherent cohort on odds of hospitalization (0.72, p<.0007). Additional significant covariates were increased odds with age (p<.002), being female (p<.0004), being new to therapy (p<.0001), or having a comorbidity (p<.0001); reduced hospitalization odds present for single therapy class (p<.0001), retail pharmacy (p<.0001), and metro areas (p<.0001). And metro area by adherent interaction (p<.05) indicated lowest odds of hospitalization for those in a metro area and adherent.
- In Table 4. the 2018 adherent group had significantly lower oncology-related LOS (-1 day, p<.02). Other significant covariates were shorter LOS with age (p<.05) or residing in metro areas (p<.03); for new to therapy there was an increased LOS (p<.0001).

Reduced odds of hospitalization and shorter LOS for adherent group in both cohorts

Table 4: Modeled Adjusted Costs for 2018 and 2018/2019 Outcomes of Prescription and Total Medical by Adherent Levels[1]

Cohort	Lower Odds	Reduce Mean Hospitalization	Reduced Days Stay
2018	0.72	-0.07	-1
2018-2019	0.60	-0.11	-2.9

[1] Values are difference between adherent group referenced to non-adherent group.

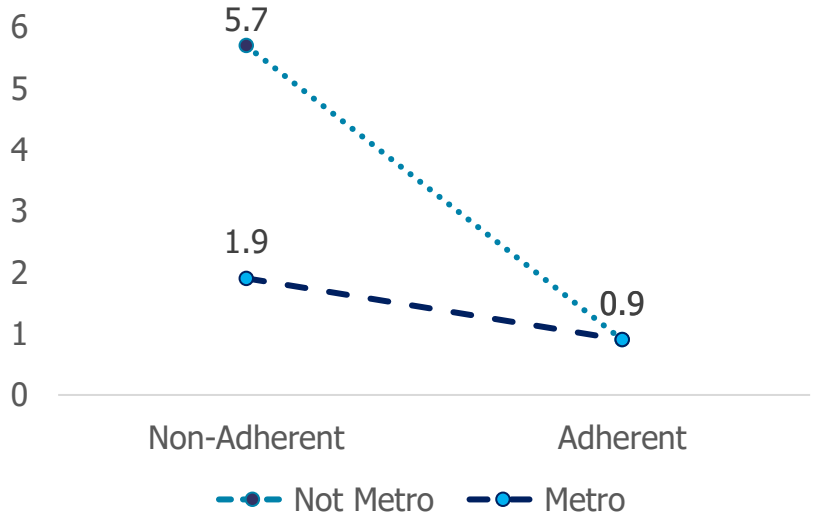
Results - continued

- Results for combined years indicated adherence effects for reduced odds for hospitalization (0.60, p<.0002). Other significant covariates included increased odds with being older (p<.03), being female (p<.005), and new to therapy (p<.0001), and with a comorbidity (p<.0001).

- For oncology-related LOS, there was a reduction for the adherent cohort by -2.9 days (p<.0007). Significant covariates included longer LOS for new to therapy (p<.0004) but shorter LOS for northeast region (p<.04) and metro areas (p<.03).

- An interaction between metro area and adherence level (p<.03) indicated 4.8 more days LOS for those not adherent and outside a metro area compared to those adherent in the same location. No difference of 1 day in LOS between adherent groups in a metro area (see Figure 2.).

Figure 2. Interaction on Adjusted Oncology Related LOS Between Adherence and MSA Area (2018-2019)



Conclusions

- An adherence metric for oral antineoplastic medications utilized by cancer patients had significant associations with yearly cost and utilization outcomes. Remaining adherent to oral antineoplastic therapy was associated with higher medication cost, lower medical costs, fewer hospitalizations, and a shorter oncology related LOS, even across multiple years. These reductions were dependent with interactions between comorbidities, new to therapy/diagnosis, or metropolitan area.

- In addition, these results help validate the PDC methodology presented. This metric can be used for yearly reporting requirements by implementing filters controlling for alternative conditions, late medication starts in the given year, and allowing product switching within a therapy class.

Contact Information

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All authors are employees of Walgreen Co for whom this research was conducted. Please contact: research@walgreens.com.