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# IMPACT OF REAL-TIME PHARMACY BENEFIT INFORMATION AT POINT OF DISCHARGE ON A PROVIDER-SPONSORED HEALTH PLAN

by

Thomas Roduta

A thesis submitted in partial fulfillment of
the requirement for the degree of

MASTER OF SCIENCE

IN

Pharmacy Leadership and Administration

University of Houston
College of Pharmacy

April 2018

Impact of Real-Time Pharmacy Benefit Information at Point of Discharge on a Provider-Sponsored Health Plan

To the Faculty of the University of Houston, College of Pharmacy:

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**Impact of Real-Time Pharmacy Benefit Information at Point of Discharge on a Provider-Sponsored Health Plan**

Purpose: Prescription medications account for nearly 10% of national healthcare expenditures ($3.4 trillion in 2016). Appropriate medication prescribing may reduce costly complications, impacting overall healthcare costs. Limited knowledge of the cost of medications coupled with the dynamic nature of prescription insurance formularies makes it difficult to ensure prescribing of cost-effective drug therapy. The objective of this study is to evaluate the impact of pharmacy benefit information availability using real-time adjudication at the point of discharge on patients' ability to acquire and remain adherent to medications as well as the economic impact to a provider-sponsored health plan.

Methods: Memorial Hermann (MH) has implemented a transmission system that provides real-time pharmacy benefit information (RTPBI) for patients at the point of prescribing within the electronic health record (EHR). A multicenter, retrospective cohort study of all covered lives under the provider-sponsored health plan treated in a MH inpatient facility from July 1, 2016 through June 30, 2017 was performed. Patients with real-time prescription benefits available through the transmission system were compared to those without to determine percentage of preferred versus non-preferred/non-formulary medications prescribed as well as the time to first/second prescription fill. Criteria for appropriate versus delayed procurement were defined.

Results: The study included a total of 2,340 patients (696 patients RTPBI functionality available and 1,644 that did not at the point of prescribing at discharge). The primary analysis showed a large difference in the prescribing of preferred medications between patients who had RTPBI available at the point of care and those that did not. RTPBI significantly reduced the amount of non-preferred/non-formulary medication prescribed at the point of discharge (6.9% non-preferred/non-formulary prescribed when RTPBI was available; $p < 0.001$, 95% CI 0.056 – 0.111). Secondary analysis of time to first prescription fill did not show a statistical difference. However, analysis of time to second fill showed that RTPBI availability significantly impacted patients' ability to acquire subsequent fills appropriately (69.0% versus 49.6%; $p < 0.001$, 95% CI 2.026 – 3.198).

Conclusion: The availability of RTPBI at the point of discharge significantly reduces the prescribing of non-formulary medications. Based on the results of this study, it has the potential to improve prescribing of preferred medications. Future studies should evaluate the implications RTPBI would have on economic impact, medication adherence, and readmission rates.

Keywords: real-time, pharmacy benefit, provider-sponsored, health plan, adjudication

**Impact of Real-Time Pharmacy Benefit Information at Point of Discharge on a Provider-Sponsored Health Plan**

Roduta TC, Vu D, Abughosh S, Cox R, Wallace D

## Introduction

Prescription medications account for nearly ten percent of national health care expenditures, reaching $330 billion in 2016.[1] The alarming annual increase in expenditures due to prescription medications has developed an urgency to focus on cost containment strategies. Appropriate medication prescribing may account for a reduction in costly complications and hospital admissions, impacting overall health care costs.[2] Decisions that govern the use of medications primarily fall on the prescriber. For prescribers to make economic decisions, accurate knowledge of the cost of medications at the point of prescribing is needed. Prescribers are not always aware of specific health care costs even though they are challenged to assume a greater role in cost containment efforts while improving patient care.[3] Recent surveys support the belief that prescribers know it is important to prescribe medications that would minimize financial burden to patients in regards to prescription copayments and total drug costs, however they are often unaware of the details needed prescribe appropriately.[3] With limited knowledge of drug costs coupled with the dynamic nature of different formularies, it may be difficult to prescribe the most cost-effective drug therapy. Making this information more available to prescribers has the potential to increase prescribing of medications with lower copayments and to increase patient access to the most affordable medications.[4]

Provider-sponsored health plans have many external and societal factors that affect benefit design decision making. With the aging population, there are increased service utilizations such as hospitalizations, urgent care and emergency room visits. Additionally, prescription medication use will inevitably increase as the population ages.[5] Nearly half of all adults have at least one chronic disease and the rates of nonadherence have increased proportionally.[5] Health plan pharmacy benefit design has a direct influence on patients' adherence to medications. Large copays and out-of-pocket expenses can lead to a reduction in the use of medication, which can lead to an increase in total medical costs (e.g. readmission).[5] There is a relational cycle between increased costs to the patient and medication adherence. Poor medication adherence for chronic disease states leads to poor health outcomes, which leads to increased utilization of acute care services and overall health care costs. A recent study demonstrates that as patients' use of medication declined due to increased out-of-pocket expenses, emergency room visits increased 17% and hospital stays rose 10% among patients with diabetes, asthma, or gastric acid disorders.[6] This increase in overall health care costs creates financial pressure on health plans, which is passed on to patients through higher premiums and higher costs to employers or plan sponsors for coverage.[5]

Formulary management within a health system across the continuum of care, between inpatient and outpatient, is essential. Despite the availability of medications with lower costs through a patient's pharmacy benefits, patients are sometimes discharged on inpatient formulary medications that are not preferred or covered by prescription insurance. Inpatient hospital drug formularies may not be the same from most pharmacy benefit formularies. For example, ProAir® may be the inhaler of choice while in the hospital based on inpatient formulary, but Proventil® may be the preferred agent determined by a patient's pharmacy benefits. Patients may receive discharge prescriptions for medications that are not covered by their insurance which has cost burden implications. Furthermore, adherence becomes an issue as patients may not fill medications due to affordability.[7]

*Previous studies*

Health plans deploy many benefit design strategies to reduce the cost of providing health care while improving the quality of care. With increased financial pressure to mitigate effects of inflation on healthcare spend per member per month (PMPM), it is imperative to review different strategies. Capp et. al. created a care coordination program to reduce acute care use by increasing primary care visits among frequent emergency care users which resulted in a 16% decrease in all-cause readmission and significantly expedited prescription filling and adherence.[8] However, the sustainability of these services was difficult due to the amount of resources used. Hodgkin et. al. optimized formulary design through the implementation of a three-tiered formulary to manage drug utilization and expenditures, decreasing utilization of non-preferred agents by 11%.[9] Lapointe-Shaw et. al. determined drug classes with multiple therapeutic equivalents and harmonized inpatient and outpatient formularies for a group of drug classes.[10] This strategy involved deploying therapeutic substitutions to direct inpatients toward the least expensive outpatient agents by initiating medications for patients in the inpatient setting with the lowest outpatient formulary prices, resulting in a 35% decrease in prescription spend for the targeted drug classes. Application of this strategy to all drug classes proves to be extremely difficult.

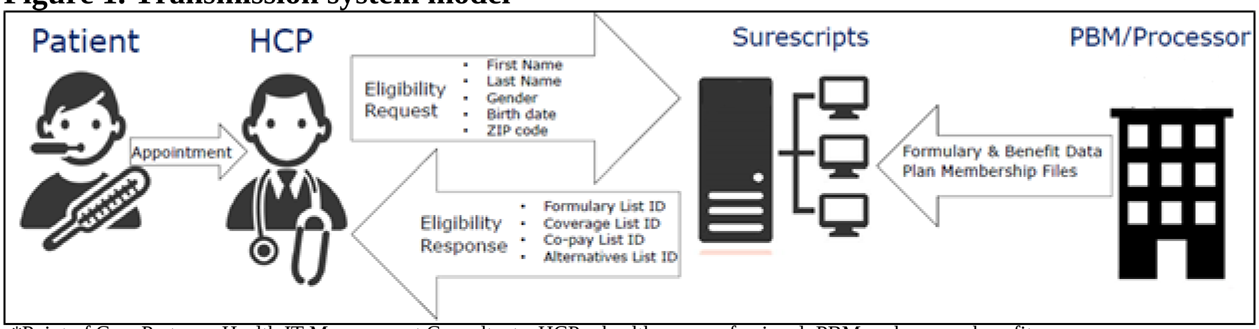
*Real-time pharmacy benefit inquiry*

One issue regarding prescribing remains unaddressed: how can prescribers at the point of care know which medications to prescribe that would minimize patients' prescription copayments and total drug costs? Ornstein et. al. developed a database that provided medication acquisition cost information in a computer-based patient record system.[2] Although this did not affect overall prescription drug costs to patients, there were significant differences in drug classes. The conclusion of this study was to improve the information that is available at the point of prescribing to allow for more patient specific prescribing. In 2014, the National Council for Prescription Drug Programs (NCPDP) developed a Real-time Pharmacy Benefit Inquiry (RTPBI) Task Group. This task group was formed in response to the Centers for Medicare and Medicaid Services (CMS) electronic health record (EHR) incentive program to achieve meaningful use standards. In regards to meaningful use standards on drug formulary and benefits, CMS proposes the need for improved interoperability need between EHRs and pharmacy benefit payers – i.e. the ability for pharmacy benefit payers to communicate up to date formulary and benefit information to prescribers' systems.[11] At that time, the NCPDP standard for formulary and benefit information had a number of limitations because it did not describe the patient's specific benefits and financial responsibility at a specific point in time. It only provided prescribers a general representation of benefit information and was not specific to each patient. The NCPDP task group was charged in developing and discussing specific use cases to formalize a transaction standard for real-time information exchange. Since then, different RTPBI systems have been released to production; however, since no formalized standards are in place, there are many inconsistencies in availability of information and services at the point of care among the different systems from the prescriber's perspective. To provide the best possible options to patients, prescribers need complete visibility into patient benefit information, accurate patient pay responsibilities, patient out-of-pocket costs, and preferred pharmacy (if limited by their health plan). The objective of RTPBI is to support the prescriber and patient at the point of prescribing.

*Surescripts®*

One of the RTPBI transmission systems in use is Surescripts®, which is also the system implemented in the EHR for this particular study. It provides a workflow within the EHR that provides real-time information at the point of care: formulary tier information, therapeutic alternatives, utilization edits (prior authorizations, quantity limits), and co-pay information. Figure 1 describes the process used to populate this information within the EHR at the point of care. A health care professional (HCP) sends an eligibility request on behalf of the patient via the EHR with patient specific information. Surescripts® serves as the transmissions system between the EHR and pharmacy benefit managers (PBM), processors, and payers and collects all relevant patient-specific information in the EHR to return an eligibility response. The PBM specific to the patient's pharmacy benefit coverage sends back real-time information and is displayed in the EHR for the HCP to prescribe medications to the patient.

**Figure 1. Transmission system model**




*Point of Care Partners. Health IT Management Consultants; HCP = health care professional; PBM = pharmacy benefit manager

## Methods

*Study site*

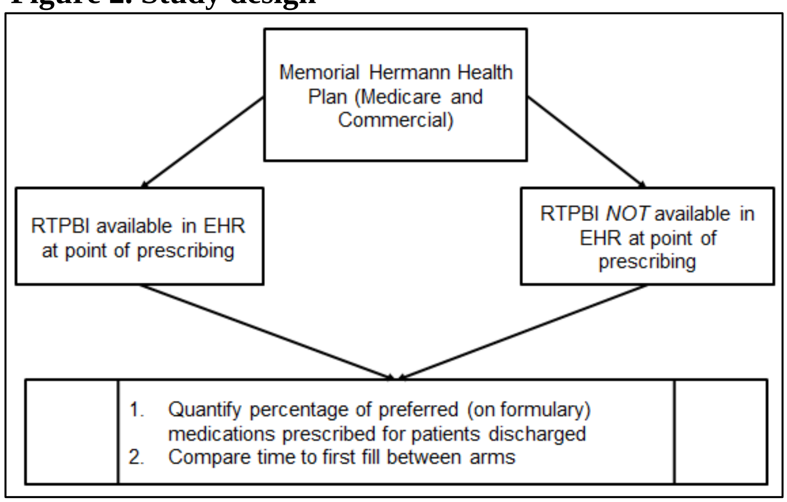
This study is a multicenter, retrospective cohort study within a fifteen hospital system, Memorial Hermann (MH). The system also has a provider-sponsored health plan that offers group commercial insurance as well as a Medicare Advantage plan for Medicare-eligible patients – all of which covers more than 30,000 lives. MH uses Cerner® EHR, which interfaces directly with the transmission system for RTPBI functionality. At MH, RTPBI functionality is not consistently available in the EHR at the point of care due to variable patient specific information available in the EHR and responses from the PBM and payers as well as variable access via the transmission system across the different hospitals within the system.

*Design*

The study analyzed prescription claims data to evaluate the impact of RTPBI availability at the point of discharge from a hospital on patients' ability to acquire prescription medications post-discharge. Additionally, difference in medication spend through optimized prescribing of preferred medications was analyzed. Figure 2 illustrates the breakdown of the study design. All covered lives within the MH provider-sponsored health plan during the study period were included. There were two arms of the study: those with RTPBI functionality available at the point of care and those without RTPBI functionality available.

*Endpoints*
The primary analysis utilized patient records in the EHR to quantify the percentage of preferred (i.e. on formulary) medications that were prescribed at discharge versus non-formulary/non-preferred and compare the percentages between the two arms. Preferred medications are any medications on the tier list (i.e. tier 1, tier 2, tier 3, etc.) for both coverages (Medicare and commercial) within the health plan, which lists both the preferred generic and preferred brand medications. Non-preferred or non-formulary medications are defined as anything outside of the preferred tier list. Secondary analysis utilized claims data to compare time to first and second fill from date of discharge between the two arms. Time to first fill was defined as appropriate if the prescription was filled less than or equal to 72 hours from the date of discharge; otherwise, it was considered delayed (>72 hours). Time to second fill, was defined as appropriate if the prescription was filled within a 7 day window of next scheduled pick up (i.e. for a 30 day prescription, if there was a prescription claim between 23 and 30 days from discharge); otherwise, it was considered delayed. Inclusion criteria restricted study subjects to all covered lives within the health plan who received treatment from a MH inpatient facility between July 1, 2016 to June 30, 2017 and who was enrolled in the health plan for at least 6 months post discharge. Patients who did not receive discharge prescriptions were excluded from the analysis. Additionally, all prior refill prescription claims were excluded (i.e. only new prescriptions and subsequent refills were included in the secondary analysis).

**Figure 2. Study design**




*Measures*
Demographic measures included age, sex, race (Caucasian, African American, Other/Unknown), number of prescriptions at discharge, length of stay, facility where the patient was treated, primary diagnostic category for admission, type of coverage (Medicare or commercial), and RTPBI availability at point of care (yes or no). In terms of the primary endpoint, each prescription was determined to be either preferred or non-preferred/non-formulary. The secondary endpoints were determined to be either appropriate or delayed based on the previously described definitions.

*Statistical Analysis*
Means and frequencies (%) were calculated for patient characteristics. Group differences for categorical variables were analyzed using chi-squared tests and for continuous variables were analyzed using student t-tests. A logistic regression analysis was performed to determine the association between the primary endpoint (prescribing of preferred versus non-preferred/non-formulary) and the availability of RTPBI at the point of prescribing. This analysis included multiple covariates that could affect the outcome: type of coverage, facility where the patient was treated, number of prescriptions at discharge, age, sex, ethnicity, and length of stay. Another logistic regression analysis with the same covariates was repeated to determine the association between the secondary endpoints of time to first and second fill and the availability of RTPBI at the point of prescribing. All analyses were performed using IBM® SPSS® statistics software, assuming a type I error of α = 0.05.

*Sub-analyses*
A sub-analysis to determine the total time of delay among patients who were determined to have a delayed time in the first and second fill was performed. Patients who had a delayed time to first fill had an additional 3 days (72 hours) added to the total time of delay due to the definition of "delayed" (> 72 hours). Total time of delay for the second fill started from the first day past the subsequent refill date (i.e. day 31 of a 30 day fill; or day 91 of a 90 day fill).

Another sub-analysis was performed to calculate potential cost-reductions on both the health plan's and patients' perspective. Preferred medications that were prescribed were separated into the specific tiers as defined by the health plan. Costs specific to the plan as well as patient copay costs among the tier groups were collected. Claims of medications in tiers 2 through 5 were subtracted from the cost of a tier 1 medication within the same class to calculate an estimate of potential savings. Those that did not have a tier 1 equivalent remained in the overall total cost to the patient and to the plan (e.g. the cost of a tier 3 medication that had no tier 1 equivalent remained in the total cost to the plan and to the patient – meaning, no cost savings calculated).

**Results**
**Table 1. Baseline characteristics**

| Variable | RTPBI | No RTPBI | *p*-value |
|---|---|---|---|
| Total population in each arm | 696 | 1644 | --- |
| | | | |
| Insurance type | Frequency (%) | Frequency (%) | |
| Medicare | 444 (63.8) | 534 (32.5) | <0.001 |
| Commercial | 252 (36.2) | 1110 (67.5) | |
| Facility | Frequency (%) | Frequency (%) | |
| *Academic medical center* | 126 (18.0) | 390 (23.8) | |
| *Large community hospitals* | 312 (44.9) | 654 (39.8) | 0.007* |
| Moderate community hospitals | 162 (23.4) | 360 (21.8) | |
| Small community hospitals | 90 (12.9) | 240 (14.6) | |
| Small rehab hospitals | 6 (0.9) | 0 (0) | |
| Average # of prescriptions | 4.21 | 3.29 | 0.159 |
| Age ± standard deviation | 62 ± 18 | 54 ± 21 | 0.006 |
| Sex | Frequency (%) | Frequency (%) | |
| Male | 312 (44.8) | 618 (37.6) | 0.001 |
| Female | 384 (55.2) | 1026 (62.4) | |

| Ethnicity | Frequency (%) | Frequency (%) | |
|---|---|---|---|
| Caucasian | 408 (58.6) | 828 (50.4) | 0.09 |
| African American | 66 (9.5) | 246 (14.9) | |
| Other (Hispanic, Asian, Unreported) | 222 (31.9) | 570 (34.7) | |
| Average Length of Stay | 4.22 | 4.01 | 0.580 |
| Primary diagnostic category at discharge | | | 0.005* |
| *Alcohol/Drug use disorder* | 0 (0) | 18 (1.1) | |
| Blood and blood forming organs | 6 (0.9) | 18 (1.1) | |
| *Circulatory system* | 162 (23.3) | 282 (17.2) | |
| *Digestive system* | 72 (10.3) | 264 (16.1) | |
| Ear, nose, throat | 6 (0.9) | 18 (1.1) | |
| *Endocrine, nutritional, and metabolic* | 6 (0.9) | 48 (2.9) | |
| Eye | 6 (0.9) | 6 (0.4) | |
| *Female reproductive system* | 12 (1.7) | 60 (3.6) | |
| Hepatobiliary system | 30 (4.3) | 60 (3.6) | |
| *Infectious and parasitic diseases* | 6 (0.9) | 48 (2.9) | |
| Injuries, poisons, and drug effects | 18 (2.6) | 18 (1.1) | |
| Kidney and urinary tract | 30 (4.3) | 42 (2.6) | |
| Male reproductive system | 6 (0.9) | 12 (0.7) | |
| Musculoskeletal | 78 (11.2) | 144 (8.8) | |
| *Myeloproliferative and neoplasms* | 6 (0.9) | 0 (0) | |
| Nervous system | 42 (6.0) | 120 (7.3) | |
| Newborns and neonates | 12 (1.7) | 42 (2.6) | |
| Pregnancy, childbirth, and puerperium | 6 (0.9) | 72 (4.4) | |
| *Respiratory System* | 84 (12.1) | 120 (7.3) | |
| *Skin, subcutaneous tissue, and breast* | 18 (2.6) | 72 (4.4) | |
| No diagnostic category | 186 (11.3) | 90 (12.9) | |

*post-hoc analysis performed (Bonferroni correction) to determine specific statistical significance between groups (italicized)

The study included a total of 2,340 patients (696 patients with RTPBI functionality available and 1644 that did not at point of prescribing at discharge). Demographic information with corresponding observed frequencies and percentages were collected for all patients (Table 1). A chi-square test was run for all categorical data: insurance type, facility where the patient was treated, sex, ethnicity, and primary diagnostic category at discharge. Two categories demonstrated unequal distributions within the study sample: facility ($\chi^2 = 34.015$, $p = 0.007$) and primary diagnostic category at discharge ($\chi^2 = 147.437$, $p = 0.005$). Post hoc analysis for these two categories involved pairwise comparisons using multiple z-tests of two proportions with a Bonferroni correction. Statistical significance was accepted for facility and diagnostic category at $p < 0.005$ and $p < 0.002$, respectively. There were statistically significant differences in the proportion of those who had RTPBI available in the EHR upon discharge at the academic medical center hospital as well as the large community hospitals compared to those who did not have RTPBI available. Additionally, the following diagnostic categories had statistically significant differences between the two arms: alcohol/drug use disorder; circulatory system; digestive system; endocrine, nutritional, and metabolic; female reproductive system; infectious and parasitic diseases; myeloproliferative and neoplasms; respiratory system; and skin, subcutaneous tissue, and breast. A student t-test was run for all continuous data: number of prescriptions, age, and length of stay. No group comparisons among the continuous variables were statistically significantly different.

**Figure 3. Number of preferred versus non-preferred/non-formulary between two arms**

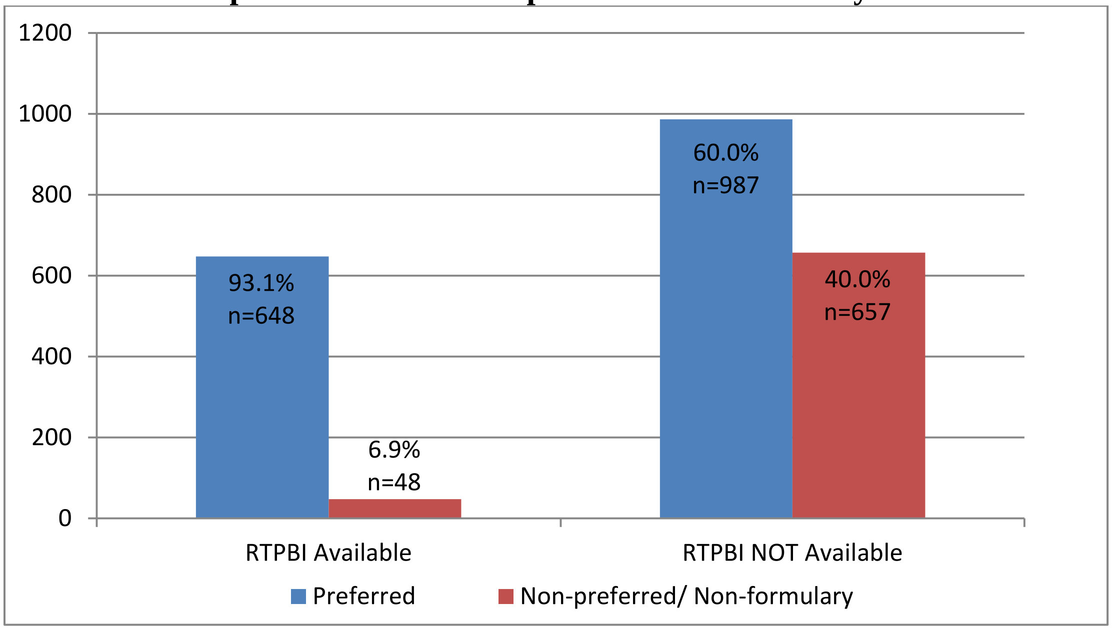



**Table 2. Primary endpoint: multivariate logistic regression analysis to access the effect of RTPBI on prescribing preferred versus non-preferred/non-formulary**

| Variable | Odds Ratio | 95 % Confidence Interval | *p*-value |
|---|---|---|---|
| Arm assignment | | | |
| No RTPBI available | Reference | | |
| RTPBI available | 0.079 | 0.056 – 0.111* | <0.001 |
| Insurance type | | | |
| Commercial | Reference | | |
| Medicare | 1.209 | 0.889 – 1.644 | 0.226 |
| Facility | | | |
| Academic medical center | Reference | | 0.003 |
| Large community hospitals | 0.566 | 0.405 – 0.790 | < 0.001 |
| Moderate community hospitals | 0.945 | 0.560 – 1.593 | 0.831 |
| Small community hospitals | 0.870 | 0.577 – 1.313 | 0.508 |
| Small rehab hospitals | 0.834 | 0.643 – 1.423 | 0.752 |
| Number of prescriptions | 0.965 | 0.926 – 1.006 | 0.093 |
| Age | 0.996 | 0.988 – 1.003 | 0.261 |
| Sex | | | |
| Female | Reference | | |
| Male | 1.364 | 1.095 – 1.699 | 0.006 |
| Ethnicity | | | |
| Caucasian | Reference | | |
| African American | 0.945 | 0.560 – 1.594 | 0.846 |
| Other | 0.707 | 0.423 – 1.182 | 0.761 |
| Length of stay | 1.467 | 0.714 – 1.642 | 0.803 |

The primary analysis showed a large difference in the prescribing of preferred medications between patients who had RTPBI available at point of care and those that did not (Figure 3). The frequency of preferred medication prescribed for those who had RTPBI available versus those who did not was 93.1% versus 60.0%, respectively. Additionally, the frequency of non-preferred/non-formulary prescribing between the two arms was 6.9% versus 40.0%, respectively. RTPBI significantly reduced the amount of non-preferred/non-formulary medication prescribed at the point of discharge (6.9 % non-preferred/non-formulary prescribed when RTPBI was available; $p < 0.001$, 95% CI 0.056 – 0.111) accounting for the different covariates within the logistic regression analysis (Table 2). Through the logistic regression analysis, there were statistical differences among the different facilities and the patients' sex when compared to the prescribing of preferred versus non-preferred. The larger hospitals (academic medical center and large community hospitals) were associated with an increased likelihood of prescribing preferred medications when RTPBI was available; however, when RTPBI was not available, the likelihood of being prescribed a non-preferred/non-formulary medication significantly increases.

Secondary analysis of time to first fill (Figure 4) did not show a statistical difference. Frequency of appropriate time to first fill among patients with RTPBI available versus those who did not was 72.4% versus 47.8%, respectively. Frequency of delayed time to first fill was 27.6% versus 52.2%, respectively. RTPBI did not significantly change the ability for the patient to acquire the medications initially post discharge (Table 3). However, based on time to second fill analysis, it may affect patient's ability to acquire subsequent refills (Table 4). RTPBI availability significantly impacted patients' ability to acquire subsequent fills appropriately ($p < 0.001$, 95% CI 2.026 – 3.198).

**Figure 4. Number of appropriate versus delayed time to first fill between two arms**

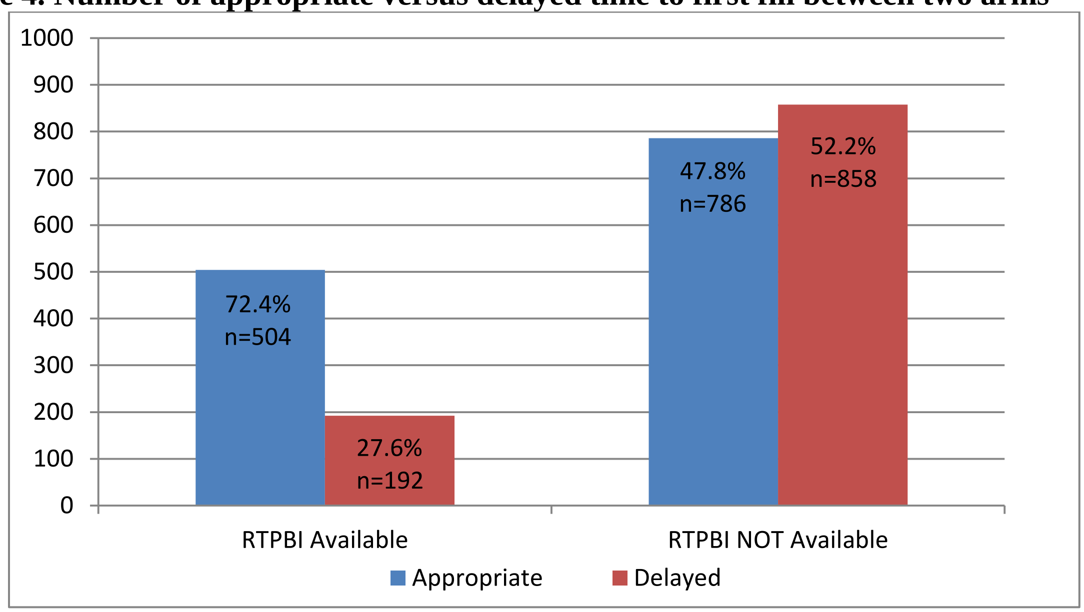


**Table 3. Multivariate logistic regression analysis to access the effect of RTPBI on time to first fill**

| Variable | Odds Ratio | 95 % Confidence Interval | *p*-value |
|---|---|---|---|
| Arm assignment | | | |
| No RTPBI available | Reference | | |
| RTPBI available | 1.073 | 0.814 – 1.415 | 0.615 |
| Insurance type | | | |
| Commercial | Reference | | |
| Medicare | 0.725 | 0.505 – 1.043 | 0.083 |
| Formulary status | | | |
| Non-preferred/non-formulary | Reference | | |
| Preferred | 178.8 | 107.0 – 298.9 | < 0.001 |
| Facility | | | |
| Academic medical center | Reference | | 0.086 |
| Large community hospitals | 0.468 | 0.396 – 0.684 | 0.067 |
| Moderate community hospitals | 0.707 | 0.423 – 1.182 | 0.761 |
| Small community hospitals | 0.746 | 0.498 – 1.167 | 0.508 |
| Small rehab hospitals | 0.867 | 0.646 – 1.392 | 0.752 |
| Number of prescriptions | 0.935 | 0.891 – 0.982 | 0.007 |
| Age | 0.995 | 0.986 – 1.004 | 0.293 |
| Sex | | | |
| Female | Reference | | |
| Male | 1.231 | 0.944 – 1.605 | 0.126 |
| Ethnicity | | | |
| Caucasian | Reference | | |
| African American | 1.114 | 0.761 – 1.630 | 0.578 |
| Other | 1.041 | 0.722 – 1.500 | 0.831 |
| Length of stay | 0.991 | 0.962 – 1.020 | 0.525 |

**Figure 5. Number of appropriate versus delayed time to second fill between two arms**

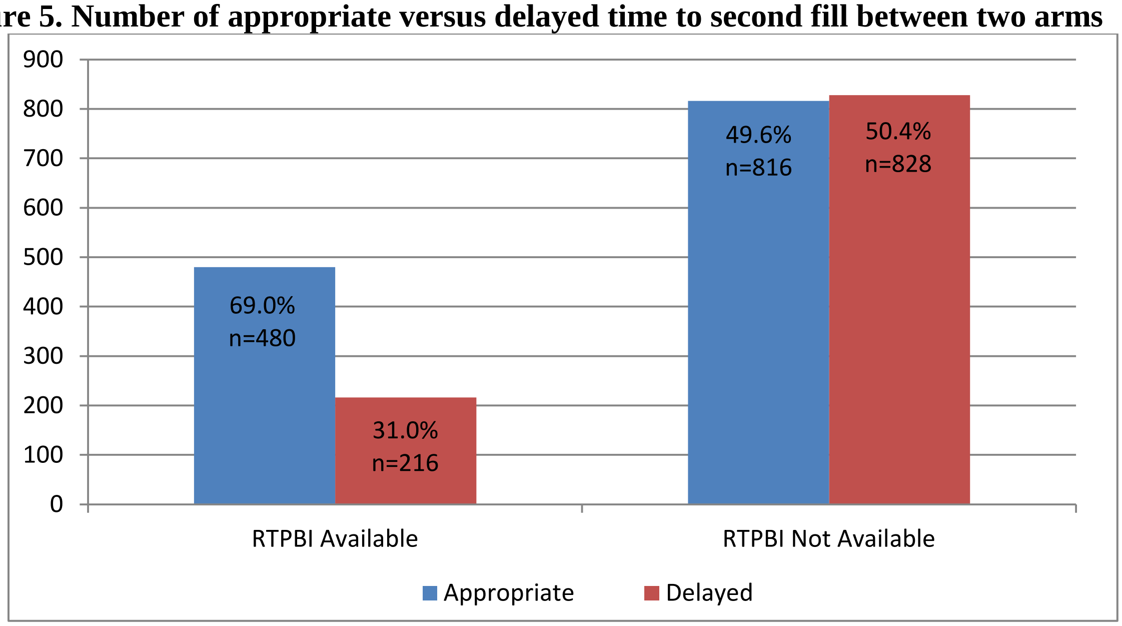


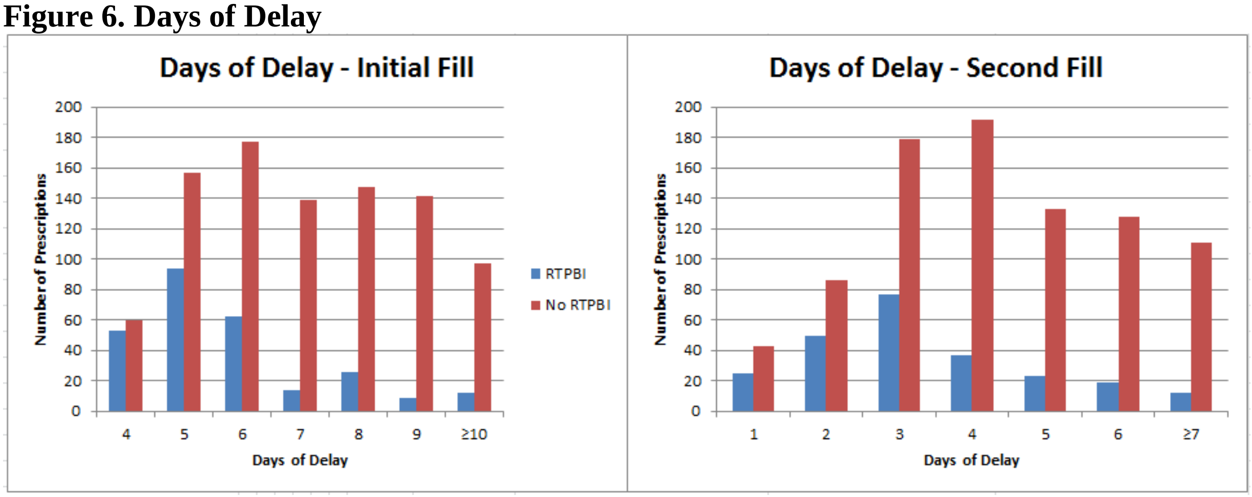
**Table 4. Multivariate logistic regression analysis to access the effect of RTPBI on time to second fill**

| Variable | Odds Ratio | 95 % Confidence Interval | *p*-value |
|---|---|---|---|
| Arm assignment | | | |
| No RTPBI available | Reference | | |
| RTPBI available | 2.545 | 2.026 – 3.198 | < 0.001 |
| Insurance type | | | |
| Commercial | Reference | | |
| Medicare | 0.864 | 0.735 – 0.976 | 0.007 |
| Formulary status | | | |
| Non-preferred/non-formulary | Reference | | |
| Preferred | 3.511 | 2.588 – 4.764 | < 0.001 |
| Time to first fill | | | |
| Appropriate | Reference | | |
| Delayed | 3.574 | 2.699 – 4.733 | < 0.001 |
| Number of prescriptions | 1.007 | 0.973 – 1.042 | 0.690 |
| Age | 1.006 | 1.000 – 1.013 | 0.062 |
| Sex | | | |
| Female | Reference | | |
| Male | 0.860 | 0.727 – 1.284 | 0.058 |
| Ethnicity | | | |
| Caucasian | | | |
| African American | 0.786 | 0.600 – 1.051 | 0.230 |
| Other | 0.556 | 0.373 – 1.107 | 0.292 |
| Length of stay | 0.991 | 0.968 -1.014 | 0.439 |

Note: facility breakdown excluded due to no statistically significant differences among all hospitals;

A breakdown of patients who were delayed in the first (> 72 hours) and second fill (>30 days) in terms of number of days of delay (for both arms of the study) is illustrated in Figure 6. Of note, 9.2% of patients had a greater than or equal to 10 days of delay on the first time fill. For the second fill, 11.0% of patients had a delay greater than or equal to 7 days past the 30 day initial fill. Within these percentages include patients who did not pick up their medications at all.

**Figure 6. Days of Delay**



The sub-analysis of the data to calculate potential cost-reductions on both the health plan and patients' perspective also prove to be significant (Table 5). Through this analysis, the plan spent a total of $647,475 through prescription claims of patients discharged from the hospital. If all prescriptions initially were tier 1 upon discharge, the plan would have been able to save roughly $499,077 based on the prescribing patterns of the study. This is equivalent to a reduction of $16.64 off the total medication spend PMPM (assuming 30,000 covered lives). On a patient's perspective, patients spend a total of $112,910 on copayments. Through the same calculation, the total amount of cost reduction for copayments would be $70,143. This is equivalent to a reduction of $2.33 off the total medication cost PMPM (again, assuming 30,000 covered lives). A limitation of this analysis is that not all class of drugs have a tier 1 equivalent; therefore, total cost-savings could potentially be much larger.

**Table 5. Potential Savings**

| Tier | # of Scripts | Patient Copay | Tier 1 equivalent | Plan costs | Tier 1 equivalent |
|---|---|---|---|---|---|
| 2 | 152 | $24,840.36 | $9,408.72 | $106,071.04 | $24,310.96 |
| 3 | 53 | $45, 164.29 | $17,106.76 | $231,006.30 | $52,945.50 |
| 4 | 7 | $12,420.18 | $4,704.36 | $20,397.65 | $4,675.04 |
| 5 | 43 | $30,485.90 | $11,547.06 | $290,000.20 | $66,466.62 |
| Total | | $112,910.73 | $42,766.90 | $647,475.13 | $148,398.13 |
| **Cost Saving** | | | **$70,143.83** | | **$499,077.00** |

**Discussion**

The availability of RTPBI at the point of discharge significantly reduces the prescribing of non-formulary medications. Based on the prescribing patterns of the population study, prescribers seem to be prescribing preferred medications regardless of RTPBI availability. However, this study demonstrates the impact of RTPBI on decreasing the prescribing of non-preferred/non-formulary medications. The analysis of the population included in this study also provided a few significant results. Medicare insured patients had a higher frequency of RTPBI available at the point of prescribing. This can be explained via the capture rate (roughly 60%) of the transmission system used. The eligibility information that is captured and sent back to the EHR is more accurate when there is more historical patient specific claims data available to the PBM/processor. Medicare patients typically have a higher incidence of polypharmacy due to the aging population as well as chronic diseases – i.e. Medicare patients typically have more historical medication claims data.[5] The transmission system was able to capture more Medicare patients' eligibility compared to commercially insured patients, which explains why the majority of patients who had RTPBI functionality available were insured by Medicare.

Patients were generally able to fill their discharge prescriptions appropriately for the first time fill regardless of whether the prescriber utilized RTPBI. However, when performing the same analysis on the second time fill, there was a statistically significant difference. Many patients in this analysis were able to appropriately acquire the first time fill but had a delay in the subsequent refill. One reason could be a Medicare exception that allows patients to bypass prior authorization with the first fill. However, the prescriber must perform the prior authorization before the subsequent fill for the patient to continue refilling the medication. Based on the results, many Medicare patients that had an appropriate time to first fill had a delayed time to the subsequent fill, which possibly accounts for the significance of insurance type on time to second fill.

The analysis of potential cost savings demonstrates the economic impact that the availability of RTPBI would have on medication spend on the both the patient's perspective as well as the health plan's. On the provider's standpoint, RTPBI allows the provider to prescribe the most cost-effective therapy at the point of care. Through upfront information at the point of care, payers (PBMs and health plans) are the not the rate limiting step for the patient's ability to acquire the medications especially when medications are not covered or requires a prior authorization. On an outpatient/retail pharmacy's perspective, RTPBI could potentially mitigate calls and faxes to the provider for therapeutic interchanges or prior authorization requests. Additionally, patients would already know the costs at the point of care since the prescriber can provide that information in real-time. This may allow for more conversation and patient involvement in the choice of medication therapy.

In the analysis of total time of delay, the percentage of patients who have a delayed time to fill for both first and second fill is a surrogate measure of non-adherence. An analysis to determine what percentage of prescriptions that were not filled at all is necessary. Additionally, further research to determine a correlation between days of delay to fill and medication adherence is also necessary.

*Limitations*

This study only includes the covered lives within the provider-sponsored health plan; therefore, the conclusions would be difficult to generalize. Additionally, due to the retrospective analysis of data, it is difficult to assess true prescriber behavior and the comfort level of reading the information generated by RTPBI. Also, use of claims data has limitations as well. It is difficult to determine cash paying patients or if the patient utilized coupons/vouchers. Lastly, in regards to the information provided by RTPBI, there are opportunities for more comprehensive information. For instance, although the information received includes tier status, it does not provide the patient specific copayment – it only provides a range to be payed (e.g. tier 1 range of $5-10).

## Conclusions

Real time pharmacy benefit information at the point of discharge has the potential to improve prescribing of preferred medications. Through this study, there was a significant reduction in non-formulary prescribing when RTPBI was available at the point of care. Further research including patients outside of a specific health plan and additional, more comprehensive information provided by RTPBI would be necessary. Additionally, an analysis of the roles of different primary diagnostic categories could provide insight into classes of drugs to focus more cost-reduction strategies. Also, following medication adherence over a longer period of time would provide a more accurate assessment of the effect of affordability on medication adherence. It is important to also capture the incidence of patients who do not fill prescriptions at all in addition to delay in acquiring the medication. Lastly, effects of RTPBI on readmission would need to be studied to accurately assess best practices in point of care prescribing.

**References**

1. Centers of Medicare and Medicaid Services. National Health Expenditures Projections 2016 – 2025 . 2017
2. Ornstein SM, MacFarlane LL, Jenkins RG, et al. Medication Cost Information in a Computer-Based Patient Record System. Arch Fam Med. 8(1): 118-121. 1999
3. Khan S, Sylvester R, Scott D, et al. Physicians' opinions about responsibility for patient out-of-pocket costs and formulary prescribing in two Midwestern states. Journal of Managed Care Pharmacy. 14(8): 780-789. 2008
4. Shrank WH, Hoang T, Ettner SL, et al. Prescribing Generic or Preferred Pharmaceuticals Improves Medication Adherence for Chronic Conditions. Arch Intern Med. 166(1):332-337. 2006
5. Iuga AO and McGuire MJ. Adherence and health care costs. Risk management and Healthcare Policy. 7:35-44. 2014
6. Improving prescription medicine adherence is key to better health care: Taking medicines as prescribed can lower costs and improve health outcomes. PhRMA Publication
7. Koroneos G. AstraZeneca digs into the cause of non-adherence. Pharmaceutical Executive. Oct 2008. < http://www.pharmexec.com/astrazeneca-digs-cause-non-adherence>
8. Capp R, Misky GJ, Lindrooth RC, et al. Coordination program reduced acute care use and increased primary care visits among frequent emergency care users. Health Affairs. 36(10): 1705-1711; 2017
9. Hodgkin D, Parks TC, Simoni-Wastila L, et al. The effect of a three-tier formulary on antidepressant utilization and expenditures. J Ment Health Policy Econ. 11(2):66-77; 2008 Jun
10. Lapointe-Shaw L, Fischer HD, Newman A, et. al. Potential savings of harmonizing hospital and community formularies for chronic disease medications initiated in hospital. PLoS ONE. 7(6): 1-7; Jun 2012
11. Interoperability Standards Advisory. The ability for pharmacy benefit payers to communicate formulary and benefit information to prescribers systems. Nov 2017 < https://www.healthit.gov/isa/ability-pharmacy-benefit-payers-communicate-formulary-and-benefit-information-prescribers-systems>