Adherence to Disease-Modifying Therapies at a Multiple Sclerosis Clinic: The Role of the Specialty Pharmacist

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Abstract

Background: Disease-modifying therapy (DMT) delays disease progression and improves quality of life for patients with multiple sclerosis (MS), but adherence to DMT is often suboptimal. Vanderbilt Specialty Pharmacy (VSP) embeds pharmacists within an outpatient MS clinic to provide medication management and address barriers to adherence. Objective: We evaluated rates and predictors of adherence to DMT among patients with MS at an integrated specialty pharmacy. Methods: We included patients with MS who filled ≥3 DMT prescriptions from VSP during the study period. Adherence was defined as medication possession ratio (MPR) or proportion of days covered (PDC) ≥0.8. Reasons for nonadherence were collected from pharmacy claims and electronic medical records. Results: The study included 653 patients. Average MPR and PDC were 0.93 and 0.94, respectively. Eighty-eight percent of patients achieved MPR ≥0.8; 89% achieved PDC ≥0.8. Using financial assistance and having $0 out-of-pocket cost were associated with higher odds of achieving MPR and PDC ≥0.8 (P < .05). Of the 12% of patients who were nonadherent, most were unreachable for refills. Conclusions: Ensuring financial assistance and low out-of-pocket costs are associated with high adherence to DMT within an integrated specialty clinic, but more work is needed to address adherence in unreachable patients.

Keywords
multiple sclerosis, disease-modifying therapy, adherence, integrated specialty pharmacy

Introduction

Multiple sclerosis is a chronic, immune-mediated inflammatory disease of the central nervous system. Patients with multiple sclerosis commonly experience transient relapses, which over time may lead to worsening neurological symptoms and disability.¹,² Although there is no cure, adherence to disease-modifying therapy results in reduced frequency and severity of relapses, delayed progression of disability, and improved quality of life.³⁻⁶ Yet, adherence to disease-modifying therapy among adults with multiple sclerosis is often suboptimal, ranging from 0.56 to 0.87.⁷,⁸ Patients with lower adherence tend to experience more inpatient hospital visits and incur higher medical costs.⁹,¹⁰ Thus, identifying and addressing barriers to adherence is critical to improve patient health outcomes and reduce health-care expenditures.

Higher patient out-of-pocket medication costs, adverse drug events, and forgetfulness are several barriers to treatment adherence.¹¹⁻¹⁵ Some institutions have implemented multiple sclerosis–specific care management programs to help patients avoid adverse drug events, which has resulted in higher medication adherence and persistence, fewer hospitalizations, and lower health-care expenditures.¹⁶ However, the process for accessing disease-modifying therapy is often complex and inefficient, requiring correspondence among physicians, insurance providers, pharmacy benefit managers, and outside specialty pharmacies to obtain insurance approval and coverage. To
simplify the process of obtaining patient access to disease-modifying therapy and better coordinate care for patients, some health systems have developed integrated specialty pharmacy practice models, which embed clinical pharmacists within the health-care team. At one outpatient multiple sclerosis clinic, average medication adherence rates among patients exceeded 90% after implementing an integrated specialty care model, highlighting promising potential for this model of health-care delivery.¹⁷

However, it is unknown whether high adherence rates to disease-modifying therapy are replicable across multiple sclerosis clinics with integrated specialty pharmacies. Moreover, little research has investigated predictors of adherence or nonadherence in patients at integrated clinic settings. Thus, the aim of this study was to evaluate medication adherence rates among patients at an outpatient Multiple Sclerosis Center utilizing an integrated specialty pharmacy, as well as explore predictors of adherence and nonadherence within this sample.

**Methods**

**Setting**

Vanderbilt Specialty Pharmacy (VSP) uses an integrated care model to support patients at the Vanderbilt Multiple Sclerosis Center, an outpatient clinic of Vanderbilt University Medical Center. A VSP team of 2 clinical pharmacists and 2 pharmacy technicians are physically embedded in the Multiple Sclerosis Center. When a patient is prescribed disease-modifying therapy, the VSP clinical pharmacist communicates with the patient in person or via telephone to conduct medication counseling including education to avoid or mitigate adverse events such as injection site reactions. The VSP team facilitates insurance authorization and coordinates financial assistance for patients through manufacturer co-pay assistance programs, charitable foundations, and a Medication Access Program funded by Vanderbilt University Medical Center. After treatment initiation, pharmacy technicians proactively call patients to schedule refills and to screen for adverse events and adherence barriers. Pharmacists intervene as needed to counsel patients in managing side effects or overcoming other barriers to medication adherence. Figure 1 demonstrates the workflow of services performed by the VSP team.

**Study Design**

We conducted a single-center, retrospective cohort study of patients diagnosed with multiple sclerosis who filled prescriptions for disease-modifying therapy through VSP between January 2016 and December 2016. Data were extracted from electronic medical records and pharmacy claims at Vanderbilt University Medical Center and VSP. The institutional review board of Vanderbilt University approved the study.

**Patient Selection**

Participants were eligible for the study if they had an *International Classification of Diseases, Tenth Revision, Clinical Modification* code diagnosis for multiple sclerosis (G35), with at least 3 prescription claims through VSP for 1 or more of the following disease-modifying therapies during the study period: Aubagio® (teriflunomide, Sanofi/Genzyme, Cambridge, MA), Avonex® (interferon beta-1a, Biogen, Cambridge, MA), Betaseron® (interferon beta-1b, Bayer, Whippany, NJ), Copaxone® (glatiramer acetate, Teva, North Wales, PA), Extavia® (interferon beta-1b, Novartis, East Hanover, NJ), Gilenya® (fingolimod, Novartis, East Hanover, NJ), Gilotra® (glatiramer acetate, Sandoz, Princeton, NJ), Plegridy® (peginferon beta-1a, Biogen, Cambridge, MA), Rebif® (interferon beta-1a, EMD Serono, Rockland, MA), and Tecfidera® (dimethyl fumarate, Biogen, Cambridge, MA). We excluded 3 patients who transferred their prescription to another pharmacy and then transferred back to VSP during the study period because standardized adherence measures cannot be computed accurately without complete claims data.

**Study Measures**

The primary study outcome was adherence to disease-modifying therapy, which we measured using 2 methods: medication possession ratio (MPR) and proportion of days covered (PDC). We used EnterpriseRx® pharmacy records to identify each patient’s medication name, claim dates, and days’ supply. MPR was calculated by dividing the total sum of a days’ supply filled of a medication during the study period by the total number of days that the patient was on therapy. To avoid overestimation of adherence and to cap the MPR value at 1, the calculation for variable MPR was used. PDC was calculated by dividing the number of days covered by a medication supply by the number of days the patient was on therapy in the study period. We classified patients as adherent or nonadherent using the cutoff threshold of 0.8, a validated measure endorsed by the Pharmacy Quality Alliance.¹⁸,¹⁹

We used pharmacy records to extract each patient’s dates of prescription fills during the study period, as well as insurance type, use of financial assistance programs, and out-of-pocket medication cost per fill. Average out-of-pocket cost per fill during the study period was computed for each patient. From electronic medical records, we collected patient age, sex, race, as well as use of disease-modifying therapy in the 6 months prior to the study period start date (ie, July 2015 to December 2015). Patients were classified as treatment naive or non-naïve depending on whether they filled a prescription for disease-modifying therapy in the prior 6 months. Among patients whose MPR during the study period was less than 0.8, we reviewed clinic notes in electronic medical records and pharmacy records to investigate potential reasons for nonadherence. Data were collected and managed using REDCap electronic data capture tools hosted at Vanderbilt University.²⁰
Statistical Analysis

We conducted descriptive statistics of the demographic and financial characteristics of the sample. Frequencies and proportions were calculated for categorical variables; means, standard deviations (SDs), medians, and interquartile ranges were computed for continuous variables. We first conducted unadjusted logistic regression to investigate whether age, race, sex, treatment naivety, insurance type, use of financial assistance, and average out-of-pocket cost per fill predicted whether patients achieved medication adherence rates $\geq 0.8$, as measured by MPR and PDC.

Next, multivariable logistic regression was used to test whether insurance type, use of financial assistance, and average out-of-pocket cost per fill predicted whether patients achieved medication adherence rates $\geq 0.8$, adjusted for 3 covariates selected a priori: age, sex, and race. Because insurance type, financial assistance, and out-of-pocket costs are highly correlated by nature, each of these variables was included as the main effect in separate multivariable models, which we ran for both outcome measures (MPR and PDC), resulting in 6 multivariable models.

For ease of interpretation, unadjusted analysis examined linear effects for quantitative independent variables (age and
average out-of-pocket cost per fill); however, nonlinear effects using restricted cubic splines with 3 knots were permitted for the multivariable models. Odds ratios (ORs) and P values were reported for logistic regression results. All analyses were performed using the programming language R version 3.3.0.

## Results

Six hundred fifty-three patients met inclusion criteria, and descriptive statistics of the sample are shown in Table 1. Most patients were white/Caucasian (n = 547, 84%), female (n = 491, 75%), held commercial insurance (n = 382, 58%), and were non-naïve to therapy at the beginning of the study period (n = 518, 79%). Average patient age was 47.6 years (SD = 11.0, median = 47.0, interquartile range = 40.0-56.0). Seventy-three percent (n = 475) used 1 or more financial assistance programs, the most common sources being manufacturer copay cards (n = 294, 45%) and foundation grants (n = 119, 18%).

More than three-quarters of the sample (n = 504, 77%) had an average out-of-pocket cost per fill of $0 USD, indicating that most patients did not incur an out-of-pocket expense for medication for any fill during the study period.

Average MPR of all study patients was 0.93, and the average PDC was 0.94. Over the 12-month study period, 575 (88%) patients achieved MPR ≥ 0.8 and 583 (89%) patients achieved PDC ≥ 0.8.

## Multivariate Analyses

In the multivariable models, patients with average out-of-pocket costs greater than $0 had significantly lower odds of achieving MPR ≥ 0.8 (OR = 0.48, P < .001) and achieving PDC ≥ 0.8 (OR = 0.39, P < .001). Patients who used a financial assistance program had greater than 2 times the odds of achieving MPR ≥ 0.8 (OR = 2.04, P = .004) and achieving PDC ≥ 0.8 (OR = 2.20, P = .002) compared to those who did not receive financial assistance. Insurance type, age, sex, and treatment naivety did not significantly differ between adherent and nonadherent patients in either MPR or PDC models.

## Reasons for Nonadherence

Seventy-eight patients (12% of the sample) were classified as nonadherent, defined as MPR < 0.8. Clinic notes were reviewed for these patients to identify potential reasons for nonadherence. Because some patients had multiple lapses during the study period, multiple reasons for nonadherence were

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**Table 1. Characteristics of the Sample (n = 653).**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>M (SD), n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (median = 47.0, IQR = 40.0-56.0)</td>
<td>47.6 (11.0)</td>
</tr>
<tr>
<td>Sex (% female)</td>
<td>491 (75.2)</td>
</tr>
<tr>
<td>Treatment naivety (% naive)</td>
<td>135 (20.7)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>547 (83.8)</td>
</tr>
<tr>
<td>Black/African American</td>
<td>81 (12.4)</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>3 (&lt;1.0)</td>
</tr>
<tr>
<td>More than 1 race</td>
<td>16 (2.5)</td>
</tr>
<tr>
<td>Unknown</td>
<td>6 (&lt;1.0)</td>
</tr>
<tr>
<td>Insurance type</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>382 (58.5)</td>
</tr>
<tr>
<td>Medicare</td>
<td>238 (36.4)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>26 (4.0)</td>
</tr>
<tr>
<td>Tricare</td>
<td>4 (&lt;1.0)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (&lt;1.0)</td>
</tr>
<tr>
<td>Financial assistance</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>178 (27.3)</td>
</tr>
<tr>
<td>Manufacturer co-pay card</td>
<td>294 (45.0)</td>
</tr>
<tr>
<td>Foundation grant</td>
<td>119 (18.2)</td>
</tr>
<tr>
<td>Medication Access Program</td>
<td>23 (3.5)</td>
</tr>
<tr>
<td>Secondary insurance</td>
<td>39 (6.0)</td>
</tr>
<tr>
<td>Patient average out-of-pocket cost per fill, $</td>
<td></td>
</tr>
<tr>
<td>$0.00</td>
<td>504 (77.2)</td>
</tr>
<tr>
<td>$0.01-$10.00</td>
<td>110 (16.8)</td>
</tr>
<tr>
<td>More than $10.00</td>
<td>39 (6.0)</td>
</tr>
</tbody>
</table>

Abbreviations: IQR, interquartile range; M, mean; SD, standard deviation.

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**Table 2. Unadjusted Logistic Regression Models Predicting Odds of Achieving Medication Possession Ratio (MPR) and Proportion of Days Covered (PDC) ≥ 0.8.**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>MPR ≥ 0.8</th>
<th>OR (95% CI)</th>
<th>PDC ≥ 0.8</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>1.01 (0.99-1.03)</td>
<td>1.01 (0.99-1.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonwhite race (vs white)</td>
<td>0.66 (0.37-1.18)</td>
<td>0.68 (0.37-1.25)</td>
<td></td>
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</tr>
<tr>
<td>Female (vs male)</td>
<td>0.76 (0.45-1.29)</td>
<td>0.87 (0.50-1.53)</td>
<td></td>
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</tr>
<tr>
<td>Treatment naivety (vs non-naïve)</td>
<td>1.35 (0.72-2.52)</td>
<td>1.45 (0.74-2.84)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federally-funded insurance (vs commercial)</td>
<td>0.64 (0.40-1.03)</td>
<td>0.77 (0.47-1.27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial assistance (vs no assistance)</td>
<td>2.04 (1.25-3.33)*</td>
<td>2.20 (1.32-3.67)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average out-of-pocket cost per fill ≥$0 (vs $0)</td>
<td>0.48 (0.29-0.79)*</td>
<td>0.39 (0.23-0.66)b</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; OR, odds ratio.

*P value <.05.

bP value <.01.

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Univariate Analyses

Results of the unadjusted logistic regression analyses are summarized in Table 2. Compared with patients who paid $0 out-of-pocket, patients with an average out-of-pocket cost more than $0 had significantly lower odds of achieving MPR ≥ 0.8 (OR = 0.48, P = .004) and achieving PDC ≥ 0.8 (OR = 0.39, P < .001). Patients who used a financial assistance program had greater than 2 times the odds of achieving MPR ≥ 0.8 (OR = 2.04, P = .004) and achieving PDC ≥ 0.8 (OR = 2.20, P = .002) compared to those who did not receive financial assistance. Insurance type, age, sex, and treatment naivety did not significantly differ between adherent and nonadherent patients in either MPR or PDC models.
identified for 19 patients. Reasons for nonadherence were grouped into the following 7 categories.

**Physician-initiated prescription change.** We identified 6 patients whose physician either discontinued medication or changed the medication dose during the study period because of pregnancy (n = 1), low absolute lymphocyte count (n = 2), or other reasons (n = 3).

**Financial barriers.** Cost or coverage problems were identified for 9 patients. Medication initiation was delayed in 2 patients due to insurance either prolonging or initially denying the prior authorization. Another 7 patients reported nonadherence due to high cost, which was caused by insurance change or termination for 2 of these patients. For 6 of the 7 patients reporting prohibitive out-of-pocket costs, the pharmacists secured manufacturer copay assistance or grant funding, or provided free medication samples for patients during their insurance lapse.

**Medical or personal barriers.** Medical or personal barriers to adherence included adverse events (n = 6), illness or hospitalization (n = 3), forgetfulness (n = 1), and self-discontinuation of therapy (n = 3). Adverse events included flushing, night sweats, and pain at the injection site; 3 patients who reported adverse events also mentioned anxiety or frustration because of a painful injection experience. Three patients self-discontinued therapy due to injection difficulty, perceived lack of treatment efficacy, or personal/familial barriers.

**Overdue lab work or clinic visit.** For 13 patients, the physician held medication refills because the patient was overdue for lab work (n = 11) or overdue for a clinic follow-up visit (n = 2).

**Declined refill.** Five patients declined a medication refill when contacted by a pharmacy technician, stating they still had remaining medication in hand.

**Unknown.** For 11 patients, no reason for nonadherence was documented in the electronic medical record.

**Unreachable for refill.** Pharmacy technicians were unable to reach 42 patients to initiate a medication refill after 3 phone calls and a mailed letter.

**Discussion**

This study assessed adherence to disease-modifying therapy in patients at an outpatient Multiple Sclerosis Center who fill prescriptions through the integrated specialty pharmacy, as well as predictors of adherence and nonadherence in this cohort. We calculated adherence using both MPR and PDC, given that neither measure is used by specialty pharmacies universally. Over the 1-year study period, patients in our sample achieved an average medication adherence rate of 0.93 as measured by MPR and 0.94 adherence rate as measured by PDC. These rates are comparable to those of Hanson and colleagues, who found 0.93 MPR among 71 patients at an outpatient multiple sclerosis clinic in the Midwestern United States that also uses an integrated specialty pharmacy at academic health system. Thus, our findings provide further evidence that such medication adherence rates can be replicated at larger integrated clinics across geographic regions, suggesting integrated specialty pharmacies can produce higher patient adherence to multiple sclerosis therapy than traditional specialty pharmacies, even those offering specialty care management programs.

The VSP team provides collaborative, comprehensive, patient-centered care for patients with multiple sclerosis at the outpatient Multiple Sclerosis Center. After a patient initiates or changes therapy, a pharmacist meets with the patient face-to-face to screen for drug interactions and to provide comprehensive medication education, including strategies for preventing and treating adverse events. For patients treated with injectable therapy, the pharmacist advises the patient how to avoid injection reactions and facilitates injection training via the drug manufacturer. While a pharmacy technician conducts a benefits investigation of the patient’s insurance plan to determine out-of-pocket cost, the pharmacist completes prior authorization (and appeals, if necessary) as required by the patient’s health insurance. After insurance approves the prescription, the VSP team helps the patient obtain financial assistance to reduce or eliminate the out-of-pocket cost. If a patient’s insurance requires the prescription be dispensed by a specific pharmacy, VSP sends all completed forms to an external pharmacy, which dispenses the medication and refills. If the patient can fill their prescription through VSP, the pharmacy technician orders the medication to be mailed to the patient. Prior to refilling the medication, the pharmacy technician calls the patient to screen for side effects or adherence barriers; if a problem is identified, the technician notifies the clinical pharmacist, who then counsels the patient via telephone. As integrated members of the health-care team, VSP pharmacists document counseling notes in patients’ electronic medical records and communicate with the physician, who can recommend treatment changes based on information collected by the VSP team.

Pharmacists embedded in integrated care clinics are in an ideal position to ensure patients can access and afford their medication at time of treatment initiation. We found that having $0 in out-of-pocket medication cost and participating in a financial assistance program were significant predictors of achieving medication adherence. In our sample, average out-of-pocket cost per fill was $0 for 77% of patients, indicating these patients did not incur an out-of-pocket expense for any prescription fill during the study period. Patients who incurred an average cost per fill greater than $0 were less than half as likely to achieve medication adherence greater than equal to 0.8 compared with patients whose average out-of-pocket cost per fill was $0 during the study period. These findings concur with previous work showing that higher out-of-pocket costs are associated with lower medication adherence.

We presume that the low out-of-pocket medication costs of patients in this study are attributable to the high utilization of
financial assistance programs. Several financial assistance pro-
grams are available for patients with multiple sclerosis: co-pay
assistance from drug manufacturers is available to patients with
commercial insurance, and various charitable foundations
award funds to patients, including those with government
insurance. Vanderbilt University Medical Center also has a
Medication Assistance Program, funded by an internal grant,
which provides financial assistance for qualifying patients. For
three-quarters of patients in the study, VSP secured funding
assistance through at least 1 source. Patients who received
financial assistance were twice as likely to achieve medication
adherence compared with nonrecipients. This underscores the
importance of specialty pharmacists assisting patients enrolling
in available programs that reduce or eliminate out-of-pocket
medication costs to minimize financial barriers to medication
adherence. Future research could explore the amount of money
patients saved through each form of financial assistance to
assess which programs result in greatest cost savings to
patients.

In addition to assessing predictors of adherence, we searched
for reasons for nonadherence by reviewing electronic medical
records of patients whose MPR was less than 0.8 during the
study period. We identified several patients whose physician
recommended they discontinue or reduce the dosing frequency
of medication, due to pregnancy or other health concerns, but the
prescription might not have been updated to reflect these dose
changes. Other patients, however, reported financial, medical, or
personal barriers to adherence. For example, several patients lost
insurance coverage during the study, and the pharmacists
secured financial assistance or provided bridge medication until
the patient’s coverage resumed. These examples highlight the
limitations of MPR and PDC calculations in reflecting true med-
ication adherence and tendency to underestimate adherence. Few
patients reported an adverse event (eg, pain, injection site reac-
tion) that led to subsequent nonadherence, whereas others
self-discontinued therapy due to perceived lack of therapeutic
efficacy or other barriers. The integrated care model allows
pharmacy technicians to screen for adherence barriers at refill
calls, so pharmacists promptly intervene to assist patients in
overcoming specific barriers. For patients who report experien-
cing adverse events, pharmacists call patients to reiterate strate-
gies for preventing or avoiding future adverse events. At other
times, pharmacists can counsel patients on the importance of
treatment adherence or consult with the physician if the patient
might benefit from changing therapy.

Pharmacists in integrated clinics can also communicate and
consult with physicians in person and through the electronic
medical record, a key benefit of integrated delivery models.
With joint access to the electronic medical records, both phy-
sicians and pharmacists can monitor patients with multiple
sclerosis. When patients report adverse effects, barriers to
adherence, or desire to discontinue or switch therapy, pharma-
cists can recommend the physician schedule a clinic visit to
meet with the patient and consider alternative treatment options
when appropriate. If the patient switches therapy, the pharma-
cists in turn provide medication counseling to patients while
pharmacy technicians handle insurance paperwork to ensure
the patient can access and afford their new medication. We
believe that communication and information-sharing between
physicians and pharmacists in integrated clinics prevents or
reduces treatment lapses and contributes to the high adherence
rates seen in our sample.

Although adherence rates in the sample were high, 12% of
patients were nonadherent during the study period as defined
by MPR less than 0.8. Most nonadherent patients were
unreachable for a refill after receiving at least 3 phone calls
and 1 mailed letter from VSP. Because patients were unreach-
able, pharmacy technicians could not conduct the screening
questionnaire to identify adherence barriers or adverse events.
Thus, for these patients, we could not ascertain whether lapses
in therapy were due to side effects, financial barriers, or other
clinical or personal reasons. It may be beneficial to devote
additional resources to multimodal communication to retain
patients in care after treatment initiation and ensure that bar-
riers to adherence are identified and addressed prior to lapses in
therapy.

This study has several limitations. We conducted a retro-
spective chart review to describe medication adherence rates of
patients treated at the Vanderbilt University Medical Center
Multiple Sclerosis Center who also filled prescriptions through
VSP. The VSP team provides medication counseling and sup-
port to all patients treated at the Multiple Sclerosis Center, but
technicians conduct refill reminder phone calls only to the
subset of patients who fill prescriptions through the integrated
pharmacy. Because we cannot access claims of other specialty
pharmacies, we could not calculate rates of adherence to
disease-modifying therapy among patients who received care
from the Vanderbilt Multiple Sclerosis Center but filled their
prescriptions at an external specialty pharmacy. Patients in the
study sample received medication counseling, financial assis-
tance enrollment support, and reminder refill calls from the
VSP pharmacist and technician. We hypothesize that each of
these services contributed to high medication adherence, but
we cannot test individual effects of these services on adherence
given the single cohort design. Several demographic character-
istics were collected for patients in the sample, but we did not
collect other patient characteristics that may be associated with
adherence rates (eg, comorbid health conditions, disease dura-
tion, concomitant medications). We also did not assess whether
days’ supply for refill (eg, 30 days vs 90 days) influenced
adherence. Finally, because data were collected at a single
Multiple Sclerosis Center, and patients were predominately
Caucasian and female, the findings might not generalize to all
integrated specialty pharmacy clinics.

Conclusions

VSP embeds clinical pharmacists within the outpatient Multi-
ple Sclerosis Center at Vanderbilt University Medical Center to
provide comprehensive, coordinated care for patients with mul-
tiple sclerosis and to reduce clinical, financial, and logistical
barriers to medication adherence. Proactively identifying and
mitigating these barriers might improve patient adherence to treatment, resulting in fewer relapses and slower disease progression. Adherence to disease-modifying therapy in this sample of patients far exceeds the industry standard as well as the PQA definition of adherence, but nonadherence in a subset of patients persists. It is critical that we continue to elucidate and implement practice methods that eliminate barriers to adherence and further study the long-term clinical outcomes of adherence in patients with multiple sclerosis.

Authors’ Note
This work was previously presented in part at the National Association of Specialty Pharmacy Annual Meeting held September 17-20, 2017, in Washington DC.

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