Impact of Inpatient Automatic Therapeutic Substitutions on Postdischarge Medication Prescribing

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Abstract

Background: Automatic therapeutic substitution (ATS) is the act of therapeutic interchange, in which patients are transitioned from a nonformulary preadmission medication to an equivalent formulary medication upon admission. ATS protocols are able to provide several benefits; however, if medications are unreconciled at the time of discharge, then use may lead to duplication or omission resulting in adverse outcomes. The objective was to assess the impact of preidentified ATS protocol use during admission on duplication and omission postdischarge. **Methods:** This study included adults who received a preidentified ATS upon admission. The primary outcome was the incidence of duplication or omission at the time of discharge. The secondary outcome was the incidence of duplication or omission at the time of discharge in moderate-to-high readmission risk patients with completed transitions of care (TOC) services compared with incomplete TOC services. **Results:** A total of 689 encounters were assessed for appropriate reconciliation, duplication, or omission at time of discharge. The incidence of duplication or omission at the time of discharge was 9% ($n = 62$). Of the 689 encounters, 287 were assessed for the secondary outcome. The rate of duplication or omission at the time of discharge was 10% ($n = 19$) in the complete TOC services group and 8% ($n = 8$) in the incomplete TOC services group ($P = .6763$). **Conclusion:** This study identified a high rate of appropriate reconciliation of ATS protocols at the time of discharge, which illustrates ATS protocols are a safe medication use management strategy if implemented as intended.

Keywords

drug substitution, medication errors, medication reconciliation

Background

Automatic therapeutic substitution (ATS) is the act of pharmacist-led therapeutic interchange in which patients are transitioned from a nonformulary preadmission home medication to an equivalent formulary medication upon hospital admission.¹⁻³ It is common practice for Pharmacy & Therapeutics (P&T) Committees to approve ATS protocols for use in the inpatient setting, and the value and role of ATS protocols in hospitals has increased over time, as they are able to streamline formularies, improve inpatient pharmacy workflow, and contribute to cost-saving initiatives.^{1,3,4} Although ATS protocols can be beneficial, there is concern that these protocols may lead to therapeutic duplication or omission, which could result in adverse outcomes and adherence issues, if not reconciled at the time of discharge.

Previous studies published on this topic have primarily evaluated the prevalence and types of ATS-related discrepancies at the time of discharge. These studies reported a range

of 15% to 49% of patients experiencing greater than 1 discrepancy post discharge when using ATS protocols. The most commonly identified contributing factors were incomplete or inaccurate discharge medication lists and unclear instructions.⁵⁻⁷ Importantly, these studies highlighted the need for thorough and thoughtful reconciliation of medication lists at the time of discharge, for example, through services focused on transitions of care (TOC).

TOC services are multidisciplinary efforts to help ensure patients are appropriately cared for throughout the continuum of care. Pharmacists contribute to TOC services by

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optimizing medication therapy. One of the primary methods employed by pharmacists to optimize medication therapy is by performing or overseeing medication reconciliation upon hospital admission and discharge.⁸

At the University of North Carolina (UNC) Medical Center, clinical pharmacists are integral members of the medical team and are responsible for managing medication therapy for patients admitted to their assigned services. The clinical pharmacists review preadmission medications for each patient admitted to their services to maximize safe and appropriate medication therapy. Clinical pharmacists are required to reconcile medications at admission and discharge and provide counseling if patients are designated as being moderate-to-high risk for readmission. In addition, pharmacy technicians and students are employed to collect admission medication histories for this same-targeted patient population. Patients are classified as moderate readmission risk if they have had 2 or more admissions within the past year or 2 or more chronic conditions (eg, heart failure, chronic obstructive pulmonary disease, diabetes). Patients are classified as high readmission risk if they have had at least 3 admissions within the past year or at least 3 chronic conditions and 10 or more preadmission medications. Clinical pharmacists document completion of admission and discharge medication reconciliation and counseling in a shared multidisciplinary progress note within the electronic health record.

Pharmacist-led medication reconciliation services have become more prominent through the years as hospitals evolve into value-based care models and improve continuity of care through all settings. There are several published studies evaluating the impact of pharmacist-led TOC on identification and resolution of medication discrepancies.⁹⁻¹² However, there are no published studies which have evaluated the impact of ATS protocol use during inpatient admission on postdischarge therapy with pharmacist-led TOC services.

The objective of this study was to assess the impact of preidentified ATS protocols on therapeutic duplication and omission post discharge.

Methods

Study Design

This single-center retrospective cohort study was conducted at a large academic medical center. The cohort included adult patients who received a preidentified ATS upon admission from June 2015 to May 2016. Patients were assessed for appropriate discharge reconciliation of preidentified ATS medications. The study was granted approval by the UNC Medical Center Institutional Review Board with waiver of consent prior to study initiation.

Inclusion Criteria

Patients admitted to UNC Medical Center from June 2015 to May 2016 were included if they were 18 years of age or older

and had received preidentified medications for which there are P&T Committee-approved ATS protocols. Due to the high number of UNC Medical Center P&T-approved ATS protocols, study investigators opted to select a sample of ATS protocols. This sample allowed for a broad range of therapeutic classes that are representative of medications commonly used to manage chronic conditions such as diabetes and chronic obstructive pulmonary disease. The preidentified ATS protocols included 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase inhibitors, glaucoma medications, steroid and asthma inhalers, insulin, alpha-1 adrenergic blockers, 5-alpha reductase inhibitors, and dihydropyridine calcium channel blockers. Table 1 highlights nonformulary medication to formulary medication substitution for classes included in this study.

Data Collection

Patients who met the inclusion criteria were identified via Carolina Data Warehouse for Health, which maintains research, clinical, and administrative data for UNC Health Care. Data points collected included baseline characteristics (eg, medical service at the time of discharge), therapeutic drug class, use of ATS protocol upon inpatient admission, and assessment of duplication, omission, or appropriate reconciliation of ATS medication upon discharge. Therapeutic duplication was defined as continuation of both preadmission home medication and formulary equivalent medication as stated in the after-visit summary document. Omission was defined as discontinuation of both preadmission home medication and formulary equivalent medication without clinically appropriate and documented rationale. Discharge reconciliation was considered appropriate when a patient was discharged on the original outpatient therapy, discharged on a clinically appropriate alternative agent, or discharged with a clinically appropriate and documented reason for discontinuation of the original medication.

Outcomes

The primary outcome was the overall incidence of therapeutic duplication or omission at the time of discharge. The secondary outcome was the incidence of duplication or omission at the time of discharge in moderate-to-high readmission risk patients with completed TOC services compared with moderate-to-high readmission patients with incomplete TOC services. Moderate-to-high readmission risk patients with completed TOC services had documented pharmacist-led discharge medication reconciliation and received discharge counseling, whereas moderate-to-high readmission risk patients with incomplete TOC services had only 1 or neither of these components documented.

Statistical Analysis

Descriptive statistics were used to report baseline characteristics and to determine the overall incidence of duplication or

Table 1. P&T Committee–Approved ATS Protocols Selected for Evaluation.

Nonformulary medication	Formulary equivalent medication
5-alpha reductase inhibitors	
Dutasteride	Finasteride
Alpha-1 adrenergic blockers	
Terazosin	Doxazosin
Alfuzosin SR	Tamsulosin
Silodosin	
Insulin	
Insulin aspart	Insulin lispro
Nondihydropyridine calcium channel blockers	
Felodipine	Amlodipine
Isradipine, Isradipine CR	
Nicardipine, Nicardipine SR	
Glaucoma medications	
Levobunolol	Timolol
Metipranolol	
Brinzolamide	Dorzolamide
Bimatoprost	Latanoprost
Travoprost	
HMG-CoA reductase inhibitors	
Fluvastatin, Fluvastatin XL	Simvastatin
Pitavastatin	
Rosuvastatin	Atorvastatin
Steroid and asthma inhalers	
Budesonide	Fluticasone
Flunisolide	
Levalbuterol	Albuterol

Note. P&T = Pharmacy & Therapeutics; ATS = automatic therapeutic substitution; HMG-CoA = 3-hydroxy-3-methylglutaryl-coenzyme A.

omission at the time of discharge. The Fisher exact test was utilized to compare the incidence of duplication or omission between moderate-to-high readmission risk patients who received completed TOC services compared with incomplete TOC services. A 2-tailed test for statistical significance was conducted using a predefined alpha value ≤ 0.05 . All analyses were performed by SPSS Statistics 24.0 (IBM Corp, Armonk, New York).

Results

ATS Protocol Encounters

In the study, 760 potential ATS protocol encounters were identified; 71 of these encounters were excluded because ATS protocols were not used during inpatient admission. Therefore, 689 ATS protocol encounters were assessed for appropriate reconciliation, duplication, or omission at the time of discharge. There were a small number of instances when the ATS was not performed according to protocol, but the substitution was clinically appropriate; therefore, the actual substitution utilized was assessed for appropriate

reconciliation at the time of discharge. Figure 1 includes the discharge services for all assessed ATS protocol encounters. The majority of encounters were reconciled by medicine and surgery discharge services. Also, of the 689 ATS protocol encounters, 287 were assessed for the secondary outcome, which focused on moderate-to-high readmission risk patients.

Primary Outcome

The overall incidence of ATS protocol encounter–related discrepancies at the time of discharge was 9% ($n = 62$); 5% ($n = 36$) of discrepancies were due to duplication and 4% ($n = 26$) were due to omission. Of note, patients experienced either a duplication or omission at the time of discharge 23% ($n = 20$) of the time for steroid and asthma inhalers, and approximately 10% of the time for insulin ($n = 12$), 5-alpha reductase inhibitors ($n = 4$), and glaucoma medications ($n = 3$). For patients receiving HMG-CoA reductase inhibitors ($n = 11$), dihydropyridine calcium channel blockers ($n = 1$), or alpha-1 adrenergic blockers ($n = 3$), either a duplication or omission at the time of discharge occurred approximately 4% of the time (Table 2).

Secondary Outcome

The rate of ATS protocol encounter–related duplication and omission at the time of discharge was 10% ($n = 19$) in the completed TOC services group and 8% ($n = 8$) in the incomplete TOC services group ($P = .6763$).

Discussion

The value and role of ATS protocols for inpatient admissions has increased over recent decades as health care institutions have expanded and implemented efficient formulary management strategies.^{1,3,4} However, with the use of ATS protocols, there is a potential for discharge discrepancies. Discrepancies due to incomplete or inaccurate discharge reconciliation of ATS protocols may lead to duplication or omission of therapies, which could result in adherence issues and medication errors. This study found that 9% ($n = 62$) of ATS protocol encounters were inappropriately reconciled at the time of discharge resulting in medication discrepancies.

Interestingly, there was not a statistically significant difference in ATS protocol medication–related discrepancies at the time of discharge for moderate-to-high readmission risk patients who received completed TOC services compared with those who did not receive completed TOC services. This finding may be due to an overall low number of discrepancies observed indicating a larger sample size would have been needed to observe a statistically significant difference in ATS protocol–related discrepancies between the groups. Also, the low overall number of discrepancies may well be due to the practice model at UNC Medical Center, in

Figure 1. Reconciliation of ATS protocol encounter medications by discharge service (n = 689).

Note. ATS = automatic therapeutic substitution.

Table 2. Incidence of Duplication or Omission of Selected ATS Medications at the Time of Discharge Based on Drug Class.

Therapeutic drug class	Appropriate reconciliation (n)	Duplication (n)	Omission (n)
Alpha-1 adrenergic blockers	97% (85)	1% (1)	2% (2)
Dihydropyridine calcium channel blockers	96% (24)	0% (0)	4% (1)
HMG-CoA reductase inhibitors	95% (215)	2% (5)	3% (6)
Glaucoma medications	92% (126)	4% (5)	4% (6)
5-alpha reductase inhibitors	89% (31)	11% (4)	0% (0)
Insulin	87% (81)	2% (2)	11% (10)
Steroid/asthma inhalers	77% (65)	22% (19)	1% (1)

Note. ATS = automatic therapeutic substitution; HMG-CoA = 3-hydroxy-3-methylglutaryl-coenzyme A.

which pharmacists are highly integrated members of medical teams.

There have been studies that have reported higher discharge discrepancy rates than what we found in our retrospective cohort assessment. For example, Chua and colleagues compared the rate of discharge discrepancies between a period of time when a Canadian hospital's proton pump inhibitor (PPI) formulary aligned with the British Columbia PharmaCare program with a period of time when their formulary was misaligned. During the period of aligned formularies, there was a 27.3% discharge discrepancy rate, and a 49.1% discharge discrepancy rate during the misaligned formularies period. In comparison with our study, Chua and colleagues identified a higher discharge discrepancy rate even when inpatient and outpatient formularies were aligned. They also defined discharge discrepancy as a difference between the preadmission home PPI and the PPI prescribed at discharge, whereas our study defined discharge discrepancy as the duplication or omission of therapy at the time of discharge. Therefore, if a patient was prescribed the

ATS protocol medication upon discharge instead of original preadmission home medication, we considered this appropriate reconciliation, as there was no duplication or omission of therapy. However, Chua and colleagues would have considered this a discharge discrepancy, which may explain the higher rate identified in their study. In addition, key limitations to their study were that a small number of PPI ATS protocol encounters were evaluated and focused solely on cardiology services.⁶

There are also published commentaries which question the need and possible harm of hospital formularies which promote the use of ATS protocols due to concerns of high probability of patients being discharged on inappropriate therapy.^{13,14} However, the high rate of appropriate reconciliation of ATS protocols at the time of discharge observed in this study provides support for continued use of ATS protocols as a safe strategy for medication use management.

Our findings also support a study published by Glaholt and colleagues, which evaluated the frequency with which

patients receiving ATS protocol medications during inpatient admission were returned to original outpatient therapy. Over a 6-month period, approximately 15% of patients receiving ATS protocol medications during inpatient admission were not returned to original outpatient therapy. Of note, 6% of these patients were discharged on a different dose or on an alternative medication.⁷

In addition, approximately 10% of identified encounters in this study did not utilize ATS protocols; therefore, targeted education efforts within our institution will help to increase utilization of protocols and to ensure safe and appropriate use of medications.

There are notable limitations to this study. A small number of P&T Committee–approved ATS protocols were evaluated in comparison to the greater than 100 P&T Committee–approved ATS protocols actively utilized at UNC Medical Center. However, we aimed to purposefully select ATS protocols which represented a broader range of therapeutic classes and represented medications commonly used to manage chronic conditions such as diabetes and chronic obstructive pulmonary disease. We were also unable to assess clinical impact (eg, adherence, adverse drug events) of ATS-related discharge discrepancies due to the complexity of outpatient follow-up. Also, due to variability of documentation in our electronic health record and the retrospective design, it was challenging to discern if each omission was based on clinical reason or error during the reconciliation process unless it was specifically documented.

Conclusion

Overall, this study identified a 91% rate of appropriate reconciliation of ATS protocols at the time of discharge, which illustrates ATS protocols can be a safe medication management strategy if implemented and utilized appropriately in the inpatient setting. There are opportunities to ensure ATS protocols continue to be an effective strategy, specifically through pharmacist-led efforts to improve discharge medication reconciliation, as 9% of ATS protocol encounters were incorrectly reconciled at the time of discharge.

Declaration of Conflicting Interests

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