

Medication-Related Problems Identified by Pharmacists in an Enhanced Medication Therapy Management Model

David Bankes, PharmD, BCGP; Katie Pizzolato, PharmD; Stephanie Finnel, PhD; Michael S. Awadalla, PharmD, BCGP; Alan Stein, MD, PhD; Joshua Johnson, PharmD, BCGP; and Jacques Turgeon, BPharm, PhD

Introduction

In 2003, the Medicare Prescription Drug, Improvement, and Modernization Act established a prescription drug benefit (ie, Part D) that required Prescription Drug Plans (PDPs) to offer medication therapy management (MTM) services as a way to optimize beneficiary medication use.¹ Whereas some PDPs have realized improvements in patient outcomes such as adherence and hospitalization costs,² MTM has been characterized by poor beneficiary enrollment and substantial performance variation between PDPs in both drug therapy outcomes (eg, resolution of drug interactions, avoidance of contraindicated medications) and health care resource utilization (eg, Medicare costs, hospitalization rates, emergency department visits).^{3,4} In 2017, the CMS—through the Center for Medicare & Medicaid Innovation (CMMI)—launched a 5-year “Enhanced MTM” model that is testing whether providing PDPs with regulatory flexibility and financial incentives can promote enhancements to the MTM program, such as improved therapeutic outcomes and reduced net Medicare expenditures. For participating PDPs, the model offers an opportunity to identify and implement innovative strategies that optimize medication use.⁵

For Blue Cross and Blue Shield Northern Plains Alliance (BCBS-NPA)—a PDP participating in CMMI’s model—adopting the MedWise Risk Score (MRS)^{6,7} represents a new paradigm for targeting beneficiaries. Unlike traditional MTM programs that target beneficiaries based upon the number of chronic diseases, number of drugs, and Part D costs,³ the MRS identifies beneficiaries who have modifiable risk factors related to their medication regimens. This new approach uses beneficiaries’ drug-related claims data to determine their medication regimen; then, pharmacokinetic and pharmacodynamic characteristics of identified active ingredients feed algorithms that compute the MRS. The previous article⁸ in this supplement found that a higher MRS was associated with a plethora of poor outcomes among BCBS-NPA’s beneficiaries: increased odds of adverse drug events (ADEs), higher Parts A and B costs, more hospitalizations, more emergency department visits, and greater mortality. These analyses controlled for several covariates, and results were in line with earlier findings from the Programs of All-Inclusive Care for

ABSTRACT

Objectives: To describe the types of clinically actionable medication-related problems (MRPs) identified and the types of resolving recommendations issued by pharmacists using an advanced clinical decision support system (CDSS) for Medicare Part D beneficiaries.

Study Design: Retrospective cross-sectional study.

Methods: We examined frequencies of MRPs and recommendations for beneficiaries who received a first-ever medication safety review (MSR) during plan years 2018-2019. MRPs were considered clinically actionable if implementation of a recommendation would alter the medication regimen.

Results: Pharmacists identified ≥ 1 clinically actionable MRP for 82.4% (18,703/22,696) beneficiaries receiving an MSR. Among these beneficiaries, 36,455 MRPs were identified (mean [SD] number of MRPs: 1.9 [1.0]). “Adverse drug reaction” (n = 14,788; 40.6%), “drug interaction” (n = 9716; 26.7%), and “medication use without indication” (n = 6496; 17.8%) represented 85.0% of all MRPs. “Start alternative therapy” was most frequently recommended to resolve “adverse drug reactions” (6724/14,788; 45.5%), followed by “change time of administration” to resolve “drug interactions” (5189/9716; 53.4%) and “discontinue medication” to resolve “drug use without indication” (5718/6496; 88.0%). Overall, “start alternative therapy” (n = 12,219) and “discontinue medication” (n = 12,059) made up 66.6% of all recommendations.

Conclusions: In Medicare Part D beneficiaries, pharmacists using an advanced CDSS identified a substantial number of MRPs pertaining to medication safety and issued recommendations to decrease the risk of adverse drug events.

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For author information and disclosures, see end of text.

the Elderly (PACE) setting⁹ and among ambulatory patients.¹⁰ Taken together, the MRS approach may be used to identify beneficiaries with high MRS and target them for risk-mitigating interventions.

For the Enhanced MTM model, BCBS-NPA is deploying the MRS in tandem with a clinical decision support system (CDSS) known as MedWise.^{11,12} This CDSS analyzes a beneficiary's medication regimen in the context of the MRS risk factors, thereby identifying and resolving medication-related problems (MRPs) that are most likely contributing to the risk of ADEs and other negative utilization outcomes.^{6,7} Therefore, resolving such MRPs has the potential to address some of the performance variation associated with traditional MTM. However, what are those MRPs? When given access to the CDSS, how do pharmacists intervene on behalf of a PDP participating within the Enhanced MTM model? And, when comparing against the broader literature, will these interventions differ from those in traditional MTM?

The purpose of this study was to determine (1) the types of clinically actionable MRPs identified by pharmacists who are intervening on behalf of a PDP that is participating in CMMI's Enhanced MTM model, and (2) the types of recommendations made to resolve identified MRPs. The research presented here was conducted by Tabula Rasa HealthCare (TRHC) with the oversight of ClearStone Solutions (CSS), the contracted Part D administrator for plan participant BCBS-NPA, without input from CMS.

Methods

Study Design and Ethical Approvals

This is a retrospective, cross-sectional analysis of the MRPs identified by pharmacists for beneficiaries enrolled and targeted in Enhanced MTM plan years 2 and 3, which aligned with calendar years January 1, 2018, through December 31, 2019. The need for an informed consent procedure was waived by the Biomedical Research Alliance of New York Institutional Review Board (19-12-172-427; May 24, 2019).

Setting and Context

This study describes the Enhanced MTM model offered to beneficiaries living in Medicare Part D Region 25 (Iowa, Minnesota, Montana, Nebraska, North Dakota, South Dakota, and Wyoming), whose coverage was provided by BCBS-NPA.⁵ Through its Part D administrator, CSS, NPA partnered with TRHC, for provision of Enhanced MTM services. TRHC is a medication-risk mitigation and technology solutions company that focuses on optimizing medication regimens. This technology is utilized by trained and certified health care professionals (typically, pharmacists).

TRHC originally deployed the MRS and CDSS in the PACE setting. PACE is a value-based environment, where programs assume full financial risk of medically complex older adults dually eligible for Medicare and Medicaid. PACE pharmacists predominantly use TRHC technologies for *prospective* risk mitigation, where regimens can be

optimized prior to ingestion (ie, at the point of prescribing/dispensing). Given TRHC's extensive experience and success in PACE, CSS sought to determine whether TRHC's technologies could be extrapolated to the larger Part D population using *retrospective* risk mitigation methods (ie, optimizing existing regimens) for Enhanced MTM.

Technology Description

The MRS ranges from 0 to 53, with higher scores representing greater risk of ADEs and other negative health utilization outcomes.^{6,7} For this analysis, high risk was defined as a score of 20 or higher.^{6,13} The MRS is based on 5 modifiable risk factors: anticholinergic burden, sedative burden, pharmacokinetic drug interactions, QT prolongation risk, and relative odds of ADEs as computed for the entire medication regimen using primary information obtained from the FDA's Adverse Event Reporting System database.^{6,7}

Whereas the CDSS is a separate and distinct tool, it works in tandem with the MRS. Specifically, it presents 4 visualizations of an individual's medication regimen in the context of the aforementioned risk factors. The cornerstone of this tool is a comprehensive, matrix-based¹¹ visual of the entire regimen. This helps pharmacists identify simultaneous multidrug interactions (SMDIs),¹⁴ such as competitive inhibition between 3 or more cytochrome P450 isoenzyme substrates. The tool also updates the archaic methodology of first assessing drug interactions as pairwise comparisons and then generating numerous clinical alerts.^{12,14} Clinical cases illustrating the CDSS matrix have been documented extensively.¹⁵⁻²⁰

Intervention Description

BCBS-NPA's intervention as a CMMI model participant was a pharmacist-provided medication safety review (MSR). MSRs were provided over the telephone by TRHC call-center pharmacists or face to face by community pharmacists. Unlike comprehensive medication reviews (CMRs)²¹ in traditional MTM, MSRs additionally "(1) focus on applying the principles of pharmacodynamics, pharmacokinetics, pharmacogenomics (when available), and chronopharmacology to medication safety rather than being driven by CMS star ratings and medication and guideline adherence; and (2) involve evaluating [SMDIs] using [the] evidence-based, proprietary CDSS."¹⁴ These 2 points are solely accomplished with a pharmacist's expert review and interpretation of TRHC's aforementioned CDSS matrix.

Prior to each program year, MRSs were computed for all beneficiaries using Part D claims data. Next, beneficiaries were stratified. Those with the highest risk received priority for MSR targeting; however, any beneficiary requesting an MSR could receive one (eg, a low-risk beneficiary whose spouse is at high risk).

Targeted beneficiaries were mailed documents describing the model. Pharmacy technicians, interns, or pharmacists then contacted the targeted beneficiaries or their designees (eg, caregiver) to gauge interest in an MSR consultation. If beneficiaries wished to participate,

they first underwent a medication reconciliation process in which they reported all legend and non-legend medications and supplements. Staff documented the name, strength, dosage, and time of administration of each product and whether the beneficiary had any medication-related concerns.

Next, beneficiaries had an MSR consultation with a pharmacist. Prior to the MSR, pharmacists analyzed the medication regimen and identified actual or potential MRPs with assistance from the CDSS matrix. After formulating a prioritized problem list, pharmacists spoke with the beneficiary (or designee) about the MRP(s) and resolution strategies.

Documentation of MSR Consults

After the consultation, pharmacists provided the beneficiary/designee with a medication action plan (MAP) along with an updated medication list. The updates in the medication list reflected time-of-day administration changes that pharmacists made within their scope of practice²⁴ to mitigate competitive inhibition.²² The MAP described the MRPs that were discussed and outlined the specific actions needed to resolve MRPs. With consent, pharmacists sent a prescriber's action plan (PAP) to the prescribing physician by fax and/or mail. This contained (1) a 1- to 3-sentence executive summary of each MRP and its corresponding recommendation for resolution; (2) a lengthier rationale describing the recommendation's evidence-based justification (if necessary); and (3) a hypothetical pre-post change in MRS after the implementation of the proposed recommendations.

Pharmacists recorded MSR details with Systematized Nomenclature of Medicine–Clinical Terms (SNOMED CT) codes. SNOMED CT is an internationally adapted, semantically rich, clinically validated, standardized medical terminology that permits consistent and accurate representation of clinical content in electronic medical records.²³ All Enhanced MTM plan sponsors were required to transmit data to CMMI using SNOMED CT.²⁴ When an MRP was encountered, pharmacists selected one SNOMED CT that described the nature of the MRP and another SNOMED CT that described a recommendation to resolve the MRP. The breadth of SNOMED CT also provided a way for pharmacists to document ancillary activities (eg, medication counseling, assessments) and problems that may not have been medication-related (eg, tobacco use, elder abuse, suicidal ideation). Such SNOMED CTs were operationally defined as “risk factors” and were not considered MRPs for this research. Once details were coded, pharmacists wrote a narrative description outlining the problems identified; the description was then given to the patient and/or prescriber.

Study Subjects

Subjects included all beneficiaries who received their first-ever MSR for plan years 2018 and 2019. First MSRs were included because the number of MRPs was likely to be greatest at the first consult.

Study Procedures and Definitions

The objective of this study was to report the frequencies of “clinically actionable” MRPs and recommendations. For this study, a “clinically actionable” MRP was defined as any SNOMED CT (1) that was included in a MAP or PAP; (2) that described an MRP; and (3) whose recommendation for resolution, if implemented, would result in a tangible alteration to the beneficiary's medication regimen. Therefore, MRPs were not considered “clinically actionable” if “continue,” “monitor,” “educate,” or “referral” was the pharmacist's recommended intervention. Excluded SNOMED CTs are reported in **eAppendix Table 1** (eAppendix available at ajmc.com).

Upon examination of the SNOMED CTs, 60 unique MRPs and 19 unique recommendation codes were documented in MAPs and PAPs. To facilitate interpretation, we recategorized SNOMED CTs using broader taxonomies. For MRPs, we reclassified SNOMED CTs into 8 MRP categories described by Hepler and Strand.²⁵ We renamed Hepler and Strand's “failure to receive drug” as “adherence/cost problem” (**eAppendix Table 2**). For recommendations, we reclassified SNOMED CTs into recommendation categories described by Hoth et al (**eAppendix Table 3**).²⁶

Analysis

We met our primary objectives by counting the number of MRPs and recommendations in each category across the MSRs. We performed several additional analyses. First, we identified medications causing or contributing to MRPs. Next, we examined whether significant differences existed between beneficiaries with and without clinically actionable MRPs. We used the unpaired *t* test to compare continuous, parametric data and the chi-square test to compare categorical data. Lastly, we examined the relationship between the MRS and the number of clinically actionable MRPs using a second-order polynomial regression weighted by the number of members at each MRS. Finally, a paired *t* test was used to evaluate the hypothetical change in MRS that would occur postconsultation, assuming 100% implementation. We considered *P* values < .05 statistically significant. Analyses were conducted using R (v. 3.5.1, 3.5.2, and 4.0.5) and Microsoft Excel (Microsoft 2019, Redmond, WA).

Results

There were 22,696 beneficiaries who received a first-ever MSR for plan years 2018 and 2019. Most beneficiaries (*n* = 18,703; 82.4%) had at least 1 clinically actionable MRP coded in their MAP and/or PAP (**eAppendix Figure 1**). Of these, the majority of MSRs (*n* = 15,643/18,703; 83.6%) were completed by call-center pharmacists, and the rest were completed by community pharmacists. Compared with the 3993 beneficiaries without clinically actionable MRPs, the group with actionable MRPs had a significantly higher mean (SD) MRS (19.0 [6.8] vs 15.6 [6.6]; *P* < .001), had a significantly greater proportion of high risk (ie, MRS ≥ 20) beneficiaries (44.1% vs

25.9%; $P < .001$), and took, on average, 2 more medications (mean [SD]:13.6 [5.0] vs 11.6 [4.8]; $P < .001$). Moreover, several medical conditions were more prevalent among beneficiaries with actionable MRPs. **Table 1** reports all demographic details.

In total, pharmacists identified 36,455 MRPs, corresponding to a mean (SD) number of MRPs of 1.6 (1.1) across the whole population and 1.9 (1.0) for the 18,703 beneficiaries with actionable MRPs. A second-order polynomial regression equation showed that the MRS is positively associated with the number of clinically actionable MRPs identified (**Figure 1**; $MRPs = 0.498 + 0.073 * MRS - 0.0006 * MRS^2$; adjusted $R^2 = 0.98$, $P < .001$).

Figure 2A depicts the distribution of clinically actionable MRPs identified by pharmacists. “Adverse drug reaction” was the most common MRP identified, which represented 40.6% ($n = 14,788$) of all identified MRPs. “Drug interaction” ($n = 9716$; 26.7%) and “drug use without indication” ($n = 6496$; 17.8%) were the next most common MRPs. These 3 MRP categories accounted for 85.1% of all MRPs. To resolve MRPs, pharmacists most frequently recommended to “start alternative therapy” ($n = 12,219$; 33.5%), “discontinue medication” ($n = 12,059$; 33.1%), “change time of medication administration” ($n = 6459$; 17.7%), and “change dose” ($n = 4393$; 12.1%). Collectively, these 4 recommendations represented 96.4% of all recommendations. The overall distribution of recommendations can be seen in **Figure 2B**. Regarding the top 3 MRPs, pharmacists most frequently recommended to “start alternative therapy” to resolve “adverse drug reactions” (45.5%; 6724/14,788); to “change time of administration” to resolve “drug interactions” (53.4%; 5189/9716), and to “discontinue medication” to resolve “drug use without indication” (88.0%; 5718/6496). As shown in **Figure 3**, pharmacists’ recommendations could significantly decrease the average MRS by 4.7 points (95% CI, 4.6–4.8; $P < .001$).

Table 2 reports the top 20 medications that were identified as causing or contributing to MRPs, along with the corresponding most commonly coded MRP and recommendation for resolution. For example, the most commonly identified problem medication was omeprazole, which was coded in 12.7% (4628/36,455) of all MRPs. Pharmacists most frequently found omeprazole not to be indicated (49.3%; 2280/4628) and most frequently recommended to have it discontinued (53.6%; 2482/4628). Pharmacists commonly coded aspirin, ibuprofen, diphenhydramine, diphenhydramine-acetaminophen,

oxybutynin, paroxetine, and naproxen with “adverse drug reaction” SNOMED CTs. Furthermore, hydrocodone-acetaminophen, amlodipine, tramadol, warfarin, clopidogrel, simvastatin, atorvastatin, metoprolol, tamsulosin, trazodone, and citalopram were commonly coded with “drug interaction” SNOMED CTs.

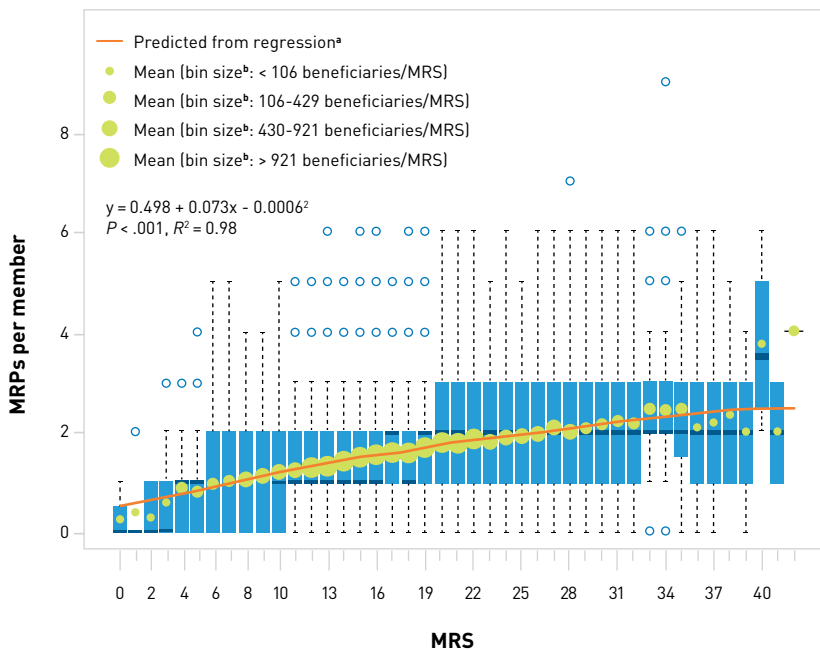
Discussion

This study examined nearly 23,000 beneficiaries who received their first-ever MSR, which was the primary intervention deployed by a PDP participating in CMMI’s ongoing Enhanced MTM model. Across 2 program years, clinically actionable MRPs were identified among 82.4% of beneficiaries, with about 2 such MRPs identified per beneficiary. Three MRPs pertaining to medication safety (ie, adverse drug reactions, drug interactions, and drug use without indication) accounted for approximately 85% of all MRPs. At roughly similar rates (~33% each), pharmacists recommended deprescribing

TABLE 1. Cohort Demographics

Characteristic	All	No clinically actionable MRP	Clinically actionable MRP	P value ^a
Beneficiaries with MSR, n (%)	22,696 (100)	3993 (17.6)	18,703 (82.4)	-
Age, mean (SD), y	76.9 (9.1)	77.1 (9.8)	76.9 (9.0)	.15
Female, n (%)	13,978 (61.6)	2461 (61.6)	11,517 (61.6)	.95
Medications, mean (SD)	13.2 (5.0)	11.6 (4.8)	13.6 (5.0)	<.001
MRS, mean (SD)	18.4 (6.9) ^b	15.6 (6.6)	19.0 (6.8) ^b	<.001
MRS ≥ 20, n (%)	9279 (40.9) ^b	1034 (25.9)	8245 (44.1) ^b	<.001
MRPs, mean (SD)	1.6 (1.1)	N/A	1.9 (1.0)	N/A
Medical conditions (ICD10), n (%)				
Hypertension (I10)	20,621 (90.9)	3511 (87.9)	17,110 (91.5)	<.001
Hyperlipidemia (E78)	19,427 (85.6)	3323 (83.2)	16,104 (86.1)	<.001
GERD (K21)	12,520 (55.2)	1809 (45.3)	10,711 (57.3)	<.001
Insomnia (G47)	10,833 (47.7)	1832 (45.9)	9001 (48.1)	.010
Major depressive disorder (F22, F23)	10,384 (45.8)	1605 (40.2)	8779 (46.9)	<.001
Coronary heart disease (I25)	10,204 (45.0)	1721 (43.1)	8483 (45.4)	.009
Anxiety disorders (F41)	9480 (41.8)	1556 (39.0)	7924 (42.4)	<.001
Diabetes, type II (E11)	8569 (37.8)	1405 (35.2)	7164 (38.3)	<.001
Atrial fibrillation (I48)	8526 (37.6)	1664 (41.7)	6862 (36.7)	<.001
Chronic kidney disease (N18)	8257 (36.4)	1462 (36.6)	6795 (36.3)	.74
Heart failure (I50)	7569 (33.3)	1381 (34.6)	6188 (33.1)	.07
Hypothyroidism (E03)	7264 (32.0)	1223 (30.6)	6041 (32.3)	.040
COPD (J44)	5220 (23.0)	840 (21.0)	4380 (23.4)	.001

COPD, chronic obstructive pulmonary disease; GERD, gastroesophageal reflux disease; MRP, medication-related problem; MRS, MedWise Risk Score; MSR, medication safety review; SD, standard deviation; y, year.
^aComparison between No MRP and MRP groups. The chi-square test was used to compare categorical variables, and the unpaired *t*-test was used to compare continuous variables.
^bMissing MRS data for 2 beneficiaries.

FIGURE 1. Relationship Between the MedWise Risk Score and Number of Medication-Related Problems Per Member^{a,b}

MRP, medication-related problems; MRS, MedWise Risk Score.

^aWeighted second-order polynomial regression.

^bBin 1 < first quartile; first quartile ≤ bin 2 ≤ median; median < bin 3 ≤ third quartile; bin 4 > third quartile.

or changing drugs to resolve MRPs. Further, we found that the MRS was positively associated with the number of MRPs, and, if recommendations were implemented, the MRS would decrease. Collectively, these results suggest that risk stratification worked as intended: Pharmacists were able to identify a substantial number of actionable MRPs that may cause or contribute to ADEs and then act accordingly to decrease risk.

Whereas this is not the only MTM model to identify medication safety-oriented problems,²⁷⁻³¹ other programs have described very different priorities. For example, a 2019 study of 80,000 Medicare patients enrolled in an MTM program at Humana found that, depending on the intervention year, nonadherence made up 50% to 90% of the MRPs.³² Drawing from 10 years of MTM experience, an integrated health system from Minnesota identified medication underuse to be the predominant problem, which manifested in “need for new medication” (28%), “subtherapeutic doses” (26%), and “nonadherence” (17%).³³ Another multistate, 7-year study found cost-efficacy management, medication underuse, and suboptimal therapy to be among the most common MTM priorities noted in the community pharmacy setting.³⁴ Similarly, several other MTM programs describe nonadherence, undertreatment, and medication cost as the main clinical priorities.³⁵⁻⁴³

We contend that the medication safety and deprescribing focus reported here is related to the advanced CDSS deployed by this PDP as part of its participation within the enhanced MTM model. A small pilot study assessed the clinical behavior of traditional MTM pharmacists when presented simulated cases of polymedicated patients (≥ 10 medications in profile).⁴⁴ Prior to CDSS exposure and training, pharmacists most frequently recommended “start new medication,” which reflected their program’s operational focus on disease-state guideline adherence. After training, pharmacists were significantly more likely to recommend deprescribing and changing medications, which reflected a new focus on ADE-risk mitigation.⁴⁴ When the CDSS was used for the care of about 1000 medically complex older adults enrolled in PACE, pharmacists similarly prioritized MRPs related to medication safety: “drug interactions” (36%), “adverse drug reactions” (18%), “high doses” (14%), and “drug use without indication” (13%). In line with the present study, PACE pharmacists most commonly recommended deprescribing, changing medications, and changing times of administration to resolve MRPs.¹⁴

Medication safety-focused interventions could help lower hospital and outpatient costs. Among older adults, ADEs may contribute to 12% of hospital admissions⁴⁵ and cause 1.2 million annual outpatient visits in the United States.⁴⁶ Since ADEs are largely preventable,⁴⁷ associated hospital and outpatient costs can likely be avoided. In this study, pharmacists prioritized high-risk medications that are associated with these negative outcomes. For example, opioids (eg, hydrocodone and tramadol), anticoagulants (eg, warfarin), antiplatelets (eg, clopidogrel, aspirin), antidepressants (eg, paroxetine), nonsteroidal anti-inflammatory drugs (eg, ibuprofen), and anticholinergics (eg, diphenhydramine, oxybutynin) are frequent culprits in drug-related hospitalizations and injurious falls.^{45,48-50} The next article⁵¹ in this supplement will illustrate how these interventions can indeed yield lower Parts A and B costs.

Limitations

The study has 4 main limitations. First, the distribution of MRPs and recommendations is dependent on pharmacists’ coding consistency and quality. This may be most relevant when a given MRP or recommendation may be coded in 2 different ways. For example, aspirin 81 mg used for primary prevention of cardiovascular disease in a 85-year-old person with low cardiovascular risk could be reasonably documented with “at risk of medication side

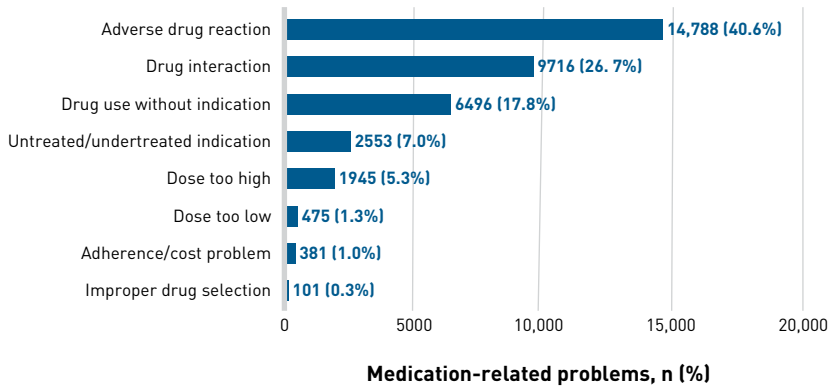
effect” (ie, bleeding) or “medication therapy unnecessary.”⁵² Miscoding could also impact the extent to which the MRS can hypothetically change after 100% implementation of recommendations. Extensive and repeated training provided to pharmacists participating in this program and continual verification and validation may have minimized the impact of this limitation. Second, recategorizing SNOMED CT codes into broader and different MRPs and recommendation taxonomies may have inadvertently biased distributions. However, expert opinion used in the recategorization process should have limited such an impact. Third, MedWise cannot account for “composite” recommendations that may influence the interpretation of pharmacists’ activities. For example, if a drug interaction is identified as the MRP, then a pharmacist may provide the doctor with 2 recommendation options to resolve the interactions: (1) discontinuing the perpetrator drug *or* (2) decreasing the dose of the victim drug. Whereas both options are written as a *narrative description* within the MAP and/or PAP, the pharmacist would have to pick 1 SNOMED CT recommendation option to code into the action plan. Fourth and finally, this study’s dataset did not capture recommendation implementation. Future studies should capture this intermediate outcome because it can help quantify the feasibility of MSR interventions. Nevertheless, the next article⁵¹ in this supplement will show that several utilization outcomes improved in the year following the receipt of a first-ever MSR, indicating that recommendations were feasible by dint of their effectiveness.

Conclusions

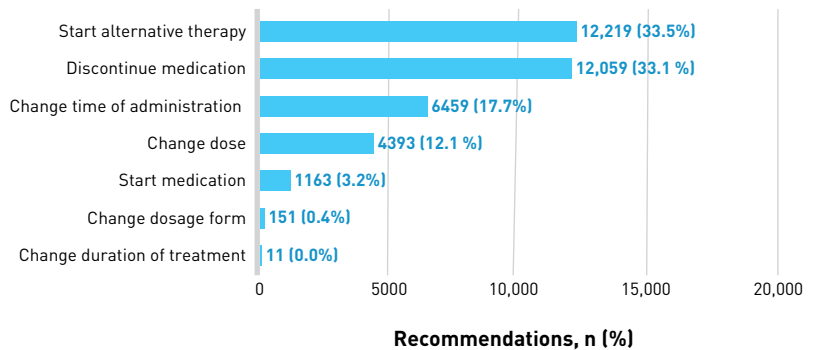
Adverse drug reactions, drug interactions, and unnecessary medication use accounted for the majority of MRPs identified by pharmacists who used an advanced CDSS, MedWise, to support one PDP’s participation within CMMI’s Enhanced MTM model. To resolve these medication safety-oriented problems, pharmacists issued recommendations capable of significantly decreasing the MRS, such as changing or deprescribing medications. These MedWise-supported medication safety interventions may augment traditional MTM programs with different priorities (eg, nonadherence, undertreatment, medication cost). The impact of medication safety-oriented interventions on economic and clinical outcomes will be illustrated in the next article.⁵¹ ■

FIGURE 2. Frequencies of Clinically Actionable Medication-Related Problems Identified and Recommendations Issued by Pharmacists

A. Medication-related problems



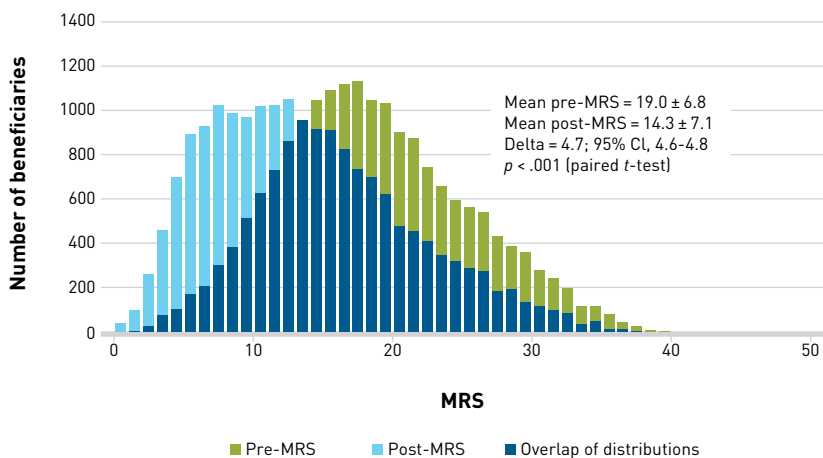
B. Recommendations



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FIGURE 3. Distribution of MedWise Risk Scores Before and After Medication Safety Review in Beneficiaries With Actionable Medication-Related Problems^{a,b}



MRS, MedWise Risk Score.

^aPost-MRS is hypothetical and assumes 100% recommendation implementation.

^bMissing MRS data for 6 beneficiaries.

TABLE 2. Top 20 Medications Causing or Contributing to Medication-Related Problems

Problem drug	MRPs n (% of all)	Most common MRP n (% of drug)	Most common recommendation n (% of drug)
Omeprazole	4628 (12.7)	NI: 2280 (49.3)	D/C: 2482 (53.6)
Aspirin	2625 (7.2)	ADR: 1026 (39.1)	D/C: 1528 (58.2)
Atorvastatin	2125 (5.8)	DDI: 1895 (89.2)	TOA: 1137 (53.5)
Metoprolol	2119 (5.8)	DDI: 1783 (84.1)	TOA: 1274 (60.1)
Ibuprofen	1392 (3.8)	ADR: 1197 (86.0)	SA: 976 (70.1)
Warfarin	1338 (3.7)	DDI: 1226 (91.6)	TOA: 669 (50.0)
Simvastatin	1309 (3.6)	DDI: 999 (76.3)	SA: 681 (52.0)
Pantoprazole	1242 (3.4)	NI: 791 (63.7)	D/C: 831 (66.9)
Clopidogrel	1236 (3.4)	DDI: 974 (78.8)	TOA: 449 (36.3)
Tramadol	1190 (3.3)	DDI: 1046 (87.9)	TOA: 857 (72.0)
Oxybutynin	1050 (2.9)	ADR: 811 (77.2)	D/C: 456 (43.4)
Hydrocodone-acetaminophen	1032 (2.8)	DDI: 905 (87.7)	TOA: 672 (65.1)
Tamsulosin	969 (2.7)	DDI: 550 (56.8)	TOA: 582 (60.1)
Amlodipine	962 (2.6)	DDI: 830 (86.3)	TOA: 592 (61.5)
Diphenhydramine	894 (2.5)	ADR: 768 (85.9)	SA: 611 (68.3)
Paroxetine	869 (2.4)	ADR: 695 (80.0)	SA: 683 (78.6)
Trazodone	797 (2.2)	DDI: 499 (62.6)	SA: 290 (36.4)
Naproxen	784 (2.2)	ADR: 695 (88.6)	SA: 580 (74.0)
Diphenhydramine-acetaminophen	739 (2.0)	ADR: 683 (92.4)	SA: 456 (61.7)
Citalopram	653 (1.8)	DDI: 236 (36.1)	SA: 251 (38.4)

ADR, adverse drug reaction; D/C, discontinue; DDI, drug interaction; MRP, medication-related problem; NI, drug use without indication; SA, start alternative therapy; TOA, change time of administration.

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Author affiliations: Office of Translational Research and Residency Programs, Tabula Rasa HealthCare, Moorestown, NJ (DB, KP); Office of Healthcare Analytics, Tabula Rasa HealthCare, Moorestown, NJ (SF); Office of Applied Pharmacotherapy, Tabula Rasa HealthCare, Moorestown, NJ (MSA); Office of Healthcare Analytics, Tabula Rasa HealthCare, Moorestown, NJ (AS); ClearStone Solutions, Government Markets Division, Blue Cross and Blue Shield of Minnesota, Eagan, MN (JJ); Tabula Rasa HealthCare, Orlando, FL, and Université de Montréal, Montréal, Québec, Canada (JT).

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Address correspondence to: Jacques Turgeon, PhD, 13485 Veterans Way, Ste 410, Orlando, FL 32827. E-mail: jturgeon@trhc.com

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