The Rural VA Multi-Center Medication Reconciliation Quality Improvement Study (R-VA-MARQUIS)

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Purpose. High-quality medication reconciliation reduces medication discrepancies, but smaller hospitals serving rural patients may have difficulty implementing this because of limited resources. We sought to adapt and implement an evidence-based toolkit of best practices for medication reconciliation in smaller hospitals, evaluate the effect on unintentional medication discrepancies, and assess facilitators and barriers to implementation.

Methods. We conducted a 2-year mentored-implementation quality improvement feasibility study in 3 Veterans Affairs (VA) hospitals serving rural patients. The primary outcome was unintentional medication discrepancies per medication per patient, determined by comparing the "gold standard" preadmission medication history to the documented preadmission medication list and admission and discharge orders.

Results. In total, 797 patients were included; their average age was 68.7 years, 94.4% were male, and they were prescribed an average of 9.6 medications. Sites 2 and 3 implemented toolkit interventions, including clarifying roles among clinical personnel, educating providers on taking a best possible medication history, and hiring pharmacy professionals to obtain a best possible medication history and perform discharge medication reconciliation. Site 1 did not implement an intervention. Discrepancies improved in intervention patients compared with controls at Site 3 (adjusted incidence rate ratio [IRR], 0.55; 95% confidence interval [CI], 0.45–0.67) but increased in intervention patients compared with controls at Site 2 (adjusted IRR, 1.22; 95% CI, 1.08–1.36).

Conclusions. An evidence-based toolkit for medication reconciliation adapted to the VA setting was adopted in 2 of 3 small, rural, resource-limited hospitals, resulting in both reduced and increased unintentional medication discrepancies. We highlight facilitators and barriers to implementing evidence-based medication reconciliation in smaller hospitals.

Keywords: hospital medicine, medication reconciliation, patient safety, quality improvement, rural health, veterans

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Patients are vulnerable to adverse drug events (ADEs), or harm due to medications, during care transitions. ADEs occur in 5% to 40% of hospitalized patients and 11% to 19% of patients after discharge.[1–4] Unintentional medication discrepancies, or unexplained differences in medication regimens across sites of care, are associated with ADEs. Discrepancies are documented in 67% of patients at admission and 40% of patients at discharge, with patients taking more than 5 medications at increased risk for medication discrepancies.[5–8] In one study within the Department of Veterans Affairs (VA), 60% of veterans were found to have one or more medication discrepancy.[9] Further, veterans living in rural areas are less likely to use clinical pharmacy services than those living in urban areas, contributing to a higher risk of discrepancies and ADEs.[10]

Medication reconciliation is the process of identifying and providing the most accurate medications for a patient anywhere in the healthcare system to resolve medication discrepancies and prevent downstream ADEs.[11] It is required by the Joint Commission at all transitions of care across all sites of care.[12] However, significant variation in the quality of medication reconciliation persists.[13] In 2008, VA started the Medication Reconciliation Initiative, a national program to track compliance with medication reconciliation requirements.[14] VA facilities must align their medication reconciliation practices to meet both Joint Commission and internal requirements, but implementing evidence-based best practices for inpatient medication reconciliation has been difficult to initiate and sustain across healthcare systems.[15]

To address these challenges, the Multi-Center Medication Reconciliation Quality Improvement Study (MARQUIS, conducted 2011–2014) used a mentored-implementation approach to test an evidence-based toolkit of best practices for inpatient medication reconciliation at 5 hospitals, including one VA hospital. In a mentored-implementation design, mentors, who have content and quality improvement (QI) expertise, guide local teams in conducting a QI project and implementation.[16] For hospital units implementing toolkit interventions, potentially harmful unintentional medication discrepancies were reduced by 8% per month.[17–19]

In 2014, the Medication Reconciliation Initiative hosted an online conference to disseminate MARQUIS results, which generated interest in conducting a similar study in VA hospitals. The objective of the Rural VA Multi-Center Medication Reconciliation Quality Improvement Study (R-VA-MARQUIS) was to implement the MARQUIS evidence-based toolkit of best practices for inpatient medication reconciliation in 3 VA hospitals serving rural veteran populations using a mentored-implementation design. The MARQUIS toolkit and implementation manual were adapted to the VA context, the effect of the intervention on unintentional medication discrepancies was measured, and facilitators and barriers to implementation were assessed.

KEY POINTS

- Medication reconciliation is key to reducing medication discrepancies. An evidence-based toolkit of best practices for medication reconciliation was adapted to Veterans Affairs (VA) hospitals.
- With guidance from distance mentors, 2 of 3 VA hospitals serving rural veterans implemented toolkit interventions. One site significantly reduced unintentional medication discrepancies.
- Facilitators of implementation and intervention effectiveness included institutional support and physician engagement.

Methods

R-VA-MARQUIS was a 2-year QI feasibility study from October 2014 to September 2016 funded by the Veterans Health Administration (VHA) Office of Rural Health.

Context. The only requirement for eligibility was that the hospital provided care for a majority rural or highly rural veteran population; of note, 54 of 168 (32%) VA medical centers meet this classification.[20] To classify veterans as rural or highly rural, the VA uses the rural-urban commuting area codes, which are based on population density at the census tract level.[21] We recruited VA medical centers to participate in this study; all 3 participating sites volunteered and were the only sites to volunteer. Each site assembled a QI team during the study's first quarter with variable representation from hospitalist physicians, pharmacists, nurses, quality managers, QI specialists, and information managers.

Site assessments. At baseline, QI teams completed assessments of their initial aims, processes, and gaps. In year 1, mentors completed a 2-day site visit to observe medication-reconciliation processes and understand the local context. Mentors triangulated data from the baseline assessments, processes, and observations. They then incorporated the local team's ideas on feasibility and generated prioritized toolkit interventions to implement at each site. In year 2, mentors completed site visits to observe interval changes in medication-reconciliation practices, identify next steps in the improvement cycle, and assess facilitators and barriers to implementation.

Intervention: Mentored implementation. Mentored implementation is often used in resource-constrained settings with limited local expertise or capacity.[16,17,22] We used two distance mentors—a hospitalist and a pharmacist; both mentors had expertise in medication reconciliation and QI, as well as extensive experience working clinically within the VA system. Mentors guided the QI teams in implementing interventions from the evidence-based toolkit via monthly phone calls with each site to assess progress, troubleshoot barriers, and monitor data collection.

Intervention: R-VA-MARQUIS toolkit. The original MARQUIS toolkit and implementation manual are based on a systematic review of inpatient medication reconciliation interventions shown to reduce medication discrepancies.[23] The manual reviews key QI principles and contains guidance on pre-implementation assessment and planning.[18] The 11 evidence-based toolkit interventions are framed as a standardized functional goal (e.g., "Train personnel to perform discharge medication reconciliation") (eAppendix A). This allows for flexibility and adaptation of toolkit interventions to the local site context. For R-VA-MARQUIS, we adapted the MARQUIS toolkit and implementation manual to the VA setting to include sources of medication information and resources unique to the VA (Table 1).

Table 1. Adaptations of MARQUIS Implementation Manual and Toolkit for Use in R-VA-MARQUIS[a]

Domain	MARQUIS	Adaptation for R-VA-MARQUIS
Definitions and regulations	Joint Commission definition of medication reconciliation	Inclusion of VA definition of medication reconciliation, directives, and metrics
Literature review	Most articles cited were based on non-VA data	Addition of VA-specific medication error data
Assembling the quality improvement team	Members from executive leadership, team leader, QI leader, clinical champion, frontline staff	Inclusion of staff from systems redesign, HIMS, medication reconciliation point of contact
Data collection	QuesGen software (QuesGen Systems Inc., Burlingame, CA)	VA version of REDCap
Intervention component: taking a best possible medication history, sources of preadmission medication information	General instructions to use pharmacy info, pill bottles, patient-owned lists, paper and electronic medical record sources	Identified all possible sources of medication information in the VA's electronic medical record, including remote medications (dispensed at other VAs), non-VA medications, recently discontinued or expired
Intervention component: patient-owned medication lists	Examples of paper and electronic forms from non-VA hospitals and commercial vendors	Links to My HealtheVet, a patient portal containing medication lists
Intervention component: discharge documentation and counseling	Encouraged use of tailored templates for discharge medication lists	Inclusion of Iowa City VA's discharge documentation improvement project; forwarding of discharge documentation to other VA providers
Intervention component: HIT	Option to implement or improve software to assist with the medication reconciliation process	Unable to change health information technology functionality within VA's electronic health record, computerized patient record system
Resources	Mostly from non-VA hospitals and commercial vendors	Provided links to: • PBM Medication Reconciliation Initiative's SharePoint • PBM web-based medication reconciliation training module • Videos developed by the Portland VA Office of Applied Clinical & Implementation Sciences • VA Enhanced Discharge Planning Taskforce

[a]EMR = electronic medical record, HIMS = health information management service, HIT = health information technology, MARQUIS = Multi-Center Medication Reconciliation Quality Improvement Study, PBM = Pharmacy Benefits Management, QI = quality improvement, REDCap = Research Electronic Data Capture, R-VA-MARQUIS = Rural VA Multi-Center Medication Reconciliation Quality Improvement Study, VA = Veterans Affairs.

Data collection and outcome measures. Study pharmacists randomly selected patients admitted to the general medicine service at their site during the prior 24 hours using a random number table. The primary outcome measure was total unintentional medication discrepancies per medication per patient. We used this measure to normalize the discrepancy results for the number of medications a patient was taking and to allow for comparison across patients taking different numbers of medications. Independent of the intervention at each site, a study pharmacist interviewed the patient or caregiver to obtain a "gold standard" medication history using the systematic method termed best possible medication history (BPMH), which involves collecting medication information from two reliable sources.[8,11] Study pharmacists then compared the gold standard medication history with the medical team's documented preadmission medication list, admission orders, and discharge orders to determine if a discrepancy was present. Discrepancies were classified as unintentional if an explanation was not documented or justified based on the clinical scenario; study pharmacists reviewed documentation and spoke to the clinical team, if needed, to make this determination. To ensure that unintentional medication discrepancies were identified and categorized consistently, the mentors provided baseline training, held monthly calls with each site's study pharmacist, and observed study pharmacists' data collection at site visits.

Each medication could be discrepant at admission and discharge.

Furthermore, each unintentional discrepancy could be due to a history error in the preadmission medication list or reconciliation error (e.g., forgetting to restart a medication at discharge that was intentionally held at admission). Unintentional medication discrepancies based on timing (admission, discharge) and type (history, reconciliation) were secondary outcomes. Study pharmacists at each site were trained by the coordinating center in how to take a BPMH and to identify medication discrepancies.

Each site collected unintentional medication discrepancy data for different patient groups, depending on local resources. Site 1 only collected data for a control group. Site 2 collected data on two groups—control (preintervention and concurrent) and intervention groups. Site 3 collected data on only preintervention and postintervention patients because their interventions were deployed hospital-wide, preventing data collection for a concurrent control group.

Patient demographics, total number of medications, hospital length of stay, and history of admission in the prior year were abstracted from the electronic medical record and recorded in VA Research Electronic Data Capture.[24]

Program evaluation. We used the following sources to inform our program evaluation: baseline site assessments, questionnaires completed by local QI teams, observations from yearly site visits, and detailed notes from monthly site phone calls and semistructured interviews of QI teams and executive leaders. We evaluated the detailed interview notes and other sources to identify facilitators and barriers to intervention effectiveness and implementation at each site related to personnel, processes, and institutional factors. We also looked to these sources to elicit themes related to caring for rural veterans.

Analysis. Descriptive statistics were used to summarize patient characteristics. Unintentional medication discrepancies per medication per patient (total, types) were compared between control and intervention groups for each site using Wilcoxon rank sum test. We performed Poisson regression of unintentional medication discrepancies per patient by patient type (control or intervention) with total number of medications as the offset and adjusted for age and prior admission, both of which have been associated with medication discrepancies.[5] We modeled data from sites 2 and 3 separately to study the effect of each site's interventions. To determine the collective effect of the study, we modeled combined data for sites 2 and 3. Additionally, average number of unintentional medication discrepancies per medication per patient for each site over time were plotted on Xbar charts, statistical process control charts. Statistical process control charts were plotted using Microsoft Excel version 15.0 (Microsoft Corporation, Redmond, WA) with the QI Macros add-in (KnowWare International, Inc., Denver, CO). Statistical analyses were completed using Stata Statistical Software (Release 14, StataCorp LP, College Station, TX).

This study was determined to be human subject research exempt by the institutional review board at the coordinating center.

Results

Pre-implementation. Site 1 is a 102-bed facility located in the Southeast United States with an academic affiliation. The site leader was a clinical pharmacist; the team had no formal QI training. At baseline, physicians were responsible for admission medication reconciliation with intermittent pharmacy assistance, and a dedicated nurse was involved in discharge medication reconciliation.

Site 2 is a 70-bed facility located in the Midwest with an academic affiliation. Site leaders were a clinical pharmacist and physician; the team had prior QI training. At baseline, nurses documented admission patient medication histories with varying completeness. A standardized pharmacist-driven discharge-medication reconciliation and counseling process was in place at baseline.

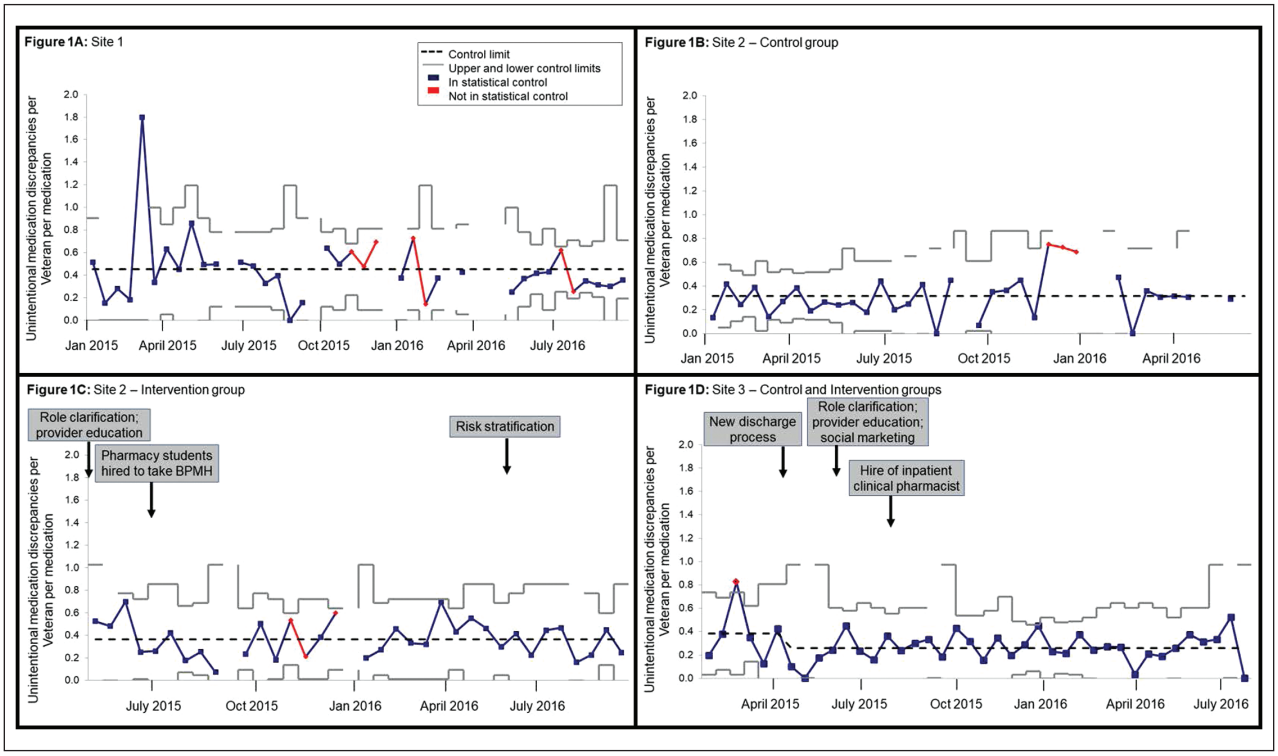
Site 3 is a 21-bed facility in the Southwest with 6 hospitalists who staff an inpatient service. The site leader was a patient safety manager; the team had no prior QI training and no inpatient clinical pharmacist. At baseline, a standardized discharge process did not exist. However, existing daily interdisciplinary care coordination huddles were a strength.

All sites had 3 common deficits in their baseline inpatient medication reconciliation practices: (1) role clarity for clinicians was lacking (e.g., physicians, nurses, and pharmacists), (2) sites did not consistently collect a BPMH, and (3) risk stratification to identify patients at high-risk for medication discrepancies was not used routinely.

Implementation:Interventions. Sites 2 and 3 successfully implemented multiple toolkit interventions (eAppendix A). Both sites clarified roles and responsibilities of clinicians regarding medication reconciliation and trained personnel on how to take a BPMH. Site 2 hired pharmacy students (MARQUIS techs) to take admission BPMHs from patients and trained providers to use the teach-back technique for patient education at discharge. Pharmacy students were trained in how to obtain BPMH by inpatient clinical pharmacists and were provided pocket cards for reference when obtaining BPMH. Staff pharmacists precepted the students, providing supervision and cosigning their documentation. Site 2 also created a risk stratification tool to identify patients at high risk of medication-related problems to more efficiently deploy pharmacy resources (Figure 1C). Site 3 trained a newly hired pharmacist to perform high-quality discharge-medication reconciliation, including the use of teach-back, and implemented discharge documentation based on improvements tested at the Iowa City VA (Table 1). Site 3 also developed social marketing tools to encourage patients to keep updated medication lists (Figure 1D). Site 1 did not implement any toolkit interventions.

Patient characteristics. In total, 797 patients were included (Table 2). The majority (94.4%) were male; mean ± S.D. age was 68.7 ±

Figure 1. Average total unintentional medication discrepancies per medication per patient by site, patient type, and period of study. The Xbar charts include a time series graph and central control limit (process mean) with upper and lower control limits (3 standard deviations [99% confidence interval] from process mean for each time period). Each data point represents the weighted average total unintentional medication discrepancies per medication per patient over a 2-week period. Using these charts, the average performance of the process—unintentional medication discrepancies per medication per patient—and the variation about the average level can be evaluated.



12.3 years. Median length of stay was 3 days (interquartile range [IQR], 2–5 days). Veterans took a mean ± S.D. of 9.6 ± 5.5 medications. Overall, 45.5% of patients had ≥1 admission in the previous year. Control and intervention patients were similar within each site, except at site 3 where control patients used more medications compared with intervention patients (mean ± S.D., 10.6 ± 5.3 versus 7.0 ± 4.3; $p < 0.001$).

Postimplementation: Unintentional medication discrepancies. At site 1, where no interventions were implemented, unintentional medication discrepancies remained stable over time (Figure 1A).

At site 2, median total unintentional medication discrepancies per medication per patient were significantly higher in the intervention group (0.33; IQR, 0.16–0.50), compared with the control (0.23; IQR, 0.11–0.47; $p = 0.031$) (Table 3). In adjusted analysis, we found a 22% increase in unintentional medication discrepancies per medication per patient in intervention compared with control patients (adjusted incidence rate ratio [IRR], 1.22; 95% confidence interval [CI], 1.08–1.36). Because the intervention group had higher discrepancies, an Xbar chart was used to determine if there were trends in unintentional medication discrepancies within this group over time; none were demonstrated (Figure 1C).

At site 3, median total unintentional medication discrepancies per medication per patient were significantly reduced in the intervention group (0.20; IQR, 0–0.40) compared with the control group (0.31; IQR, 0.15–0.67; $p = 0.039$). In adjusted analysis, unintentional medication discrepancies per medication per patient were reduced 45% in intervention compared with control patients (adjusted IRR, 0.55; 95% CI, 0.45–0.67). All types of discrepancies per medication per patient were significantly reduced (eAppendix B). Following intervention implementation, unintentional medication discrepancies remained within statistical control; this improvement was sustained and variation was reduced for the remainder of the study (Figure 1D).

When data from sites 2 and 3 were combined, we found no difference in unintentional medication discrepancies per medication per patient in preintervention (control) (median, 0.25; IQR, 0.10–0.47) compared with postintervention patients (median, 0.25; IQR, 0.08–0.44), with an adjusted IRR of 1.04 (95% CI, 0.92–1.17). We present additional data on the timing and type of unintentional medication

Table 2. Patient Characteristics at 3 Sites by Patient Type (Control or Intervention)[a]

Characteristics	Total *n* = 797	Site 1 Control *n* = 227	Site 2 Control *n* = 154	Site 2 Intervention *n* = 161	Site 3 Control *n* = 26	Site 3 Intervention *n* = 229
Male, %	94.4	96.8	91	98	96	92.1
Age (yr), mean ± S.D.	68.7 ± 12.3	69.0 ± 13.8	65.9 ± 12.6	68.4 ± 11.9	71.8 ± 9.2	70.2 ± 11.3
Length of stay (days), median (IQR)	3 (2–5)	3 (2–6)	2 (1–4)	2 (1–4)	3.5 (2–5)	3 (2–5)
Hospitalized in the prior year, %	45.5	26.0	58	49	69	45.8
Number of medications, mean ± S.D.[b]	9.6 ± 5.5	9.6 ± 5.0	11.1 ± 5.5	11.9 ± 6.1	10.6 ± 5.3	7.0 ± 4.3

[a]IQR = interquartile ranges. Site 1 = control group only; site 2 = concurrent control and intervention groups; site 3 = control (pre-intervention) and intervention (postintervention) groups
[b]From gold standard medication history collected at admission, does not include supplies.

Table 3. Unintentional Medication Discrepancies and Incidence Rate Ratios of Unintentional Medication Discrepancies per Medication per Patient[a]

Study site	Unintentional medication discrepancies per medication per patient, median (IQR)	Unadjusted incidence rate ratio (95% CI)[b]	Adjusted incidence rate ratio (95% CI)[b]
Site 1	0.43 (0.17–0.67)	N/A	N/A
Site 2			
Control	0.23 (0.11–0.47)	Ref	Ref
Intervention	0.33 (0.16–0.50)	1.18 (1.06–1.33)	1.22 (1.08–1.36)[c]
Site 3			
Control	0.31 (0.15–0.67)	Ref	Ref
Intervention	0.20 (0–0.40)	0.60 (0.49–0.73)	0.55 (0.45–0.67)[c]
Sites 2 and 3 combined			
Control, pre-intervention)	0.25 (0.10–0.47)	Ref	Ref
Intervention, postintervention	0.25 (0.08–0.44)	1.00 (0.89–1.13)	1.04 (0.92–1.17)[d]

[a]CI = confidence interval, IQR = interquartile range, N/A = not applicable.
[b]Poisson regression: total unintentional medication discrepancies per patient (dependent variable), patient type—control or intervention (independent variable), total number of medications (offset variable).
[c]Adjusted for age and history of admission within year prior to study hospitalization.
[d]Adjusted for age, history of admission within year prior to study hospitalization, and study site.

discrepancies per medication per patient by site in eAppendix B.

Postimplementation: Program evaluation. We present results from our program evaluation in Table 4, including facilitators and barriers related to personnel, processes, and institutional factors. At sites 2 and 3, senior leadership support and interdisciplinary engagement were integral to the implementation efforts. At site 2, committed pharmacy leadership and a dedicated pharmacist medication reconciliation coordinator also aided their work. The effectiveness of site 3's interventions, specifically pharmacist-driven discharge-medication reconciliation and patient counseling, were bolstered by daily interdisciplinary huddles and audit and feedback to providers.

All sites identified the barriers of time constraints of clinicians and competing mandates at the institutional level. At site 1, the lack of senior

Table 4. Facilitators and Barriers to Implementation and Intervention Effectiveness of R-VA-MARQUIS Toolkit Interventions[a]

	Site 1	Site 2	Site 3
Personnel	**Facilitators** Institutional knowledge from prior QI work An ED pharmacist program exists, could provide opportunities for improvement in medication reconciliation in this setting	**Facilitators** Institutional knowledge from prior QI work Committed project champions, including pharmacist and hospitalist Interdisciplinary QI team Physician champion affiliated with academic institution that staffed intervention unit	**Facilitators** Committed project champions, including pharmacist and patient safety manager Buy-in from frontline staff Interdisciplinary QI team with strong working relationships Small size of facility and number of providers promoted engagement Clinical pharmacist was hired with focus on discharge medication reconciliation
	Barriers Lack of physician champion Lack of involvement by nursing, hospitalists, and health information technology on the QI team High staff turnover Competing clinical demands and time constraints precluded implementation by inpatient clinicians or clinical pharmacists	**Barriers** Medication reconciliation coordinator worked in isolation prior to this study without integration into education and workflow processes Limited coverage of MARQUIS techs (4 hr/weekday) Pharmacy tech program did not create new roles with formalized responsibilities Frequent rotation of housestaff on- and off-service at their site	**Barriers** Newly hired providers at start of study No inpatient clinical pharmacist at start of study Expanded scope of newly hired inpatient pharmacist challenged the capacity to provide clinical contribution to every discharge
Processes	No facilitators identified, no toolkit intervention implemented	**Facilitators** QI team monitored process of information transfer from MARQUIS techs to physicians Existing training sessions were used to teach residents how to take a BPMH Local team accessed data on performance of risk stratification tool to refine process	**Facilitators** Weekday interdisciplinary huddles to discuss admissions and discharges No existing standardized process for discharge medication reconciliation at the facility Standardized discharge documentation and process adapted to local site QI team monitored use of interventions (discharge documentation) with audit and feedback to providers Used continuous improvement to refine interventions
	Barriers ED pharmacists were managed by outpatient, not inpatient, pharmacy leadership; MARQUIS team leaders didn't have leverage	**Barriers** Difficulty integrating MARQUIS techs' BPMH into workflow of inpatient clinicians Irregular quality assurance checks and retraining of MARQUIS techs taking BPMH No competency assessment of BPMH skills for housestaff or MARQUIS techs Lack of rigorous audit and feedback oversight of MARQUIS techs	**Barriers** No competency assessment of BPMH for hospitalists Quality checks of hospitalists' BPMH were not performed Intervention required change to providers' individual processes/practices

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Table 4. Facilitators and Barriers to Implementation and Intervention Effectiveness of R-VA-MARQUIS Toolkit Interventions[a]

	Site 1	Site 2	Site 3
Institutional factors	**Facilitators** Institutional motivation to be in compliance with EPRP measures for medication reconciliation	**Facilitators** Senior hospital leadership support Facility was receptive to pharmacy students acting as techs and taking BPMH Funding from R-VA-MARQUIS allowed for hiring part-time pharmacy students (MARQUIS techs) Institutional motivation to be in compliance with EPRP measures for medication reconciliation	**Facilitators** Senior hospital leadership support Medication reconciliation was a high priority, emphasized as a patient safety issue Site achieved culture shift through social marketing and patient education campaign to promote patient-owned medication lists Institutional motivation to be in compliance with EPRP measures for medication reconciliation
	Barriers Medication reconciliation identified as a "middle of the pack" priority Competing mandates existed from other QI initiatives Lack of support from senior hospital leadership Concern of local health information technology personnel that changes to documentation would not be in compliance with EPRP, Joint Commission measures	**Barriers** Medication reconciliation was a lower institutional priority Competing mandates existed from other QI initiatives	**Barriers** Competing mandates may impede ongoing work in medication reconciliation Limited resources to hire new or reallocate existing staff to expand intervention to performing medication review in the ED

[a]BPMH = best possible medication history, ED = emergency department, EPRP = External Peer Review Program, MARQUIS = Multi-Center Medication Reconciliation Quality Improvement Study, QI = quality improvement, R-VA-MARQUIS = Rural VA MARQUIS, VA = Veterans Affairs.

leadership support and a physician champion were the primary barriers to implementing an intervention. At site 2, they had trouble integrating the pharmacy technicians' BPMHs into the clinicians' workflow prior to ordering medications, sporadically checked the quality of pharmacy technicians' BPMHs, and had limited coverage. Although site 3 successfully reduced unintentional medication discrepancies, their newly hired inpatient clinical pharmacist contended with increasing clinical demands during implementation.

Medication reconciliation issues specific to rural veterans. All sites identified specific issues related to medication reconciliation for rural veterans. Rural veterans often see providers and obtain medications outside the VA system, presumably because the closest VA facility may be far from their home and/or they maintain a primary care provider in their community. This observation is timely and relevant, as the Veterans CHOICE Act to expand community access for veterans became law 6 months prior to our project's start.[25] As a result, obtaining medication information from outside sources is critical to creating a BPMH for these patients. An additional rural-specific issue was extensive postdischarge travel arrangements requiring precise timing of discharge counseling.

Discussion

In this feasibility study, our first step was adapting the previously studied MARQUIS toolkit and implementation manual to the VA setting. Using a mentored implementation framework, 2 of 3 sites implemented evidence-based interventions from the toolkit, and 1 site improved unintentional medication discrepancies per medication per veteran. R-VA-MARQUIS results indicate that an evidence-based toolkit of best practices in medication reconciliation can be deployed in smaller, resource-limited hospitals. However, additional study is needed about the effectiveness of the toolkit in a wider sample of hospitals.

Our study had results comparable to those of the original MARQUIS, the largest mentored-implementation study of best practices for medication reconciliation. In MARQUIS, 4 of 5 sites implemented toolkit interventions; 3 sites reduced potentially harmful unintentional medication discrepancies.[19] Although our primary outcome was unintentional medication discrepancies, these are known to correlate with potentially harmful discrepancies.[26]

Prior studies have shown that pharmacy-driven medication reconciliation processes and patient counseling at discharge can reduce unintentional medication discrepancies and preventable ADEs.[27-29] Site 3's reduction in unintentional medication discrepancies after hiring an inpatient clinical pharmacist and implementing a pharmacy-driven discharge-medication reconciliation and counseling process reinforces the importance of this type of intervention. Site 2's results differed from those in a prior study in which unintentional medication discrepancies were reduced after implementing pharmacy technicians to obtain admission medication histories.[30] The other study's pharmacy technicians were closely supervised by pharmacists, which was inconsistently done at our site 2 and may have contributed to our results. Additionally, the pharmacy technicians' BPMH were not consistently integrated into the clinicians' workflow to inform admission or discharge medication orders, which was a barrier to intervention effectiveness.

The factors contributing to successful implementation—institutional and senior leadership support, alignment with institutional priorities, physician engagement, teamwork, interdisciplinary coordination, and emphasis on patient safety—are similar to previously reported facilitators.[31] The common barriers to implementation are echoed in a prior mentored-implementation study, including time constraints of staff and perceived lower priority of the project institutionally. If the toolkit is adopted by hospitals with large rural populations, future iterations must address the specific issues in caring for rural patients including the need for greater coordination at discharge to accommodate travel and to gather medication information from outside sources.

The divergent findings of increased medication discrepancies at one site for intervention patients could be explained in several ways. First, even evidence-based interventions may have unintended consequences when implemented in different settings, especially complex ones like medication reconciliation. Second, site 2, which had increased discrepancies after intervention, had a lower baseline rate of medication discrepancies per medication per patient and, thus, were at greater risk for regression to the mean. That is, site 2's process may have been better at the beginning of the intervention, which made it more difficult to improve. This finding underscores a limitation of single-site studies in which baseline rates of medication discrepancies may be high, making it easier to show improvement.

Strengths. R-VA-MARQUIS used evidence-based interventions and mentored implementation, an effective QI approach.[16,22] We targeted smaller hospitals, which are infrequently included in multisite studies. Additionally, the mentors understood VA-specific structures and challenges. Unlike MARQUIS, we had a pharmacist mentor, who provided important perspective and experience to sites. Our study included a relatively large patient sample and collected approximately 18 months of data.

Our study does have limitations. We have limited baseline data, which precluded an interrupted time-series analysis. Sites 2 and 3 had distinct types of control and intervention groups, limiting our ability to pool data. Because of limited resources, we were not able to provide real-time feedback on discrepancies rates to sites. Additionally, we were unable to collect information on other variables that may be related to medication reconciliation, including source of the patients' medications (VA or non-VA pharmacy), or type of service or provider. Study pharmacists who collected the gold standard medication history were not blinded to patient type (control versus intervention); however, this embodies real-world implementation. We did not assess distal health outcome such as ADEs, although unintentional medication discrepancies are more numerous and easier to assess. Finally, sites volunteered to participate in the study, which may introduce selection bias and limit generalizability of our findings, although participating sites varied in size, location, and academic affiliation.

Conclusion

R-VA-MARQUIS demonstrates that an evidence-based toolkit of best practices for medication reconciliation can be deployed in smaller, resource-limited facilities, including those serving rural patients who have limited access to clinical pharmacy services.[10] Institutional and senior leadership support are critical to successful implementation. Competency assessments for BPMH education and monitoring of intervention fidelity are integral to intervention effectiveness in medication reconciliation improvement work. Reconciling medications at discharge, with allocation of resources to high-risk patients, may also be important for success. These results highlight the need for additional study within the VA and smaller hospitals serving rural populations. Results and experience gleaned from R-VA-MARQUIS have informed the VA's national medication reconciliation policy and tools, including a VA-wide effort to standardize and improve medication reconciliation.

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Additional information

The content is solely the responsibility of the authors and does not necessarily represent the official views of the VHA Office of Rural Health. The VHA Office of Rural Health was not involved in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. The contents do not represent the views of the U.S. Department of Veterans Affairs or the U.S. government. All authors had full access to the data.

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