

Grant Final Report

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**Medication Safety in Primary Care Practice
Translating Research into Practice (MS-TRIP)**

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Abstract

Purpose: Develop medication safety measures for primary care practice and assess the impact of a validated quality improvement (QI) intervention on performance on these measures among practices in an electronic health record (EHR)-based, practice-based research network.

Scope: Medication errors in primary care practice cause morbidity, but work is needed to specify relevant measures and conduct interventions designed to reduce these errors.

Methods: We conducted a 6-month consensus development process to select a set of medication safety measures, followed by a 2-year multi-method QI intervention in 20 independent practices designed to improve practice performance on these measures. The QI intervention included EHR-generated audit and feedback; annual practice-site visits for performance review, academic detailing, EHR clinical decision support training, and QI assistance; and annual project network meetings for sharing of “best practice” approaches.

Results: The consensus development process produced medication safety measures in five categories: avoiding potentially inappropriate therapy, avoiding potentially inappropriate dosages, avoiding potential drug-drug interactions, avoiding potential drug-disease interactions, and monitoring or prevention of adverse drug events. Strategies adopted to improve medication safety included developing procedures to ensure the accuracy of patient medication lists, increasing use of EHR decision support, adopting medication refill protocols, and using performance reports to identify patients with potential prescribing errors. During the intervention, practice performance improved significantly ($P < 0.05$ for the trend) on avoidance of potentially inappropriate therapy, drug-disease interactions, and appropriate monitoring. Practice-level avoidance of potential drug-drug interactions and potentially inappropriate dosages were high at baseline and did not change significantly over time.

Key Words: medication safety, quality improvement, electronic health records, performance measurement

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Final Report

Purpose

The objectives of this study, conducted among 20 primary care practices in the Practice Partner Research Network (PPRNet), were to:

1. Develop a set of medication safety measures relevant for primary care.
2. Incorporate these measures in practice performance reports sent quarterly to participating practices.
3. Assess the impact of a validated quality improvement model on participating practice performance on these measures over a 24-month period.

Scope

Medication errors in primary care practice are an important cause of morbidity, but the extent of these errors is largely unknown, and effective interventions for reducing these errors need to be developed and tested. The Practice Partner Research Network (PPRNet) is a practice-based research network among primary healthcare providers practicing across the United States who use a common Certification Commission for Health Information Technology (CCHIT)-certified EHR (McKesson Practice Partner® (PP), Seattle, Washington) and pool data for quality improvement and research projects. PPRNet has developed a quality improvement model for successfully translating research into primary care practice, termed PPRNet-TRIP. PPRNet-TRIP incorporates prioritization of evidence-based quality philosophies involving all staff (teamwork), delivery system redesign, patient activation, and EHR tools for individualized and population-based medicine. PPRNet-TRIP is implemented in practice settings through a combination of practice performance reports, practice-site visits, network meetings, and web-based tools. This study, “Medication Safety in Primary Care Practice Translating Research into Practice (MS-TRIP),” was designed to assess the impact of PPRNet-TRIP on safe medication prescribing and monitoring.

Methods

The study design combined a 6-month consensus development process to select a set of medication safety measures followed by a 2-year multi-method QI intervention, with repeated time series observations.

The medication safety measure consensus development process, using published methods, occurred in five phases: pre-selection, adding and rating, potential measure review, reflection, and combination of similar measures. PPRNet members and participating clinicians served as the expert panel in this process. First, 90 potential medication prescribing and monitoring measures were identified, drawn from published medication-related quality measures and the functionality embedded in the decision support features of PP. Next, a session was conducted at the 2007 PPRNet network meeting in which 12 primary care physicians provided iterative feedback to the research team on the content of the measure set and a recommended number of measures for inclusion in practice reports. Based on an available taxonomy, measures were grouped into five categories: potentially inappropriate treatment, inappropriate dosing, drug-drug interactions, drug-disease interactions, and monitoring or prevention of adverse drug events (ADEs). Third, the lead clinician from each participating practice then completed a survey to prioritize proposed measures. Fourth, measures with greater numbers of votes were reviewed by the research team for primary care relevance and feasibility of calculation from available EHR data. Finally, groups of similar measures were combined.

The 2-year QI intervention was conducted in 20 volunteer practices from 14 U.S. states and began on July 1, 2008. It incorporated quarterly audit and feedback on the MS-TRIP measures; annual practice site visits, consisting of performance review, academic detailing, EHR clinical decision support training, and QI assistance; and annual project network meetings for “best practice” sharing. Each practice identified a clinician and clinical staff liaison to serve as local “champions” for the project and as representatives for annual project network meetings. The majority of participating practices were family practices (n = 17; n = 3 internal medicine) and had four or fewer prescribing clinicians (n = 18; n = 2 with more than nine).

Audit and feedback reports, prepared after quarterly EHR data extracts, presented three types of feedback. Summary reports, using statistical process control techniques, displayed practice performance over time and the median and benchmark performance for the five medication safety categories: avoiding potentially inappropriate therapy, avoiding potentially inappropriate dosages, avoiding potential drug-drug interactions, avoiding potential drug-disease interactions, and monitoring or prevention of adverse drug events. The reports also included practice performance on the individual measures and a registry of de-identified patients not meeting medication safety criteria. Practices were able to re-identify patients using a tool within PP.

One member of the research team (A.W.) with expertise in safe medication use, QI implementation, and the PP EHR facilitated two annual site visits for each practice. All clinical staff attended these half-day visits. Initial site visits included academic detailing and interactive discussions on the problem of medication safety in primary care, review of the MS-TRIP measures and initial performance preview, dissemination of medication safety-focused QI strategies, and participatory planning. The QI strategies incorporated lessons from prior studies and optimal use of EHR decision support. Medication safety decision support tools embedded in the PP EHR include allergy, overdose by age, and drug-drug and drug-interaction alerts during the prescription-writing process. A dose calculator may be invoked within the prescription writer and uses available patient data (gender, age, weight, and most recent serum creatinine available in the EHR) to recommend renal adjustments. Medication monitoring protocols may be adjusted at the practice level and applied to patients’ health maintenance tables along with other reminders for preventive care and disease management.

The preliminary evaluation of practice improvement plans resulted in a refined set of QI strategies, which were presented at the network meeting and follow-up site visits; were customized according to individual practice needs; and included review of practice performance to date, local adaptation of QI strategies, academic detailing on specific measures, and advanced training on the medication safety EHR decision support tools.

Practice liaisons participated in two project network meetings in September 2008 and 2009. The purpose of the first meeting was to introduce the final MS-TRIP measure set, review initial audit and feedback reports, and present medication safety-focused QI strategies. Small-group discussions among clinician and clinical staff liaisons were held to facilitate implementation of medication safety strategies in daily practice and share approaches to team involvement and training. The second meeting largely involved sharing of “best practice” approaches to improve medication safety, small-group discussions on the roles of the project liaisons in overcoming barriers to implementation of the MS-TRIP QI approaches, and setting additional goals for the final year.

Results

Medication safety measure development

The medication safety measure set resulting from the consensus development process includes five categories and 30 specific measures as follows:

Avoiding Potentially Inappropriate Therapy

- Avoidance of antibiotics in upper respiratory infection.
- Avoidance of inappropriate medications in the elderly.
- Avoidance of rarely appropriate medications in the elderly.

Avoiding Potentially Inappropriate Dosages

- Avoidance of allopurinol in renal dysfunction.
- Avoidance of high doses of short-acting benzodiazepines in the elderly.
- Avoidance of digoxin doses above 0.125 mg per day in the elderly with CHF.
- Avoidance of H2 blockers in renal dysfunction.

Avoiding Potential Drug-Drug Interactions

- Avoidance of macrolide antibiotics (excluding azithromycin) and digoxin.
- Avoidance of tetracycline and digoxin.
- Avoidance of itraconazole and statin.

- Avoidance of lithium and thiazide.
- Avoidance of methotrexate and trimethoprim.
- Avoidance of (ACE inhibitor or angiotensin receptor blocker) with potassium-sparing diuretic in the elderly or patients with CrCl < 50 mL/min.
- Avoidance of sulfonylurea and sulfamethoxazole in the elderly.

Avoiding Potential Drug-Disease Interaction

- Avoidance of anticholinergics in dementia.
- Avoidance of bupropion in epilepsy.
- Avoidance of metformin in renal impairment.
- Avoidance of metoclopramide in Parkinson's disease.
- Avoidance of NSAID or COX2 inhibitor in congestive heart failure, CrCl < 20 mL/min, hypertension, or peptic ulcer disease.
- Avoidance of thiazolidinediones in congestive heart failure.

Monitoring/Preventing Potential Adverse Drug Events

- Annual serum creatinine monitoring for ACE inhibitor, angiotensin receptor blocker, digoxin, diuretics, metformin, NSAID, COX2 inhibitor.
- Serum creatinine in the past 6 months for (ACE inhibitor or angiotensin receptor blocker) with potassium-sparing diuretic in the elderly or patients with CrCl < 50 mL/min.
- Annual potassium monitoring for ACE inhibitor, angiotensin receptor blocker, digoxin, diuretics.
- Potassium in the past 6 months for (ACE inhibitor or angiotensin receptor blocker) with potassium-sparing diuretic in the elderly or patients with CrCl < 50 mL/min.
- Most recent potassium > 3.5 mEq/L for thiazide diuretics.
- Annual hemoglobin and platelet count for antiplatelets (excluding aspirin) or oral anticoagulant.
- Annual glucose and weight for antipsychotics.
- INR in the past 30 days for warfarin.

- Most recent INR < 5 for warfarin.
- Folic acid use in patients on methotrexate.

Quality improvement strategies

The refined set of medication safety quality improvement strategies developed during the project focused on four general objectives with specific strategies for each as follows:

Ensure the Accuracy of Patient Medication Lists

- Implement a process for patient review of EHR medication list.
- Inquire and evaluate use of nonprescription therapy and medications from outside providers.
- Distribute printed medication list at the end of each visit.

Integrate Medication Safety EHR Decision Support Features into Routine Practice

- Review alerts and adjust prescribing as necessary.
- Calculate doses based on renal function.
- Apply medication monitoring protocols.

Implement a Practice Medication Refill Protocol

- Limit refills for patients overdue for follow-up.
- Empower staff to review EHR monitoring prompts and implement standing orders.

Utilize Medication Safety Practice Performance Reports

- Design and execute case management for patients who meet criteria for potential errors (i.e., notify providers, flag error on patient’s medication list, contact patients with adjustments or monitoring instructions).

Primary results of the Intervention

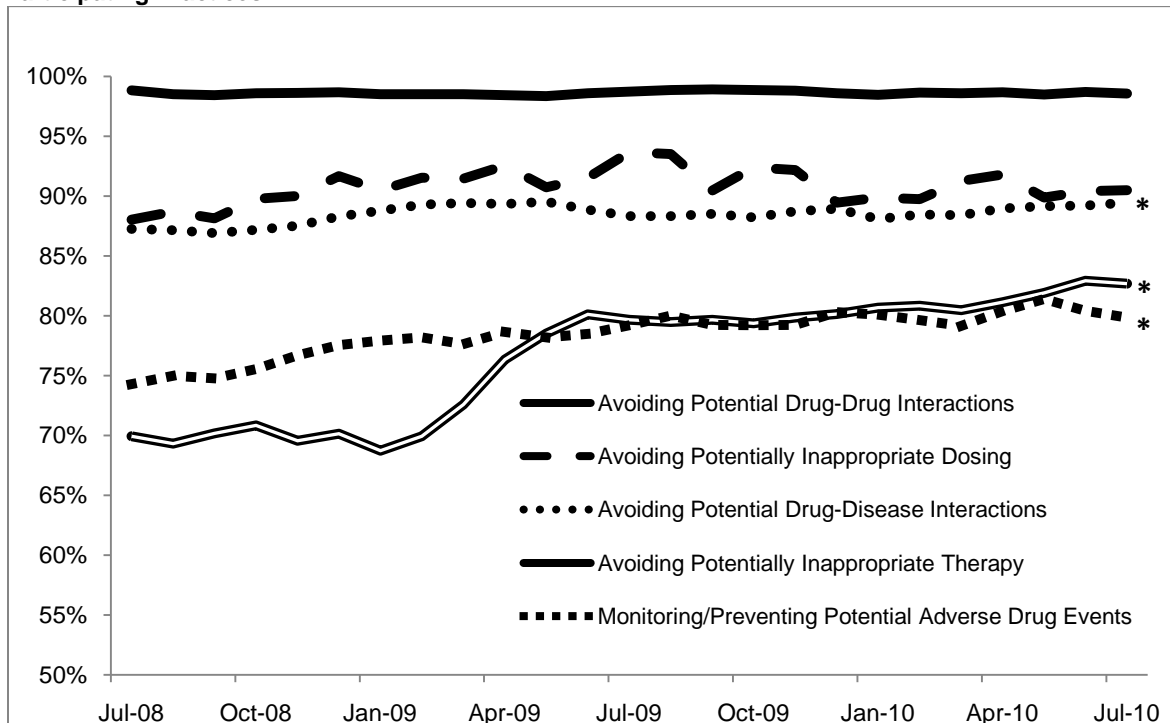
During the 2-year intervention, 49,047 patients over the age of 18 years were eligible for at least one of the medication safety measures. The mean age of eligible patients was 53.6 years (SD = 17.2, range = 18 to 109.5 years); 26.1% were 65 years or older. Fifty-seven percent were women, and, among the 41.6% of participants who had race recorded, 87.8% were White, 10.0% were Black, 1.1% were Asian, 0.3% were American Indian or Alaska Native, and 0.8% were ‘Other.’

The 2-year trends in practice performance across the medication safety categories are presented in the Figure below. Performances for three measure categories improved significantly

($P < 0.05$ for the trend): the avoidance of potentially inappropriate therapy, drug-disease interactions, and appropriate monitoring. Baseline practice-level avoidance of potential drug-drug interactions and potentially inappropriate dosages were high at baseline, 98% and 88%, respectively, and did not change significantly over time.

There were statistical significant improvements in several specific measures, including avoidance of concurrent use of lithium and thiazide; avoidance of NSAID or COX2 inhibitor in patients with hypertension; serum creatinine and potassium monitoring for patients on ACE inhibitors, angiotensin receptor blockers, or diuretics; platelet monitoring in patients on anticoagulants; and glucose monitoring for those on antipsychotics. Trends toward improvement were evident for a number of measures; however, avoidance rates close to 100% at baseline and across the study time frame, small numbers of eligible patients, and greater variability in performance across practices may have contributed to a lack of significant change for the remaining measures.

Figure 1. Median Practice Performance on Medication Safety Measure Categories Over Time for 20 Participating Practices



* Indicates $P < .05$

Discussion

We were able to successfully achieve the three objectives of our project: develop a robust set of medication safety measures relevant for primary care, incorporate these measures in quarterly practice performance reports, and conduct an intervention to assess that demonstrated that our QI model improved practice performance on several categories of preventable prescribing and monitoring errors. Through dissemination of quarterly audit and feedback reports, annual

practice site visits for QI planning, and network meetings for best practice sharing, practices selected and implemented a variety of improvement strategies. Broad efforts, such as enhanced medication reconciliation, formalized refill protocols, and implementation of standing orders for laboratory monitoring, necessitated the involvement of the entire team in local practice redesign. More specific strategies were prioritized in response to report results and involved greater use of EHR monitoring, interaction, and dosing tools at the point of care as well as patient activation and outreach activities.

This is the first project of its kind in independent practices, which still constitute the majority of primary care settings in the United States. Though the study is limited by the non-representativeness of its participants (all were EHR users, volunteers, and part of a practice-based research network), our inability to completely ascertain the accuracy of participant medication lists, and the lack of a concurrent control group, our findings have important implications for medication safety. The measure set we developed encompasses both medications and aspects of the prescribing process commonly associated with harm and could be used more widely. Our QI interventions incorporating audit and feedback, and the practice implementation and adaptation of safety strategies, are relevant to the growing number of U.S. practices that will adopt EHRs in this era of physician incentives for meaningful use of EHRs. Endeavors to disseminate our findings more broadly are needed; we have begun this process with a follow-up AHRQ-funded study, “Dissemination of the PPRNet Model for Improving Medication Safety,” 1R18HS019593.

List of Publications and Products

Nemeth LS, Wessell AM: Improving Medication Safety in Primary Care Using Electronic Health Records. *Journal of Patient Safety* 2010, 6(4): 238-243.

Wessell AM, Litvin C, Jenkins RG, Nietert PJ, Nemeth LS, Ornstein SM. Medication Prescribing and Monitoring Errors in Primary Care: A Report From the Practice Partner Research Network. *Qual Saf Health Care* 2010, 19:1-5.

(A manuscript summarizing the primary findings of the study was submitted recently to *Quality and Safety in Health Care*.)