Imbedding Research in Practice to Improve Medication Safety

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Abstract

Objective: The objective of this project was to improve medication safety at Kaiser Permanente Colorado (KPCO). **Methods:** Six projects that included over 400,000 members were conducted at medical offices and pharmacies. They focused on drug-drug interactions, warfarin-drug interactions, dosing in patients with impaired kidney function, prescribing among elderly patients, prescribing during pregnancy, and laboratory monitoring of therapy. Physicians and pharmacists collaborated to determine study medications, develop intervention guidelines, and implement interventions. Pharmacists were alerted to potential errors through a computerized tool that prevented prescription dispensing until after intervention. Multiple techniques were used in change management. **Results:** All interventions reduced errors (range, 13 to 45 percent), with more than 4,000 errors avoided during the research phases. Five interventions were maintained/modified into routine care at KPCO; some were implemented elsewhere. **Conclusion:** This program supports goals common to many health systems. It was developed through communication, staff support, and stakeholder involvement and successfully decreased medication errors through interventions implemented at medication dispensing.

Introduction

Patient safety initiatives are intended to reduce the occurrence of harm and the risk of harm from medical errors. One area for reducing errors is medication use, an Institute of Medicine (IOM) priority area for transforming health care.[1, 2] For several years, a collaborative team at Kaiser Permanente Colorado (KPCO) has worked to decrease medication errors and improve patient outcomes. Beginning in 2000, investigators from the KPCO Clinical Research Unit (now KPCO Institute for Health Research) conducted a series of epidemiologic needs assessment studies of medication errors in ambulatory care. These studies revealed several types of medication errors and prompted development of the KPCO Improving Medication Safety Program.

Using knowledge gained from the epidemiologic studies, we designed, implemented, and evaluated a series of projects for patients who: (1) are prescribed critically interacting drugs (Critical Drug Interactions); (2) receive anticoagulation treatment and are prescribed drugs that interact with warfarin (Warfarin-Drug Interactions); (3) receive high-risk drugs requiring laboratory monitoring (High-Risk Drug Lab Monitoring); (4) have chronic kidney disease and are prescribed drugs requiring dosage adjustment based on renal function (Renal Dosing); (5) are

pregnant and are prescribed drugs that are contraindicated during pregnancy (Prescribing during Pregnancy); or (6) are elderly and are prescribed drugs considered inappropriate in that age group (Prescribing in the Elderly).

The KPCO Improving Medication Safety Program was initiated at the end of 2000 and continues to the present. Our program has a unique focus on the ambulatory care patient setting with interventions that occur at the point of medication dispensing. Initial purposes of the Improving Medication Safety Program included:

- Develop and implement a Pharmacy Alert System (PAS) that uses linked data from pharmacy and clinical information systems to identify and alert pharmacists to potential medication prescribing errors.
- Develop and implement medication safety projects (that use the linked data) at KPCO medical offices and pharmacies.
- Evaluate the impact of each medication safety project on the occurrence of that type of medication error by comparing outcomes between the intervention group and a usual care group. In all projects, the outcome we were specifically trying to achieve was a reduction in medication errors.
- Translate the findings of each successful project into routine clinical practice at KPCO.
- Share the findings from the KPCO Improving Medication Safety Program across other Kaiser Permanente regions and disseminate the findings to other organizations.

The purpose of this article is to share what we did and what we learned from this series of projects (i.e., the Program). We briefly describe the methods and results of each of the six separate medication safety projects. The primary goal of this paper is to reflect on and share our experiences while conducting these studies. We describe how we aligned with organizational priorities and obtained sponsors and collaborators, managed change, and focused the projects to be transferable and sustainable. We also discuss what still needs to be done.

Methods

Population, Setting, and Intervention

KPCO Improving Medication Safety Program (the Program) projects were conducted in all 18 KPCO medical offices and all 21 KPCO pharmacies. They included more than 400,000 KPCO members in the Denver-Boulder area and involved all KPCO physicians, pharmacists, and nurses. KPCO health plan members were included in the initiatives if they had the targeted characteristic(s) that increased the risk of medication error or patient harm (e.g., all patients aged 65 years or older were included in the Prescribing in the Elderly initiative).

All projects promoted the KPCO principle of physician support in two ways: they were designed not to add work to the office visit, and they included redundant safeguards. Pharmacists working in standard clinical settings under usual circumstances delivered the interventions. Five projects were rigorously evaluated for at least 1 year to determine whether individual interventions were

successful. If evaluation showed that an intervention reduced medication errors, the project was continued, modified, or expanded. An interim evaluation was conducted after 4 months for the sixth project (Prescribing during Pregnancy), and the project was terminated early (see below for additional information).

The overall intervention design was similar for all projects. The projects used the KPCO-developed PAS to intercept potential medication errors after a prescription had been ordered but before it was dispensed. The PAS combined data from the electronic medical record (EMR) and clinical databases with screening functions of the pharmacy information system in order to alert pharmacists to potential errors in targeted medication prescribing for targeted patient groups. For example, for interventions for patients who had chronic kidney disease, were elderly, or were pregnant, the PAS contained a proprietary disease/medical condition module (proprietary to Medi-Span; licensed through McKesson, San Francisco, CA; at the time of some of the projects, NDC Health) within which medical conditions could be linked to specific patients. For these projects, we designed a file format to send medical record numbers for patients meeting the intervention criteria by way of an interface (usually a daily batch interface). The files were processed by linking each patient in the file by medical record number to the condition (e.g., age 65 or older, decreased creatinine clearance, pregnancy).

Each prescription was screened for potential errors using guideline-driven decision rules developed using nationally published recommendations and a consensus of KPCO clinicians, researchers, and administrators. Detection of potential errors triggered alerts. The pharmacist could not dispense a prescription carrying an alert without actively intervening. The pharmacist first confirmed an alert's validity and then consulted decision-support guidelines that assisted the pharmacist in resolving potential errors in collaboration with the prescriber (see Appendixes A and B for decision-support guideline excerpts).

Pharmacists used scripted conversations to explain to patients the reasons for the alerts and the rationale for medication changes in a manner that supported the physician-patient relationship. Factors documented to affect care processes and patient outcomes positively were incorporated into the PAS intervention (i.e., use of practice guidelines, opinion leaders, and audit and feedback). Project-specific information is briefly detailed below. The primary outcome measure for each project was the incidence of medication errors, defined as the dispensing or monitoring of the targeted medications that deviated from the agreed upon published clinical guidelines or product labeling recommendations (Table 1).

Critical drug interactions.[3] Pharmacists were alerted to the drug-drug interactions deemed most clinically significant in a manner that prevented these medications from being dispensed without active intervention. This active alert process was in contrast to traditional drug interaction screening that uses an easily bypassed passive alert process. In the Critical Drug Interactions project, the pharmacist recommended a therapeutically similar drug to the prescribing clinician as an alternative to the interacting medications (e.g., ranitidine instead of cimetidine in a patient also prescribed phenytoin).

Warfarin-drug interactions. Pharmacists were alerted to critical warfarin-drug interactions for the nearly 8,000 KPCO members prescribed warfarin. Typically, there is not a good alternative

Table 1. Kaiser Permanente Colorado improving medication safety program

Project	Outcome measure (direction of desired outcome)	Main Results
Critical-drug interactions[3]	Codispensing of interacting drugs (decrease)	• N = 555 instances of codispensing of 8 pairs of interacting drugs. • Patients with codispensings of interacting drugs: o Pre-intervention rate: 21.3 per 10,000 prescriptions. o Post-intervention rate: 14.7 per 10,000 prescriptions (*P* = 0.0125).
High-risk drug lab monitoring[4, 5]	Laboratory evaluation according to guidelines (increase)	<u>At therapy initiation:</u> • N = 9,565 patients received prescriptions to initiate therapy with any of the 15 intervention drugs. • Patient-drug combinations with laboratory evaluation at initiation of therapy: o Usual care group: 70.2%. o Intervention group: 79.1% (*P* <0.001). <u>During ongoing therapy:</u> • N = 9,139 patients received prescriptions for ongoing therapy with any of the 14 intervention drugs. • Patient-drug combinations with laboratory evaluation during ongoing therapy: o Usual care group, 58%. o Intervention group, 64% (*P* <0.001).
Prescribing during pregnancy[6]	Dispensing of contraindicated drugs (decrease)	• N = 11,000 women, randomized to intervention or usual care. • Patients dispensed contraindicated drugs: o Usual care group, 5.5%. o Intervention group, 2.9% (*P* <0.001).
Prescribing in the elderly[7]	Prescribing of drugs to be avoided (decrease)	• N = 59,680 health plan members, aged ≥65 years, randomized to intervention or usual care. • Patients newly dispensed prescriptions for drugs to be avoided in the elderly: o Usual care group, 2.2%. o Intervention group, 1.8% (*P* = 0.002).

Table 1. Kaiser Permanente Colorado improving medication safety program (continued)

Project	Outcome measure (direction of desired outcome)	Main Results
Warfarin-drug interactions[a]	INR monitoring (increase)	• N = 8,283 warfarin-drug interactions. • Patients with followup INR monitoring: o Pre-warfarin drug-interaction alert, 45%. o Post-warfarin drug-interaction alert, 58.2%.
Renal dosing[a]	Drug dosing not adjusted for kidney function (increase in appropriate dosing)	• N = 5,053 prescriptions for drugs requiring dosing adjustment in patients with chronic kidney disease received by patients with renal impairment. • Proportion of prescriptions with correct dosing for drugs for patients with chronic kidney disease that require dosing adjustment in renal impairment: o Usual care group, 60%. o Intervention group 77%.

a Preliminary, not final, results included in poster presentation: Chester EA, et al. Improving medication safety. Kaiser Permanente National Quality Conference. Monterey, CA. June 2005.

therapy, and the recommended intervention was to closely monitor the patient's anticoagulation status and adjust the warfarin dosage if needed.

High-risk drug lab monitoring.[4, 5] Pharmacists were alerted to missing recommended laboratory tests for the more than 10,000 KPCO members per year receiving prescriptions from among a group of high-risk drugs. An example of this intervention was assessing thyroid function in patients prescribed amiodarone.

Renal dosing. Pharmacists were alerted to errors in drug choice or dosing for the 19,000 KPCO patients with chronic kidney disease, a condition in which medication dosages frequently need adjustment based on the patient's level of kidney function. The intervention consisted of recommending an alternative drug or an adjusted dosage of the originally prescribed drug.

Prescribing during pregnancy.[6] Pharmacists were alerted that a patient who was pregnant was prescribed a medication classified in the United States Food and Drug Administration (FDA) pregnancy risk category D (i.e., evidence of fetal risk; therapeutic benefits of the drug can outweigh the risk) or category X (i.e., evidence suggests that the risk to the fetus outweighs the therapeutic benefit). The intervention consisted of recommending an alternate drug that was safer to use during pregnancy or contacting the obstetrics department for assistance in medication selection.

Prescribing in the elderly.[7] When a prescription was received for a medication for a patient aged 65 years or older, pharmacists were alerted if the medication was potentially inappropriate for use in the elderly. The intervention consisted of recommending an alternate drug that was safer to use in the elderly. For example, when a prescription was received for amitriptyline for depression, the pharmacist recommended nortriptyline according to guideline.

The Critical Drug Interactions and Warfarin-Drug Interactions projects employed a before-and-after design, with the intervention provided to all KPCO members. The effectiveness of these two projects was assessed by comparing rates of medication errors before and after the interventions. The High-Risk Drug Lab Monitoring, Renal Dosing, Prescribing during Pregnancy, and Prescribing in the Elderly projects were prospective and randomized in design, with all KPCO members randomized to either intervention or usual care groups. These four projects were analyzed by comparing rates of medication errors between the intervention and usual care groups. The proportion of medication errors was determined by dividing the number of patients who did not receive the recommended dosing adjustment, drug change, or monitoring specific to the project (numerator) by the total number of eligible patients (denominator).

Sponsors, Collaborators and Broad-Based Participation

As Henriksen and colleagues have pointed out, clear vision from organizational leadership is not enough to bring about commitment to change.[8] Consistency across decisions and actions from leadership results in commitment and trust throughout the organization. We sought and obtained sponsors, collaborators, and participation throughout KPCO. We recruited leaders from the Pharmacy Department, the Clinical Research Unit, the Patient Safety team, and the chiefs of physician departments. The leadership and staff of the Pharmacy Department were instrumental in developing both the commitment to the Program and the trust necessary to imbed the Program within the KPCO culture.

The individual projects were collaboratively developed and implemented by the Pharmacy Department and the Clinical Research Unit. The multidisciplinary project teams included strong representation from professional and administrative stakeholders within KPCO and Kaiser Permanente nationally, including health plan and medical group personnel. KPCO departments that contributed included Pharmacy, Information Technology, Clinical Research, Training and Development, Communications, Internal Medicine, Family Medicine, Pediatrics, Emergency Medicine, Obstetrics and Gynecology, Reproductive Endocrinology, Continuing Care, Long-Term Care, Gastroenterology, Neurology, and other medical specialties. Clinician physicians were actively involved in project development.

Kaiser Permanente has a strong commitment to organized labor[9]; pharmacists in KPCO pharmacies are members of the United Food and Commercial Workers Local 7 Labor Unit. From inception to implementation to completion of all projects, labor and management worked together as partners to communicate and solve problems, recognizing that the pharmacists at the point of project implementation possessed the expertise to ensure project success. Overall, 85 percent of the project team was from a labor unit. For example, clinical pharmacists from the Local 7 Labor Unit led the planning, delivery, and modification of the High-Risk Drug Lab Monitoring project.

Outside of KPCO, grant support was received from the Agency for Healthcare Research and Quality (AHRQ) and the Garfield Memorial Foundation. Without this sponsorship, the Program would not have been possible.

Concordance with Organizational Priorities

The Program interconnected with KPCO departmental, medical center, and patient safety program priorities. Patient safety priorities directly related to the Program included:

- Identifying and analyzing near-misses and errors.
- Identifying and analyzing potential risks of harm.
- Examining systems issues that contribute to near-misses or errors.
- Examining alternative patient safety strategies.
- Selecting and implementing strategies.
- Monitoring interventions to document the effectiveness of the program in reducing harm.

The Program also related to national Kaiser Permanente priorities. For example, the Kaiser Permanente Care Management Institute (www.kpcmi.org) monitors high-risk medication use in the elderly across the Kaiser Permanente Medical Care program nationally. The KPCO Program implemented an intervention designed to directly affect dispensing of several medications, the use of which was monitored through the Care Management Institute.

Change Management

With any patient safety project, change management issues should be encouraged to surface and then be effectively addressed. Most issues that surfaced during the Program were related to human factors and the time trade-off necessary to conduct the interventions within busy outpatient pharmacy settings—i.e., the universal production-protection space of the organization.[10] Essentially all change management issues that were encountered related to the perceived value of the Program compared to other initiatives.

These issues were addressed using several tools and techniques. The first group of tools and techniques involved preparing/disseminating background facts, encouraging stakeholder buy-in, and minimizing practical barriers to implementation. Existing data were analyzed to demonstrate medication error problems and to document problem scope. We sought and encouraged interdepartmental collaboration in developing and narrowing the foci of interventions. We paid attention to and addressed the demands of testing interventions in everyday work settings, and we listened and applied input from stakeholders. Our intent was to focus on practical challenges *a priori* to minimize problems, reduce resistance, and promote success. We pilot-tested the alerts to confirm software stability and flexibility. We also focused on smoothly integrating interventions into daily work routines, using systems already present in the work setting.

The second group of tools and techniques used in change management focused on providing education, information, and feedback to assist in building confidence among those providing or receiving interventions. Training programs were developed, as were awareness campaigns and reference documents, to help pharmacists and physicians understand, anticipate, and embrace the Program's dividends. We provided scripts to pharmacists to enhance their confidence with the

information provided during interactions with physicians and patients. We provided intermittent reports to pharmacy leadership to show levels of project performance/success and to identify problems. These reports were to be shared with pharmacists. The scripting used by pharmacists also served to inform patients who received the interventions that we were taking extra steps towards patient safety. For example, the following script was used when telling a patient aged 65 or older that the pharmacist was contacting his or her physician about a medication: "At Kaiser Permanente, we are trying to improve health care above and beyond the standard practice, so we are taking extra steps to ensure the best prescribing possible. I just want to double-check with your physician before I fill the prescription."

The third technique was to foster the development of a cadre of opinion leaders on-site in the pharmacies. This opinion leader group of pharmacists was called the "Intervention Champions." Although there were few external incentives (e.g., a couple of lunches) for the Intervention Champions, they continue to promote the Program and answer questions on a real-time basis in the pharmacies. These opinion leaders are motivated by internal incentives (e.g., a sense of contributing to improving the safety of medication use).

The final set of tools and techniques employed involved seeking feedback and modifying the Program to improve effectiveness. For example, the research team actively sought input and feedback from Intervention Champions about modifications to enhance Program processes. The Intervention Champions in turn gathered informal feedback from participating pharmacists on how the Program was working and what could be improved. The research team also met with Pharmacy Department leadership to discuss Program successes and limitations and to determine continuation of individual projects.

A dramatic example of addressing an emerging issue was provided by the Prescribing during Pregnancy project.[6] Although this project was successful at decreasing the proportion of pregnant women with contraindicated drug dispensings, the project was stopped after 4 months. Two major situations contributed to ending the intervention. First, due to limitations inherent to the pharmacy information system pregnancy software module, pharmacists received alerts for some drugs that were not contraindicated in pregnancy (e.g., inhaled albuterol). Second, information about the end of a pregnancy, especially a miscarriage, was not always promptly available in the clinical database that provided information to the pharmacy information system. This resulted in the pharmacist being alerted incorrectly that a woman was pregnant. Both situations were technically false-positive alerts. The first situation (receiving alerts for nontargeted drugs) resulted in a high false-positive alert rate, whereas the second situation (not receiving up-to-date clinical information) had the potential to—and in a few cases did—result in extremely awkward interactions between pharmacists and patients.

Systems limitations that resulted in false-positive alerts and unacceptable human interaction issues led us to stop the project. The problem of including nontargeted drugs should not occur in systems with more sophisticated software. However, we are uncertain as to whether the false alert problem of not receiving reliable pregnancy status information could be overcome on a systems level.

Results

The projects described here have been completed. Medication errors were reduced in all projects. The main results for each project are summarized in Table 1.[3-5, 7] During the research phases of the projects, more than 4,000 medication errors were avoided. For example, in the High-Risk Drug Lab Monitoring project, for patients with ongoing drug therapy, 1,981 recommended laboratory tests were ordered by pharmacists.[4] Five projects have been maintained as conducted during the research phase (with subsequent expansion to all patients, not just the intervention group), modified, or expanded.

Additional results from this Program included gratitude expressed by patients, enhanced professional satisfaction expressed by pharmacists, and appreciation expressed by physicians. Physicians commented that they appreciated the collaboration and assistance in monitoring laboratory test results for high-risk drugs and the reminders about reducing dosages of targeted drugs in patients with reduced kidney function. Pharmacists stated that they appreciated the opportunity to use their clinical knowledge and that they enjoyed the patient contact these interventions facilitated. Patients spontaneously stated interest and pleasure that we were paying attention to their individual needs (e.g., adjusting drug dosage based on kidney function, providing reminders to obtain recommended laboratory tests). Although an occasional complaint was received (e.g., a physician felt professional autonomy was challenged), the volume of positive feedback outweighed the negative.

Discussion

Measuring medication errors avoided is a surrogate marker for reduced adverse outcomes. It is not possible to directly evaluate numbers of hospitalizations or deaths prevented or patient suffering avoided. However, it is evident from the reduced number of medication errors observed with the Program that these interventions reduced hospitalizations, deaths, and patient suffering because the proper and safe use of medications was enhanced, and preventable medication errors were avoided. For example, numerous publications document patient hospitalizations due to bleeding complications related to the interaction between warfarin and trimethoprim-sulfamethoxazole, an interaction targeted in the Warfarin-Drug Interactions intervention. By avoiding such complications, these interventions enhanced patient safety and avoided patient harm.

Although the Program was not designed as a patient education or physician reminder program, these were benefits. The information provided by pharmacists about potential drug-drug interactions, the need for laboratory monitoring with selected medications, dosing adjustments for selected drugs in patients with kidney disease, etc., resulted in expressions of thanks from several patients. Physicians seemed particularly grateful for reminders that individual patients had reduced kidney function (and that the prescribed drug should have a reduced dosage) and that specific drug-drug combinations had potentially harmful interactions.

Transferability and Sustainability

Not only is the KPCO Program innovative, it also is generalizable and transferable. The projects within the Program are relevant to other health systems, as medication errors are common in outpatient medical office settings. Many health systems have access to the clinical data used in our Program (e.g., age, laboratory results) and have information systems that enable them to make these data available to pharmacists at the point of dispensing. Even in settings where pharmacists do not have routine access to patients' medical records, they often can access the data needed to inform these medication safety interventions. The interventions are practical and can be cost effective because they are delivered by pharmacists working in usual care settings. No increased staffing would be necessary to conduct these projects. Additionally, the structures and processes of these interventions are integrated into the usual work flow of pharmacy staff and of physicians and nurses in medical offices, thus enabling seamless, practical, efficient delivery of the intervention.

Some individuals maintain that medication safety programs should start with an EMR- or computerized prescriber order entry (CPOE)-based intervention that responds directly to prescriber input, rather than providing alerts at medication dispensing. There are important reasons why point-of-dispensing alerts remain vital in the EMR/CPOE environment. First, EMR/CPOE-based prescribing safety alerts are overridden by physicians in 49 to 96 percent of cases.[11] Second, software-based alerts cannot match the professional judgment of a pharmacist in determining the validity of an automated alert. Third, alerts in our Program do not interrupt physician workflow unless first validated by a pharmacist. Alerting the pharmacist frees the physician to focus on other patient needs while providing high reliability to specific medication dispensing processes. Fourth, a program like ours supports physicians in keeping patients safe without placing the sole responsibility for medication safety within the confines of an office visit. This Program of medication safety interventions supports physician practice by removing tasks from the face-to-face office visit and creating redundant safeguards for error-prone tasks that are sometimes overlooked during patients' medical office visits. In the KPCO Program, these error-prone tasks are incorporated into a high-reliability model elsewhere in the delivery system—i.e., at the point of dispensing medication. Thus, we believe that even health care organizations that want to start an EMR- or CPOE-based medication safety program can benefit by incorporating the pharmacy-level alerts we developed into their systems.

The results of this Program are sustainable. Five of six projects have continued through the period of this writing and have sustained reductions in medication errors beyond 1 year. Further evidence of the sustainability of these projects is found in the fact that the projects are not static. For example, newly recognized critical drug interactions were added in 2004, 2005, 2006, and 2007. In 2004 the Laboratory Monitoring intervention was modified to add some drugs (e.g., antidepressant combinations, spironolactone) and to drop others (e.g., metformin, nefazodone).

Although all the medication safety interventions within the Program are relevant to other health care systems, other organizations may not be able to introduce all six medication safety interventions concurrently. Also, the relative importance of the interventions can be debated and would vary depending on the organization's priorities. One approach to prioritizing intervention implementation is the following rank order: (1) Warfarin-Drug Interactions, (2) Critical Drug Interactions, (3) Renal Dosing, (4) Prescribing in the Elderly, (5) High-Risk Drug Lab

Monitoring, and (6) Prescribing during Pregnancy. This suggested prioritization is based on several considerations. For example, health care organizations typically have existing information systems that support implementation of the critical drug and warfarin-drug interaction interventions. Also, prescribers and pharmacists are familiar with reports of associations between drug interactions or lack of renal dosage adjustments and adverse clinical events.

The results of the Lab Monitoring intervention were not as impressive as those observed with the drug interactions and renal dosing interventions.[3-5] Prescribing in the Elderly also has many nuances (e.g., some indications for use are appropriate for certain medications) that make decision rules complex. Finally, the Prescribing During Pregnancy intervention was fraught with numerous barriers.[6]

Dissemination

The results of these projects are either already published in medical or pharmacy journals,[4-7] are being revised for submission to journals,[3] or manuscripts are in preparation. Additionally, the projects' results have been disseminated widely through invited presentations at national conferences (Gaps in Medication Safety Conference in Washington, DC, 2005; Annual Patient Safety and Health Information Technology Conference in Washington, DC, 2005; Kaiser Permanente National Quality Conference in Monterey, CA, 2005; HMO Research Network Conferences in Denver, CO, Dearborn, MI, and Santa Fe, NM, in 2003, 2004, and 2005, respectively; American College of Clinical Pharmacy Spring Practice and Research Forum in Monterey CA, 2006). Furthermore, the Program and its results have been featured by local and national media.[12, 13, 14]

With regard to others implementing the KPCO Improving Medication Safety Program, the KP Northwest region has adopted and put into practice portions of the High-Risk Drug Lab Monitoring, Renal Dosing, and Critical Drug Interactions projects. Furthermore, two other U.S. health care systems have sought consultation from KPCO on adapting and implementing their own versions of the High-Risk Drug Lab Monitoring project.

Looking Toward the Future

The implications of these projects include improved patient safety and clinical outcomes and reduced costs due to fewer medication-related adverse events. The projects have facilitated enhanced dialogue, improved collaboration, and fostered education among pharmacists, physicians, laboratory personnel, call center staff, and patients. Interventions from several of these projects are now routine clinical practice at KPCO.

We have recently introduced selected medication error alerts into the KPCO EMR system. These alerts have the potential to further improve medication safety in our health care system. We intend to evaluate the impact of the combined pharmacy-based and EMR-based alerts.

We believe further work is yet to be done to assist KP and other health care systems in implementing similar error-reduction practices. We are committed to working with other health care systems to assist in integrating these patient safety interventions into their delivery systems.

Conclusion

The KPCO Improving Medication Safety Program projects support patient safety goals common to many health systems. The KPCO Program was successful at decreasing medication errors through a series of interventions employing alerts implemented at the point of medication dispensing. This successful Program was team-based and developed and implemented through collaboration, communication, staff support, and key stakeholder involvement. We believe that a pharmacy-based alert program is complementary to EMR alerts.

Acknowledgments

We thank Michael Chase, MD, Associate Medical Director for Quality, for his tireless championing of the Improving Medication Safety Program. We thank the Pharmacy Department personnel and leadership, especially the late Kent Nelson, PharmD, who supported and/or contributed programming, operational, and clinical skills to this initiative.

The work was supported by the Agency for Healthcare Research and Quality (1UC1HS014249), the Garfield Memorial Fund (101-9501), and Kaiser Permanente Colorado.

Conflict of interest notification: The authors have no commercial associations that might pose a conflict of interest in connection with this article. Authors had access to study data and authority over manuscript preparation and the decision to submit the manuscript for publication, and we take responsibility for the accuracy of the analysis.

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Appendix A

CIPROFLOXACIN

INTERACTION:

Dosage adjustment recommended for CIPROFLOXACIN when CrCl <51 mL/min

CrCl (mL/min)	Recommended Dose
<51	250-500 mg every 12 hours
<30	250-400 mg every 18-24 hours

CIPROFLOXACIN EXTENDED RELEASE TABLETS

Indication	CrCl (mL/min)	Recommended Dose
Complicated Urinary Tract Infection Acute Uncomplicated Pyelonephritis	<30	500 mg every 24 hours

INTERVENTION:

1. **Confirm:** Patient has CrCl <51 mL/min.
2. **Determine:** Whether CIPROFLOXACIN is dosed appropriately based upon patient's CrCI (*see above table*). If dosed at or below recommended dose, dispense Rx as written. If dosed too high, proceed with intervention.
3. **Contact:** Provider
4. **Inform provider:** CIPROFLOXACIN requires dosage adjustment in renal insufficiency.
5. **Recommend:** ➔ Appropriate dose based upon patient's CrCl (*see above table*).
6. **If provider disagrees:** Inform provider that CIPROFLOXACIN accumulates in renal insufficiency, and patient should be monitored for toxicity (e.g., acute renal failure, seizures). *Okay to dispense.*
7. **Documentation:** PIMS CENSUS NOTE.

Appendix B

Drug-Elderly Intervention Guidelines KAISER PERMANENTE®

Amitriptyline

Summary of Prescribing Concern
In many instances, amitriptyline is not recommended for use in older adults due to its strong anticholinergic and sedative properties.

Indications Which DO NOT Require Intervention:

- ☐ Irritable bowel syndrome
- ☐ Incontinence, urinary urgency or bladder spasm
- ☐ There may be other indications, not listed, for which the provider may wish to continue the medication for this patient

INTERVENTION:
For the indications listed in the table below, switch amitriptyline to an equivalent dose of nortriptyline. (Maximum dose for nortriptyline in the elderly is 75 mg daily and 150 mg daily for amitriptyline.)

Indication	Amitriptyline	Nortriptyline
Insomnia, pain (e.g., neuropathic, fibromyalgia, headache, migraine, etc.), depression, anxiety, or any combination of these indications	10 - 25 mg	10 - 25 mg
	30 - 50 mg	25 mg
	60 -100 mg	50 mg
	110 - 150 mg	75 mg

Intervention Script

1. **Review to determine if prior PIMS Elder census note exists for this drug and this dosage**. If a prior census note exists, determine if the prescriber of the current prescription has already been contacted. If the provider has already been contacted regarding this prescription and a final determination was made, you do not need to contact the prescriber again. Simply document this in the census note as "Provider previously contacted." If the current provider has not previously been contacted for this drug, please proceed with the next step. If a prior PIMS Elder census note does not exist for this drug, please proceed with the next step.
2. **Check in PIMS to determine if this is the first time amitriptyline is being dispensed at this dose for the patient in the past year.** No intervention is necessary if the patient has been previously dispensed amitriptyline at this dose. If no prior dispensing at this dose, proceed to step 3.
3. **Obtain indication information from the prescription.** If the indication is not available from the prescription, ask the patient or caregiver for indication information. If no indication information is available from either of the previous sources, consult HealthConnect or provider.
4. **If the indication requires intervention explain to the patient:** "At KP, we are trying to improve health care above and beyond the standard practice, so we are taking extra steps to ensure the best prescribing possible. I just want to double-check with your physician before I fill the prescription."
5. **Contact provider.** For indications listed in table above, recommend switching patients from amitriptyline

to an equivalent dose of nortriptyline. Refer *to* the above table to determine the right dose of nortriptyline. *Note: If therapeutic equivalent drug substitution for amitriptyline is authorized by the RDCs in the future, it will be incorporated in this guideline.*

6. **If provider disagrees: Dispense the medication as written.**
7. **Documentation: PIMS CENSUS NOTE.**