

Identification of and Intervention to Address Therapeutic Gaps in Care

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Objectives: To determine if therapeutic gap identification, notification of community pharmacists, and intervention results in increased gap closure, reduced gap closure time, and fewer adherence gaps reopening.

Study Design: Prospective, controlled, cluster-randomized study.

Methods: State of Illinois employees and beneficiaries of State health plans filling prescriptions at independently owned community pharmacies were included. For selected chronic conditions and medications, gaps in medication adherence and omitted essential therapies were identified from prescription claims and sent as alerts for resolution with the patient and/or physician. Adherence and omission gap closure at 90 days were analyzed with Kaplan-Meier (KM) survival curve approach and Cox proportional hazards models including covariates.

Results: A total of 1433 intervention and 1181 control adherence gaps were identified, while 677 intervention and 534 control omission gaps were generated. Pharmacists intervened on 639 (44.6%) adherence and 506 (74.7%) omission gaps. Gaps were closed more often in intervention than control at 30 days (55.5% in intervention vs 50.6% in control), 45 days (61.1% vs 58.4%, respectively), 60 days (66.1% vs 65.2%, respectively), and 90 days (73.0% vs 72.9%, respectively; adjusted hazard ratio [HR] = 1.242; $P = .022$; 95% confidence interval [CI] 1.115-1.385). Adherence gaps reopened less frequently in the intervention group (HR = 0.863; $P = .012$; 95% CI 0.769-0.968). A total of 89 (13.1%) intervention and 29 (5.4%) control omission gaps closed within 90 days (adjusted HR = 1.770; $P = .005$; 95% CI 1.182-2.653).

Conclusions: Independent community pharmacists reduced gaps in care and had fewer reopened adherence gaps, suggesting improvement in adherence. A continuation study will examine the impact of the program on long-term adherence.

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Underutilization of medications, exemplified by poor medication adherence and errors of omission, is a significant barrier to optimizing patient care. Adherence to chronic medications is reported to be as low as 50% after 1 year of therapy, thereby reducing the clinical effectiveness of drug therapy.^{1,2} Medication non-adherence is commonly associated with cost, number of medications, duration of treatment, regimen complexity, and patient cognition.³ Likewise, omission gaps, where essential drug therapies are underutilized, are also common. In 1 Veterans Affairs study, omission errors accounted for 20% of all identified medication errors.⁴ Omissions in therapy have been shown to increase morbidity and mortality with greater potential to cause harm than unjustified prescribing.⁵

In patients with diabetes, hypertension, hypercholesterolemia, and heart failure, poor adherence has been associated with increased hospitalizations and emergency department visits.⁶ Poor adherence to medications has been shown to increase mortality, as exemplified by increased post-myocardial infarction fatality in patients with low adherence to statins and beta-blockers.⁷ In patients with diabetes and dyslipidemia, poor adherence has also been associated with increased medical and total costs of care.⁶ Overall, non-adherence to medications is believed to cost the United States healthcare system an estimated \$100 billion annually.⁸ While there are no available direct estimates for the implications and cost associated with omitted therapies, these costs could be greater because indicated, evidence-based therapies are not being used at all.⁴

Automated physician notifications of needed omitted therapies have also been tried to increase use of these medicines.⁹ While many notifications were either ignored or perhaps were not true gaps, automated physician notification did result in increased use of omitted therapies. The involvement of a pharmacist to screen out these unnecessary notifications may be more efficient, but has not been evaluated.

Studies in the community setting aimed at improving patient adherence using mailings¹⁰ and telephone reminder systems¹¹⁻¹⁴ have met with mixed results. Those programs that focus solely on reminders tend to be less effective, since medication adherence is generally considered to be multifaceted and affected by system and health barriers, patient behaviors and beliefs, and patient self-efficacy.¹⁵ As such, multifaceted interventions are more likely to be successful in changing patient behavior and improving adherence.¹⁶ More comprehensive interventions addressing adher-

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ence have generally shown better results.¹⁷⁻¹⁹

Pharmacists are in an optimal position to address therapeutic gaps in care. Community pharmacists are knowledgeable about potential barriers and solutions to adherence issues. They have frequent contact with their patients, know them well, and when needed, reach out to physicians on their behalf.

They are also widely considered a trusted source for providing information to patients and practitioners about medication therapies.²⁰ Therefore, with the right supportive infrastructure, the community pharmacist may be very effective at validating and addressing therapeutic gaps in care related to underutilization of medications. Such an infrastructure includes pharmacists having access to evidence-based gaps in care alerts and comprehensive medication and fill history at the point of care.

The objective of this study was to determine if the identification of therapeutic gaps in care from prescription claims data, notification of community pharmacists of gaps through alerts, and intervention on those alerts results in higher gap closure, reduced time to closure, and reduced proportion of gaps reopening in the case of adherence gaps.

METHODS

This study was a prospective, cluster-randomized, controlled quality assurance study. The study was approved by the University of Illinois at Chicago institutional review board and conducted in compliance with all regulations of the Health Insurance Portability and Accountability Act of 1996.

Pharmacy Selection and Random Assignment

All pharmacies were required to 1) service members in the State of Illinois network, 2) be located in Illinois, 3) be independently owned, 4) utilize a commercially available web-based clinical documentation platform capable of relaying real-time gap information from Medco to pharmacists and capturing pharmacists' documentation of gap causes and status, patient disposition, and comments, and 5) have 10 or more patients with identified care gaps over the 13-week period prior to randomization. In all, 96 independently owned community pharmacies met inclusion criteria and were invited to participate. Pharmacies were randomized to either provide the intervention or not (usual care control).

Population and Patient Inclusion Criteria

State of Illinois employees and beneficiaries (spouses, children, and retired workers) with continuous eligibility during

Take-Away Points

- This targeted patient outreach program involved identifying patients with poor adherence and omitted therapies (referred to as gaps in care) and notifying independent community pharmacists of these gaps in care.
- Prior to the program, community pharmacists underwent case-based training focused on disease management, motivational interviewing, and communication.
- The program resulted in increased adherence and omission gap closure and fewer adherence gaps reopened. An indicator of adherence was also improved by the program.
- This evaluation of our program can be used to develop more effective, targeted, evidence-based strategies to improve patient adherence and reduce errors of omission.

the study period, and all of their pharmacy claims, were included. Patients were assigned to a particular pharmacy based on where the patient was filling the majority of their prescriptions in the 6 months prior to the study. Patient assignment was solely for the purpose of providing the intervention. Specifically, gap alerts were sent to the assigned intervention pharmacy. Control pharmacies did not receive gap in care alerts. At the start of the project, a letter was sent to the intervention pharmacy patients to inform them of the services being offered. Patient participation was optional; patients were not informed about the study. Patients were not required to fill medications at the assigned pharmacy.

Therapeutic Gaps in Care

Adherence and omission gaps in care were identified daily, using Medco's prescription claim warehouse and defined clinical criteria. Gaps in care were transmitted as alerts to the pharmacy via the web-based platform. Adherence gaps occurred when a patient on selected chronic medications had a medication possession ratio (MPR) of less than 80% over the last 18 months and was late to fill the medication. Omission gaps occurred when a patient with a selected chronic condition was missing a medication on their profile. Omission gaps were selected based on documentation of clinical evidence and general consensus supporting the medication's use for a particular condition. The alert definitions and situations for which they were generated are shown in **Table 1**.

Intervention Pharmacy Training and Practice

Control pharmacies and pharmacists continued to provide the services normally provided to their patients and did not receive gap in care alerts. Beyond the usual patient services, intervention pharmacies provided the additional service of addressing care gaps identified by Medco and communicated via a web-based clinical documentation and communication platform. All participating pharmacists at intervention pharmacies were required to undergo a certified continuing education program comprising 7.5 hours of online and 3.5 hours of in-person case-based training conducted by residency-trained clinical pharmacists with experience in medication

■ **Table 1.** Gap Definitions and Situations Resulting in an Alert Being Generated

Adherence Gap: Generated when a patient on selected chronic medication has a medical possession ratio of <80% and is late to fill the medication

Included medication classes:

Antidepressants

Anti-epileptics

Antihypertensives

Antiplatelets

Cholesterol medications

Inhaled long-acting beta agonist or long-acting anti-cholinergic in patients with COPD

Oral diabetes medications

Omission Gap: Generated when a patient with selected chronic condition is missing medication or test generally warranted by that condition in their current treatment regimen as identified with prescription claims

Included situations and drug classes:

Lack of inhaled corticosteroid while on long-acting beta agonist or long-acting anti-cholinergic in patients with asthma

Lack of migraine-preventive medications in patients taking acute migraine medications

Lack of ACE inhibitor/ARB in patients with hypertension and diabetes

Lack of statin medication in patients with diabetes 45 years of older

Lack of self-monitoring blood glucose test strips in patients with diabetes and receiving insulin

ACE indicates angiotensin converting enzyme; ARB, angiotensin receptor blocking agent; COPD, chronic obstructive pulmonary disease.

therapy management and ambulatory care specialty clinics. Training focused on disease management (see Table 1 for conditions), motivational interviewing, and communication. Program sponsors held monthly telephone conferences with the intervention pharmacists to gather feedback on process improvement and best practice sharing and provide updates. Additional education and communication materials were provided when requested, such as the American Diabetes Association treatment guidelines.

The approach to addressing therapeutic gaps depended on the type of gap identified, as well as patient-, pharmacist-, and pharmacy-specific factors. In-person communication was encouraged for the first patient visit, with follow-up visits being in-person or by telephone. Communication with prescribers by telephone or facsimile was encouraged. However, pharmacists were allowed to conduct the intervention as appropriate, according to the pharmacy's policies, procedures, and established relationships.

An adherence gap was considered "closed" once a prescription was filled for the medication in question. An adherence gap was considered "reopened" if an alert was generated for the gap for a second time during the study period. An omission gap was considered closed when a new prescription was written for an appropriate medication. Typically, adherence gaps were addressed directly with the patient, while omission gaps were addressed with the patient's primary care or other provider as appropriate.

Pharmacists documented their interventions for the identified gap in care using the web-based clinical platform. All pharmacist activities were within the scope of practice, as defined by Illinois State and national pharmacy organizations and by the Illinois State practice laws. Pharmacies were reimbursed \$30 for the initial session and \$15 for each of up to 2 follow-up sessions to a maximum of \$60 per gap addressed.

Sample Size and Data Analysis

A power analysis, conducted prior to the study start, established that a sample of 410 adherence and omission gaps per group were required to detect a difference in absolute gap closure rate of 10%, assuming alpha of 0.05 and power of 0.8. We estimated that approximately 1500 adherence gaps and 1000 omission gaps would be available for analysis if 45 pharmacies were enrolled in each group. We targeted 48 intervention and 48 control pharmacies, in case any pharmacies needed to drop out.

Prescriber, pharmacy, and patient characteristics were analyzed with summary statistics of counts and proportions, as were data regarding number of gap openings, closings, and in the case of adherence gaps, reopening. Gaps that existed at the start of the study as well as new gaps that occurred within 90 days after the study start date were analyzed. Gap closure was analyzed at 90 days after an alert was sent to the pharmacy (or would have been sent in the case of control pharmacies). Where a patient had 2 gaps during the intervention period for the same gap category, only the first gap was used in assessing gap closure.

Identifying and Addressing Therapeutic Gaps

■ Table 2. Patient, Pharmacy, and Provider Characteristics

Description	Intervention Cohort	Control Cohort
Patient characteristics		
Number of patients	1445	1126
Age (SD)	66.6 (13.9)	67.4 (13.6)
Gender		
Female, n (%)	794 (55.0%)	658 (58.4%)
Pharmacy characteristics		
Number of pharmacies	45	47
Mean number of Medco prescription claims per store during study period (SD)	6865 (3659)	6635 (3407)
Mean number of potential patients at each pharmacy	138 (165)	102 (101)
Prescriber characteristics^a		
Number of providers	482	453
Mean prescriber age (SD)	52.8 (10.6)	53.2 (10.7)
Gender		
Female (%)	78 (18.2%)	68 (16.5%)
Practitioner type		
Physician, n (%)	428 (88.8%)	414 (91.4%)
Non-physician, n (%)	51 (10.6%)	32 (7.1%)
Prescriber specialty		
Generalist, n (%)	274 (56.8%)	266 (58.7%)
Specialist, n (%)	142 (29.5%)	138 (30.5%)
Medco patient count during study period (SD)	280 (251)	265 (232)
Medco prescription count during study period (SD)	2999 (2412)	2891 (2810)
SD indicates standard deviation.		
^a Included as covariates in models assessing omission gaps.		

Unadjusted analyses of gap closure at 90 days were initially conducted using the χ^2 test statistic. In the case of adherence gaps, an unadjusted χ^2 analysis was conducted assessing the proportion of gaps that reopened prior to the end of the study.

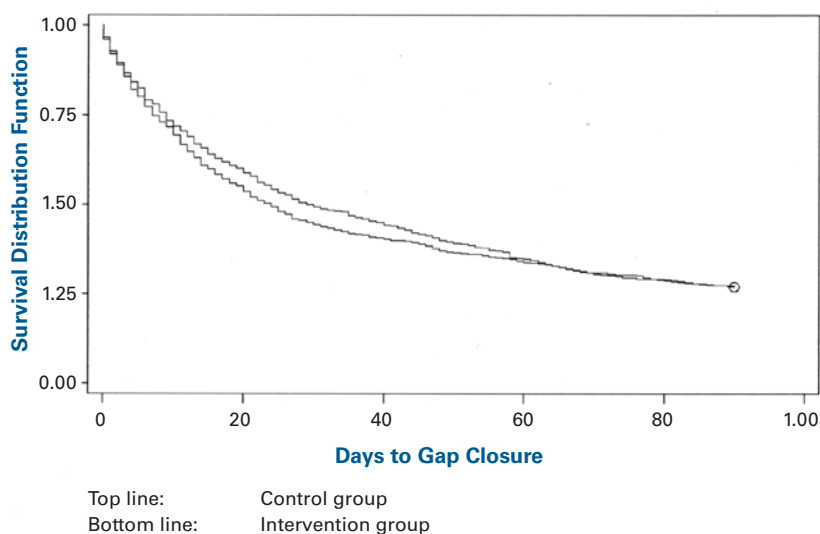
Adherence and omission gap closure over time were analyzed using the Kaplan-Meier (KM) survival curve approach²¹ and Cox proportional hazards models.²² For the adherence gap model, patient age and gender and total number of Medco prescription claims during the study period and Medco patient count for the pharmacy were included as potential covariates in the model. For the omission gap model, the same patient and pharmacy covariates were included, along with prescriber age, gender, specialty, practice type, practice size (estimated by number of Medco patients), and number of Medco prescription claims. Variable selection methods were used to find the final model following the selection criteria; both the entry and stay *P* values were .15.

Sensitivity analyses were run to assess the effects of certain operational decisions on the models. In the initial models, we chose to include multiple gap categories for each patient

if these existed. For example, if a patient was non-adherent with multiple medications, he or she could potentially contribute to statin, beta-blocker, and ACE-inhibitor adherence gaps. Since this violates the assumption of independence of observations, we ran a sensitivity analysis including only 1 of the gaps selected at random. We also ran a sensitivity analysis examining only those gaps generated after the study start date and excluding all those that existed when the study began.

An analysis of refill compliance, as an insight into adherence during the study, was conducted using a continuous multiple interval measures of medication gaps (CMG) method described by Steiner and Prochazka.²³ Specifically, we identified the number of days after which medication supplies were exhausted between the start of an adherence gap and the end of the study divided by the number of days in the same period. The numerator was not adjusted for oversupplies. Rather, the minimum of days supplied or time between fills was used to calculate the number of days for which medication supplies were available. The intervention CMG was compared with the control group CMG using a Mann-Whitney *U* test.

■ **Figure 1.** Proportion of Adherence Gaps Remaining Open Over Time KM Survival Curve



KM indicates Kaplan-Meier.

Economic Analysis

The cost of providing the intervention, excluding administrative costs, was calculated from the insurer's perspective. Specifically, the counseling reimbursement was calculated as total cost and as a cost per eligible patient per month (ie, those patients who were on medications and were eligible for the program). The costs associated with generating and communicating gaps, pharmacist educational sessions, administrative support, and program evaluation were not included in this analysis.

RESULTS

A total of 96 pharmacies were subject to randomization. Three pharmacies in the intervention group were unable to have a pharmacist complete the training program and 1 control pharmacy closed before the study began. As a result, 92 pharmacies participated in the study. Of these, 45 pharmacies were assigned to conduct the intervention and 47 were assigned as the control group. A total of 2571 patients (1445 intervention and 1126 control patients) with therapy gaps were assigned to these pharmacies. Pharmacy, patient, and provider characteristics are shown in **Table 2**. During the 90-day intervention period after the study start, 2614 existing and new adherence gaps were identified that met inclusion criteria and were included in the study (1433 intervention and 1181 control) while 1211 omission gaps were included in the study (677 intervention and 534 control gaps). Out of 1433 adherence and 677 omission gaps sent to intervention pharmacies, pharmacists intervened on 639 (44.6%) and 506

(74.7%) gap alerts respectively. Gaps that were unaddressed by pharmacists included 441 (30.8%) adherence and 57 (8.4%) omission gaps recalled because the criteria required for generating the gap were no longer met. For example, to generate an alert, a patient must have filled the medication at least 1 time in the past 6 months. An additional 335 (23.4%) adherence and 16 (2.4%) omission gaps were recalled because a claim for the medication was received prior to pharmacist intervention, thereby automatically closing the gap. The patient declined intervention in 10 (0.7%) adherence and 20 (3.0%) omission gaps. The remaining 8 (0.6%) adherence and 78 (11.5%) omission gaps remained unaddressed for unknown reasons.

Adherence Gap Closure

In total, gaps were closed from the alert notification more often in the intervention group than control at 30 days (55.5% closure rate in intervention vs 50.6% in control), 45 days (61.1% vs 58.4%, respectively), 60 days (66.1% vs 65.2%, respectively), and 90 days (73.0% vs 72.9%, respectively). When evaluated using the Cox proportional hazards model, including control variables for the adjusted analysis, a significant difference was observed at 90 days (hazard ratio [HR] = 1.242; $P = .022$; 95% confidence interval [CI] 1.115-1.385) and at all of the time points (30-, 45-, and 60-day adjusted P values all $<.001$). **Figure 1** shows the KM survival curves for gap closure. All final models included 2 covariates: standardized number of pharmacy claims and pharmacy patient count (these variables were standardized for better convergence in SAS 9.2).

Adherence Gap Reopenings

Including only those gaps that had sufficient time to reopen (45 days) prior to the end of the study, adherence gaps reopened in 59.6% of intervention and 67.0% of control patients. The difference was statistically significant when compared using a Cox proportional hazards model (HR = 0.863; $P = .012$; 95% CI 0.769-0.968). The final model included 2 covariates: standardized number of pharmacy claims and standardized pharmacy patient count.

Estimated Short-term Change in Adherence

The proportion of days in which medication supply was

exhausted was 52.3% in the intervention group using a CMG method. The corresponding CMG was 55.6% in the control group. This difference in CMG was statistically significant ($P = .001$). When only those patients filling a medication during the study period were included (ie, those who remained persistent with therapy), the CMG was 39.5% in the intervention group and 43.5% in the control group ($P < .001$).

Omission Gap Closure

There were 89 (13.1%) intervention and 29 (5.4%) control gaps that had closed within 90 days of the gap alerts being sent to the pharmacists (unadjusted $\chi^2 P < .001$). This statistical significance was maintained when evaluated using the Cox proportional hazards model (HR = 1.770; $P = .005$; 95% CI 1.182-2.653). The KM survival curve for open omission gaps is shown in **Figure 2**. The final omission gap model included the covariates patient age, patient gender, and practitioner's prescription claim count.

Sensitivity Analyses

The results of the models developed in the sensitivity analyses were consistent with those in the main analyses. Because of the smaller sample size, the results analyzing only new gaps and excluding gaps that existed at the study start were not statistically significant. The KM survival curves were very similar, as were the final model parameter estimates. The sensitivity analysis evaluating only a single gap per patient, rather than allowing multiple gaps per person, showed similar results.

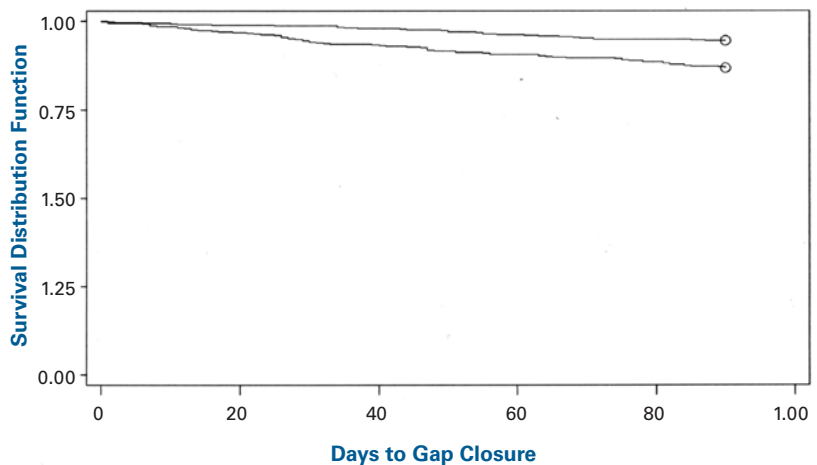
Economic Analysis

Pharmacists provided 639 first sessions and 427 follow-up (second and third) sessions for adherence gaps. Pharmacists conducted 506 first sessions and 506 follow-up sessions for omission gaps. The total cost of counseling over the first 3 months of the intervention period was \$48,345. Given that 6398 patients were assigned to intervention pharmacies and monitored for gap identification, the mean cost per patient per month for the first 3 months of the program was \$2.52.

DISCUSSION

This study demonstrates that a program designed to improve adherence and reduce omission gaps utilizing commu-

Figure 2. Proportion of Omission Gaps Remaining Open Over Time KM Survival Curve



Top line: Control group
Bottom line: Intervention group

KM indicates Kaplan-Meier.

nity pharmacists was effective in closing those gaps sooner. In addition, a fewer number of adherence gaps reopened during the time frame of the analysis. In the case of omission gaps, the result was fewer omission gaps open at 90 days. These results are promising and suggest that community pharmacists can effectively address medication underutilization when appropriately supported.

Patients who demonstrated suboptimal adherence (MPR less than 80% over the past 18 months) and were late to fill a prescription were identified for intervention and approached at a time when adherence was potentially problematic. A greater proportion of adherence gaps were closed at 30 and 60 days after alert generation. This finding indicates that study patients were likely to fill their prescriptions sooner in the intervention group. Additionally, patients in the intervention group were more likely (absolute difference 7.4%) to refill their prescriptions again during the study period, suggesting that adherence was actually impacted. However, we observed no difference in the proportion of adherence gaps closed at 90 days, indicating that persistence was not improved by this intervention. Lack of persistence would commonly be addressed by alerting the prescribing physician, recommending an alternative therapy, and discussing other (including non-prescription) options with patients. Our analysis was not designed to identify drug switching or the impact of this intervention on drug switching. Therefore, we do not know if this intervention had any impact on improving therapy for non-persistent patients.

We identified 3 previously published studies designed to improve medication adherence via patient and/or physician outreach. In 1 multisite, controlled clinical trial at a medi-

um-sized grocery chain, over 3000 patients were randomized to 1 of 2 interventions or control.¹⁹ One intervention involved directly notifying the physician that a patient was overdue for refills. The other intervention involved telephone outreach by a pharmacist or technician to discuss an overdue refill, assess barriers to therapy, and suggest potential solutions to non-adherence. Over half of the physicians contacted chose to either opt out of the study (45.1%) or did not respond (13.7%) to the study questionnaire. Pharmacists or technicians were successful in contacting 81% of patients. There were no significant differences in the time to refill medications among any of the groups.¹⁹ While the study was well designed, the results suggest that either the method of identifying poorly adherent patients or the intervention as conducted was not effective. Specifically, identification of poor adherence based on late to fill criteria alone may not be sufficient. Our study differed in that adherence over the past 18 months and late to fill criteria were simultaneously used to identify patients with long-standing adherence issues. In addition, intervention pharmacists in our study received training in motivational interviewing and were solely responsible for conducting the intervention. The intervention was reinforced over the course of up to 3 sessions, rather than in a single telephone call.

Another study, conducted within the outpatient pharmacies of 1 hospital system, incorporated automated telephone reminders, patient information pamphlets with pictorial representations of how and when to take medications, and training sessions for pharmacists on improving communication with patients.¹⁴ While an improvement in the adherence in the intervention group compared with baseline, the difference did not achieve statistical significance. Also, limitations in the study's design, such as a lack of random assignment exacerbated by important differences between the control and intervention groups at study baseline, make the results of this study difficult to interpret. Our study employed randomization to ensure similar study groups.

The third study also used a prospective, non-randomized design evaluating the impact of a nurse case-manager intervention in 155 "high-risk" patients with diabetes participating in a cardiovascular disease management program.¹⁷ Patients who were more than 60 days late to refill their prescriptions were referred to nurse case managers with training in health behavior change techniques for counseling on barriers to adherence and resources available to assist with medication adherence. Compared with control patients from a health plan without a diabetes disease management program, a significantly higher rate of prescription refills was observed in the intervention group (42.1% vs 59.3%, respectively). However, whether the program had any real impact

on adherence is difficult to assess due to lack of randomization and because patients in the intervention had access to a diabetes disease management program not offered to control patients.

While reminders may be helpful for a few individuals, a more comprehensive intervention is generally needed to improve medication adherence.² The timing and type of method by which information is conveyed to the patient is crucial to patient acceptance. Motivational interviewing has been proved useful in efficient patient communication and improvement in patient-provider relationship.²⁴ In order to be considered sustainable, an intervention must be delivered by the pharmacist in a relatively short, cost-effective manner. We developed our intervention with these goals in mind. When used in conjunction with the community pharmacists' existing patient relationships, and specialized knowledge of assessing and addressing adherence barriers, we anticipated that the community pharmacists would successfully effect behavior change in many patients.

With regard to omission errors, we identified only 1 publication.⁹ In this randomized, controlled study, prescription and physician claims were scanned for specific situations where a therapy or monitoring was absent, placing a patient at risk of an adverse or suboptimal outcome. Intervention alerts were sent directly to physicians. Of the 394 recommendations to start a new medication, 24% of the intervention group recommendations were initiated by physicians compared with 17% of medications being initiated in the control group over an unspecified period of observation (the study was conducted over a 12-month period), for a relative increase of 42%. In comparison, our study observed omission gap closures in 13.1% of intervention and 5.4% of control gaps, for a relative increase of 143%. The ability of the pharmacists to thoroughly evaluate the gap, screen out false positive gaps, and communicate the need for an omitted medication with the physician professional-to-professional may be responsible for the larger relative effect size we observed in this study.

There are several limitations to our study that must be acknowledged. First, the study assesses the short-term impact of the intervention on an intermediate outcome for adherence. While gap closure is a necessary step in improving adherence, whether facilitated gap closure is associated with long-term improvement in adherence has yet to be determined. Our analyses of adherence gap reopening and cumulative medication gaps hints at the potentially positive effect of the intervention on actual adherence, but still only for the shorter term. The long-term outcome of the intervention on adherence, as measured by proportion of days covered, is being assessed in a continuation phase of this study.

CONCLUSIONS

A program designed to identify adherence and omission gaps in care and utilizing community pharmacists to address those gaps significantly affected underutilization of medications. Specifically, the program resulted in increased adherence gaps closure over time, fewer adherence gap reopenings, and a considerable 143% relative increase in omission gap closures at 90 days.

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REFERENCES

1. Chapman RH, Petrilla AA, Benner JS, Schwartz JS, Tang SS. Predictors of adherence to concomitant antihypertensive and lipid-lowering medications in older adults: a retrospective, cohort study. *Drugs Aging*. 2008;25(10):885-892.
2. Haynes RB, McDonald HP, Garg AX. Helping patients follow prescribed treatment: clinical applications. *JAMA*. 2002;288(22):2880-2883.

3. Doggrell SA. Adherence to medicines in the older-aged with chronic conditions: does intervention by an allied health professional help? *Drugs Aging*. 2010;27(3):239-254.
4. Hayward RA, Asch SM, Hogan MM, Hofer TP, Kerr EA. Sins of omission: getting too little medical care may be the greatest threat to patient safety. *J Gen Intern Med*. 2005;20(8):686-691.
5. Green CJ, Du-Pre P, Elahi N, Dunckley P, McIntyre AS. Omission after admission: failure in prescribed medications being given to inpatients. *Clin Med*. 2009;9(6):515-518.
6. Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. *Med Care*. 2005;43(6):521-530.
7. Rasmussen JN, Chong A, Alter DA. Relationship between adherence to evidence-based pharmacotherapy and long-term mortality after acute myocardial infarction. *JAMA*. 2007;297(2):177-186.
8. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med*. 2005;353(5):487-497.
9. Javitt JC, Steinberg G, Locke T, et al. Using a claims data-based sentinel system to improve compliance with clinical guidelines: results of a randomized prospective study. *Am J Manag Care*. 2005;11(2):93-102.
10. Linton A, Bacon TA, Trice S, et al. Results from a mailed promotion of medication reviews among Department of Defense beneficiaries receiving 10 or more chronic medications. *J Manag Care Pharm*. 2010;16(8):578-592.
11. Ascione FJ, Brown GH, Kirking DM. Evaluation of a medication refill reminder system for a community pharmacy. *Patient Educ Couns*. 1985;7(2):157-165.
12. Reidel K, Tamblyn R, Patel V, Huang A. Pilot study of an interactive voice response system to improve medication refill compliance. *BMC Med Inform Decis Mak*. 2008;8:46.
13. Simkins CV, Wenzloff NJ. Evaluation of a computerized reminder system in the enhancement of patient medication refill compliance. *Drug Intell Clin Pharm*. 1986;20(10):799-802.
14. Gazmararian J, Jacobson KL, Pan Y, Schmotzer B, Kripalani S. Effect of a pharmacy-based health literacy intervention and patient characteristics on medication refill adherence in an urban health system. *Ann Pharmacother*. 2010;44(1):80-87.
15. Touchette DR. Improving adherence in the community and clinic pharmacy settings: an emerging opportunity. *Pharmacotherapy*. 2010;30(5):425-427.
16. Kripalani S, Yao X, Haynes RB. Interventions to enhance medication adherence in chronic medical conditions: a systematic review. *Arch Intern Med*. 2007;167(6):540-550.
17. Lawrence DB, Allison W, Chen JC, Demand M. Improving medication adherence with a targeted, technology-driven disease management intervention. *Dis Manag*. 2008;11(3):141-144.
18. Peterson AM, Takiya L, Finley R. Meta-analysis of trials of interventions to improve medication adherence. *Am J Health Syst Pharm*. 2003;60(7):657-665.
19. Nietert PJ, Tilley BC, Zhao W, et al. Two pharmacy interventions to improve refill persistence for chronic disease medications: a randomized, controlled trial. *Med Care*. 2009;47(1):32-40.
20. Donohue JM, Huskamp HA, Wilson IB, Weissman J. Whom do older adults trust most to provide information about prescription drugs? *Am J Geriatr Pharmacother*. 2009;7(2):105-116.
21. Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. *J Amer Statist Assn*. 1958;53:457-481.
22. Collett D. *Modeling Survival Data in Medical Research*. Chapman & Hall/CRC Press; 2003.
23. Steiner JF, Prochazka AV. The assessment of refill compliance using pharmacy records: methods, validity, and applications. *J Clin Epidemiol*. 1997;50(1):105-116.
24. Rubak S, Sandbaek A, Lauritzen T, Christensen B. Motivational interviewing: a systematic review and meta-analysis. *Br J Gen Pract*. 2005;55(513):305-312. ■