Quality and Cost Outcomes of Clinical Pharmacist Interventions in a Capitated Senior Drug Benefit Plan

OBJECTIVES: To measure the cost outcomes of interventions by clinical pharmacists in the drug therapy of high-use patients in a Medicare+Choice managed care plan.

DESIGN: Prospective pre/post design without a control group.

SETTING: Ambulatory care setting within an integrated health care delivery system.

PARTICIPANTS: 80 patients, aged 65 or older, on five or more medications with a limited prescription drug benefit ($1,000 per year maximum).

MEASURES: The study evaluated the impact of drug regimen review and subsequent interventions on prescribing alignment with national and local health-system disease management guidelines, drug selection and appropriate dose, prescription costs per-patient-per-month (PPPM), total medical and drug cost PPPM, number of prescriptions PPPM, and provider/patient satisfaction. Medication appropriateness and compliance were assessed through medical records, prescription claims data, and patient interviews. Recommendations were communicated to the primary care provider for each patient.

RESULTS: Of 294 patient conditions, 238 (80.9%) cases were in alignment with national guidelines for treatment pre-intervention; 262 (89.1%) were in alignment post-intervention. This represents a 10.2% relative increase in alignment (p=0.001) with national therapy guidelines. Overall, 206 (73.5%) recommendations were implemented. Average PPPM prescription costs (cost incurred by plan) were $175.70 prior to intervention and $158.66 after. This represents a decrease in average prescription costs PPPM of $17.04 ± 7.01 (p=0.012). The average number of prescriptions PPPM decreased from 7.6 to 7.1 (p=0.001). Total cost of care (includes hospitalizations, pharmacy costs, and all medical encounters), medical encounters, and adverse events did not differ statistically from baseline (p=0.146, p=0.077 and p=0.672, respectively).

CONCLUSIONS: Drug regimen review and redesign was successful at reducing pharmacy costs without increasing other health care costs. Most important, drug costs were decreased while adherence to evidence-based national guidelines, an intermediate measure of clinical outcome, and a favorable quality outcome improved.

KEY WORDS: Geriatric, Pharmacy costs, Polypharmacy, compliance, Prescription paid claims data

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by Nella Bieszk, Vinay Bhargava, Tony Pettita, Nancy Whitelaw, and Barbara Zarowitz

The geriatric population represents a significant challenge to the health care professional. Elderly patients are commonly faced with many concurrent conditions requiring pharmacological treatment. Having multiple medical disorders also leads elderly patients to multiple providers, which can further complicate care, despite the conscientious approach of primary care physicians to managing this population. Multiple conditions often result in polypharmacy and medication “misadventures.”1,2,3

Currently, there is no universally accepted definition for the term “polypharmacy.” Many investigators define polypharmacy a priori as exceeding a certain number of medications. For the purposes of this investigation, polypharmacy is the concern that a patient is receiving medications that carry a risk that is greater than their potential benefit. The term “medication misadventure” has been defined as an iatrogenic hazard or incident: that is an inherent risk when medication therapy is indicated; that is created through either omission or commission by the administration of a medicine or medicines by which a patient may be harmed (with effects ranging from mild discomfort to fatality), whose outcome may or may not be independent of the pre-existing pathology or disease process, that may be attributable to error (human, system, or both), immunologic response, or idiosyncratic response; and that is always unexpected or undesirable to the patient and health professional.

Medication misadventures have been estimated to cost the U.S. health care system $76 billion annually in the ambulatory setting.4 A more recent study indicates that the cost of drug-related morbidity and mortality

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 exceeded $177.4 billion in 2000. The majority of these costs are due to hospitalizations, admissions to long-term-care facilities, physician visits, emergency room visits, and additional prescriptions.

Geriatric patients, who consume more than 33% of all prescription drugs, are at the greatest risk of experiencing a medication misadventure with associated morbidity and mortality. The incidence of adverse drug reactions in the elderly is two to three times that of younger adults. This may be an underestimate because adverse drug reactions are often misdiagnosed in the elderly. In fact, for every dollar spent on drugs in nursing facilities, $1.33 in health care resources is consumed in the treatment of drug-related problems. Altered pharmacokinetics, pharmacodynamics, and decreased organ reserve capacity are potential reasons for the increased risk.

Polypharmacy in this population also increases associated drug-drug and drug-disease interactions. When two or more medications are taken, the potential for an interaction is approximately 6%, but this risk increases to 50% with five medications and to nearly 100% with eight medications. Reducing polypharmacy has been shown to decrease the likelihood of adverse drug reactions.

Despite the occurrence of polypharmacy in the geriatric population, omission of necessary drug therapy remains a significant cause of geriatric drug-related hospital admissions. For example, the beneficial effects of angiotensin-converting enzyme (ACE) inhibitors on total mortality, heart-failure mortality, hospital rates, progression of left ventricular dysfunction, exercise tolerance, and symptom severity in patients with congestive heart failure have been well documented. However, ACE inhibitors are underutilized. Only 46% of cardiologists and 22% of all other physicians prescribed ACE inhibitors in situations where they were indicated.

Underdosing of medications is another significant cause of geriatric drug-related hospital admissions. In a study examining adherence to National Cholesterol Education Program treatment goals in postmenopausal woman with heart disease, it was found that 91% of women taking lipid-lowering medication did not meet a low density lipoprotein cholesterol (LDL) goal of 100mg/dl. The prescribing of target ACE inhibitor doses also has been prospectively evaluated in patients with heart failure to identify differences in ACE-inhibitor utilization among elderly and nonelderly patients. Fewer elderly patients were prescribed target ACE inhibitor doses compared with nonelderly patients.

Interdisciplinary teams that include a clinical pharmacist have been shown to improve outcomes, reduce polypharmacy, and reduce cost. However, the impact on concomitant adherence to national guidelines has not been assessed. We report the results of a prospective evaluation of pharmacist-initiated care in a high-risk elderly outpatient population using improved adherence to national and local health-system guidelines for major disease states as a measure of improved quality of care and an intermediate measure of clinical outcome. The impact on the pharmacy benefit with respect to both pharmacy utilization and pharmacy costs incurred by the plan is evaluated and contrasted with changes in the total cost of care, medical encounters, and adverse events.

Methods

Study Population

To be considered for inclusion in the study, patients had to be at least 65 years of age and taking five or more medications regularly. Pharmacy paid claims data along with demographic data obtained from the relational database of the integrated health system were queried to obtain a pool of potential patients. Patients were required to be current “Senior Plus” members with prescription benefits and enrolled for at least six months from the day of review. Senior Plus is a Medicare+Choice managed care program. The Senior Plus plan offers a pharmacy rider that provides an annual drug benefit maximum of $1,000. Only managed care patients were included because complete health care utilization data were available for these patients.

From a pool of 600 system-wide patients meeting the selection criteria, 100 patients were found to be aligned to the two geographical regions of the integrated health system where the pharmacists involved in the study were located. The initial query identified patients who had received more than 30 prescriptions each within a 6-month period. To ensure that these patients had received five or more maintenance drugs, a clinical pharmacist reviewed the claim detail for the 100 selected patients. A total of 80 patients met the selection criteria of at least five maintenance drugs received in the six-month pre-intervention period. The 80 patients served as their own control, establishing a baseline used to examine quality and appropriateness before and after the pharmacist’s intervention. Paid-claims prescription data utilized in the patient review process were generated on the day of review for the individual patient; follow-up review and evaluation occurred 3 months later.

Clinical pharmacist interventions in this population of 80 patients occurred between September 1998 and April 1999. The last assessment of prescription drug per-patient-per-month (PPPM) cost was made in July 1999. Total cost of care was assessed for each patient for the 4-month period preceding clinical pharmacist interventions and for the 4-month period after clinical pharmacist interventions.

The protocol was reviewed and approved by the institutional human rights committee, which waived the requirement for written informed consent from patients.

Database

The data warehouse is a mainframe relational database that is comprised of tables containing records for all office visits, hospitalizations, prescription paid claims, and ancillary health care resources used, such as laboratory and radiology. The data warehouse has a graphical SQL-based query tool (GQL, Andyne .
TABLE 1 National and Local Health-System Guidelines for Clinical Interventions

<table>
<thead>
<tr>
<th>Disease State</th>
<th>Applicable Guideline</th>
<th>Intent of Interventions Based on Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension16</td>
<td>The sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure</td>
<td>Attaining blood pressure goals as outlined in guideline through dose titration or addition of antihypertensive. Assuring medication selection is most appropriate choice based on concomitant disease states.</td>
</tr>
<tr>
<td>Asthma17</td>
<td>Guidelines for the Diagnosis and Management of Asthma</td>
<td>Assuring appropriate medication choice and use based on patient severity.</td>
</tr>
<tr>
<td>Congestive heart failure18</td>
<td>Diagnosis and Management of Congestive Heart Failure. Clinical Guideline: Ambulatory Care Series</td>
<td>Medication management based on patient staging and symptoms. Maximizing drug therapy recommendations per guideline.</td>
</tr>
<tr>
<td>Diabetes21</td>
<td>Standards of Care for Patients with Diabetes Mellitus</td>
<td>Attaining blood glucose goals as outlined in guideline.</td>
</tr>
<tr>
<td>Hyperlipidemia22</td>
<td>Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II)</td>
<td>Attaining lipid goals based on patient risk factors as outlined in guideline.</td>
</tr>
</tbody>
</table>

Limited, Kingston, Ontario) that allows end users to submit queries and create reports based on the query results. For the patients included in the study, demographic data and a full prescription history including drug costs were assessed.

**CarePlus**

CarePlus is the institutional electronic medical record that is used to access various types of clinical patient information and record patient transactions. Patient information viewed within CarePlus included inpatient and outpatient encounters, clinical laboratory results, medications, and office visit notes.

**Data Collection and Intervention**

The pharmacist gathered basic demographic information, disease/conditions, laboratory parameters, and medication information from the patient’s medical record on CarePlus. The reviewers were not blinded to the hypothesis of the study. Assessing medication appropriateness entailed looking for the correct dose, contraindications, indications, drug interactions, adverse effects, likelihood of adherence to the drug therapy regimen, route of administration, and possible drug duplication. Information was collected for legend, over-the-counter, and herbal products. Following the initial evaluation of the medical record data, the pharmacist discerned the prescriptions the patient had filled over the preceding 6 months from prescription paid claims data to determine if they corroborated medications listed in the medical record.

Pharmacists evaluated each patient to determine alignment with national or health-system guidelines for hypertension, asthma, congestive heart failure, depression, pain control, diabetes, and hyperlipidemia.17–22 Health-system guidelines (institutional guidelines) reflected the most current published guidelines while directing professionals within the health system to institutional resources and clarifying formulary choices. Pharmacists were given copies of the guidelines referenced and each pharmacist determined whether the patient’s current disease management was aligned with the intent of the guideline.

The process was based on explicit criteria outlined in published guidelines. Heart-failure patients, for example, were expected to be receiving treatment with an ACE inhibitor or hydralazine plus an oral nitrate. Patients with hypertension were expected to be at their corresponding blood pressure goal. If these criteria were not met, treatment of the disease was judged to be out of alignment with the corresponding guideline. The pharmacist’s goal was to improve alignment with clinical practice guidelines, for example, titration of blood pressure medications, to achieve the therapeutic goal (see Table 1, above). Appropriateness of medication choices and doses using calculated renal function23 and hepatic function24 were confirmed. Medication choices and doses for elderly patients were assessed based on body weight (when applicable), potential effects on mental status, possible adverse effects, drug interactions, and allergies.

Recommendations were communicated orally and in writing to the primary care physician (PCP). Medication adherence was determined through a telephone interview in conjunction with analysis of pharmacy claims data. Claims data provided a 6-month medication history that included dates the prescriptions were filled at various pharmacies as well as the number of days of drug therapy supplied to the patient. Patients who missed more...
than 10% of their scheduled doses in a one-month period received counseling on the importance of medication adherence as well as compliance aids (personal calendars and pillboxes).

Only maintenance prescriptions (prescriptions used to treat chronic conditions) were used to determine the average number of prescriptions a member was taking per month as well as PPPM prescription costs. Prescriptions for antibiotics, for example, were not counted as maintenance medications. This was done in an attempt to reduce the effects of seasonal variations on pharmacy costs. Prescriptions for medications that are often used intermittently, such as pain medications or H2 antagonists, were considered maintenance drugs when the patients’ histories (paid claims) provided 3 months of evidence that the drug was being used on a regular basis.

Follow-up assessment of recommendations implemented, prescription costs PPPM, and the number of prescriptions PPPM occurred 3 months after suggestions were communicated to the provider, as many interventions did not take place until the next scheduled physician visit.

Physician office visits that were prompted by the drug regimen review were tracked by comparing the frequency of office visits in the 3 months prior to intervention to the frequency in the 3 months after intervention. Adverse drug events before and after pharmacy intervention were tracked similarly. Adverse drug events included allergic reactions, intolerance to medication, loss of effectiveness of medications, or worsening of a condition thought to be due to a change in medication.

The accuracy of the electronic medical record, the paper medical record, and pharmacy paid claims data were compared to the patients’ self-reports with respect to the medication list and regimen. Agreement with patient self-report, as the source of truth, was recorded for each information source. Patient self-report also was used to ascertain if any prescription medications were being filled outside the system (i.e., patient paid cash and did not present a health plan benefit card).

### Data Analysis

The number of conditions where treatment adhered to national or system guidelines was determined for each subject enrolled in the study. A Wilcoxon matched-pairs signed rank test was used to compare pre- to post- rate estimates, as the data were not normally distributed. Data from each patient were evaluated independently, whether or not they shared a physician.

The number of prescriptions per patient and cost were evaluated prior to and at 3 months post-pharmacist intervention, using a Wilcoxon matched-paired signed-rank test. A McNemars test was used to analyze the agreement between information sources.

### Justification for Number of Subjects

It was anticipated that the number of prescriptions PPPM should be about 9 ± 4 in this elderly population. One hundred patients were needed to detect a change in prescriptions of 1.1 per person, given an alpha of 0.05, at a power of 80% using a paired t-test to estimate power for the Wilcoxon matched-pairs signed rank test. The sample size allowed a 5% influence on average PPPM drug costs for this population to be detected with power in excess of 95% with a two-sided test at an alpha level of 0.05.

### Results

#### Pharmacy Intervention

A total of 80 patients, average age 71.2 ± 6.17 years (see Table 2, next page), were reviewed by two clinical pharmacists over a seven-to-eight-month period. The average number of medical conditions per patient was 3.7 (range 1–8), with each patient receiving an average of 7.6 ± 3.05 prescription medications per day. A large number of patients, 35/80 (43%), had decreased renal function (CrCl < 50%), while only one patient had hepatic dysfunction. Three patients had some degree of dementia.

Nonadherence as well as risk of nonadherence to medication regimens was assessed for each patient using a variety of methods. The Koecheler risk assessment tool predicts noncompliance risk based on the presence of a variety of indicators, such as the use of five or more medications regularly, the need for 12 or more medication doses per day, etc. (see Table 3, next page). The tool detected 22 patients at high risk of noncompliance with 23 and 35 patients at low and moderate risk, respectively. Pharmacists also interviewed patients and determined, based on patient reporting, how adherent they were on a weekly basis to their prescribed medication regimens. A third assessment of compliance was made by pharmacists who evaluated pharmacy paid claims data for lag time in prescription refilling.

In this evaluation, patients’ self-assessments of adherence did not agree with assessment of adherence through pharmacy paid claims data (see Table 3, next page), nor did it compare well with Koecheler risk assessments. Further study in this area is needed to better discern the most reliable method of assessing nonadherence in this population. Physicians were alerted to patients with significant medication adherence problems. Most patients at high risk of medication nonadherence received counseling and individual medication calendars.

An average of 92.9 days (range 82–153) elapsed between presenting recommendations to the PCP and follow-up. The results, summarized in Tables 4 and 5, indicate a decrease in the average cost of prescriptions PPPM of $17.04 ± 7.01 (p=0.012), and a decrease in the average number of prescriptions PPPM of 0.5 (p=0.001). The number of medical encounters and adverse effects did not change significantly (p=0.077, p=0.672, respectively).

A total of 206 interventions (73.5%) were implemented during this period. Eighteen medications were discontinued because they were not necessary. Thirty-nine recommendations for new or different drug therapies were made because they were deemed necessary but not currently prescribed. Many of these recommendations required addition of medications or a change in choice of medications, and some required addition of laboratory monitor-
Quality and Cost Outcomes of Clinical Pharmacist Interventions in a Capitated Senior Drug Benefit Plan

### TABLE 2 Baseline Demographics and Clinical Characteristics for 80 Enrolled Seniors

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average ± SD age of patients (yr)</td>
<td>71.2 ± 6.17</td>
</tr>
<tr>
<td>Number of males/females</td>
<td>30/50</td>
</tr>
<tr>
<td>Average number of medical conditions (range)</td>
<td>3.7 (1-8)</td>
</tr>
<tr>
<td>Average ± SD number of prescriptions per patient</td>
<td>7.6 ± 3.05</td>
</tr>
<tr>
<td>Patients with CrCl ≤ 50%</td>
<td>35/80 (43%)</td>
</tr>
<tr>
<td>Patients with hepatic dysfunction (Child-Pugh Score ≥ 1)</td>
<td>1/80 (1.25%)</td>
</tr>
<tr>
<td>Patients with some dementia</td>
<td>3/80 (3.75%)</td>
</tr>
</tbody>
</table>

### TABLE 3 Compliance Assessment by Patient Self-Assessment and Paid-Claims Assessment

<table>
<thead>
<tr>
<th>Number of patients falling into low, moderate, and high risk categories per Koecheler non-compliance risk assessment*</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients claiming to take &gt;80%, 50%-80%, or &lt;50% of doses prescribed as per patient self-assessment of compliance through pharmacist interview†</td>
<td>61 (&gt;80%), 18 (50%-80%), 1 (&lt;50%)</td>
</tr>
<tr>
<td>Number of patients taking &gt;80%, 50%-80%, or &lt;50% of doses prescribed as per paid claims assessment of compliance‡</td>
<td>49 (&gt;80%), 29 (50%-80%), 2 (&lt;50%)</td>
</tr>
</tbody>
</table>

* Koecheler noncompliance risk assessment based on the presence or absence of the following prognostic indicators: lower risk, 1-2 indicators = lower risk, 3-4 indicators = moderate risk, and 5-6 indicators or history of noncompliance = highest risk. Prognostic indicators include: five or more medications in present drug regimen, 12 or more medication doses per day, medication regimen changed four or more times in the past 12 months, more than three concurrent disease states, history of noncompliance, and the presence of drugs that require therapeutic drug monitoring.

† The patient’s response to the question, “Approximately how many doses per week do you think you forget to take?”

‡ Based on paid claims, the number of days late in refilling maintenance medications based on days supplied.

### Agreement Between Information Sources

Prescription paid claims data agreed with the patients’ accounts of what medications they actually were taking at home 87.5% (70/80) of the time. The prescription paid claims data and the medical record (office notes listing what the physician believed the patient to be on) agreed 56.3% (45/80) of the time. The agreement between the medical record and patient account was also 56.3% (45/80). The three sources of data agreed with each other 55% (44/80) of the time, with complete disagreement occurring 10% (8/80) of the time. The 87.5% agreement rate was significantly higher than the 56.3% rate for patient account versus the medical record (or medical record versus prescription paid data) with p-value less than 0.001.

### Patient and Physician Satisfaction Survey

All patients enrolled in the study were sent mail surveys along with pre-addressed, pre-paid return envelopes to assess their satisfaction with the interactions that had taken place with the pharmacist. Patients were asked to rate the importance of the service that had been provided on a scale of 1 to 10, with 10 being of highest importance and 1 of no importance. Twenty-five percent of the patient surveys were returned. Survey results indicated a high degree of patient satisfaction, with more than 90% of patients rating the importance of the interaction 8 or greater. The physician surveys that were completed (12/23) indicated a high degree of service satisfaction, with 100% of physicians rating the importance of the interaction with the pharmacist 8 or greater.

### Effect on Total Costs

Total cost of care for enrolled patients was evaluated for the 4 months prior to randomization, then again 4 months after pharmacy intervention. The change in total cost of care, which included external costs, inpatient costs, outpatient costs, and pharmacy costs, was not statistically significant (see Table 6, page 129).

### Discussion

The primary aim of this study was to measure the impact of medication regimen review and redesign by a clinical pharmacist on quality of care. The term quality of care implies adequacy of clinical interventions. In this study of clinical interventions, the adequacy of many medication regimens improved through increased adherence to national guidelines. To our knowledge, this trial is the first to provide evidence that adherence to national guidelines (our marker for quality of care) can be improved through drug regimen review and redesign without adversely affecting the total cost of care.

Pharmacy intervention studies traditionally have been designed to measure clinical outcomes, humanistic outcomes (patient satisfaction), or economic outcomes. Studies that have measured both clinical outcomes and economic outcomes generally have focused on one aspect of health care costs, such as pharmacy costs, hospitalization costs, or the number of emergency interventions such as lifestyle modifications or introduction of blood glucose monitoring also were categorized as needed but not prescribed. Twenty-seven dosage changes were made. As a result of intervention, 22 patients switched to a lower-cost drug alternative.

A total of 294 disease conditions (patients often had multiple conditions) were found to have corresponding evidence-based guidelines; 238 unique cases (80.9%) were in alignment with these guidelines prior to intervention from the pharmacist, 262 (89.1%) were in alignment after intervention. Congestive heart failure, diabetes, and hypertension were the most common disease states. This represents a 10.2% increase in alignment (p=0.001).
Impact of Intervention on Total Number of MedicationRegimen Reviews

In the study, pharmacists were able to reduce polypharmacy (average number of maintenance prescriptions PPPM) and average prescription costs (maintenance drugs only) PPPM, again without affecting total cost of care. It should be noted that drug costs for this outcome measure (see Table 6) were calculated manually by the clinical pharmacist in order to extrapolate drug costs after the $1,000 benefit was consumed. The drug costs were reduced by $17.04 ± 7.01 (p=0.012). Annually, this could result in a $204.00 savings per patient, extending the drug benefit 2 to 3 months longer per year. Each medication regimen review required approximately 2 hours of the pharmacist’s time, thereby enabling us to show significant differences with pre- and post-measures despite the reduced sample size.

### TABLE 4 Impact of Intervention on Alignment with National and System Guidelines

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time</th>
<th>No. of cond.</th>
<th>% diff</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment*</td>
<td>pre-</td>
<td>238</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>post-</td>
<td>262</td>
<td>10.2</td>
<td>0.001</td>
</tr>
<tr>
<td>* Number of patient conditions with disease management in alignment with national or local health-system guidelines.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 5 Impact of Intervention on Total Number of Medical Encounters/Adverse Events

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time*</th>
<th>Mean</th>
<th>St Err</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of medical encounters</td>
<td>pre-</td>
<td>2.86</td>
<td>0.22</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>post-</td>
<td>2.50</td>
<td>0.15</td>
<td>0.077</td>
</tr>
<tr>
<td>Number of adverse effects</td>
<td>pre-</td>
<td>0.09</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>post-</td>
<td>0.05</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>diff</td>
<td>-0.04</td>
<td>0.06</td>
<td>0.672</td>
</tr>
</tbody>
</table>

*Total number of medical encounters and adverse events 3 months prior to the intervention were compared to the 3-month period immediately following the intervention.

### TABLE 6 Secondary Outcomes Measures of Cost Impact

<table>
<thead>
<tr>
<th>Cost Variables</th>
<th>Time</th>
<th>Mean</th>
<th>St Err</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average prescription cost</td>
<td>pre-</td>
<td>175.70</td>
<td>10.35</td>
<td></td>
</tr>
<tr>
<td>PPPM (maintenance drugs only)</td>
<td>post-</td>
<td>158.66</td>
<td>10.36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>diff.</td>
<td>-17.04</td>
<td>7.01</td>
<td>0.012</td>
</tr>
<tr>
<td>Average number of maintenance</td>
<td>pre-</td>
<td>7.6</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>prescriptions PPPM (maintenance drugs only)</td>
<td>post-</td>
<td>7.1</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>diff.</td>
<td>-0.5</td>
<td>0.1</td>
<td>0.001</td>
</tr>
</tbody>
</table>

This study showed that pharmacists were able to reduce polypharmacy and maintenance drug costs PPPM without adversely affecting total cost of care. This was accomplished while the adequacy of medication regimens was improved. This implies that quality improvement efforts are not always associated with an increase in expense. Overall, average prescription costs PPPM were reduced by $17.04 ± 7.01 (p=0.012). Annually, this could result in a $204.00 savings per patient, extending the drug benefit 2 to 3 months longer per year. Each medication regimen review required approximately 2 hours of the pharmacist’s time, thereby providing a second quality of care marker. The number of adverse drug events did not change, validating that medical changes were appropriate and did not result in new or more drug-related problems. However, statistical power may have been deficient given that so few adverse events occurred both pre- and post-intervention.

The secondary aim of this clinical intervention trial was to determine whether the drug review process could reduce polypharmacy (average number of maintenance prescriptions PPPM) and average prescription costs (maintenance drugs only) PPPM, again without affecting total cost of care. It should be noted that drug costs for this outcome measure (see Table 6) were calculated manually by the clinical pharmacist in order to extrapolate drug costs after the $1,000 benefit was consumed. The drug costs included in the Total Cost of Care calculation (see Table 7, next page) were obtained from the health system claims database which are derived from the net health plan cost, calculated as the drug cost discounted by estimated rebate payments plus the dispensing fee and less the member cost-share (copayment). Hence, this cost would be zero ($0) for members after the $1,000 annual maximum was exceeded.

This study showed that pharmacists were able to reduce polypharmacy and maintenance drug costs PPPM without adversely affecting total cost of care. This was accomplished while the adequacy of medication regimens was improved. This implies that quality improvement efforts are not always associated with an increase in expense. Overall, average prescription costs PPPM were reduced by $17.04 ± 7.01 (p=0.012). Annually, this could result in a $204.00 savings per patient, extending the drug benefit 2 to 3 months longer per year. Each medication regimen review required approximately 2 hours of the pharmacist’s time, thereby providing a second quality of care marker. The number of adverse drug events did not change, validating that medical changes were appropriate and did not result in new or more drug-related problems. However, statistical power may have been deficient given that so few adverse events occurred both pre- and post-intervention.

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Quality and Cost Outcomes of Clinical Pharmacist Interventions in a Capitated Senior Drug Benefit Plan

**TABLE 7** Change in Total Cost of Care

<table>
<thead>
<tr>
<th>Variable</th>
<th>n†</th>
<th>Pre: mean ± SD</th>
<th>Post: mean ± SD</th>
<th>Difference: mean ± SD</th>
<th>Median</th>
<th>p-value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost*</td>
<td>72</td>
<td>4101 ± 6515</td>
<td>3278 ± 4445</td>
<td>-824 ± 5020</td>
<td>-145</td>
<td>0.146</td>
</tr>
</tbody>
</table>

*Includes external costs (external facility-ambulatory use), inpatient costs, outpatient costs and pharmacy costs incurred by plan after rebates and member co-payments; †Number of subjects with at least one change in cost (pre- or post-); ‡Wilcoxon matched-paired signed-rank p-value

high risk for noncompliance. Nineteen of these patients were noncompliant through patient self-assessment. Through inspection of pharmacy claims data, which provided the date the prescription was filled along with days supplied, 31 patients were found to be noncompliant. It appears that prescription claim data are a valuable way to identify the greatest number of noncompliant patients.

In this study it was found that prescription paid data agreed with the patients’ accounts of what medications they actually were taking more often than with the medical record (87.5% versus 56.25%, p<0.01). This finding is significant because the primary care physician relies on the dictated medical office note as a medication history source. This study found that pharmacy claims data provide a more accurate medication history than traditional office notes. Further studies are needed to measure the potential usefulness of pharmacy claims data as a clinical tool for physicians.

The value of this service has been recognized and has prompted the providers of the Senior Plus insurance to implement this service with high-risk Senior Plus members in an independent practice association (IPA) network. Patients are currently being identified through a case management nursing service. With the expanded population base, next steps in improving the process of drug therapy review will include the revision of process quality markers. Although local health-system and national guidelines will continue to guide pharmacy interventions, true outcome measures will be introduced and followed to allow for the continuous process improvement of this service.

**Conclusions**

Drug regimen review and redesign by clinical pharmacists was successful in improving adherence to national clinical practice guidelines and optimizing the pharmacy benefit for seniors. The health system benefited through improved patient and physician satisfaction (service outcomes) and was not adversely affected by a shift in costs to other areas of care. This study suggests that clinical and service quality need not be opposed to favorable cost outcomes and can be attained through clinical pharmacist interventions in high-use senior patients.

**DISCLOSURE**

Nella Bieszk is the principal author of this paper. Study concept and design, analysis and interpretation of data, and critical revision of the manuscript were performed by Bieszk, Tony Petitta, Nancy Whitelaw, Barbara Zarowitz, and Vinay Bhargava. The drafting of the manuscript was primarily the work of Bieszk and Zarowitz. Statistical expertise was contributed by the Department of Biostatistics, Henry Ford Health System and staff there also provided technical and administrative assistance. No outside funding supported this work.

**REFERENCES**

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