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Reducing Cost by Reducing Polypharmacy: The Polypharmacy Outcomes Project

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INTRODUCTION

Long-term care residents are generally frail and vulnerable elderly people with numerous and complex comorbid conditions. It is not surprising that this population receives more medications than any other population group.¹ Polypharmacy in long-term care settings is common, with a reported prevalence of approximately 40% in the U.S. (defined as taking nine or more medications),² 15.5% in Canada (nine or more medications),³ and 24.3% (range 8.8–56.7%) in European countries (10 medications).⁴ Although the use of multiple medications may be appropriate and necessary in the care of the complex long-term care population to optimize medical conditions or quality of life, polypharmacy can potentially expose residents to the risk of serious consequences because of age-related changes in pharmacokinetics and pharmacodynamics. Polypharmacy has been shown to be associated with increased risks of adverse drug reactions and drug-drug interactions.^{5–8} In addition to the pharmacodynamic and drug-drug effects of polypharmacy, inappropriate and unnecessary medication use may waste limited medical resources and nursing staff time to administer medications. Drug-related adverse events also negatively impact health care costs

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CONFLICT OF INTEREST/DISCLOSURE

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by increasing hospital admissions,⁹ emergency room visits and clinic visits.¹⁰ This increased use of health care resources further burdens the health care system.

Potentially inappropriate medications, defined as medications with potential risks outweighing the potential benefits,¹¹ are widely used in the long-term care population.

Nursing home Residents with polypharmacy are often prescribed potentially inappropriate medications, with increased drug-drug interactions, emergency room visits, hospitalizations, death, and increased health care costs.¹²⁻¹⁵

Previous pharmacist intervention studies on medication management of the long-term care population have targeted polypharmacy, potentially inappropriate medication use, and healthcare costs.¹⁶⁻¹⁸ A physician intervention for polypharmacy among long-term care residents, **which we have reported previously**, demonstrated significant reduction in number of medications, but did not examine cost outcomes.¹⁹ To our knowledge, there are no other studies of a physician intervention for polypharmacy for long-term care residents in the U.S. The purpose of this study was to investigate the **effect on the** medication costs **of** a physician intervention using two readily available tools among long-term care residents with polypharmacy.

METHODS

Study Design and Population

The Polypharmacy Outcomes Project was a quality improvement study conducted at Kuakini Geriatric Care, a 180-bed long-term care and rehabilitation facility in Hawaii that serves as a major teaching site for the University of Hawaii Geriatric Medicine Fellowship program. This project was designed to partially fulfill core competency training for Geriatric Medicine fellows in Practice-Based Learning and Improvement (to know and apply scientific methods and analytic tools to improve patient care practices) and Systems-Based Practice (to demonstrate knowledge of the environmental context and health care systems) which are required by the Accreditation Council for Graduate Medical Education (ACGME).²⁰ Of the 160 residents at the facility in October 2007, 74 were identified as having polypharmacy, defined by the Minimum Data Set quality indicator criterion as taking nine or more medications.²¹ Two residents died and another two were discharged before the intervention, leaving a final sample of 70 residents. This project was approved by the Institutional Review Boards of Kuakini Medical Center and the University of Hawaii.

Data Collection

The medical charts of all the study participants were reviewed by nine Geriatric Medicine fellows using a standardized data collection tool. The data collected from the chart review included the names of medications, starting dates, therapeutic indications, dosages, frequencies of dosing, routes of administration, and nature of the order (scheduled or as needed). Scheduled and pro re nata (PRN) medications were defined as those given on a regular and as-needed basis, respectively. Demographic information gathered from the participating residents included age, gender, and level of care (intermediate care facility (ICF) or skilled nursing facility (SNF)). Data collection was monitored by a faculty geriatrician and two advanced Geriatric Medicine fellows for quality and consistency. Any possible data discrepancies were addressed by second data extraction and resolved through consensus. Medication costs were obtained from the Thompson Red Book 2006 and the nursing home consultant pharmacist, referenced against internet pharmacy sources.

Intervention

High risk medications among the final population of 70 residents with polypharmacy were identified by two tools. The first tool was the 2003 Beers Criteria, a comprehensive set of explicit criteria for potentially inappropriate medication use in elderly populations (aged 65 and older)²² partially adopted by the Center for Medicare and Medicaid Services (CMS) as a quality indicator measure for long-term care facilities. The second tool used in this study was the Epocrates online drug-drug interaction program, a regularly updated drug information database.²³ There were two steps in the medication review.

First, medication lists of the residents with polypharmacy were reviewed by the Geriatric Medicine fellows for any high risk medications based on the 2003 Beers Criteria. For each resident, the fellows then generated a list of recommendations: to continue, taper, or discontinue each medication. Medications were recommended to be continued if they were not listed on the Beers Criteria and valid indications were documented. Medications were recommended to be tapered if they were listed on the Beers Criteria but were unable to be safely discontinued abruptly. Medications were recommended to be discontinued if they were listed on the Beers Criteria and were able to be safely discontinued. Medications without documented indications for their use were recommended either to be discontinued or tapered as necessary.

Second, the medication lists were further reviewed using the Epocrates online drug-drug interaction program to reinforce the recommendations in view of potential drug-drug interactions or contraindications. A second set of recommendations of potentially unsafe medications to be discontinued or tapered was then generated. The faculty geriatrician revised and compiled the final recommendations for each resident incorporating the results of the two-step review process.

The two advanced Geriatric Medicine fellows and/or the faculty geriatrician contacted each nursing home resident's primary attending physician and discussed the final recommendations. Final decisions were made by the primary attending physician: either to continue, taper, or discontinue each medication. Long term viability of the project was an important goal; therefore no attempts were made to coerce the decision-making process of the primary physician. To ensure follow through, the actual final medication order was written by the fellow or the faculty geriatrician, with consent from the primary attending physician.

Statistical Analysis

The mean medication costs per resident per month before and after the intervention were calculated. Medication costs were compared using paired t-tests, with separate analyses for overall, scheduled and PRN medication costs. The overall administration time was calculated by multiplying the number of doses of discontinued medications by the average nursing time required to administer medications, previously reported to be 45 seconds per medication.²⁴ The nursing costs for medication administration were estimated based on nursing staff average hourly wage of \$23.10 using publicly available labor statistics²⁵ and RN/LPN staffing ratios at this facility.

We stratified the cohort by: (1) gender, (2) age group (>85 years old, < 85 years old), (3) level of care (intermediate care facility, skilled nursing facility), and (4) route of medication administration (by mouth or by tube), and repeated the analyses to compare means of overall medication costs before and after the intervention for each stratified group using paired t-tests.

We used descriptive statistics to study the costs of discontinued medications by categories. Medications were assigned to categories based on the most common effect or use of the medication.

SAS software package (version 9.2; SAS Institute, Cary, North Carolina) was used for the data analyses. Two-tailed p values were used and $p < 0.05$ was considered statistically significant.

RESULTS

Of the 160 residents in the long-term care facility, 74 (46.3%) were on nine or more medications. The final sample included 70 residents, after excluding four residents who died or were discharged prior to the intervention. The mean resident age was 82.7 years (range=47-104), with 55.7% aged 85 years and older. The majority of residents were female (72.9%). Although comorbidity data from this cohort were not available, the prevalence rates of stroke and Alzheimer disease among nursing home residents in Hawaii are higher than national average (29.5% vs. 20.1% and 17.6% vs. 16.9%, respectively).²⁶ Thus, the population in this study had a high prevalence of stroke and dementia with a high level of comorbidity.

Before intervention, the average number of medications per resident was 16.6 (11.3 scheduled and 5.3 PRN). During the intervention, **a total of 151** recommendations with average of 3.0 recommendations per resident, were generated for 71.4% of residents (50 of 70). Of these 50 residents, the recommendations were accepted by the primary attending physicians for 43 residents (86.0%) and were declined for 7 residents (14.0%). The mean number of medications per resident decreased from 16.6 to 15.5 after the intervention.¹⁹

Table 1 shows the mean monthly costs per resident for overall, scheduled, and PRN medications before and after the intervention. The mean monthly medication cost per resident was \$874.27 (\$814.05 for scheduled and \$60.22 for PRN medications). After the intervention, the overall, scheduled, and PRN medication costs all significantly decreased. Estimated cost savings from the reduction of nursing administration time after the intervention was \$22.43 per resident per month.

Table 2 displays the mean monthly overall medication costs per resident before and after the intervention, stratified by: (1) gender, (2) age group, (3) level of care, and (4) route of administration. Statistically significant reductions in medication costs were observed in all stratified groups except in the skilled nursing facility subgroup.

Table 3 displays the cost reductions by medication category. Gastrointestinal medications demonstrated the highest cost savings of all categories overall (e.g. promethazine and proton pump inhibitors). The category with the next highest savings was central nervous system-active medications, including benzodiazepines and fluoxetine. The next two categories were analgesics and diabetes medications. Diabetes medications demonstrated the highest cost savings for scheduled medications. The cost savings for the gastrointestinal, CNS and analgesic medications were primarily due to reductions in PRN medication use.

DISCUSSION

To our knowledge, this is the first study to systematically explore the cost savings of a simple physician intervention on polypharmacy among long-term care residents in the U.S. This nursing home polypharmacy reduction quality improvement project significantly reduced the number of medications¹⁹ and successfully demonstrated significant cost reductions in overall, scheduled, and PRN medications. The intervention by Geriatric

Medicine fellows and a faculty geriatrician used easily accessible tools: the 2003 Beers Criteria and an Epocrates online drug-drug interaction program. Significant cost reductions were demonstrated in both men and women, residents older than 85 and younger than 85 years, intermediate care facility residents and in medications taken by mouth and by tube. The greatest cost reductions were demonstrated due to reduction in gastrointestinal, central nervous system and analgesic medications.

This study used the 2003 Beers Criteria, the most frequently used explicit criteria¹³⁻¹⁵ to detect potentially inappropriate medications, and the Epocrates program to detect drug-drug interactions. The Beers criteria were updated in 2012 and are available online.²⁷ The Beers criteria have been utilized in multiple research studies^{13-15,28} [ENREF 13](#) including a large pharmacist-led intervention study on polypharmacy among long-term care residents in the U.S.¹⁷ There are three U.S. studies which reported cost savings for pharmacist interventions on NH residents with polypharmacy.^{17,18,29} One study reported actual cost reductions from recommendations that were accepted by physicians and potential cost reductions from recommendations that were subsequently rejected by physicians.¹⁸ There was a physician intervention study using the Good Palliative-Geriatric Practice algorithm to reduce polypharmacy among long-term care residents in Israel, which showed decreased medication numbers and costs as well as 1-year mortality and acute care facility referral rate.³⁰ However, to our knowledge, there have been no previous studies reporting cost savings from physician interventions for polypharmacy in U.S. nursing home residents.³¹

This project focused on the Beers criteria to determine appropriate medications, however, there are medications not listed on the 2003 Beers criteria which have been shown to be inappropriate among elderly nursing home residents, especially with advanced dementia.^{32,33} Thus, our intervention did not include additional medications which could have been discontinued, potentially resulting in even greater cost reductions.

Although this project consisted of physician medication reviews performed independently from the reviews routinely performed by the facility consultant pharmacist, many of the medications identified had been on lists previously generated by the consultant pharmacist. We used readily available quickly accessible tools. The time required by the fellows was significantly longer than the time needed by the faculty geriatrician due to familiarity with documentation and the tools. However, the entire review was completed over three 2-hour workshop sessions between the fellows and the faculty geriatrician who provided teaching. The time required to contact the primary physicians varied. For most medical directors, this review could be completed in collaboration with a facility consultant pharmacist, and the facility medical director, nurse practitioner, or physician assistant could contact the primary physicians as part of the medical director or quality improvement.

Optimal treatments for elderly long-term care residents with multiple medical problems sometimes include potentially inappropriate medications, or the combination of medications which may be susceptible to drug-drug interactions. It is critical to make individualized decisions with clinical judgment based on each patient's life expectancy and goals of care.³¹ In this study, medication lists were reviewed and recommendations were made by the Geriatric Medicine fellows and a faculty geriatrician. In addition, all the recommendations were discussed directly with each resident's primary attending physician either in person or on the phone to finalize the intervention, while other studies used indirect communication such as written reports.¹⁸

Limitations

The study was conducted at a single long-term care facility in Hawaii with a relatively small number of subjects. The study design was cross-sectional without a control group. The long-

term effects of the interventions in this study were not measured, and comparison to residents who did not receive the intervention was not performed.

Strengths

A long-term care facility with a stable environment and nursing supervision and monitoring is an ideal place to review the medication regimen systemically and to withdraw or taper medications cautiously and selectively. The Geriatric Medicine fellows and faculty Geriatrician were involved in all the intervention processes and final decisions were made by discussion with each resident's primary attending physician. The majority of attending physicians were not geriatricians.

We successfully implemented medication changes that had been previously recommended by the consultant pharmacist but had not been adopted, resulting in medication and cost reduction in addition to reduction already achieved by the consultant pharmacist. We felt that the success of this intervention beyond the results of the consultant pharmacist was because of the personal contact and phone calls with the primary physicians and the completion of the actual medication orders, providing a follow-through not usually available to consultant pharmacists.

Through the experience of this quality improvement project, eleven Geriatric Medicine fellows improved their understanding of polypharmacy in a long-term care setting. These fellows gained skills to identify potentially inappropriate medications and drug-drug interactions which are important in the care of nursing home patients. The fellows then applied their expertise and knowledge to improve clinical practice. Although we did not quantitatively measure the fellows' knowledge improvements, the fellows qualitatively reported and the faculty geriatrician evaluated improved ability to identify and reduce polypharmacy in the long-term care setting.

CONCLUSION

This study demonstrated that polypharmacy was extremely prevalent in a long-term care setting. Physician intervention using readily available tools to identify high risk medication use among long-term care residents with polypharmacy successfully achieved significant overall medication cost reduction. The intervention also potentially decreased nursing medication administration time and drug-related adverse health outcomes. This quality improvement project provided practice-based learning and improvement and systems-based practice core competency training experience to Geriatric Medicine fellows.

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Table 1

Medication costs before and after intervention (mean cost per patient per month in USD \$)

Medications	Pre-Intervention Cost (\$)	Post-Intervention Cost (\$)	Cost Change (\$)	p value
Overall cost (\$)	874.27±859.01	843.56±853.23	-30.71±47.93	<0.0001
Scheduled (\$)	814.05±843.51	801.14±846.67	-12.91±38.99	0.007
PRN (\$)	60.22±57.70	42.43±45.30	-17.79±33.14	<0.0001
Nursing cost (\$)	483.43±186.51	461.01±185.05	-22.43±41.65	<0.0001

Table 2

Medication costs before and after intervention by patient characteristics (mean cost per patient per month in USD \$)

Characteristic	Pre-Intervention Cost (\$)	Post-Intervention Cost (\$)	Cost Change (\$)	p value
Gender				
Female (72.9%)	877.62±972.39	843.68±969.00	-33.94±52.13	<0.0001
Male (27.1%)	865.29±449.44	843.26±427.19	-22.03±33.89	0.01
Age Group				
85 y/o (55.7%)	661.20±393.24	633.090±393.97	-28.11±51.41	0.002
<85 y/o (44.3%)	1142.34±1169.62	1108.355±1160.94	-33.98±43.77	0.0002
Level of care				
ICF (80%)	815.85±771.08	783.06±770.25	-32.79±49.64	<0.0001
SNF (20%)	1107.96±1152.20	1085.57±1129.22	-22.39±40.90	0.06
Route of Administration				
By Mouth (75.7%)	784.39±755.31	751.97±754.46	-32.42±50.88	<0.0001
Via Tubes (24.3%)	1154.50±1103.58	1129.12±1084.05	-25.38±38.12	0.01

Table 3

Medication cost reductions after intervention by medication category (mean cost per patient per month in USD \$)

Medication Category	Overall Cost Reduction (\$)	Scheduled Meds Cost Reduction (\$)	PRN Meds Cost Reduction (\$)
1. Gastrointestinal	9.25±22.70	3.64±19.02	5.61±13.62
2. CNS	4.87±20.01	0.64±5.38	4.23±19.41
3. Analgesics	4.09±16.64	0.53±4.42	3.56±16.16
4. Diabetic	3.81±31.91	3.81±31.91	0
5. Antimicrobials	3.51±13.75	3.51±13.75	0
6. Anticholinergic	3.25±13.63	0.04±0.36	3.21±13.64
7. Respiratory	1.66±8.76	0	1.66±8.76
8. Ocular	0.73±5.39	0.64±5.28	0.09±0.50
9. Cardiovascular	0.26±1.52	0	0.26±1.52
10. Topical steroids	0.13±0.61	0.09±0.50	0.04±0.36