Combining Quality Improvement and Geriatrics Training: The Nursing Home Polypharmacy Outcomes Project

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Abstract

To examine sustained effects of an educational intervention, we repeated a successful quality improvement (QI) project on medication safety and cost-effectiveness. In October 2007 and

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August 2008, facility leadership and geriatrics faculty identified all patients receiving 9 medications (polypharmacy cohort) in a 170-bed teaching nursing home and taught Geriatric Medicine fellows (n=12 in 2007, 11 in 2008) to: 1) systematically collect medication data; 2) generate medication recommendations (stop, taper, or continue) based on expert criteria (Beers Criteria) or drug-drug interaction programs; 3) discuss recommendations with patients' attending physicians; and 4) implement approved recommendations. Over the two projects, the polypharmacy cohorts demonstrated decreased potentially inappropriate medications (odds ratio (OR) 0.78, 95% confidence interval (95%CI)0.69–0.88, p<0.001), contraindicated medications (OR=0.63, 95%CI=0.47–0.85, p=0.002) and medication costs (OR=0.97, 95%CI=0.96–0.99, p<0.001). Our findings suggest that programs planning educational QI projects for trainees may benefit from a multi-year approach to maximize both clinical and educational benefits.

INTRODUCTION

Clinicians require skills in developing, implementing and leading quality improvement (QI) programs (Brennan, 2002; Holmboe, 2007), however, inadequate QI training is a barrier (Audet, 2005; Brennan, 2002; Kim, 2010). Nursing homes are ideal sites for teaching QI (Tolson, 2011). Polypharmacy, common in nursing homes, (Dwyer, 2010; Tamura, 2012a) provides an excellent focus for QI initiatives (Hughes, 2011; Little, 2013). Many nursing home patients require multiple medications for chronic medical problems and face higher risks of potentially inappropriate medications, potential drug-drug interactions, and health care costs (Rollason, 2003; Tamura, 2012b).

The Polypharmacy Outcomes Project QI model was developed in 2007 and optimized medication safety and cost-effectiveness (Kojima, 2012; Tamura, 2011), educated practicing physicians, and trained Geriatric Medicine fellows on QI project implementation, but longer-term outcomes were not examined. We repeated the project one year later because we suspected that polypharmacy remained a problem in the facility, despite improvements from the 2007 project, possibly because of unsustained changes in physician practice and clinical training to support optimal prescribing. The goal in 2008 was to further modify physicians' prescribing patterns and fellow clinical training to sustain avoidance of inappropriate medication use in future years. We describe our QI model, and examine medication and educational impacts over the two years.

METHODS

Study Design

In October 2007, the nursing home performance improvement team, led by the medical director and director of nursing, teamed up with the Geriatric Medicine faculty and 12 Geriatric Medicine fellows to develop and implement a polypharmacy QI project. To assess

sustained practice changes one year later and effectiveness of a second intervention and to further enhance sustained practice changes, the project was repeated in August 2008, with 11 Geriatric Medicine fellows (5 new first-years, 6 returning second-years). The university and facility Institutional Review Boards approved this de-identified QI project.

QI Project

Each year, the project included six phases (Table 1). The polypharmacy cohort, based on the facility's Medicare-mandated Minimum Data Set quality indicator report, included all patients receiving   nine medications. Patients who died, were discharged, or had rapidly changing medication lists prior to the intervention were excluded. Fellows were trained to identify high-risk medications with the 2003 Beers Criteria, a comprehensive set of potentially inappropriate medications for the elderly (Fick, 2003), and high-risk drug combinations or contraindications with Epocrates' online drug-drug interaction program (Dallenbach, 2007). Faculty reviewed all fellow recommendations before discussions with attending physicians.

Statistical Analysis

We compared counts (overall, scheduled, and *pro re nata* (as-needed) medications; potentially inappropriate medications; potential drug-drug interactions; high-cost medications ($100 per month); and monthly scheduled medication costs) within years (pre vs. post) and across the four points of time (pre-2007, post-2007, pre-2008 and post-2008) using negative bionomial or Poisson regression models. Negative binomial regression is useful when counts are common and the distribution may be skewed (i.e., number of medications). Poisson regression assumes the outcome is rare (many participants' count =0; i.e., mean number of contraindicated medications was <0.1 medications per patient per month). We used generalized estimating equations with unstructured covariance matrices to correctly handle the repeated measurements from the patients in the study, as 40 patients in the first-year cohort (n=70) were also in the second-year cohort (n=75). Data analyses used SAS, version 9.2 (SAS Institute, Cary, NC). All statistical tests were two-tailed and $p < 0.05$ was considered significant.

RESULTS

QI Implementation

The QI projects were feasible to conduct within the fellowship program didactic schedule. The pre-intervention training session required one hour, workgroup sessions needed five hours total to collect data and generate recommendations, and contacting attending physicians regarding medication recommendations required three hours. Geriatrics faculty and lead fellows worked closely with the facility performance improvement team to design and conduct the project and presented findings each year to the team. This collaborative relationship and QI model used in this project, involving facility leadership, faculty and fellows, serves as the template for ongoing QI projects in our fellowship program.

Recommendations and Discussions with Attending Physicians

The polypharmacy cohorts were cared for by faculty geriatricians, who supervise fellows, and non-geriatrician attending physicians, who do not supervise fellows. Fellows discussed faculty patients' recommendations directly with faculty attendings. Faculty assisted fellows to discuss recommendations with non-geriatrician attendings through telephone or in-person meetings. Discussions with attendings involved explaining the project, the Beer's criteria for inappropriate medications, the medication lists and the recommendations. The attendings responded with reasons for accepting or rejecting the recommendations.

Medication Outcomes over the Two Years

In 2007, recommendations most frequently targeted benzodiazepines, anticholinergic medications (i.e., antihistamines), and unused as-needed medications. Attendings were unaware that routine refills of as-needed medications at expiration dates contributed to medication costs and often accepted these recommendations. Recommendations were not always accepted. Of 65 recommendations for potentially inappropriate medications, attendings accepted 40 and rejected 25, frequently citing failure or intolerance of more appropriate medications. Four of the 25 rejected recommendations were for complex patients with end-stage disease, unstable psychiatric conditions, or unstable family dynamics.

In 2008, more recommendations targeted switching medications to cost-effective generics, especially bisphosphonates and proton pump inhibitors. Thirty recommendations targeted potentially inappropriate medications; attendings accepted 11 and rejected 19, 7 of which were for complex patients. Hospice or palliative care patients did not meet polypharmacy criteria for cohort inclusion.

In 2007, 74/160 (46.3%) patients had polypharmacy, and 70 were included in the intervention (4 patients died or were discharged before intervention). The patients' mean age was 82.7 years and 72.9% were female. In 2008, 81/168 (48.1%) patients had polypharmacy, and 75 were included in the intervention (five patients died or were discharged before intervention and one patient's medication list changed too rapidly for a meaningful intervention). The patients' mean age was 83.5 years and 65.3% were female.

Table 2 shows polypharmacy cohort medication characteristics before and after intervention each year. Using regression analyses, both years' interventions demonstrated significant reductions overall, scheduled, as-needed, potentially inappropriate, contraindicated, and high-cost medications and monthly scheduled medication costs.

Table 3 shows trends for medication changes over the two projects using regression analyses. Although overall effects were small, potentially inappropriate and contraindicated medications and medication costs decreased significantly over the two projects.

Lessons Learned

Five major lessons learned resulted in modifications in both years. First, data collection methods for fellows needed to be explicit, standardized and supervised in work sessions during protected didactic times to minimize distractions. Second, additional education was

required and provided to fellows during work sessions (i.e., a typical stepwise bowel protocol was not inappropriate or redundant medication use). Third, data collection forms were revised to enhance transfer of information and documentation, including comparisons with consultant pharmacist reviews (14 of 87 fellows' recommendations in 2008 were identified in the consultant pharmacist reviews). Fourth, additional training on QI methods was required and provided in 2008. Fifth, educational outcomes were initially not collected and were added in 2008.

Educational Impact

Key educational outcomes included fellows' rating of training sessions, performance on board exams and overall practice and training outcomes. In 2008, fellows rated the introduction session 4.75 (mean, using 5-point scale: 5=excellent, 4=very good, 3=good, 2=fair, 1=poor) and the three workgroup sessions 4.75, 4.66 and 4.33, indicating high acceptance. Ratings were not collected in 2007. On fellows' geriatric medicine board examinations, the average percentage of correct answers for the pharmacology section was 64% in 2006, 68.5% in 2007, 70.3% in 2008 and 70.5% in 2009. Table 4 displays practice and training outcomes resulting from these QI interventions. Since 2009, these practices have been assimilated into routine clinical care by attending physicians and geriatric medicine fellows.

DISCUSSION

Repeating the Polypharmacy QI project demonstrated: 1) room for improvement in physician prescribing habits after 2007; 2) the 2008 project was effective; 3) further repeating this project would likely result in diminishing returns, as reductions achieved in 2008 were smaller than in 2007; 4) the project overall was more effective in reducing potentially inappropriate or harmful (contraindicated) medications while overall number of medications did not decrease as much; and 5) the 2008 project resulted in ongoing practice and teaching changes to sustain the project goals through routine care at this facility (physician awareness, physician prescribing changes, and changes in fellows' clinical training), and strengthened collaboration with the facility performance improvement team, allowing ongoing quality improvement projects focused on other areas. Repeating this QI project was beneficial in terms of the medication outcomes, clinical practice outcomes and the educational impact of this project.

Repeating this project in 2008 may have helped physicians to complete the "unfreeze-change-refreeze" process critical in changing practice (Glanz, 2008). In 2007, the physician prescribing habits unfroze and changed, as previously reported (Tamura, 2011), but in 2008 we re-educated physicians and fellows on the importance of identifying potentially inappropriate medications, resulting in refreezing, or sustained practice change. The second year also primed this facility to expect ongoing collaborations with the faculty and fellows, resulting in annual quality improvement initiatives for the fellowship program with this facility performance improvement team. Programs planning educational QI projects for trainees may benefit from a multi-year approach to maximize both clinical and educational benefits.

This QI model followed literature recommendations (Thomas, 2006) to use free, readily available high-quality tools, quick clinical interventions connected to physicians' usual activities and stakeholder (the facility performance improvement team, faculty and fellows) involvement from the start to increase investment. Prior medical trainee-led QI projects targeted Internal Medicine, Family Practice, or Pediatrics residents (Fox, 1998; Frey, 2003; Leshan, 1997; Mohr, 2003; Naughton, 2010; Parenti, 1994), but none focused on geriatrics trainees or nursing home settings. We focused on the practice-based learning and improvement and systems-based practice Accreditation Council for Graduate Medical Education core competencies for Geriatric Medicine fellows (ACGME, 2005; Medina-Walpole, 2004; White, 2008) and educated non-geriatrician attending physicians about medication safety. Faculty providing structured QI experiences for trainees must overcome time constraints, organizational issues and knowledge deficits (Patow, 2009; Windish, 2009). We navigated knowledge and organizational challenges by building from lessons learned in the projects, developing data collection templates, training slides and collaborative relationships with the facility performance improvement team, and implementing best practices in clinical care.

This QI project enhanced interactions with the facility performance improvement team. Our facility Director of Nursing identified the polypharmacy cohorts using the MDS 2.0 polypharmacy quality indicator flag. The fellows and faculty collaborated with the consultant pharmacist and may have enhanced follow-through of some of the consultant pharmacist's monthly medication review recommendations. The project provided direct two-way discussion of recommendations with non-geriatrician attendings and translated accepted recommendations into actual written orders. After two years of this project, sustained changes in physician knowledge have occurred. Fellows' pharmacy section board scores improved. Physicians are more aware of potentially inappropriate medications and scrutinize medication lists on every patient at every visit. Fellows receive annual didactic training on potentially inappropriate medications and clinical training to develop the habit of assessing the need for every medication for each patient and tapering medications present on admission when indicated.

Multiple tools identify potentially inappropriate medications (Gokula, 2012). The Beers Criteria, developed by geriatric care experts (Beers, 1991), have been updated (Expert Panel, 2012; Fick, 2003) and validated in long-term care settings (Dedhiya, 2010; King, 2007; Ruggiero, 2010; Trygstad, 2005). Other tools for specific populations or settings could be substituted for the Beers Criteria, including the Screening Tool of Older Person's Potentially Inappropriate Prescriptions (STOPP) and Screening Tool to Alert Doctors to the Right Treatment (START) criteria (Gallagher, 2008), Good Palliative-Geriatric Practice (GP-GP) algorithm (Garfinkel, 2007), Improved Prescribing in the Elderly Tool (IPET) (Naugler, 2000), or Assess, Review, Minimize, Optimize, Reassess (ARMOR) (Haque, 2009).

Limitations and Strengths

This model could be implemented in various settings with Geriatric Medicine fellows, Family Medicine or Internal Medicine residents, and nurse practitioner, physician assistant or pharmacy students. The fellows' clinical knowledge and skills were not assessed,

although their recommendations resulted in improved tertiary clinical outcomes, suggesting enhanced knowledge and skills.

Conclusion

Repeating our Polypharmacy QI project resulted in ongoing practice and teaching changes at this facility (physician awareness, physician prescribing, and fellows' clinical training), and strengthened collaboration with the facility performance improvement team, allowing ongoing quality improvement projects focused on other areas. This model is replicable, with free, readily available tools, and accessible data collection instruments, introduction lecture slides and other information posted on the Portal of Online Geriatric Education website (POGOe #21297).

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Table 1

Quality Improvement Protocol.

Phase 1: Identification of target population: Polpharmacy Cohort The Facility Medical Director and Director of Nursing generated a list of all residents with nine or more medications using the Minimum Data Set polypharmacy quality indicator measure.
Phase 2: Pre-intervention training session The Medical Director and faculty geriatrician led a one-hour interactive seminar to train Geriatric Medicine fellows on polypharmacy, potentially inappropriate medications, and validated tools to identify high-risk medications.
Phase 3: Data collection in Structured, Supervised Work Sessions During Protected Didactic Time The Geriatric Medicine fellows used a standardized form to collect medication names, starting dates, therapeutic indications, dosages, schedules, routes of administration, and nature of the prescription (scheduled vs. as needed, PRN) for each patient with polypharmacy from the physicians' order sets in the nursing home medical chart.
Phase 4: Identification of potentially inappropriate medications The Geriatric Medicine fellows identified potentially inappropriate medications using the Beers Criteria and generated a recommendation to discontinue, taper, or continue each medication.
Phase 5: Identification of potential drug-drug interactions and contraindicated medications The Geriatric Medicine fellows and faculty identified potential drug-drug interactions and contraindicated medications using Epocrates online drug-drug interaction program, and the faculty geriatricians reviewed and approved the final set of recommendations for each patient.
Phase 6: Implementation The Geriatric Medicine fellows and faculty geriatrician met in person or called each patient's attending physician, discussed the recommendations, educated the attending physicians on the Beers Criteria and inappropriate medication use, elicited the patient's clinical situation and wrote orders to change the medications for recommendations approved by the attending physicians.

Table 2

Pre- and Post-Quality Improvement (QI) Project Medication Measures in 2007 and 2008.

Medication Measures (mean per patient)	2007 (n=70)[1]				2008 (n=75)			
	Pre-QI	Post-QI	change	p value	Pre-QI	Post-QI	change[2]	p value
Overall medications	16.6	15.5	1.1	<0.001	16.7	16.5	0.2	<0.001
Scheduled medications	11.3	11.0	0.3	<0.001	11.9	11.9	0.1	0.02
As-needed (PRN) medications	5.3	4.5	0.8	<0.001	4.8	4.6	0.1	0.002
Potentially inappropriate medications	0.9	0.7	0.2	<0.001	0.6	0.5	0.1	0.007
Potential drug-drug interactions	6.1	4.8	1.3	<0.001	5.2	5.1	0.1	0.06
Contraindicated medications	0.3	0.1	0.2	0.002	0.1	0.04	0.08	0.01
High-cost medications[3]	2.6	2.5	0.1	0.02	2.2	2.1	0.1	0.005
Monthly scheduled medication costs[4]	814.05	799.52	14.53	0.006	755.37	726.06	29.31	<0.001

[1] Results from 2007 using simple t-test analyses have been previously published.

[2] Due to rounding, change does not always equal the pre- and post-QI differences.

[3] Medications which cost more than $100 (U.S.) per month

[4] Costs in U.S. dollars

All p values were determined using negative binomial regression (due to non-normal distribution of data) with unstructured covariance matrices, except p values for contraindicated medications, which were determined by Poisson regression due to rare occurrence of events.

Table 3

Pre- and Post-Quality Improvement (QI) Project Medication Measures, trend over time from 2007 to 2008.

Medication Measures (mean per patient)	OR	95% CI	p value for trend
Overall medications	0.99	0.98–1.01	0.49
Scheduled medications	1.00	0.99–1.00	0.34
As-needed (PRN) medications	0.97	0.95–0.99	<0.001
Potentially inappropriate medications	0.78	0.69–0.88	<0.001
Potential drug-drug interactions	0.95	0.90–1.00	0.06
Contraindicated medications	0.63	0.47–0.85	0.002
High-cost medications[1]	0.95	0.90–1.00	0.04
Monthly scheduled medication costs[2]	0.97	0.96–0.99	<0.001

[1] Medications which cost more than $100 (U.S.) per month

[2] Costs in U.S. dollars

OR: odds ratio; 95%CI= 95% confidence interval. All p values were determined using negative binomial regression (due to non-normal distribution of data) with unstructured covariance matrices, except p values for contraindicated medications, which were determined by Poisson regression due to rare occurrence of events.

Table 4

Polypharmacy Quality Improvement Practice and Training Outcomes.

Step 1: Facility-wide physician and fellow practice before first Quality Improvement project: • Multiple inappropriate medications, high-cost medications, medications on admissions sometimes continued without scrutiny. • Low physician awareness of inappropriate medication use criteria or costs of medications.
Step 2: Quality Improvement project in 2007: • Achieved reductions in inappropriate medication use and medication costs. • Every attending physician in facility received some education regarding inappropriate medication use and medication costs. • Every geriatric medicine fellow participated in project and learned about inappropriate medication use and medication costs. • Facility QI team collaborated in project and reviewed results of project. • Unclear long-term effects.
Step 3: Quality Improvement project in 2008: • Achieved reductions in inappropriate medication use and medication costs, although smaller effect than first year. • Every attending physician in facility received reinforcement of education regarding inappropriate medication use and medication costs. • Every geriatric medicine fellow participated in project and learned about inappropriate medication use and medication costs. • Facility QI team collaborated in project and reviewed results of project. • Significant trend in reducing inappropriate medication use.
Step 4: Sustained attending physician practice changes 2009-present: • Every attending physician is aware of criteria for inappropriate medication use and medication costs (due to presentations at Grand Rounds). • Every attending physician scrutinizes every patient's medication list and question necessity of each medication and more aggressively discontinues medications when patients are admitted to facility with polypharmacy.
Step 5: Sustained educational changes 2009-present: • Every geriatric medicine fellow receives formal didactic training on inappropriate medication use and medication costs. • Every geriatric medicine fellow receives clinical training to scrutinize every patient's medication list and question necessity of each medication. • As fellows graduate and become attending physicians, they are incorporating this training into their clinical practice and training others in these practices.