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Cost Reduction Associated with Comprehensive Medication Reviews in a Student-Run Free Clinic

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Abstract

Background: Patients taking multiple medications are at increased risk for drug-drug interactions, adverse drug effects, and increases in drug costs. Patients of low socioeconomic status and health literacy have further risk for experiencing these unwanted effects. This study aimed to determine if student-pharmacist led comprehensive medication reviews (CMRs) for patients of a student-run free clinic on multiple chronic medications decreased drug costs and inappropriate overprescribing of medications. Secondary objectives included determination of most overprescribed medication classes and the number and types of recommendations made by student-pharmacists.
Methods: Student-pharmacists conducted CMRs on consenting patients seen during a weekly student-run free clinic at a rural university clinic. Included patients were taking six or more chronic medications for two or more chronic disease states at the start of the visit. Information from patient interviews was used to make drug therapy recommendations to interprofessional student teams and an attending provider. Accepted recommendations were implemented into patients' care plans. The average 30-day drug costs of patients' medications before and after receiving a CMR were calculated using average wholesale prices and compared using paired t-tests. The most common drug classes recommended to be deprescribed and the total number of accepted recommendations (in the categories of safety, efficacy, and indication) were collected from forms used during CMR.
Results: A total of 31 CMRs were completed during the study period, with 92 recommendations made by students and 91% of recommendations accepted by the attending. Average drug costs for a 30-day supply of medication decreased from $698.16 pre-CMR to $619.31 post-CMR, a cost reduction of $78.85 ($p = 0.049$). The most common recommendations made by students were removal of an unnecessary drug (N = 27), dose too low (N = 15), and additional drug needed (N = 13). The two most overused classes of medications were selective serotonin reuptake inhibitors and proton pump inhibitors.
Conclusions: Student-pharmacist led CMRs conducted in a rural free clinic population resulted in a significant decrease in drug spending and identification of drug therapy problems.

Background

Adverse drug reactions, or unintended harmful effects of medications, cause significant burden for patients and have a large annual economic impact through increased medical visits, prolonged hospitalizations, injury, or death.[1-3] In the outpatient setting, over 4.3 million provider and emergency department visits occur annually as a result of adverse drug reactions.[4] The economic impact of these reactions is difficult to quantify, but may be up to $30 billion annually in direct and indirect costs.[5]

The term polypharmacy as it is used in literature and practice is an ambiguous term referring to multi-drug therapy, although there is no standardized definition. Some studies refer to polypharmacy as the general inappropriate use of medication while others place numerical values of the number of prescriptions patients receive.[6] Patients experiencing polypharmacy are at increased risk for adverse drug reactions

including serious reactions associated with hospital admissions.[7] Medication Therapy Management (MTM) is a service provided by pharmacists to help ensure optimal medication regimens for patients. MTM is especially important in situations of polypharmacy, as the service can help identify and resolve drug therapy problems. A large cross-sectional study which examined the benefit of performing a comprehensive medication review (CMR) in elderly patients on five or more medications found that, on average, approximately three medication related problems were discovered per patient, with a majority of these patients experiencing overtreatment or inappropriate over-prescribing of medications.[8]

Health literacy is also a potential risk factor for improper medication use and medication errors. Health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."[9] One study of patients with heart failure demonstrated that those living in urban areas have almost twice the health literacy when compared to rural communities (33% versus 61%). Low health literacy tends to be associated with low socioeconomic status and geographically rural areas.[10] MTM is a useful tool to assist patients with low health literacy, as the time spent with patients reviewing their medications promotes better patient understanding of medication uses and intended outcomes.

One way to prevent complications resulting from medication overuse and low health literacy is deprescribing. Deprescribing certain medications based on mutual goals between clinicians and patients can improve outcomes for patients taking multiple medications. The process of deprescribing requires identifying medications that have the potential to cause, or are causing, harm, and systematically removing them from the patient's care plan.[11] Though individual drugs alone may be causes of concern, the process of deprescribing looks at the patient's treatment plan cumulatively, as is done in a CMR, to assess for instances of harm related to medication overtreatment. Scott et al. describe a five-step "Deprescribing Protocol" by which inappropriate or unnecessary medications are identified. Steps one through three mimic the steps completed during a CMR, where information on the full medication regimen is gathered from patients and caregivers.[11] Steps four and five are used to develop and implement a plan for discontinuing medications.

Deprescribing improves outcomes and decreases overall healthcare costs.[12] A meta-analysis including 44 studies on the clinical and economic effects of pharmacy-led MTM services found that MTM improved clinically important outcomes such as medication appropriateness, adherence, and reduced medication dosing. Medication costs for patients receiving MTM were reduced overall in this study; however, there were large variations between the studies included. One of the goals of MTM services is to promote team-based care and optimize medication use for improved health outcomes. Studies show that MTM services such as pharmacist-driven CMRs can lead to identification of medication-related problems and a reduction in healthcare costs, especially in those with a complex medication profile and in the elderly.[12,13] Evidence on the clinical and economic benefits of MTM services, including CMRs, in underserved and socioeconomically disadvantaged populations is lacking.

Overall, patients taking excessive medications are at risk for more drug-drug interactions, adverse effects, inappropriate dosing, and increased financial burden. Patients with low health literacy and of lower socioeconomic status may be at an increased risk of such adverse outcomes due to language barriers or misunderstandings.[7] The primary objective of this study was to determine if completion of CMRs for patients taking six or more chronic medications led to a change in drug costs in a rural free clinic setting. Secondary objectives were to determine the drug classes most commonly associated with overprescribing and to classify the number of accepted recommendations made in the categories of safety, efficacy, and indication.

Methods

This study was a prospective, interventional study of patients seen in a student-run free clinic setting between September 2017 and August 2018 and was approved by Campbell University's Institutional Review Board.

Clinic Setting

The clinic setting for this study is a student-run charity care clinic in a rural setting. Approximately 20% of the population in the county the clinic serves is uninsured (total county population 115,000 as of 2015), and access to care can be difficult for some, as the two closest major cities are 45 minutes away. The clinic runs one night per week and serves approximately 200 patients in total. All clinic patients are uninsured. Healthcare services offered through the clinic focus on management of common chronic conditions, treatment of low-acuity acute conditions, pharmacy services (through the in-house pharmacy and Patient Assistance Programs), nutrition counseling, and referrals to specialty providers.

The clinic is staffed by six interprofessional teams of medical, pharmacy, and physician assistant students. Teams are overseen by attending physicians or physician assistants and a pharmacist. Social workers and social work students are also available at the clinic based on patient needs. Appointments are required for visits and approximately twelve patients are seen per clinic day.

Participants

Eligible patients were 18 years or older, on six or more chronic medications, and had two or more Centers for Medicare and Medicaid Services-defined core disease states (i.e. Alzheimer's disease, congestive heart failure, diabetes mellitus, dyslipidemia, end stage renal disease, hypertension, respiratory disease, osteoarthritis, rheumatoid arthritis, osteoporosis, or a mental health disorder). To ensure completeness, patients were excluded if they were receiving prescription medications from sources outside of the free clinic.

On weekly scheduled clinic nights, all student volunteers are briefed on clinic workflow and standard policies and procedures. Students are then divided into interprofessional teams and assigned patients. During the study recruitment period, student pharmacists were given an overview of the research project, including inclusion/exclusion criteria for the study, as a part of the standard clinic briefing.

Eligible study participants were given an overview of the research at their appointment by the student pharmacist and asked if they would like to participate in the study. Patients who agreed were provided with consent forms and any questions or concerns were addressed before the CMR was conducted.

Intervention

During the CMR process, the student-pharmacist gathered a full medication list, including prescription, herbal, and over the counter medications, and documented this information on a standardized form. Information on this form included: drug list, recommended changes in therapy, accepted therapy recommendations, rejected therapy recommendations, and reason the attending provider rejected a recommendation. Duplications in therapy, medication omissions, safety concerns, and areas for cost savings were analyzed. Patients were also asked a set of standard disease-state specific questions to determine if their disease states were controlled or uncontrolled and to gauge patient level of understanding on how and why they were using each medication (Online Appendix). Answers to these questions assisted student-pharmacists in making therapy recommendations to their provider team.

After reviewing the gathered patient medical information, any suggested changes in the pharmacotherapy for that patient (i.e. discontinue a medication; add a medication; change in therapy) were documented on the aforementioned form. During consultation with the team's attending provider, therapy recommendations were discussed, and resulting provider responses were documented on the form. At the end of the visit, the patient was given a care plan which included the medication action plan and a summary of the implemented medication changes.

Once the visit was completed, patients were seen at the clinic on their individualized schedule. Participation in the study did not impact future visits to the free clinic. Information for each patient's CMR and therapy recommendations were documented on paper forms and scanned into the patient's chart in the electronic health record (EHR) to improve continuity of care during future visits.

Outcomes

After the patient encounter, the total average wholesale price (AWP) for a 30-day supply of each

Table 1. Patient characteristics

Characteristic	
Female, n (%)	20 (64.5%)
Average age (range), years	53.5 (47-60)
Average medication count pre-CMR (range)	9.16 (6-16)
Average medication count post-CMR (range)	8.45 (6-15)

CMR: comprehensive medication review

medication the patient was taking before and after the CMR was calculated using pricing from the dispensing pharmacy's wholesaler. The primary endpoint was a change in monthly drug cost (measured by AWP) before and after the CMR was conducted.

The most common drug classes recommended to be deprescribed and the total number of accepted recommendations (in the categories of safety, efficacy, and indication) were collected from the CMR forms.

Statistical Analysis

A paired t-test was used to compare the change in the total monthly AWP for included patients before and after CMR completion using an a priori two-tailed alpha of 0.05. Of the 200 patients seen in the clinic annually, it was estimated that roughly 50% would meet the inclusion criteria to our study. Given the small population size, it was estimated to achieve 80% power, a true sample size calculation would not be needed; instead, an estimate of 15% of total free clinic patient population, or 30 CMRs, was used.

Results

During the intervention period, 31 CMRs were completed. Of the 31 patients enrolled in the study, 20 (64.5%) were female, with an average age of 53.5 (47 - 60) years, and taking an average of 9.2 medications at the start of the encounter (Table 1).

Results for the primary endpoint are found in Table 2. The average monthly medication cost to the clinic pre-CMR was $698.16 and average cost post-CMR was $619.31. This was a mean cost difference of -$78.85 per patient per month (p = 0.049). This difference is both clinically and statistically significant. There was an average reduction of -0.71 medications per patient pre- and post-CMR (range +1 to -7) which was also statistically significant (95% confidence interval -0.11 to -1.30, p = 0.021).

Table 2. Average total 30-day drug cost before and after participation in a comprehensive medication review (N = 31)

Average drug cost*	
Pre-CMR	$698.16
Post-CMR	$619.31
Difference†	-$78.85

CMR: comprehensive medication review
**Drug costs calculated with average wholesale price*
†p = 0.049

A total of 92 recommendations were made throughout the study period, with 84 recommendations (91%) accepted and eight recommendations rejected by the patient's attending provider (Table 3). The most common recommendations made by students were removal of an unnecessary drug (N = 27), dose too low (N = 15), and additional drug needed (N = 13). As determined by the disease-state questions asked of each included patient (Online Appendix), the two most overused classes of medications were selective serotonin reuptake inhibitors (SSRIs) and proton pump inhibitors (PPIs). Based on a review of follow-up progress notes documented in patients' EHR as well as their medication list documented in the pharmacy's dispensing system, it was identified that there were no reports of adverse effects or worsening of symptoms after medications were discontinued as a result of the CMR.

Discussion

Our study demonstrated that there is a potential for significant cost-savings through conducting CMRs for patients on multiple medications in a rural free clinic setting. A statistically significant average difference of $78.85 was saved per patient per month, which could result in large scale savings when performed continually in the clinic population for those meeting our parameters. Based on AWP, $251,683 was spent on drugs dispensed through the free clinic in 2017. Extrapolating annual savings based on these 31 patients,

Table 3. Number and type of accepted recommendations identified during CMR process

Safety	N	Efficacy	N	Indication	N
Duplicate therapy	3	Dose too low	15	Unnecessary drug	27
Dose too high	7	Adherence	1	Additional drug needed	13
Adverse effect	7	Counsel on device/drug	5		
De-escalate therapy	4	Escalate therapy	2		

there is a potential drug cost savings of $29,332 or 11.65% of annual drug costs through the addition of this service.

Participating patients generally left their visit with streamlined medication regimens; therefore, the potential for adverse drug reactions was reduced with no reports of worsening disease state control or symptoms after medication discontinuation. Identifying patients at risk of adverse events due to excessive drug therapy is important for patient safety and cost-savings. Our results support current literature on polypharmacy stating that many patients could benefit from CMRs and deprescribing to optimize outcomes.[11]

Polypharmacy represents a significant economic healthcare burden, the extent of which is difficult to estimate.[14] Adverse drug reactions have a high economic impact in both inpatient and outpatient settings, and these economic ramifications can be exacerbated in those experiencing health disparities.[1-3] Polypharmacy may be even more costly in those who are at an economic or educational disadvantage due to misunderstanding or financial burden that impairs proper medication use.[7] Deprescribing is an important tool to utilize as part of the effort to combat polypharmacy. Of the recommendations made in this study, 57% resulted in the removal of a medication either due to safety or the patient being on an unnecessary medication for their disease states. This leads to not only a decreased pill burden for the patient, but also a decreased propensity for adverse reactions.

Through a patient-centered protocol, providers were able to manage their patients' medications in a way that accounted for the adverse effects and risks of individual medications as well as the patient's entire medication regimen. Our study found that SSRIs and PPIs were the most overused medication classes in this patient population. Drugs in these classes can cause untoward adverse effects if not managed appropriately. The most commonly over-treated disease state was acid reflux. Patients were either taking a combination of a PPI and an H2 receptor antagonist (H2RA) but only needed one medication, or had an indication to de-escalate therapy from a daily PPI to a daily or as needed H2RA. Long term use of PPIs is associated with increased risk of bone fractures and dementia, especially in the elderly, and an increased risk for development of clostridium difficile associated infections. Certain SSRIs are known to cause sexual dysfunction, weight gain, QT prolongation, and hyponatremia.[15]

This study supports what is found in the literature: pharmacists are positioned to identify medication related problems and have a positive impact on the patient care process through MTM. Our study was unique in that it evaluated a typically underserved, low-income patient population with low health literacy, cared for in an outpatient setting. By assessing the effect of CMRs not only in an outpatient clinic but also in one that serves the underserved, we are able to start the conversation about closing the gap on healthcare disparities through CMRs. Previous studies indicate that low socioeconomic status and health literacy increase the likelihood a patient will have an adverse reaction to their medication.[7] Through this service we were able to not only increase access to affordable healthcare, but also implement this study to ascertain if CMRs benefit the patient and the clinic as a whole.

Limitations

One challenge faced during the initial recruitment period was ensuring student-pharmacists were aware when their patients were eligible for the study. Because of this, we did not recruit some patients who met inclusion criteria early on.

As a remedy, one of the medical student directors reviewed medication lists in the EHR for all patients with appointments that evening and made a list of potentially eligible patients. Student-pharmacists were alerted if their team was assigned one of these patients. This aided in improving student cognizance of the enrollment process so all eligible patients were included in the study.

The main limitation of our results is the generalizability to other free clinic populations due to the time commitment of each CMR and the integration of the student-pharmacist onto the interprofessional team. Our affiliation with a School of Pharmacy provides us with an ample supply of highly trained student-pharmacists to conduct these CMRs and provide physicians with feedback on medication regimens. It may be difficult for other student-run free clinics to replicate this clinical service if student-pharmacists are not available to complete the CMR. Additionally, it can be time-consuming to complete the full patient interview required during the CMR, so without the added help of students, other clinics may find it difficult to meet the time demand of their normal operations with the addition of completing CMRs for their patients. Lastly, aside from a chart review, there was no formal follow-up or surveys for patients after the completion of the CMR. Assessing changes in health status before and after administration of a CMR is an area of focus for future studies.

Conclusions

Despite numerous studies evaluating the therapeutic burden of varying definitions of polypharmacy, there are few that outline the financial strains on outpatient clinics.[6] Additionally, the literature is lacking in data focused on the underserved population in the United States. As indicated in this study, student-pharmacist completed CMRs conducted in a student-run free clinic population may have the ability to decrease costs for patients and the clinic. Further research is needed to determine long-term therapeutic benefit gained from participation in the CMR and simplification of patient medication regimens. In addition to cost savings, further studies should investigate changes in patient medication adherence, medication health literacy, and safety with a more simplified medication regimen. This study identified several areas where completion of CMRs by a pharmacy team member is beneficial, especially regarding the economic benefit in a rural free clinic setting.

Disclosures

The authors have no conflicts of interest to disclose.

References

1. Aronson JK. Distinguishing hazards and harms, adverse drug effects and adverse drug reactions: implications for drug development, clinical trials, pharmacovigilance, biomarkers, and monitoring. Drug Saf. 2013 Mar;36(3):147-53. LINK
2. Olsen S, Neale G, Schwab K, et al. Hospital staff should use more than one method to detect adverse events and potential adverse events: incident reporting, pharmacist surveillance and local real-time record review may all have a place. Qual Saf Health Care. 2007 Feb;16(1):40-4. LINK
3. Pirmohamed M, James S, Meakin S, et al. Adverse drug reactions as cause of admission to hospital: prospective analysis of 18 820 patients. BMJ. 2004 Jul 3;329(7456):15-9. LINK
4. Bourgeois FT, Shannon MW, Valim C, Mandl KD. Adverse drug events in the outpatient setting: an 11-year national analysis. Pharmacoepidemiol Drug Saf. 2010 Sep;19(9):901-10. LINK
5. Sultana J, Cutroneo P, Trifiro G. Clinical and economic burden of adverse drug reactions. J Pharmacol Pharmacother. 2013 Dec;4(Suppl 1):73. LINK
6. Bushardt RL, Massey EB, Simpson TW, Ariail JC, Simpson KN. Polypharmacy: misleading, but manageable. Clin Interv Aging. 2008;3(2):383-9. LINK
7. Chinthammit C, Armstrong EP, Boesen K, Martin R, Taylor AM, Warholak T. Cost-effectiveness of comprehensive medication reviews versus noncomprehensive medication review interventions and subsequent successful medication changes in a Medicare Part D population. J Manag Care Spec Pharm. 2015 May;21(5):381-9. LINK
8. Chau SH, Jansen AP, van de Ven PM, Hoogland P, Elders PJ, Hugtenburg JG. Clinical medication reviews in elderly patients with polypharmacy: a cross-sectional study on drug-related problems in the Netherlands. Int J Clin Pharm. 2016 Feb;38(1):46-53. LINK
9. Moser DK, Robinson S, Biddle MJ, et al. Health literacy predicts morbidity and mortality in rural patients with heart failure. J Card Fail. 2015 Aug;21(8):612-8. LINK
10. Fredericksen RJ, Gibbons L, Brown S, et al. Medication understanding among patients living with multiple chronic conditions: implications for patient-reported measures of adherence. Res Social Adm Pharm. 2018 Jun;14(6):540-4. LINK
11. Scott IA, Hilmer SN, Reeve E, et al. Reducing inappropriate polypharmacy: the process of deprescribing. JAMA Intern Med. 2015 May;175(5):827-34. LINK
12. Viswanathan M, Kahwati LC, Golin CE, et al. Medication therapy management interventions in outpatient settings: a systematic review and meta-analysis. JAMA Intern Med. 2015 Jan;175(1):76-87. LINK

13. Kiel WJ, Phillips SW. Impact of pharmacist-conducted comprehensive medication reviews for older adult patients to reduce medication related problems. Pharmacy (Basel). 2017 December 31;6(1):pii:E2. LINK
14. Frazier SC. Health outcomes and polypharmacy in elderly individuals: an integrated literature review. J Gerontol Nurs. 2005 Sep;31(9):4-11. LINK
15. Kostev K, Ehlken B, Rex J, Engelhard J, Altmann V, Heilmaier C. Which adverse effects influence the dropout rate in selective serotonin reuptake inhibitor (SSRI) treatment? Value Health. 2014 Nov;17(7):A460. LINK