Effects of pharmacy interventions at transitions of care on patient outcomes

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Purpose. An interdisciplinary group developed a care transitions process with a prominent pharmacist role.

Methods. The new transitions process was initiated on a 32-bed medical/surgical unit. Demographics, reconciliation data, information on medication adherence barriers, medication recommendations, and time spent performing interventions were prospectively collected for 284 consecutive patients over 54 days after the pharmacy participation was completely implemented. Outcome data, including 30-day readmission rates and length of stay, were retrospectively collected.

Results. When comparing metrics for all intervention patients to baseline metrics from the same months of the previous year, the readmission rate was decreased from 21.0% to 15.3% and mean length of stay decreased from 5.3 days to 4.4 days. Further improvement to a 10.2% readmission rate and a 3.6-day average length of stay were observed in the subgroup of intervention patients who received all components of the pharmacy intervention. Additionally, greater improvements were observed in intervention-period patients who received the full pharmacy intervention, as compared to those receiving only parts of the pharmacy intervention, with a 10.2-percentage-point lower readmission rate (10.2% vs 20.4%, $P = 0.016$) and a 1.7-day shorter length of stay (3.6 days vs 5.3 days; 95% confidence interval, 0.814-2.68 days; $P = 0.0003$). For patients receiving any component of the pharmacy intervention, an average of 9.56 medication recommendations were made, with a mean of 0.89 change per patient deemed to be required to avoid harm and/or increased length of stay.

Conclusion. A comprehensive pharmacy intervention added to a transitions intervention resulted in an average of nearly 10 medication recommendations per patient, improved length of stay, and reduced readmission rates.

Keywords: discharge medication reconciliation, length of stay, medication adherence, medication errors, pharmacists, readmissions

When patients transition from one level of care to another there are many opportunities for pharmacists to intervene to prevent errors and optimize care. Numerous studies indicate that errors during transitions of care (TOC) are common.[1-3] Medication errors in particular are very frequent in this period, with medication transition errors accounting for about one-half of reported TOC errors.[3-5] It is reported that 12% to 20% of all discharged patients have an adverse medication event after discharge, with 30% to 50% of these errors classified as posing a risk of serious morbidity.[6-8]

In addition to resulting in increased morbidity, transition errors increase direct medical costs. In 2007, the cost to Medicare of 30-day readmissions was over $15 billion. Studies indicate that 50% to 75% of these readmissions are avoidable, representing an important opportunity for healthcare providers. Research has shown that in patients greater than 65 years of age, up to 23%

of readmissions are due to medication-related problems.[8-10]

Since medication errors are one of the most common types of transition errors, it seems logical that a pharmacist should become more integrally involved in TOC processes. In addition to medication reconciliation, many other medication issues that affect outcomes may occur at transitions. A transition encounter with a pharmacist offers an opportunity to assess and improve medication adherence, patient medication knowledge, and optimization of medication therapy. All of these medication-related activities could further improve patient outcomes. Supervising obtainment of accurate medication histories, performing medication adherence interviews, and optimizing medication adherence and medication therapy based on patient-specific information constitute a skill set emphasized in pharmacist training programs, making pharmacists highly qualified members of transition teams.

Literature regarding the pharmacist's role within TOC programs has been overwhelmingly positive. A 2012 systematic analysis of medication transition programs indicated that successful programs were characterized by pharmacy staff involvement in the obtainment of a medication history, pharmacist review of medication reconciliations, direct communication between providers and pharmacists, and telephone follow-up with patients after discharge.[7] A meta-analysis of 19 studies including 15,525 patients indicated that pharmacist-led medication reconciliation programs led to a significant reduction in the likelihood of medication discrepancies (relative risk, 0.34; 95% confidence interval [CI], 0.23-0.5).[11] A 2018 review of 29 studies (72% of which were in the United States) found a statistically significant reduction of readmissions in 16 of 29 studies (55%), with relative risk reductions ranging from 3.3% to 30%.[12] Of the 29 studies, 9 focused primarily on predischarge medication reconciliation. The researchers concluded that pharmacists provide substantial value

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KEY POINTS

- A comprehensive pharmacy intervention added to a transitions intervention resulted in nearly 10 medication change recommendations per patient.

- Decreased length of stay and reduced readmission rates were also noted, with greater changes observed when the full pharmacy intervention was completed.

- Significant barriers overcome during program implementation included time constraints; conflict related to overlapping roles of pharmacy staff, nurses, and physicians; scheduling barriers; and training requirements.

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when working individually or as part of an interdisciplinary team.

A systematic review of randomized studies of patients with heart failure looked at the pharmacist's role in patient care and showed not only a significant reduction of heart failure–related hospitalizations (odds ratio [OR], 0.69; 95% CI, 0.51-0.94) but also a significant reduction in all-cause hospitalizations (OR, 0.71; 95% CI, 0.54-0.94).[13] Clinical pharmacists' involvement in TOC for patients with heart failure, a particularly high-readmission-risk population, has also been demonstrated to have a positive effect on relevant patient outcomes.[14] Across patient subpopulations, especially those deemed at high risk for readmission, involvement of pharmacists has been shown to be beneficial. However, few studies have evaluated pharmacists' contributions to the care of patients at all readmission risk levels.

Here we will report on the process of developing and implementing the pharmacy component of an interprofessional inpatient transitions intervention that focused on patients admitted and discharged from a hospital
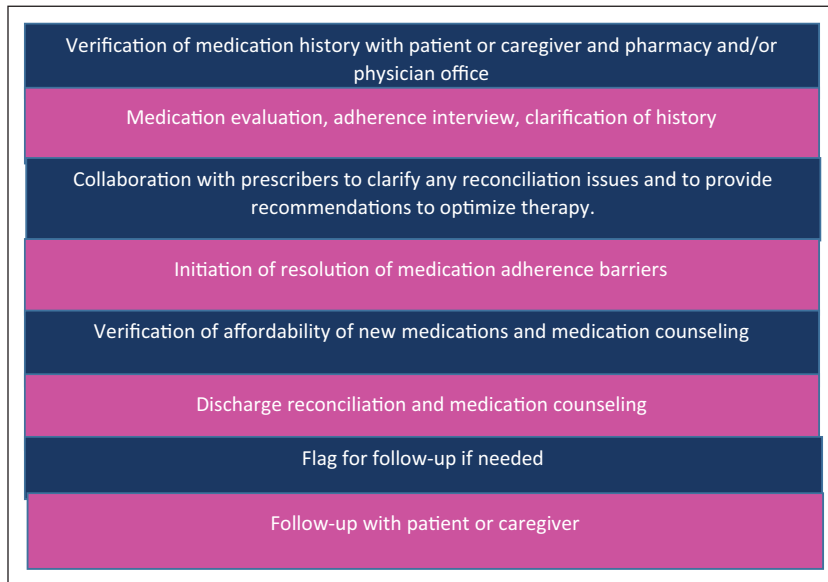
unit—regardless of their level of risk for readmission. In addition, we will identify barriers that were encountered, discuss tools that were developed to increase efficiency, and describe the following outcomes: number of medication recommendations, 30-day readmissions, and length of stay.

Methods

The project was determined to be a quality improvement project by the hospital's institutional review board. An interprofessional group consisting of administrators, physicians, nurses, social workers, pharmacists, psychologists, information technology specialists, respiratory therapists, and quality improvement specialists was formed to develop a new process to improve patient outcomes around the time of care transitions. Modeled after Boston University's Project RED (Re-Engineered Discharge),[15] the program used existing nursing and social work personnel to create a patient-centered, team-based approach to improving TOC. This new process for transitions was provided to all patients admitted to and discharged from one medical/surgical unit at the study site. Strategies to improve communication included daily interprofessional discharge planning rounds and use of an electronic health record with communication fields. The primary purpose of the communication fields included, but was not limited to, the communication of any potential medication-related barriers to discharge. In addition, an effort was made to ensure that patients understood their after-visit care plans and that primary care and specialist postdischarge appointments were scheduled prior to discharge. In Project RED, a nurse care manager was added to the care team to help coordinate transitions, whereas our program instead added dedicated pharmacy staff to a unit-based transition team.

The pharmacy process. There were 8 key components in the full pharmacy intervention (Figure 1). This process incorporated a pharmacy assistant in several steps. Within Summa Health System, Akron, OH, a pharmacy

Figure 1. Components of the pharmacy process for transitions of care at the study site.

Verification of medication history with patient or caregiver and pharmacy and/or physician office

Medication evaluation, adherence interview, clarification of history

Collaboration with prescribers to clarify any reconciliation issues and to provide recommendations to optimize therapy.

Initiation of resolution of medication adherence barriers

Verification of affordability of new medications and medication counseling

Discharge reconciliation and medication counseling

Flag for follow-up if needed

Follow-up with patient or caregiver

assistant is defined as a certified pharmacy technician with expanded task-specific training and responsibilities.

The pharmacy intervention begins with a pharmacy assistant obtaining a medication history. The pharmacy assistant obtains a medication history from the patient's pharmacies or, if necessary, physicians' offices. The pharmacy assistant then verifies this history through a patient or caregiver interview. Next, a comprehensive medication evaluation and a medication adherence interview are completed by the pharmacist. Any questions or discrepancies in the history may be resolved with the patient or caregiver at this time as well. The pharmacist then collaborates with the prescriber to clarify any reconciliation issues and to provide recommendations to optimize therapy. Subsequently, the pharmacist works with interprofessional team members, the patient, and patient caregivers to resolve identified medication adherence barriers and to continue to optimize therapy. As new outpatient medication therapy is finalized, the pharmacist performs medication counseling throughout the hospital stay. This includes a screen for high-cost medications to ensure

affordability and/or provide an opportunity to suggest more cost-effective alternatives. At discharge, the discharge medication list is reconciled by collaboration between the prescriber and pharmacist. The pharmacist then performs final discharge medication counseling just prior to discharge. If the patient has a medication-related issue that the pharmacist feels needs follow-up, the pharmacist uses clinical judgment to flag that patient for a follow-up phone call within 72 hours of discharge. In summary, the full pharmacy intervention for the project included medication history verification using 2 sources; comprehensive medication review; an adherence interview; collaboration with prescribers to clarify reconciliation issues and to optimize therapy; addressing medication adherence barriers; new medication counseling, with verification of affordability; discharge reconciliation, with just-prior-to-discharge medication counseling; flagging patients for follow-up; and a postdischarge phone call to those patients who were flagged for follow-up.

To improve efficiency and communication among pharmacy personnel during the pilot project, all data

collected were entered into an electronic patient profile that was not part of the permanent medical record. In addition to demographics, this profile contained all components of the patient intervention, including the medication adherence interview, the time spent performing each component of the intervention, medication discrepancies identified, medication recommendations made, and any follow-up needs identified.

Complete pharmacy participation included the addition of a full-time pharmacist and pharmacy assistant to weekday staffing. These positions were added to assist the efforts of an existing unit-based pharmacist who performed targeted monitoring and order verification for the unit. The pharmacists were cross-trained and often cross-covered each other, bringing the pharmacist:patient ratio to 1:16. The pharmacy assistant was responsible for collecting accurate medication histories, a function that was previously the responsibility of the nurse.

Overcoming barriers. Several barriers were encountered during the development and implementation of the pharmacy intervention. First, the time needed to perform a medication history and review was a concern; pharmacy assistants were deployed to overcome this barrier. Another barrier related to overlapping roles of pharmacists, pharmacy assistants, nurses, and physicians. This overlap initially led to some inefficiencies in communication and care. Re-education on the use of the interprofessional communication field in the medical record and regular inclusion of the pharmacist in interprofessional rounds helped to alleviate these issues. Another barrier identified was the inability to quickly obtain a list of medications from Veterans Affairs (VA) pharmacies. Meetings with representatives from a local VA facility resulted in development of policies at both institutions to expedite this process. Staffing issues also became a barrier. Use of data and case examples helped to justify permanent staffing of the pharmacist and pharmacy assistant

positions that were used during pilot testing, with additional staffing provided on weekends. Finally, at the time of implementation most of the pharmacy assistants and pharmacists had no prior training in the area of transitions. A thorough training program was developed to provide pharmacy assistants and pharmacists with the skills required in their new roles.

Training and education. Pharmacy assistants and pharmacists were educated on the poor outcomes associated with transitions issues, as well as methods to perform an accurate medication history, via didactic and simulation sessions. Pharmacists were also educated on a method (dubbed the COST-B method) developed by one of the authors to quickly perform a medication adherence interview (Table 1) and on different techniques for performing patient interviews and medication counseling. Competency was determined by both simulation exercises and direct observation of performance. A rubric was used to ensure consistency and competency in all required areas.

Outcome measurement. Components of the pharmacy process were initiated on a 32-bed medical/surgical unit at a 543-bed level 1 trauma unit at an academic medical center hospital in January 2016. Complete pharmacy staff participation, consisting of the addition of both a full-time transitions pharmacy assistant and a pharmacist during the pilot project, was fully implemented in May 2016. The medical/surgical unit

had a focus on pulmonary diseases but also admitted patients with other diagnoses, depending on daily hospital bed availability. Data were collected from all patients who were admitted during the first 54 days after implementation of complete pharmacy staff participation. Data from patients who were transferred off the unit were excluded. Demographic information, medication reconciliation data, and data on medication adherence barriers, medication changes, and time spent performing interventions were prospectively collected using the electronic patient monitoring form. Retrospectively collected outcomes data included 30-day readmission rates and hospital length of stay. Medication changes were ranked as "serious medication changes" if, without a change, a delay in hospital discharge, patient harm, or an increased risk of readmission was likely to occur, as determined by the first and second authors. For example, not restarting a multivitamin would not be included as a serious medication change, but not restarting a β-blocker in a patient with atrial fibrillation without a contraindication to reinitiating therapy (eg, bradycardia or hypotension) would be considered a serious medication change. Another common example was restarting a medication that had been intentionally discontinued by another provider or was self-discontinued by the patient prior to admission. If such medication use was stopped due to lack of efficacy, this was not rated as serious; however,

if it had been stopped due to a significant adverse effect of the medication, this was rated as serious. Readmission and length of stay data were compared to the unit's prior-year values for the same months. In addition, readmission and length of stay data were compared between patients in whom all 8 components of the pharmacy intervention were completed vs those receiving only partial intervention.

Statistical analysis. Descriptive analyses were used to report on demographics, medication reconciliation data, medication adherence barriers, other medication issues, and time spent performing the intervention and also for comparison of readmission and discharge data with historical data. Statistical analysis was done using SAS version 9.4 software (SAS Institute, Cary, NC). A χ^2 test was used to compare the difference in the proportions of patients with 30-day readmissions among those who received the full pharmacy intervention and those who did not. A 2-tailed 2-sample t test was performed to compare the difference in length of stay between the 2 groups.

Results

In all, 284 consecutive patients admitted after implementation of full pharmacy participation were included in the analysis. There were 176 patients under 65 years of age and 108 patients 65 years of age or older. There were 165 male patients and 119 female patients. Compared with a mean baseline readmission rate of 21.0% during the same months of the prior year, readmissions decreased to 15.3% during the intervention phase. A further decrease to 11.6% was noted when the adherence interview was completed, with the rate decreasing to 10.2% when all components of the pharmacy intervention were performed (Figure 2). Length of stay decreased from a baseline mean of 5.3 days during the same months of the previous year to 4.4 days with the intervention, with further decreases to 4.0 days when an adherence interview was completed and to 3.6 days when all components of

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Table 1. Quick Medication Adherence Screen: COST-B Method

Nonadherence Issue	Sample Open-ended Question
Cost	Medications can be expensive. How do you afford to pay for your medications?
Organization	How do you remember to take your medications when they are due?
Side effects	What side effects are you having from your medications?
Transportation	How do you obtain your medications?
Benefit	How are your medications helping you?

the pharmacy intervention were completed (Figure 3).

There was an attempt to provide the full pharmacy intervention to all patients, but staffing constraints during the pilot program made this difficult. The full pharmacy intervention was provided to 147 patients, while 137 patients received some parts of the intervention. For patients receiving only parts of the intervention, pharmacy verification of the medication history was not performed for 2.2%, 2.9% did not get a pharmacist medication admission reconciliation, 44.5% did not receive medication adherence counseling, 79.0% did not receive new medication counseling or assessment for a follow-up phone call, discharge medication reconciliation by a pharmacist was not performed for 18.2%, and 27.0% did not receive a discharge medication calendar. When comparing outcomes between the 2 intervention subgroups, patients receiving all components of the pharmacy intervention had a lower 30-day readmission rate (10.2% vs 20.4%; $P = 0.016$) (Figure 4). Mean length of stay was also 1.7 days shorter in the complete intervention group (3.6 days vs 5.3 days; 95% CI, 0.814-2.68 days; $P = 0.0003$) (Figure 5).

For patients receiving any component of the pharmacy intervention, the mean numbers of medications at the time of admission and at discharge were 10 (range, 0-32) and 11.4 (range, 0-29), respectively. There was also an average of 2.75 (range, 0-15) new "home-going" medications added prior to discharge.

A total of 207 patients were interviewed using the adherence screening tool. Of these, 80 (38.6%) reported medication adherence barriers. Adherence barriers identified by patients were as follows: cost (27.5%), lack of an organization system to ensure medications were taken when due (18.7%), adverse effects (13.7%), transportation issues (7.5%), and lack of knowledge on the benefit of therapy (5%).

Mean pharmacist and pharmacy assistant time spent per patient per hospital stay were 41 and 36 minutes, respectively (Figure 6). A mean of 9.56 medication change recommendations were made per patient. Approximately 1 change (actual value, 0.89) per patient was deemed to have potentially avoided harm or an increased length of stay.

Discussion

In a real-world, prospective, inpatient, transitional care quality improvement project, we were able to demonstrate a significant impact on relevant patient outcomes, including reduced 30-day hospital readmission rates and length of stay. These impacts were accomplished by preventing and correcting medication-related errors and optimizing medication therapy. The targeted patient population, consisting of those with predominately pulmonary-related hospitalizations, carries a high risk of readmission. Hospital reimbursement from the Centers for Medicare and Medicaid Services is directly related to readmission rates for patients discharged with a primary diagnosis of pneumonia. Not only did the comprehensive intervention reduce readmissions and length of stay, but the greatest reduction was seen when all pharmacy components of the intervention were completed, suggesting the importance of the pharmacy assistants' and pharmacists' roles in the intervention.

The large number of opportunities to intervene to improve medication therapy identified during the project was unexpected. This finding may have been due in part to the low health literacy of many of the patients regarding their home medication regimens, but there were also many opportunities to optimize medication regimens and improve medication adherence. It is noteworthy that over 10% of pharmacist-initiated medication changes (approximately 1 change per patient) were deemed to be critical enough by 2 of the authors such that failure to resolve these medication issues potentially would have led to a delay in hospital discharge, patient harm, or an increased risk of readmission.

Our project results confirmed those of other studies that have shown the impact pharmacists can have at care transitions.[11-16] In addition, we documented many opportunities to optimize a patient's medication therapy and adherence. Several other strengths of the project are worth noting.

First, we studied a real-world population in a real-world practice environment. Only patients transferred off

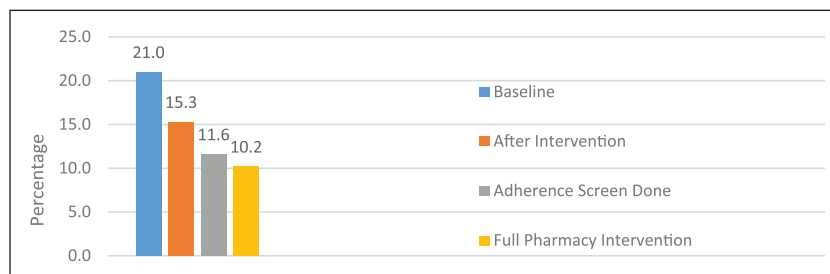**Figure 2.** Readmission rates at various stages of the intervention project.

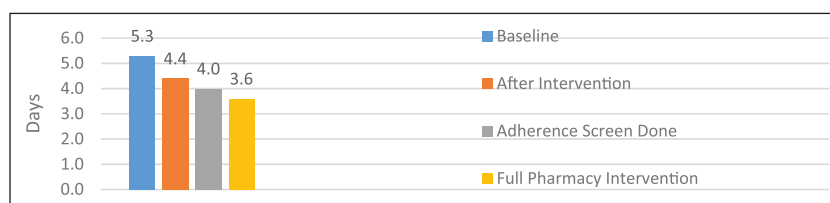**Figure 3.** Mean length of stay at various stages of the intervention project.

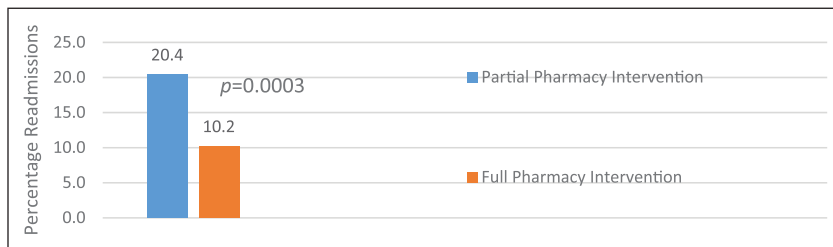**Figure 4.** Readmission rates with partial and full implementation of the pharmacy intervention.

Figure 5. Mean length of stay with partial and full implementation of the pharmacy intervention.
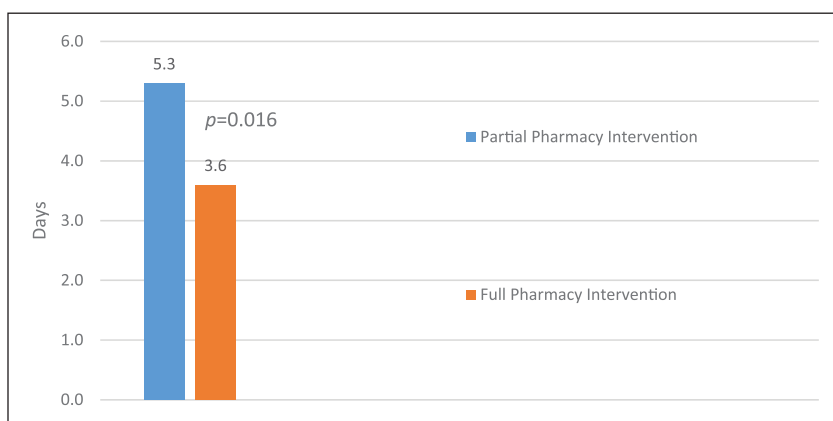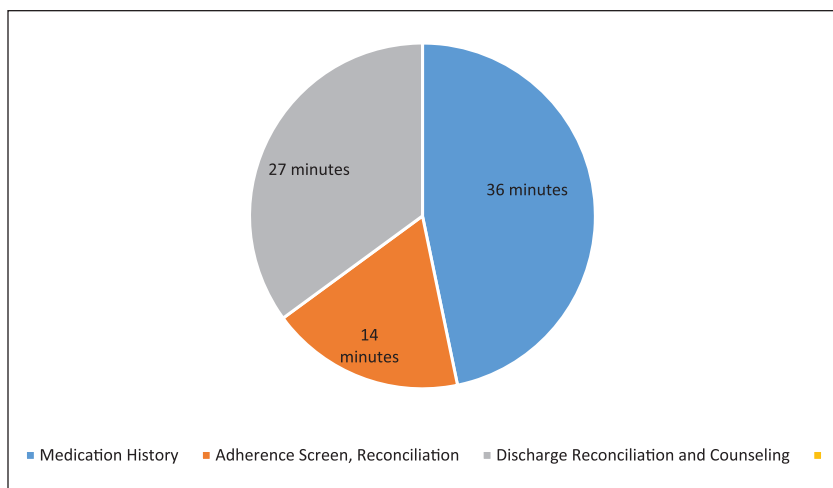

Figure 6. Mean time spent performing components of intervention (in minutes per admission).

This allowed for an after-discharge pharmacist phone call to communicate regarding any outstanding needs while also giving the pharmacist an opportunity to further coordinate with other members of the inpatient interprofessional team who may have been previously involved in a patient's care.

Study limitations included the fact that the quality improvement project was completed at a single hospital and that the patient population was admitted predominantly for pulmonary issues. While patients with other acute problems were routinely admitted or transferred to this unit, the results may not be applicable to other patient populations (eg, patients with primary heart failure, orthopedic surgery patients) or other hospitals. Another limitation was that some patients did not receive the full intervention. Although this allowed for the comparisons presented in this article, the baseline characteristics of the comparison groups were not tracked; therefore it is possible that the differences between those getting the partial intervention were due to something other than the lack of the full pharmacy intervention.

We were unable at the time of the project to find a validated adherence screen that covered the common causes of medication nonadherence that the authors documented in the evaluated patient population. Therefore the use of a nonvalidated adherence screen introduced another limitation.

The quality improvement project also allowed pharmacists to use their judgment to determine if a patient needed a call-back from a pharmacist. This nonstandardized approach may also be viewed as a limitation.

Finally, our pharmacy interventions were not the only changes occurring during the project period. Contributions from other team members cannot be overlooked, as multiple interventions likely also impacted outcomes. Still, the use of a tabulation of outcomes based on completion of the full vs partial pharmacy intervention

the unit were excluded. Our patient population included those with mental illness and/or cognitive impairment and those discharged to extended-care facilities. Therefore our model captured patients with an especially high risk of readmission, a wide range of illness acuity, and variable cognitive abilities. Also, our system allowed pharmacists to use their professional judgment to identify patients who might be at particularly high risk for readmission.

may have helped to isolate the specific impact of the pharmacy interventions.

Use of our transition model has continued, with expansion of staff to cover weekends and restructuring of the schedule for coverage of late afternoons on weekdays. Developing a staffing model for pharmacists that includes weekends as well as an overlap in coverage from mid-morning to late afternoon has helped to ensure that nearly all patients now receive the full intervention. The recent addition of an on-site retail pharmacy that provides delivery of discharge prescriptions to a patient's bedside has also improved and simplified the discharge process, further facilitating communication from the inpatient to outpatient settings. Outcomes continue to be sustained, and expansion of the program to additional hospital units has been approved.

Conclusion

Pharmacists and pharmacy assistants are essential members of the interprofessional care transitions team. A comprehensive pharmacy intervention added to a transitions intervention resulted in an average of nearly 10 medication change recommendations per patient. Decreased length of stay and reduced readmission rates were also noted, with greater changes observed when the full pharmacy intervention was completed. Significant barriers overcome during implementation of the program included time constraints; conflict related to overlapping roles of pharmacy staff, nurses, and physicians; scheduling barriers; and training requirements. Data from the program were used to justify 7-days-per-week pharmacist and pharmacy assistant coverage and hospital administrative

support for expansion of the program beyond the pilot testing unit.

Previous affiliations

At the time of the study, Dr. King was affiliated with Summa Health System, Akron, OH, as a clinical lead pharmacist. Dr. Sampson and Dr. Shah were affiliated with Summa Health System, Akron, OH, as pharmacy students.

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