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Pharmacist-Provider Collaborative Visits following Hospital Discharge in a Comprehensive Acute Kidney Injury Survivor Model

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Abstract

Background: Post-discharge follow-up in primary care is an opportunity for pharmacists to re-evaluate medication use in AKI survivors. Of the emerging AKI survivor care models described in literature, only one involved a pharmacist with limited detail about the direct impact.

Objective: To describe pharmacist contributions to a comprehensive post-discharge AKI survivorship program in primary care (the AKI in Care Transitions Program, ACT).

Methods: The ACT program was piloted from May to December of 2021 at Mayo Clinic as a bundled care strategy for patients who survived an episode of AKI and were discharged home without the need for hemodialysis. Patients received education and care coordination from nurses before discharge and later completed post-discharge laboratory assessment and clinician follow-up in primary care. During the follow-up encounter, patients completed a 30-minute comprehensive medication management visit with a pharmacist focusing on AKI survivorship considerations. Medication therapy recommendations were communicated to a collaborating primary care provider before a separate 30-minute visit with the patient. Primary care providers had access to clinical decision support with evidence-based post-AKI care recommendations. Medication-related issues were summarized descriptively.

Results: Pharmacists made 28 (median 3 per patient, interquartile range 2-3) medication therapy recommendations and identified 14 medication discrepancies for the 11 patients who completed the pilot program and 86% of the medication therapy recommendations were acted on by the primary care provider within seven days. Six recommendations were made to initiate renoprotective medications, and five were acted upon (83%).

Conclusion: During the pilot phase of a multifaceted transitional care program for AKI survivors, pharmacists' successfully identified and addressed multiple medication therapy problems, including for renally-active drugs. These results demonstrate the potential for pharmacist-provider collaborative visits in primary care to improve safe and effective medication use in AKI survivors.

Keywords

acute kidney injury; medication review; pharmacists; primary health care; transitional care

Background

Acute kidney injury (AKI) affects one in five hospitalized patients and is associated with an increased risk of long-term adverse outcomes.[1-5] Medications processed by, protective for, or toxic to the kidney are one of the few modifiable determinants of outcomes after an episode of AKI.[6] For example, renin-angiotensin-aldosterone system inhibitors (RASi)[7]

may be renoprotective in the post-AKI period.[8] Nephrotoxin exposure is prevalent among AKI survivors and indepdently increases the risk for chronic kidney disease.[8] Improving medication management in AKI survivors is, therefore, a high priority.

Given the influence of medication optimization on clinical outcomes in this population, comprehensive medication reconciliation is a best-practice recommendation incorporated into emerging AKI survivor care models.[9,11-14] AKI survivor care models are structured, post-discharge interventions focused on providing high-level evidence-based care to improve AKI survivor outcomes. Most of these care models are driven by nephrologists, but an untapped opportunity exists to leverage primary care resources to increase access to high-quality care. From a medication perspective this may include initiation of renoprotective medications (e.g., renin-angiotensin system inhibors), optimizing fluid management, and minimizing exposure to potentially nephrotoxic medications. Additionally, AKI survivors commonly have multimorbidity (e.g., diabetes) and benefit from the comprehensive medication review and patient education offered by pharmacists in primary care.[15,16] We are aware of only one other report of an AKI survivor care team which included a pharmacist. In this intervention the pharmacist worked with nephrologists rather than primary care providers (PCP) and medication therapy problems or discrepancies were identified in 33% of encounters.[9] Available detail surrounding these encounters and interventions was limited.

At Mayo Clinic, we developed and piloted a multidisciplinary AKI survivor care model (termed AKI in Care Transitions, or ‘ACT’) based in primary care.[17] Pharmacists who consulted directly with patients after discharge from the hospital were embedded within this existing team infrastructure. Prior studies at Mayo Clinic in patients with polypharmacy and on high-risk drugs medications have demonstrated that such a model may reduce hospital readmissions and total costs of care compared to usual care without a pharmacist.[18,19] The ACT pilot focused their attention toward the addition of evidence-based AKI survivor care to their existing comprehensive medication review.

Objective

The objective of this brief report was to characterize the medication management interventions made by pharmacists for AKI survivors involved in the pilot phase of the ACT model.

Methods

Setting and participants.

The ACT model was implemented at an academic medical center including six primary care clinics with both family medicine and internal medicine practices. The ACT model and feasibility details have been previously published.[17] Briefly, individuals with an episode of stage 3 AKI, discharging from hospital to home, not on dialysis, and assigned to a Mayo Clinic PCP received a bundled intervention designed to facilitate kidney health education and follow-up. Nurse education and care coordination were provided before hospital discharge and laboratory and clinical follow-up occurred within primary care within 14 days. Clinical pharmacists collaborated directly with PCPs (physicians or advanced

practice providers) to deliver comprehensive team-based care. We summarized data from these encounters, which occurred between May and December 2021. Participation in the ACT was voluntary, and all patients provided written informed consent. The study was approved by the Mayo Clinic Institutional Review Board and registered on clinicaltrials.gov (NCT04505891)

Pharmacist and PCP intervention.

Pharmacist visits were scheduled for 30 minutes before a 30-minute visit with the PCP. Patients were asked to bring all medications to the visit, including over-the-counter medications and supplements to the visit as this has been shown to improve pharmacists ability to identify medication discrepancies.[20] All visits included a thorough medication reconciliation to identify discrepancies, drug interaction screening, medication adherence and solutions assessment, identification of medication therapy problems, and electronic health record (EHR) documentation using a standardized template. Medication therapy problems were reviewed with the collaborating PCP before their visit. Guidance was provided to pharmacists to discuss recommendations with PCPs in-person if able while written or electronic tools could also be used.

As AKI survivorship was the core area of focus, a structured review of kidney health considerations was performed in alignment with the KAMPS framework for post-AKI care (Kidney function assessment, Advocacy/education, Medication review, individualized blood Pressure assessment, Sick-day counseling).[21] Kidney function assessment included ensuring that necessary kidney labs were ordered before the follow-up visit and after as clinically indicated. Advocacy focused on medication-related education delivery pertinent to kidney disease and nephrotoxic medication use. Pharmacists assessed the potential for use of renoprotective medications such as renin-angiotensin system inhibitors and sodium-glucose cotransporter-2 inhibitors. Blood pressure was evaluated, and anti-hypertensive recommendations were provided as appropriate. Standardized sick day instructions were utilized to outline when patients should contact their care team for further evaluation. A best practice document was developed for pharmacists which included specific guidance and resources to address all components of the KAMPS framework. A passive clinical decision support alert was available for PCPs and pharmacists which further highlighted KAMPS recommendations.

Outcomes.

Medication discrepancies identified by pharmacists through medication reconciliation were described for all medications and categorized as related to a nephrotoxic or renoprotective medication or not. Medication discrepancies were defined as “any lack of agreement between the medication list in the EHR and the patient-reported medication regimen.”[22] Medication therapy problem recommendations provided from the pharmacist to the PCP for all medications and those specific to nephrotoxic or renoprotective drugs were described. Medication therapy problems were defined as “any undesirable event experienced by a patient that involves, or is suspected to involve, drug therapy and that interferes with achieving the desired goals of therapy and requires professional judgment to resolve.”[23] Medication therapy problem recommendations were classified as relating to indication,

efficacy, safety, or adherence. [23] Within these classifications medication therapy problem recommendations were further described. For example, those relating to adherence were described as either simplify regimen or medication too expensive. The percentage of medication therapy problem recommendations acted on by the clinician within seven days of pharmacist contact was exstracted from the EHR. Last, we evaluated whether the pharmacist documented delivery of AKI education.

Data collection and analysis.

All patient characteristics and outcomes were manually exstracted from the EHR. Medication data at hospital admission was collected from pharmacist medication reconciliation documentation or the most recent medication list available before admission. Medication data at hospital discharge was collected from the discharge summary provided to the patient. Medication data 30 days after the outpatient visit was collected from the medication list on that corresponding date in the EHR. The standardized documentation template used by pharmacists allowed for manual extraction of medication discrepancies, medication therapy problems and education provided. Descriptive statistics are reported as median (interquartile range), mean (standard deviation) or number (percentage). All analyses were performed using SAS version 9.4 software (SAS Institute, Inc.; Cary, NC).

Results

Participants.

Eighteen individuals consented to receive the ACT intervention and no other patients received the intervention during the pilot period. Three were excluded (two because education was not delivered before discharge, a requirement for follow-up visits to be scheduled, and one due to requiring dialysis). Of the 15 individuals eligible for a pharmacist visit, 11 (79%) completed the encounter from which details were summarized. The four individuals who did not complete the pharmacist visit either declined or did not present. Participants were, on average, 66 ± 13 years old, 91% male (N = 10), with a history of hypertension and diabetes in 91% (N = 10) and 82% (N = 9) of cases, respectively (Table 1). The median (IQR) length of hospital stay was 10 (5, 12) days and the median time to the outpatient visit was 7.5 (4, 13) days. Participants took a median of 16 (7, 19) medications at discharge.. Two patients (18%) had baseline non-steroidal anti-inflammatory drug use before hospital admission, which were discontinued following admission. Ten patients (91%) had renoprotective medications on their medication list before admission of which two (20%) were explicitly instructed to resume them at discharge. Of those on baseline renoprotective therapies, by 30 days six patients (60%) had resumed them.

Outcomes.

During medication reconciliation, pharmacists identified 14 medication discrepancies among the eleven patients, one of which was related to a renoprotective medication (Table 2). In this case, the discharge summary indicated to hold a renin-angiotensin system inhibitor, but the patient was unaware and continued medication use. Pharmacists made 28 medication therapy problem recommendations on the 11 patients (median 3 per patient, interquartile range 2-3), of which the provider acted on 86% within seven days. Most medication

therapy problemss pertained to indication (39%) and safety (32%). Four of the five medication therapy problems specific to nephrotoxic or renoprotective medications were acted upon by PCPs within seven days. All five of these recommendations were to start a renoprotective medication for a patient with an indication. At least one medication discrepancy or medication therapy problem was identified in all 11 visits. In nine patients (82%), pharmacists documented the delivery of AKI education.

Illustrative case.

To highlight the role of the pharmacist-PCP collaborative visit in AKI survivor care, we present the following illustrative case. The patient was a 56-year-old man discharged from the hospital following AKI in the setting of reduced oral intake and diarrhea after initiation of dulaglutide for type 2 diabetes (HbA1c 7.1%). The patient's serum creatinine was 1.20 mg/dL at baseline, 4.22 mg/dL at hospital admission, and 1.49 mg/dL by hospital discharge. Baseline medications that were held at admission included dulaglutide, ibuprofen, hydrochlorothiazide, lisinopril, and metformin. These medications remained held at hospital discharge. The pharmacist-PCP collaborative visit occurred four days after discharge. Medication reconciliation was completed from the patient's memory and home medication list. One discrepancy was identified in his insulin dose which was 38% lower than listed (using 10 units of glargine daily rather than the 16 units documented). The self-reported fasting blood glucose and post-prandial blood glucose were both elevated. The patient denied symptoms of hypoglycemia or hyperglycemia and reported improvement in his appetite to baseline. During the visit, the patient was provided specific education on medications to avoid following kidney injury, focusing on non-steroidal anti-inflammatory drugs and alternatives for pain and fever if needed. Serum creatinine at follow-up was 0.99 mg/dL, and the collaborating PCP accepted the pharmacist's recommendation to restart metformin, lisinopril, and hydrochlorothiazide which were categorized as "indication". The pharmacist also identified that a sodium-glucose cotransporter-2 inhibitor could be substituted for dulaglutide (which the patient did not tolerate) to facilitate glycemic control and kidney protection, also in the category of indication. The patient was open to starting a sodium-glucose cotransporter-2 inhibitor; however, the PCP, though agreeable with the recommendation, preferred to wait until the patient was further out from hospitalization. Approximately four weeks later, utilizing a collaborative practice agreement, the ambulatory pharmacist team prescribed empagliflozin, ordered additional kidney monitoring, and arranged continued pharmacist telehealth visits.

Discussion

Medication management following AKI is one of the few modifiable factors that impact patient outcomes. We described a comprehensive outpatient transitional care intervention in primary care that includes outpatient clinical pharmacists as central in delivering comprehensive medication management to AKI survivors. Medication therapy problem recommendations, which included issues with renoprotective and nephrotoxic drugs, were accepted in most cases by the collaborating PCP.

Pharmacists are uniquely qualified to deliver comprehensive medication management due to their extensive, focused training on medications and the pharmacist-patient care process.[24] In the transition from hospital to home, pharmacist visits in outpatient clinics in coordination with physicians or advanced practice providers have been found to reduce hospital readmission risk in many populations.[19, 25-27] In the ACT pilot, pharmacists used a comprehensive medication management approach with an added focus on AKI survivorship. This strategy allowed for a broad clinical assessment and a focused evaluation of renally-active medications. This comprehensive patient-centered approach is sensitive to the fact that for patients, post-AKI care is typically just one of many conditions they face.

Many medication therapy problem recommendations involved decisions on whether to restart renin-angiotensin system inhibitors or sodium-glucose cotransporter-2 inhibitors after the AKI episode. In the appropriate context, these drugs have been shown to have renoprotective properties; however, use in patients with volume or hemodynamic abnormalities may increase patient risk for adverse events. Due to their expertise in pharmacotherapy, pharmacists are well-suited to assess these challenging clinical scenarios and outline appropriate care plans for collaborating primary care clinicians. The identification of several medication discrepancies during medication reconciliation highlights the importance of a thorough review of medications, despite standard hospital discharge medication reconciliation. The medication therapy problem and medication discrepancy identification rates (at least one issue identified in 100% of patients) contrast with a previously reported 33% frequency during a post-AKI clinic assessment.[9] We hypothesize this is due to the ACT intervention taking place in primary care which may confer a broader focus than a focused nephrology evaluation. The intervention is also highlighted by 82% of patients receiving AKI and medication-specific education materials from the pharmacist during the visit.

Given the established feasibility of the ACT intervention and promising preliminary results for the first 11 patients, our future goal will be to assess translation to improved short and long-term outcomes compared to usual care. We anticipate that the inclusion of the ambulatory clinical pharmacist visit may reduce hospital readmission risk through comprehensive medication management, which has been observed previously.[19] We hypothesize the added focus on post-AKI care using an established framework, particularly relating to nephrotoxins and renoprotective medications, will translate to improved kidney outcomes. There are also potential barriers to the intervention that must be considered. Scheduling collaborative visits with a PCP and pharmacist is technically challenging, may add increased time for the patient, may increase costs depending on the reimbursement structure, and patients who are unfamiliar with the role of pharmacists may not understand the importance of the encounter. Close coordination with the patient and family in the scheduling process and up-front clarification of the rationale for the visit may improve satisfaction and adherence.

Limitations of this report include a small sample size which limits our ability to assess clinical outcomes. In addition, though a standardized documentation template was utilized, differences in documentation by pharmacists may have limited our ability to capture all medication therapy problem recommendations and discrepancies identified during the

retrospective review. For consistency, we chose to review the EHR for seven days after the visits to determine if a pharmacist recommendation was implemented by the PCP and therefore may not have captured outcomes beyond this timeframe. We also lacked a control group for the pilot study thus it is possible the medication therapy problems and discrepancies may have been independently identified by the PCP. Lastly, a proportion of candidate AKI survivors did not participate in pharmacist visits which precluded a detailed assessment of their medication therapy program.

Conclusion

During the pilot phase of a multifaceted transitional care program for AKI survivors, inclusion of pharmacists in primary care follow-up led to the identification of multiple medication therapy problems per patient which were readily addressed by a collaborating PCP.

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Abbreviations

ACT	acute kidney injury survivor care model
AKI	acute kidney injury
EHR	electronic health record
PCP	primary care provider

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Key Points

What was already known

- Medications processed by, protective for, or toxic to the kidney are one of the few modifiable determinants of outcomes after an episode of AKI.
- Transitional care interventions in primary care involving pharmacists may reduce hospital readmission risk and cost

What this study adds

- Direct involvement of pharmacists with AKI survivors after discharge identified frequent medication therapy problems and discrepancies.
- Recommendations by pharmacists, especially for renally-active medications, can enhance the care delivered to AKI survivors and may improve outcomes.
- This is the first study to our knowledge to involve a pharmacist in an AKI survivorship team within primary care.

Table 1:

Participant Characteristics

Characteristic	Summary (N =11)
Age, mean (SD), y	66 (13)
Female, No. (%)	1 (9%)
Caucasian, non-Hispanic, No. (%)	11 (100%)
Operative reason for admission, No. (%)	0 (0%)
Comorbidities, No. (%)	
Chronic kidney disease	3 (27%)
Diabetes	9 (82%)
Hypertension	10 (91%)
Vascular disease[a]	1 (9%)
Hospital length of stay, median (IQR), days	10 (5, 12)
Estimated glomerular filtration rate at discharge, median (IQR), mL/min/1.73m^2	32 (19, 55)
No. of medications at discharge, median (IQR)	16 (7, 19)
Use of any renoprotective medication[b], No. (%)	
At hospital admission	10 (91%)
At hospital discharge	2 (18%)
Thirty days following intervention	6 (55%)
Days from hospital discharge to follow-up visit, median (IQR)	7.5 (4, 13)
Estimated glomerular filtration rate (post-discharge, closest to visit), median (IQR), mL/min/1.73m^2	42 (25, 71)

[a]Stroke, Transient Ischemic Attack, Peripheral Vascular Disease

[b]Angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, glucagon-like peptide-1 receptor agonists, sodium-glucose cotransporter-2 inhibitors

Table 2:

Outcomes of Pharmacist Intervention

Pharmacist intervention	**Summary (N = 11)**
Acute kidney injury education delivered, No. (%)	9 (82%)
Medication therapy problem recommendations	
Total across all patients on any medication, No. Per patient, median (IQR)	28 3 (2-3)
Indication, No (%)	11 (39%)
Needs additional therapy, No (%)	11 (39%)
Efficacy, No (%)	4 (14%)
Dose too low, No (%)	4 (14%)
Safety, No (%)	9 (32%)
Adverse medication reaction, No (%)	4 (14%)
Dose too high, No (%)	2 (7%)
Laboratory monitoring needed, No (%)	3 (11%)
Adherence, No (%)	5 (18%)
Medication too expensive	1 (4%)
Simplify regimen	4 (14%)
Acted on within 7 days, No. (%)	24 (86%)
Nephrotoxic[a] or renoprotective medication across all patients, No.	5
Acted on within 7 days, No. (%)	4 (80%)
Discrepancies[b]	
Any medication across all patients, No.	14
Nephrotoxic or renoprotective medication across all patients, No.	1

[a]Nephrotoxic medication queried include; acyclovir, aminoglycosides, amphotericin B, carboplatin, ciprofloxacin, cisplatin, colistimethate, cyclophosphamide, cyclosporine, foscarnet, ganciclovir gemcitabine, ibrutinib, ifosfamide, imatinib, irinotecan, lenalidomide, lithium, melphalan, methotrexate (>20 mg per week), mesalamine, nafcillin, non-steroidal anti-inflammatory drugs, oxacillin, oxaliplatin, pamidronate, penicillin, piperacillin-tazobactam, polymyxin, proton-pump inhibitors, rifampin, sirolimus, sorafenib, sulfasalazine, tacrolimus, temozolomide, tenofovir, ticarcillin, topiramate, topotecan, trimethoprim-sulfamethoxazole, valacyclovir, vancomycin (intravenous), zoledronic acid, zonisamide

[b]Active medications omitted, medication listed but no longer being taken, wrong dose of medication, schedule other than prescribed