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Improving transitions of care for critically ill adult patients on pulmonary arterial hypertension medications

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Purpose. The purpose of this report is to describe the activities of critical care and ambulatory care pharmacists in a multidisciplinary transitions-of-care (TOC) service for critically ill patients with pulmonary arterial hypertension (PAH) receiving PAH medications.

Summary. Initiation of medications for treatment of PAH involves complex medication access steps. In the ambulatory care setting, multidisciplinary teams often have a process for completing these steps to ensure access to PAH medications. Patients with PAH are frequently admitted to an intensive care unit (ICU), and their home PAH medications are continued and/or new medications are initiated in the ICU setting. Inpatient multidisciplinary teams are often unfamiliar with the medication access steps unique to PAH medications. The coordination and completion of medication access steps in the inpatient setting is critical to ensure access to medications at discharge and prevent delays in care. A PAH-specific TOC bundle for patients prescribed a PAH medication who are admitted to the ICU was developed by a multidisciplinary team at an academic teaching hospital. The service involves a critical care pharmacist completing a PAH medication history, assessing for PAH medication access barriers, and referring patients to an ambulatory care pharmacist for postdischarge telephone follow-up. In collaboration with the PAH multidisciplinary team, a standardized workflow to be initiated by the critical care pharmacist was developed to streamline completion of PAH medication access steps. Within 3 days of hospital discharge, the ambulatory care pharmacist calls referred patients to ensure access to PAH medications, provide disease state and medication education, and request that the patient schedule a follow-up office visit to take place within 14 days of discharge.

Conclusion. Collaboration by a PAH multidisciplinary team, critical care pharmacist, and ambulatory care pharmacist can improve TOC related to PAH medication access for patients with PAH. The PAH TOC bundle serves as a model that may be transferable to other health centers.

Keywords: patient care team; patient transfer; hypertension, pulmonary; prior authorization; pharmacist; quality improvement

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Over 25% of patients are hospitalized within a year of diagnosis of pulmonary arterial hypertension (PAH). The total cost associated with a PAH-related admission is \$79,607 (in 2012 US dollars).¹⁻⁴ Approximately 25% of patients hospitalized with right heart failure secondary to PAH will be admitted to an intensive care unit (ICU).⁵ At the time of ICU admission, 60% to 90% of patients with PAH are taking disease-specific medications.⁵⁻⁷

Additionally, up to 62.6% of these patients are initiated on a new PAH medication in the ICU.⁶ When home PAH medications are continued and/or newly prescribed PAH medications are initiated in the hospital, there is a potential for delays in care and hospital discharge related to medication access during transitions of care (TOC) in this population.⁸⁻¹⁰ The complexities involved in the medication access process for PAH medications may include

dispensing from a specialty pharmacy, requirement of prior authorization, utilization of a specialized administration device, and enrollment into a risk evaluation and mitigation strategies (REMS) program.¹¹⁻¹³ There are limited published data describing the prevalence of medication access complexities surrounding the initiation of PAH medications in the hospital setting.^{11,14}

Pharmacists are key members of the multidisciplinary PAH care team due to the complexity of these therapies and the medication access process.^{11,12,14} Critical care pharmacists are in an ideal position to improve TOC in the PAH population due to the high frequency of new initiations of PAH medications in the ICU setting. Furthermore, critically ill patients are increasingly being recognized as a population that benefits from postdischarge interventions in the ambulatory care setting by a pharmacist.^{15,16} Ambulatory care pharmacist activities such as a postdischarge telephone call have been associated with a reduction in hospital readmission and improvement in medication adherence in high-risk populations.¹⁷⁻²⁰ To date, there are no reports of collaborations between critical care and ambulatory care pharmacists to improve TOC of critically ill patients with PAH. The purpose of this report is to describe the activities of critical care and ambulatory care pharmacists in a multidisciplinary TOC service for critically ill patients with PAH receiving PAH medications.

Program description

The multidisciplinary pulmonary hypertension team at the program site is comprised of 4 physicians, 2 nurse coordinators, a nurse practitioner, critical care pharmacists, an ambulatory care pharmacist, and a central authorization specialist. Members of this team meet once weekly for 2 hours to collaboratively discuss complex care decisions for hospitalized patients and those in the community setting.

The pulmonary hypertension program at Henry Ford Hospital (HFH) was designated as a Center of Comprehensive Care (CCC) by the

KEY POINTS

- Critical care pharmacists involved in the care of patients with pulmonary arterial hypertension (PAH) can identify and develop a plan to resolve PAH medication access barriers during hospitalization.
- Development of an inpatient standardized medication access workflow for newly initiated PAH pharmacotherapies through collaboration by a multidisciplinary team can streamline the medication access process for PAH medications.
- Ambulatory care pharmacists can use postdischarge patient telephone calls to ensure access to PAH medications and provide disease state and medication education.

Pulmonary Hypertension Association (PHA) in 2017. Centers with accreditation serve as a referral site for patients with PAH.¹² There were 55 adult centers with this designation as of January 2020. After earning the CCC designation, the pulmonary hypertension team experienced an increase of new patient referrals from ambulatory care settings, as well as increased patient volume resulting from direct ICU transfer of patients with severe PAH necessitating initiation of advanced therapies. All emergent parenteral prostacyclin agents, as well as a majority of inhaled and oral therapies, are initiated in the medical ICU at HFH. Patients receiving parenteral epoprostenol or treprostinil are admitted to a dedicated medical ICU or pulmonary medicine floor according to the level of care required. Parenteral epoprostenol and treprostinil are administered using an ambulatory infusion pump that is operated by the nurse caring for a given patient. The nursing teams on these

dedicated floors are trained to operate the ambulatory infusion pumps. Inpatient procedures surrounding the use of parenteral epoprostenol and treprostinil have been implemented to prevent medication errors and ensure care is provided by trained healthcare practitioners.^{8,14} Patients receiving only oral or inhaled PAH medications can be admitted to any ICU or general medicine floor of the hospital. The PAH physicians round in the medical ICU and on the general pulmonary medicine floor. Critical care pharmacists round as part of the ICU multidisciplinary team Monday through Friday and are experienced in the care of the PAH population. A shared-faculty ambulatory care pharmacist provides services in the pulmonary clinic 3 days per week. The ambulatory care pharmacist has a collaborative practice agreement that allows for the provision of clinical pharmacy services to patients with a variety of lung diseases, including PAH.

Prior to PHA accreditation, planning for initiation of most advanced PAH therapies occurred prior to a patient's hospital admission, which allowed for time to resolve all medication access steps before hospital admission. In the ambulatory care setting the physicians, nurse coordinators, nurse practitioner, and central authorization specialist have an established process to complete the medication access steps required for PAH medications. The central authorization specialist works with the pulmonary hypertension team to resolve prescription insurance prior authorizations for PAH medications. This task may include providing supporting evidence and facilitating peer-to-peer conversations between the medical team and insurance company, if needed. The prior authorizations are completed and then maintained as needed.

In the ICU, PAH medications are initiated before the outpatient medication access steps are completed to prevent delays in treatment. It was identified that a TOC process was needed to assist in completing the medication access steps associated with PAH medications

when started for critically ill patients. This process was also necessary to ensure access to therapies at hospital discharge and safe care transitions for patients treated with these complex drugs.

PAH medication access steps

The medication access steps for a hospitalized patient started on a PAH medication may involve completing an enrollment form unique to a PAH medication, enrollment in a REMS program, completing an insurance prior authorization, assignment of a specialty pharmacy, medication-specific administration device training, coordination of medication delivery at discharge, and medication-related complexities related to discharge disposition.^{13,14} Only certain access steps apply to each PAH medication class, and these steps must be completed in the order outlined above.

The enrollment form is completed and submitted when a PAH medication is initiated. This form may function as a prescription for the new therapy, document assessment of insurance coverage, assist in assignment of a specialty pharmacy, and include an option for selection of additional patient support in the form of in-home nursing visits. The medication-specific REMS enrollment form requires a patient signature after clinicians provide education surrounding the necessary monitoring criteria (eg, pregnancy testing for females of childbearing potential, liver function tests) and adverse effects of the medication. A prior authorization is required in a majority of instances when PAH medications are initiated. Once the insurer approves the prior authorization request, the insurance company assigns a specialty pharmacy to dispense the medication in the outpatient setting. If the new PAH medication requires an administration device (eg, inhaled, subcutaneous, or intravenous [i.v.] prostacyclin agents) the assigned specialty pharmacy coordinates a nurse visit to the hospital to teach the patient and a caregiver how to prepare the medication and use the

device to administer therapy. Specialty pharmacy nurses ensure that the patient and caregiver are able to prepare the medication and operate the device independently prior to discharge. Prior to discharge, patients must coordinate the delivery of medication to their residence with the designated specialty pharmacy so that the medication is available upon discharge. Medication-related complexities related to discharge disposition of PAH medications arise when patients require temporary inpatient rehabilitation care after hospitalization. Facilities are often unable to provide support for ambulatory infusion devices because their staffs are not trained to operate the devices or dispense medications subject to REMS requirements due to the pharmacies not being certified inpatient REMS dispensing pharmacies for a prescribed agent. Additionally, PAH medications are expensive and dispensing them may exceed the set daily reimbursement rate allowed per day, thus preventing a patient's acceptance to a facility.

Inpatient TOC service

Due to the increasing number of patients initiated on PAH medications in the medical ICU and the medication access complexities involved, a pharmacy-generated PAH ICU TOC service was implemented for patients admitted to any ICU area who were prescribed a medication for treatment of PAH, including ambrisentan, bosentan, epoprostenol (i.v.), iloprost (inhaled), macitentan, riociguat, selexipag, sildenafil, tadalafil, and treprostinil (inhaled, i.v., oral, and subcutaneous). This service is completed by critical care pharmacists for both new initiations and continuation of PAH medications from home. Critical care pharmacists attend an in-service that reviews the process for obtaining a PAH medication history, updating information on home PAH medications in the electronic medical record (EMR), identifying specialty pharmacies, and completing a standard note template in the EMR. The note serves as a record of the pharmacist-conducted PAH TOC

ICU consult that documents patient care and the plan to resolve PAH medication access steps. After the in-service, critical care pharmacists completed their first 3 PAH TOC ICU consults with a colleague involved in development of this service to demonstrate competency with the new service.

Daily, critical care pharmacist run an electronic report that generates a list of patients in the ICU who have a PAH medication on their home or inpatient medication list to identify those who are eligible for the TOC service. The critical care pharmacist then obtains the following information from the patient, caregiver, and/or specialty pharmacy: medication history for PAH medications, healthcare insurance information, pharmacy that dispenses home PAH medications, and any identified medication access steps that need to be resolved prior to discharge. The critical care pharmacist communicates the medication access steps that need to be completed to the PAH team. Patients who survive their critical illness and plan to follow up with the HFH pulmonary hypertension team after discharge are eligible for referral to the ambulatory care pharmacist in the pulmonary clinic for a postdischarge telephone call. The critical care pharmacist places a standardized PAH ICU TOC note in the patient's EMR to document all the activities completed and sends an electronic referral for the patient to the ambulatory care pharmacist, if applicable. If the PAH medication access steps are not resolved prior to patient transfer from the ICU to the general practice floor, an internal medicine pharmacist continues to work with the PAH team to ensure all steps are resolved prior to discharge. Shortly after the ICU PAH TOC service was developed, it was identified that a standardized workflow for hospitalized patients initiated on PAH medications would be beneficial in ensuring completion of required medication steps in the correct order; the developed workflow also lists the responsible personnel for each step.

Table 1. Pulmonary Arterial Hypertension Inpatient Medication Access Workflow for Newly Initiated Therapies

Medication Class and Agent	Required Step (Responsible Party)						Step 6: Medication-Related Disposition Barrier Based on Discharge Location?
	Step 1: Prescription Enrollment Form Required?	Step 2: REMS Enrollment Required?	Step 3: PA and/or Assistance Program Required?	Step 4: Inpatient Device Training Required?	Step 5: Medication Home Delivery Required?	Step 6: Medication-Related Disposition Barrier Based on Discharge Location?	
Phosphodiesterase 5 inhibitor Sildenafil Tadalafil	No	No	Yes (PAH CAS and PAH NC)	No	No	Home: no Facility: no	
Soluble guanylyl cyclase stimulator Riociguat	Yes (PAH NP)	Yes (PAH NP or physician)	Yes (PAH CAS and PAH NC)	No	Yes (PAH NC)	Home: no Facility: yes ^b (PAH NC)	
Endothelin receptor antagonist Ambrisentan Bosentan Macitentan	Yes (PAH NP)	Yes (PAH NP or physician)	Yes (PAH CAS and PAH NC)	No	Yes (PAH NC)	Home: no Facility: yes ^b (PAH NC)	
Oral prostacyclin agents Treprostinil diolamine Selexipag	Yes (PAH NP)	No (PAH NP or physician)	Yes (PAH CAS and PAH NC)	No	Yes (PAH NC)	Home: no Facility: yes ^b	
Parenteral and inhaled prostacyclin agents Epoprostenol (i.v.) Treprostinil (i.v.) or subcutaneous Treprostinil (inhaled) Iloprost (inhaled)	Yes (PAH NP)	No (PAH NP or physician)	Yes (PAH CAS and PAH NC)	Yes (PAH NC)	Yes (PAH NC)	Home: no Facility: yes ^c (PAH NC)	

Abbreviations: CAS = central authorization specialist; i.v., intravenous; NC, nurse coordinator; NP, nurse practitioner; PA, prior authorization; PAH, pulmonary arterial hypertension; REMS, risk evaluation and mitigation strategies.

Editor's note: The following instructions and accompanying footnotes are as worded in workflow document used at implementation site.

^aThe unit based pharmacist will determine the steps that need to be completed to ensure medication access at discharge for patients initiated on a pulmonary arterial hypertension medication. The steps required to gain access to a medication are listed in the top row from left to right. Not every step is applicable to each medication class. The steps are ordered in the sequence in which they need to be completed (e.g. Step 3: obtaining prior authorization, cannot be completed until Step 2: REMS enrollment is completed). When a medication is initiated, the pharmacist should use the respective medication class row and move from Step 1 to Step 6 in sequential order from left to right. To determine if a given step is applicable to the medication class, the box will say, "Yes" or "No." If it states "Yes," that particular step is applicable to the medication and should be completed. If the box says "No," the step is not applicable to the medication. Once a step is complete, the next step can be addressed until all access steps have been completed. The pharmacist should contact and work with the responsible party that is listed in parenthesis to complete the respective step. Step 1: The nurse practitioner is responsible for filling out the medication enrollment form with the patient. If the medication does not have an enrollment form the nurse practitioner sends an electronic prescription to the patient's pharmacy. Step 2: The physician or nurse practitioner is responsible for completing the necessary steps to enroll a patient in the REMS program, obtain the patient's signature, and fax the completed form to the REMS coordinating center. Step 3: The central authorization specialist submits claims to the patient's insurance company and contacts a PAH physician if additional clinical information is required before approval. Once the prior authorization is approved, the central authorization specialist places a standardized note in the electronic medical record. After the prior authorization is approved the patient is assigned a specialty pharmacy that will dispense the medication in the outpatient setting. If the patient is unable to afford the medication copay the nurse coordinator assists in identification of a copay assistance program from the medication's manufacturer or national PAH organization. Step 4: If the PAH medication requires administration device training the nurse coordinator will contact the assigned specialty pharmacy to coordinate a specialty pharmacy nurse to train the patient and a caregiver on the medication's preparation and device operation while in the hospital. Step 5: If a specialty pharmacy is being used to dispense the PAH medication the nurse coordinator will request a specialty pharmacy representative to contact the patient while hospitalized to coordinate delivery of the medication to the patient's residence. Step 6: The inpatient case manager works with the PAH nurse coordinator to coordinate which facilities are able to accept patients on these therapies.

^bStrategy to overcome barrier can be to use home medication at facility if allowed by the facility.

^cStrategy to overcome barrier is to identify a facility willing to accept patient with medication administration device.

Table 2. Patient Characteristics and Activities Completed by Critical Care Pharmacist

Characteristic or Variable	No. (%) of Patients (n = 120)
Age, median (IQR), y	62.5 (54.3-69.0)
Gender	
Female	96 (80.0)
Male	24 (20.0)
Race	
African American	69 (57.5)
Caucasian	49 (40.8)
Hispanic	2 (1.7)
Admission location	
Medical ICU	118 (98.3)
Surgical ICU	2 (1.7)
ICU LOS, median (IQR), d	5 (3-10)
Hospital LOS, median (IQR), d	10 (6-16)
TOC activities completed by pharmacist	
PAH home medication updated ^a	22 (18.3)
PAH medication dose updated	8 (6.7)
PAH medication added	8 (6.7)
PAH medication formulation updated	6 (5.0)
PAH medication removed	2 (1.7)
TOC communications to PAH team ^a	
Notified physician home medication list updated	21 (17.5)
Notified physician of pending prior authorization	32 (26.7)
Documented assigned specialty pharmacy	35 (29.2)
Critical care pharmacist time spent with patient on TOC activities, min	
<15	96 (80.0)
15-30	6 (5.0)
>30	1 (0.8)
Not reported	17 (14.2)
PAH regimen at ICU admission	
Treatment naive	32 (26.7)
Monotherapy	43 (35.8)
Dual therapy	35 (29.2)
Triple therapy	10 (8.3)
PAH medication initiated during hospitalization	36 (30.0)
PA required for new PAH medication	32 (26.7)
PA approved prior to hospital discharge	27 (22.5)

Continued on next page

Standardized medication access workflow

The purpose of the workflow for newly initiated PAH medications is to identify what access steps apply to each medication, the sequence for completion of all steps, and the party responsible for completing each step (including contact information). The multidisciplinary members involved in this workflow's development included the PAH physicians, nurse coordinators, nurse practitioner, central authorization specialist, inpatient case manager, and inpatient pharmacists. The inpatient pharmacist caring for the patient is responsible for initiating and coordinating resolution of all the medication access steps with the appropriate member of the multidisciplinary pulmonary hypertension team (Table 1). As part of the new workflow, the central authorization specialist documents the status of the prior authorization in the EMR using a standard note template.

Ambulatory care TOC service

The electronic referrals from the critical care pharmacist are sent to the ambulatory care pharmacist's electronic "in basket." Patients are eligible for a telephone call from the ambulatory care pharmacist if they choose to receive follow-up care from the center's pulmonary hypertension team. The ambulatory care pharmacist reviews the referrals on clinic days to assess if the patient has been discharged from the hospital. Once the patient is discharged from the hospital the ambulatory care pharmacist contacts the patient within 3 business days from discharge. Patients are ineligible for a call if they expired, enrolled in hospice care, or were discharged to a temporary rehabilitation center; if a member of the PH team has already contacted the patient after discharge; or if no changes to the PAH medication regimen were made during the inpatient admission.

Prior to the telephone call the ambulatory care pharmacist reviews the PAH team notes, hospital discharge summary, PAH ICU TOC note, and discharge medication list. The purpose

Continued from previous page

Table 2. Patient Characteristics and Activities Completed by Critical Care Pharmacist

Characteristic or Variable	No. (%) of Patients (n = 120)
Pharmaceutical manufacturer program used to allow for patient discharge until PA approval	3 (2.5)
Time for insurance PA approval, median (IQR), d	3 (0.25-7)
PAH medication initiated during admission ^b	
Intravenous treprostinil	15 (12.5)
Sildenafil	10 (8.3)
Macitentan	4 (3.3)
Riociguat	3 (2.5)
Selexipag	2 (1.7)
Subcutaneous treprostinil	1 (0.8)
Oral treprostinil diolamine	1 (0.8)
Inhaled treprostinil	1 (0.8)
Pulmonary hypertension regimen at discharge	
Treatment naive	2 (1.7)
Monotherapy	68 (56.7)
Dual therapy	38 (31.7)
Triple therapy	12 (10.0)

Abbreviations: ICU, intensive care unit; LOS, length of stay; PAH, pulmonary arterial hypertension; TOC, transitions of care; PA, prior authorization.

^aData points are not mutually exclusive; a single patient may have had more than one categorization.

of the telephone call is to ensure accurate use of the PAH medications and diuretic regimen, ensure access and adequate supply of PAH medications, provide medication and disease state education (eg, education on fluid and salt restrictions, daily monitoring of weight and blood pressure, use of prescribed oxygen therapy), assess for PAH medication-related adverse effects, discuss proper use of supportive medications to alleviate adverse effects, confirm which specialty pharmacy will be used for PAH medications, and identify any acute symptoms that need immediate attention. After the call, the ambulatory care pharmacist places a telephone encounter note in the patient's EMR, enters updates to resolve any discrepancies on the patient's

home medication list, and sends an electronic message in the EMR to the pulmonary hypertension team that summarizes the results of the telephone encounter, including any medication or PAH problems that need to be resolved. Emergent issues are communicated directly to a physician or nurse coordinator. The electronic message is routed to the pulmonary department's administrative clerk. This message serves as a trigger for the administrative clerk to schedule a TOC office visit with a physician or nurse practitioner within 14 days of discharge or sooner if more urgent needs are identified.

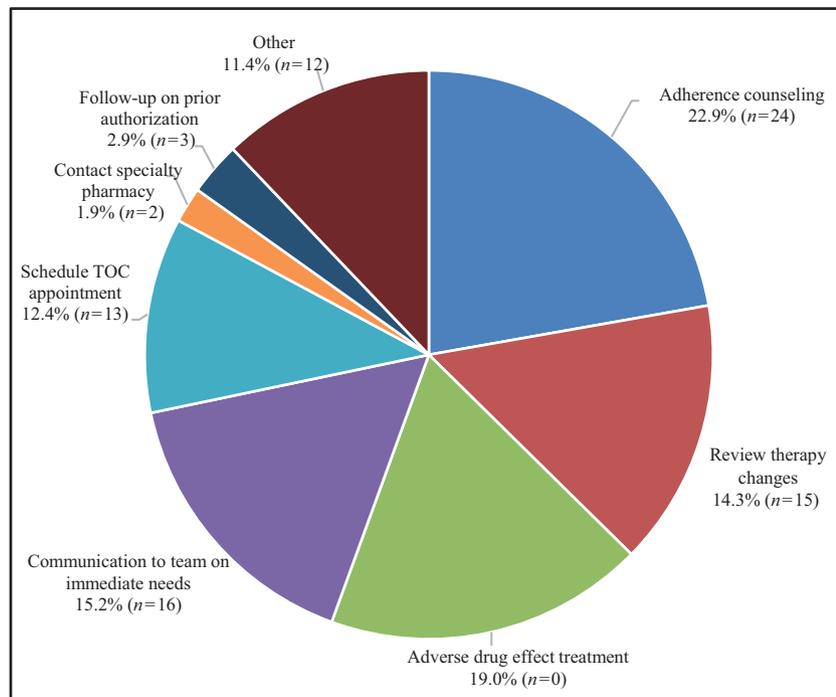
Initial experience

A retrospective chart review-based study approved by the institution's

investigational review board was conducted to evaluate early experience with the TOC service. From March 1, 2017, through December 31, 2018, there were 131 patients admitted to the ICU who were eligible for the TOC service; for 120 of those patients, a PAH ICU TOC note was entered in the EMR by the critical care pharmacist. A PAH ICU TOC note was not entered in the record in 1 admission involving initiation of a new PAH medication (sildenafil). The PAH home medication list was updated in 19.2% of ICU admissions (n = 23). Of the patients requiring updates to their home PAH medication list, 22 were patients for whom a PAH medication was not initiated during the hospital admission. TOC activities completed by the critical care pharmacist and data describing the resolution of medication access steps are detailed in Table 2. In 30% of patients, a new PAH medication was initiated; 88.9% of newly initiated medications required prior authorization. The median time to obtain a prior authorization approval was 3 (interquartile range [IQR], 0.25-7.0) days. A total of 94 of the 95 ICU patients for whom a PAH ICU TOC note was placed were eligible for the TOC service and were appropriately referred to the ambulatory care pharmacist for a postdischarge telephone call. The 30- and 90-day hospital readmission rates in the 120 patients with a PAH ICU TOC note were 20% (n = 24) and 40% (n = 48), respectively.

The ambulatory care pharmacist completed a telephone call with 29 of the 94 patients after discharge. Forty-nine patients did not meet the ambulatory care pharmacist's telephone call criteria, and 16 eligible patients could not be reached or were readmitted before the telephone call. Sixteen of the patients contacted did not have a new PAH medication started while hospitalized. A mean (SD) of 3.6 (0.8) activities were completed per patient (Figure 1). The numbers of activities completed were similar for patients who had a new PAH medication initiated during hospitalization and those who did not. For 2 patients, the ambulatory

Figure 1. Ambulatory care pharmacist's transitions of care (TOC) activities ($n = 105$ instances). Other activities included counseling for other disease-related concerns and ordering durable medical equipment to assist patients at home.



care pharmacist worked with the pulmonary hypertension multidisciplinary team after discharge to secure a prior authorization to prevent gaps in care. Following the ambulatory care pharmacist's telephone call, 24 patients had a TOC office visit with the pulmonary hypertension team, with a median follow-up time of 14 (IQR, 11.0-21.5) days. The 30- and 90-day hospital readmission rates in patients who received a postdischarge telephone call were 10.3% (3 of 29) and 41.2% (12 of 29), respectively.

Discussion

This report describes a novel pharmacy TOC service for patients with PAH admitted to the ICU setting and provides an example of collaboration that can occur between critical care and ambulatory care pharmacists to improve TOC in this population. Our experience demonstrated that critical care pharmacists were able to complete a PAH medication history, resolve PAH medication-related discrepancies on

the home medication list, and identify medication access barriers. In the ICU approximately a third of patients were initiated on a new PAH medication, and most medications required an insurance prior authorization. The use of a multidisciplinary medication access workflow helped ensure access to these therapies within days from the time of submission of a prior authorization request. Referral to the ambulatory care pharmacist was completed in 98.9% of eligible encounters resulting in a PAH ICU TOC note.

The ambulatory care pharmacist was integral in reinforcing the importance of adherence to PAH therapies, using supportive medications to address adverse effects, and identifying clinical scenarios requiring immediate attention. The management of adverse effects included education regarding prostacyclin adverse effects expected during parenteral dose titration, titration of gabapentin for prostacyclin-related adverse effects, and use of nonprescription medications for

prostacyclin-related adverse effects. Clinical scenarios requiring immediate attention that prompted intervention by the ambulatory care pharmacist included significant weight gain necessitating intensification of the diuretic regimen, patient downtitration of parenteral treprostinil without communication to the medical team, and inadequate medication supply. The rate of completion for discharge TOC telephone calls was similar to that for other pharmacist-driven postdischarge interventions.²¹ Additionally, ambulatory care pharmacist follow-up ensured that the majority of patients who received a telephone call attended an office visit within 14 days of discharge. Collaboration by the pulmonary hypertension multidisciplinary team secured access to therapy and prevented gaps in treatment throughout the TOC continuum.

The implementation and success of the TOC service was possible because members of the pulmonary hypertension multidisciplinary team have clearly defined roles within the medication access workflow and effective communication.^{12,14,22} The critical care and ambulatory care pharmacists are integrated into their settings within the practice model at the study institution and work closely with the pulmonary hypertension multidisciplinary team.^{12,14} Furthermore, use of an inpatient electronic referral process within the center's EMR supported the clinical workflow and assisted in the development of the new service.^{23,24}

Potential areas for future practice-based research include expanding services to non-critically ill PAH populations, defining the patient factors that predict who will benefit the most from pharmacist-directed TOC services, incorporation of a specialty-trained pharmacy technician into the TOC process, and conducting research comparing the effects of novel TOC services to standard care in a PAH population.

Conclusion

Including critical care and ambulatory care pharmacists as a part

of a multidisciplinary PAH team and targeting TOC efforts may constitute a novel way to improve patient outcomes. Future studies to evaluate clinical outcomes associated with novel PAH-focused TOC practices in patients with PAH admitted to the ICU setting are warranted.

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