Impact of pharmacist-led chronic disease management in a Federally Qualified Health Center

Caitlin McCarthy Pharm.D. 1,2 | M. Thomas Bateman Jr. Pharm.D. 1,2

1Ernest Mario School of Pharmacy, Rutgers, the State University of New Jersey, Piscataway, New Jersey, USA
2Henry J. Austin Health Center, Trenton, New Jersey, USA

Correspondence
Caitlin McCarthy, Ernest Mario School of Pharmacy, Rutgers, the State University of New Jersey, William Levine Hall, Room 418, 160 Frelinghuysen Road Piscataway, NJ 08854, USA. Email: c.mccarthy@rutgers.edu

Abstract
Introduction: There is growing interest in pharmacist-led chronic disease management (CDM) for underserved populations such as those treated within Federally Qualified Health Centers (FQHCs).

Objectives: To assess the impact of adding a pharmacist to the healthcare team within an FQHC for CDM.

Methods: This is a non-randomized, 6-month prospective pilot study whereby any member of the healthcare team could refer a patient to receive CDM from a pharmacist. The primary outcome is change in disease control as measured by primary clinical endpoint. Primary clinical endpoints for the most common disease states include glycated hemoglobin (A1C) for type 2 diabetes mellitus (T2DM), systolic blood pressure (SBP) for hypertension, Generalized Anxiety Disorder-7 (GAD-7) score for anxiety, and Patient Health Questionnaire-9 (PHQ-9) score for depression. Primary clinical endpoints are compared using a paired t test for the modified intention-to-treat population. Secondary outcomes include change in self-reported health and healthcare utilization and difference in satisfaction with care between the primary care provider (PCP) and pharmacist.

Results: Three hundred patients were enrolled of whom 199 were included. Most patients were referred by their PCP. Statistically significant differences in the mean primary endpoint were observed for all disease states with at least 20 participants, including T2DM (n = 96, change in A1C -2.1%, P < 0.001), hypertension (n = 32, change in SBP -29.7 mmHg, P < 0.001), anxiety (n = 25, change in GAD-7 score – 7, P < 0.001), and depression (n = 22, change in PHQ-9 score – 11.1, P < 0.0001). While statistically significant changes in self-reported healthcare and healthcare utilization were not observed, patients were more satisfied with care.

Conclusion: When provided with prescriptive authority and working within an interdisciplinary primary care team, pharmacists were able to impact clinical and humanistic outcomes in the FQHC, leading to improved CDM for a variety of illnesses. More studies should be conducted to validate these results in other settings.

KEYWORDS
chronic disease, community health centers, disease management, patient care team, patient outcome assessment, prospective studies
1 | INTRODUCTION

Chronic disease poses a significant healthcare burden in the United States, affecting six in ten adults and accounting for 90% of the nation’s annual healthcare expenditures. Addressing chronic illness is a major challenge in the United States (US); however, with appropriate management, morbidity and mortality can be mitigated. A common component of chronic disease management (CDM) is through long-term pharmacotherapy. In 2018, nearly 70% of outpatient physician visits in the United States involved drug therapy, and over 860 million drugs were provided or prescribed in this setting. Similarly, almost half of the US population reported using at least one prescription drug in the last 30 days, and retail outlet sales of prescription drugs totaled $456.3 billion US dollars. Those living with chronic illness utilize more prescription drugs than those without chronic illness, and utilization and cost of prescriptions increase with the number of concurrent chronic illnesses that an individual has.

Despite their frequent use, prescription medications can be complicated, both from the perspective of the prescriber as well as the patient, and they are not without the ability to cause harm. According to 2013-2014 data, an estimated four emergency department visits for adverse drug events occurred per 1000 individuals annually, and in 2018, there were 861,000 emergency department visits in the United States associated with a primary diagnosis related to adverse drug events, drug poisoning, or underdosing of drugs. Some key challenges encountered when using prescription medications include ensuring they are prescribed for an appropriate indication, utilizing the safest and most effective option, and promoting medication adherence. Due to these challenges, pharmacists are often incorporated into chronic disease models of care and have served as the lead in these initiatives. As medication experts, pharmacists are well suited to provide medication management services to enhance CDM by promoting safe and effective medication use in collaboration with other healthcare professionals to achieve optimal patient outcomes. When delivered in outpatient settings, medication management by pharmacists can improve medication appropriateness and adherence and reduce medication dosing, hospitalizations, and healthcare costs.

There is growing interest in incorporating pharmacist services in Community Health Centers like Federally Qualified Health Centers (FQHCs) for CDM. FQHCs are community-based healthcare providers that receive funds from the Health Resources and Services Administration Health Center Program to provide primary care services in underserved areas. Much of the available literature describing pharmacist services within FQHCs focuses on the management of diabetes mellitus and associated cardiovascular disease and results indicate that when pharmacists are added to the healthcare team, clinical outcome measures such as glycated hemoglobin (A1C), blood pressure, and cholesterol levels improve. Such studies are of variable quality and include limitations such as being retrospective, lacking comparison groups, being descriptive in nature without statistical analyses, focusing on only one disease state, and/or including a small number of patients. As such, there is an ongoing need to provide additional evidence which describes the provision of CDM services by pharmacists to further define the ways in which they can impact care in the FQHC setting.

Henry J. Austin Health Center (HJAHC), an FQHC in Trenton, NJ, is a system of 8 sites and one mobile health unit that provides care to over 18,000 patients throughout Mercer County. In 2020, 91% of patients were at or below 200% of the federal poverty level, 31% were uninsured, most patients with insurance had government-funded insurance, and 93% of patients identified as racial and/or ethnic minorities, with 51% identifying as Black/African American and 48% identifying as Hispanic/Latino. Being a patient-centered medical home, HJAHC follows a team-based healthcare delivery model to provide high-quality comprehensive and accessible medical care. Each medical team is comprised of a unit receptionist, medical assistant, nurse, and primary care provider (PCP). HJAHC also follows an integrated behavioral healthcare model whereby behavioral health services are embedded within the medical teams. At the time of the study, the behavioral health team included behavioral health consultants and a behavioral therapist. In addition to its core primary care services, HJAHC offers dental, podiatric, nutrition, social work, and pharmacy services. Pharmacy services were first established at HJAHC in August 2014 with the support of grant funding to assess the impact of adding a pharmacist to the healthcare team. Via this grant, the pharmacists were responsible for conducting a pilot study in which Medicaid-eligible patients with uncontrolled type 2 diabetes mellitus (T2DM) were randomized to receive standard of care (control arm) or standard of care plus the care of the pharmacist (intervention arm) for 12 months, the results of which have been published elsewhere. As pharmacy services were first introduced via a specific protocol in which pharmacists proactively identified eligible patients and services were restricted based on insurance status and disease state, it is unclear for which disease states the clinical staff of HJAHC would seek assistance from pharmacists and if pharmacists could help to improve clinical outcomes for HJAHC patients across a variety of disease states. To further define the role of the pharmacists based on the needs of the health center and to reach a larger population of patients, the pharmacy team developed a new protocol for CDM by which any member of the healthcare team could refer a patient to receive CDM from a pharmacist, the details of which are described in this paper.

2 | METHODS

The main purpose of this study is to assess the impact of adding a pharmacist to the healthcare team within an FQHC for CDM. This non-randomized, 6-month prospective pilot study was approved by the Rutgers University and HJAHC institutional review boards. The primary outcome of this study is the change in disease control at the end of 6 months of pharmacist management via CDM. The research team determined a consistent clinical endpoint for each referred disease state which served as the marker for change in disease control. As this was an exploratory assessment and referrals were not limited to specific disease states, the primary clinical endpoint could not be
TABLE 1  Referred disease states with associated markers of disease control

| Outcome                  | Endpoint                                      |
|--------------------------|-----------------------------------------------|
| Anxiety                  | Generalized Anxiety Disorder 7               |
| Attention Deficit Hyperactivity Disorder | Adult ADHD Self-Report Screening Scale-5       |
| Bipolar Depression       | Bipolar Depression Rating Scale               |
| Congestive Heart Disease | Healthcare Utilization                       |
| Dementia                 | Mini Mental Status Exam                      |
| Depression               | Patient Health Questionnaire 9               |
| Diabetes Mellitus        | Glycated Hemoglobin                          |
| Hypertension             | Systolic Blood Pressure                      |
| Hypertriglyceridemia     | Triglycerides                                 |
| Insomnia                 | Insomnia Severity Index                      |
| Migraine Headaches       | Migraine Prevention Questionnaire-5           |
| Pain                     | Numerical Severity                           |
| Panic Disorder           | Panic Disorder Severity Scale                |
| Post-Traumatic Stress Disorder | Short Post-Traumatic Stress Disorder Rating Interview |

Predetermined for all referred disease states before initiating the study. However, the research team conducted an internal review at HJAHC and hypothesized which disease states were likely to be the reason for referral to anticipate the primary clinical endpoint for each. If a patient was referred for a condition that was not listed among the predetermined disease states, the research team would determine the most appropriate primary clinical endpoint to use. When subjective surveys of disease control were used, such as for anxiety and depression, validated survey instruments already used at HJAHC as part of standard practice were selected as the primary clinical endpoint. Table 1 provides a comprehensive list of referred disease states and the associated clinical endpoint which served as a marker for disease control. Secondary outcome measures include change in self-rated health, change in healthcare utilization, and difference in satisfaction with care between the PCP and the pharmacist. A descriptive report of CDM by the pharmacist with a focus on medication therapy problems (MTPs) and associated interventions are included in Appendix A.

The pharmacy team who took part in this study includes two full-time shared faculty members from the Ernest Mario School of Pharmacy at Rutgers University, one of whom acts as the Lead Clinical Pharmacist (0.5 full-time equivalents at HJAHC) and the other as the Director of Pharmacy (0.5 full-time equivalents at HJAHC). Pharmacists at HJAHC are encouraged to practice at the top of their licensure and training and have prescriptive authority. Both pharmacists are Doctors of Pharmacy, have completed residency training, are privileged and credentialed by the HJAHC governing Board of Directors, and are pre-approved by the New Jersey Board of Pharmacy to enter into collaborative practice agreements. However, rather than practicing under a collaborative practice agreement, pharmacists are delegated by prescribers to place electronic orders on their behalf.

Patients were referred to receive CDM services from a pharmacist via a referral order placed within the electronic health record (EHR). A patient navigator reached out to each referred patient and scheduled the initial evaluation. The pharmacist determined if the patient met criteria for enrollment into the study by performing chart review of scheduled patients prior to their appointment. Patients were eligible if they were 18 years or older, English-speaking, and referred for the management of at least one newly diagnosed or pre-existing disease state that is a chronic medical condition in which pharmacotherapy is indicated and expected to continue for a minimum of 6 months after the referral. Patients of all genders, races, ethnicities, socioeconomic classes, and insurance status were included.

Exclusion criteria included pediatric patients, pregnant patients, and those seen by an outside provider for management of the referred disease state. Any patient who failed to adhere to the study protocol by missing appointments, failing to reschedule missed visits, or switching to an outside PCP was administratively withdrawn, with further details provided in Appendix B. Finally, patients who were eligible for, or currently enrolled in, the T2DM randomized controlled trial were excluded from participation in this study.

If eligible, study participants were invited to join the research study. Either the pharmacist or patient navigator reviewed the written informed consent with the patient. If they accepted, the participant signed the informed consent, was provided a copy, and was enrolled at that time.

Upon enrollment, the patient completed a demographic form. The patient completed a Self-Rated Health Form, Healthcare Utilization Form, and Provider Satisfaction Survey at baseline and 6 months. The Self-Rated Health Form and Healthcare Utilization Form were originally developed by the Stanford University self-management resource center and were chosen as these were the same forms used by the researchers for the T2DM randomized controlled trial.¹⁹ The baseline Provider Satisfaction Survey was regarding the care received from the PCP and the 6-month form was regarding care from the pharmacist. This is not a validated survey, and it was adapted from that already in use at HJAHC. The pharmacist completed a Clinical Data Form at baseline and 6 months. This form included information regarding the specialty of the referring team member, reason for referral, vital signs, and the primary clinical endpoint. Data collection forms are included in Appendix C.

Initial visits with the pharmacist were scheduled for 60 minutes and subsequent visits for 30 minutes. The pharmacists conducted a minimum of three study visits. Contents of these visits included a comprehensive medication review and medication management with a specific focus on improving clinical outcomes for the referred disease state. All visits were conducted following the Joint Commission of Pharmacy Practitioners Pharmacists’ Patient Care Process.²⁰ Encounters were conducted independently by the pharmacists; however, the pharmacist may have coordinated visit times such that they occurred on the same day as visits with other members of the healthcare team to improve ease of collaboration and convenience for the patient. Pharmacists documented all clinical measures, vital signs, and
contents of meetings in HJAHC’s EHR, athenahealth. If the referring provider was not the prescriber, the pharmacist first needed to confirm that the prescriber agreed with the referral to be permitted to place orders for the patient on their behalf. Pharmacists also communicated recommendations to PCPs verbally or via electronic notifications in the EHR. Documentation of MTPs follows the MTP Categories Framework as developed by the Pharmacy Quality Alliance’s Measure Development Team.

The primary outcome is reported for the modified intention-to-treat (mITT) population. The mITT analysis for the primary outcome includes all participants who had at least one additional measurement of the primary clinical endpoint after the baseline assessment and within 6 months of enrollment, and removes any participant who was administratively withdrawn, was lost to follow up and did not have at least one additional measurement of the primary clinical endpoint after baseline, was enrolled in error, withdrew consent, or died during the study (Figure 1). Change in the primary outcome is compared from baseline to end of study (last observation carried forward) using a paired t-test. Results of the Generalized Anxiety Disorder-7, Patient Health Questionnaire-9, and Short Post-Traumatic Stress Disorder Rating Interview were assessed as continuous variables, with scores across all variables being summed to yield a continuous measure of symptom severity. Secondary outcomes are reported for participants who completed the evaluation at both baseline and end of study. Change in self-rated health and healthcare utilization is compared using a Wilcoxon signed-rank test and satisfaction with care is compared between the PCP and pharmacist using Pearson’s χ² test. Statistical analyses are performed in GraphPad Prism Version 9.3.1 and Microsoft Excel with statistical significance set at a P-value of <0.05.

3 | RESULTS

Between March 3, 2017, and February 21, 2020, 446 patients were referred to the pharmacist and assessed for enrollment. One hundred and one patients did not meet inclusion criteria, 45 declined to participate, and the remaining 300 met inclusion criteria and signed informed consent to participate in the study. Of those enrolled, 199 are included in the analysis, (Figure 1). Demographic information for patients included in the analysis is summarized in Table 2.

Of enrolled patients, most were referred by their PCP, with 195 (65%) referred by a nurse practitioner (NP) and 80 (26.67%) by a physician. Fourteen were referred by a behavioral health consultant, five by a registered dietician, four by a behavioral therapist, and two by a nurse.

3.1 | Primary outcome

The results of the primary outcome for the most commonly referred disease states (at least 20 participants) are summarized in Table 3.
Statistically significant differences in the mean primary clinical end-point measures from baseline to the last observation carried forward were seen for T2DM (n = 96, change in mean A1C from 10.8 ± 2.2 to 8.7 ± 2.3, \( P < 0.001 \)), hypertension (n = 32, change in mean systolic blood pressure from 167.7 ± 24.7 to 138 ± 21.0 mmHg, \( P < 0.001 \)), anxiety (n = 25, change in mean Generalized Anxiety Disorder-7 score from 16.5 ± 3.7 to 9.5 ± 6.0, \( P < 0.001 \)), depression (n = 22, change in mean Patient Health Questionnaire-9 score from 19.3 ± 6.6 to 8.2 ± 6.4, \( P < 0.001 \)), post-traumatic stress disorder (n = 6, change in mean Short Post-Traumatic Stress Disorder Rating Interview score from 19.3 ± 6.6 to 8.2 ± 6.4, \( P = 0.04 \)), and chronic pain (n = 4, change in mean numerical severity score from 7.1 ± 1.7 to 3.3 ± 2.0, \( P = 0.03 \)).

### Secondary outcomes

Statistically significant improvements in self-rated health and healthcare utilization were not observed. Patients rated their health on a Likert scale from 1 ("Excellent") to 5 ("Poor"). The median score at both baseline and end of study remained 3 (baseline interquartile range [IQR] = 1, end IQR = 2). Similarly, median self-reported healthcare utilization remained the same from baseline to end of study for all queries of healthcare services (Table 4).

Patient satisfaction with care is summarized in Figure 2. Patients consistently reported higher satisfaction scores for care received from the pharmacist as compared to the PCP. When considering each question individually, pharmacists received an ideal score from a higher percentage of respondents than the PCPs, which was statistically significant for all questions but one.

### Discussion

Patients were most likely to be referred to the pharmacist by their PCP as compared to other team members. This was expected as it is
Finally, many of the reasons for referral coincided with the most common chronic conditions encountered at HJAHC, with hypertension and diabetes mellitus being the first and second most common, respectively, and anxiety being the sixth most common. All commonly referred disease states were considered poorly controlled at baseline, suggesting that referrals may have been made in reaction to poor disease control as compared to proactively referring patients for other reasons, such as to avoid future adverse events or costs.

Mean A1C for patients with T2DM met UDS criteria for poorly controlled diabetes mellitus at baseline (A1C > 9.0%), but by the end of the study, the mean A1C no longer met this definition. Other studies which have assessed the impact of medication management by pharmacists in FQHCs have demonstrated that pharmacist management can significantly improve A1C control. The magnitude of A1C percentage point change seen in this study appears comparable to that seen in similar studies.

When considering hypertension, the mean SBP at baseline was consistent with Grade 2 hypertension, and at the end of the study, the mean SBP was reduced to Grade 1 hypertension and met the essential hypertension goal as defined by the 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Like T2DM, the mean SBP at the end of the study no longer met UDS criteria for uncontrolled hypertension (SBP ≥140 mmHg).

In the anxiety population, the mean GAD-7 score was consistent with severe anxiety at baseline, and at the end of study, the mean score was consistent with mild anxiety. Similarly, in the depression population, the mean baseline PHQ-9 score was consistent with moderately severe depression and the final mean score with mild depression. In a comparable practice setting in which a pharmacist provided depression management within an FQHC, mean baseline PHQ-9 scores were like those observed in this population, and the change in PHQ-9 score was also statistically significant.

There are several limitations to note regarding this study and the interpretation of its results. As this was an exploratory pilot study, no power calculation or sample size was determined prior to initiating the study. There was no limit to the types of chronic disease states which could have been referred for CDM; therefore, there was variability in the primary endpoint to measure disease control. This led to many statistical analyses without the use of a correction factor which may have increased risk of alpha error. This study only occurred at one FQHC and generalizability of the results is limited. The short duration of the intervention may have led to an inability to observe the impact on disease control for some of the referred disease states as well as some of the secondary outcome measures, such as self-reported health and healthcare utilization. As median healthcare utilization was low at baseline, it is unlikely a change would be seen for

| Disease state | Primary clinical Endpoint, units | n | Baseline | End | P-value |
|---------------|---------------------------------|---|----------|-----|---------|
| T2DM          | A1C, %                          | 96| 10.8 ± 2.2 | 8.7 ± 2.3 | <0.001 |
| Hypertension  | SBP, mmHg                       | 32| 167.7 ± 24.7 | 138 ± 21.0 | <0.001 |
| Anxiety       | GAD-7, total score              | 25| 16.5 ± 3.7 | 9.5 ± 6.0 | <0.001 |
| Depression    | PHQ-9, total score              | 22| 19.3 ± 6.6 | 8.2 ± 6.4 | <0.001 |

Abbreviations: A1C, glycated hemoglobin; GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9; SBP, systolic blood pressure; T2DM, Type 2 diabetes mellitus.

| Healthcare service | Baseline | End |
|--------------------|----------|-----|
| Primary care visits| 2 (3.5)  | 2 (3)|
| Emergency department visits | 0 (1) | 0 (1) |
| Hospitalizations | 0 (0) | 0 (0) |
| Total nights in hospital | 0 (0) | 0 (0) |

not common for other members of the healthcare team to directly place referrals. Of the 275 patients referred by a PCP, about 70% were referred by a nurse practitioner, which is consistent with the staffing at HJAHC, as the full-time equivalent ratio of physicians to nurse practitioners is approximately 1 to 3.

The most common disease states prompting referral include T2DM, hypertension, anxiety, and depression, which may be due to a few key reasons. Firstly, pharmacy services were originally established at HJAHC for management of T2DM more than 2 years before the start of this study, and enrollment into the T2DM randomized controlled trial continued concurrently during the first 7 months of this study; therefore, the medical teams were encouraged to make referrals to the pharmacist for this reason. Secondly, targeted education to providers may have contributed to a large number of referrals for depression and anxiety. The integrated behavioral healthcare model at HJAHC was established shortly before introducing pharmacy services, and to establish rapport with the medical teams and meet educational needs, one pharmacist who is a Board Certified Psychiatric Pharmacist developed and delivered a series of in-services on psychotropic medications to the medical teams during the first year. Thus, the choice of in-service topics may have influenced the type of referrals received. Thirdly, the Uniform Data Systems (UDS) measures that FQHCs are required to report annually may have led to more referrals for T2DM and hypertension. The UDS is a standardized data set and annual program requirement of FQHCs. The UDS is comprised of several measures, including quality performance measures related to control of diabetes mellitus and hypertension. Finally, many of the reasons for referral coincide with the most common chronic conditions encountered at HJAHC, with hypertension and diabetes mellitus being the first and second most common, respectively, and anxiety being the sixth most common. All commonly referred disease states were considered poorly controlled at baseline, suggesting that referrals may have been made in reaction to poor disease control as compared to proactively referring patients for other reasons, such as to avoid future adverse events or costs.

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this outcome. The small sample sizes for several of the disease states may have also impacted the ability to detect change in disease control. Additional limitations include a high attrition rate, use of self-reported data (eg, healthcare utilization, comorbid conditions), lack of a cost-effectiveness analysis, and use of a historical control arm rather than an active control. The lack of an active control introduces more chances of confounders impacting disease control, and outside factors may have contributed to the improvement in disease control seen in this study.

5 | CONCLUSIONS

When provided with prescriptive authority and working within an interdisciplinary primary care team, pharmacists at HJAHC were able to positively impact clinical and humanistic outcomes, leading to improved CDM for a variety of medical and mental illnesses. The types of disease states prompting referral were often those most frequently encountered at HJAHC, those associated with specific clinical outcome measures that were tracked and reported by HJAHC to outside agencies to ensure high standards of clinical care, those for which the pharmacy team had already demonstrated knowledge and skills, such as through previous studies and targeted presentations, and those poorly controlled at baseline. Other outpatient facilities may use these findings to help develop new pharmacy services that address unmet patient and provider needs with emphasis placed on granting pharmacists prescriptive autonomy when instituting interventions. Additional studies which address those limitations identified in our own are encouraged to validate the results of this analysis and improve the generalizability of our findings.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ORCID

Caitlin McCarthy  https://orcid.org/0000-0002-8034-051X
M. Thomas Bateman Jr.  https://orcid.org/0000-0002-2135-6191

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There was a total of 669 pharmacist encounters for patients who completed the study without deviating from the study protocol with an average of 6.6 visits per patient over the 6-month study period (SD = 2.47). Medication therapy problems (MTPs) were identified for patients with chronic disease management service.

### Table A1  Medication therapy problems (MTPs) identified, grouped into categories per the pharmacy quality alliance framework

| MTP                                      | N   | %   |
|------------------------------------------|-----|-----|
| Total                                    | 683 | 100 |
| Indication                               |     |     |
| Indication-needs additional therapy      | 134 | 19.6|
| Needs additional therapy-synergistic therapy | 113 | 84.3|
| Needs additional therapy-untreated condition | 57  | 50.4|
| Needs additional therapy-preventative therapy | 48  | 42.4|
| Indication-unnecessary therapy           | 8   | 7.1 |
| Unnecessary therapy-no medical indication at this time | 21  | 15.7|
| Unnecessary therapy-duplicate therapy    | 9   | 42.9|
| Unnecessary therapy-non-pharmacotherapy therapy more appropriate | 1   | 4.8 |
| Effectiveness                            | 238 | 34.8|
| Effectiveness-dosage too low             | 195 | 81.9|
| Dosage too low-dose too low              | 186 | 95.4|
| Dosage too low-frequency inappropriate   | 7   | 3.6 |
| Dosage too low-incorrect administration  | 2   | 1.0 |
| Effectiveness-ineffective medication     | 43  | 18.1|
| Ineffective medication-more effective medication available | 32  | 74.4|
| Ineffective medication-condition refractory to medication | 8   | 18.6|
| Ineffective medication-dosage form inappropriate | 3   | 7.0 |
| Safety                                   | 160 | 23.5|
| Safety-adverse medication event          | 122 | 76.3|
| Adverse medication event-undesired effect | 97  | 79.5|
| Adverse medication event-incorrect administration | 14  | 11.5|
| Adverse medication event-unsafe medication for patient | 6   | 4.9 |
| Adverse medication event - medication interaction | 5   | 4.1 |
| Safety-dosage too high                   | 37  | 23.1|
| Dosage too high-dose too high            | 31  | 83.8|
| Dosage too high-frequency inappropriate  | 4   | 10.9|
| Dosage too high-medication interaction   | 1   | 2.7 |
| Dosage too high-incorrect administration | 1   | 2.7 |
| Safety-needs additional monitoring       | 1   | 0.6 |
| Adherence                                | 151 | 22.1|
| Adherence adherence                      | 142 | 94.0|
| Adherence-medications product not available | 46  | 32.4|
| Adherence-patient does not understand instructions | 38  | 26.8|
| Adherence-patient forgets to take        | 30  | 21.1|
| Adherence-patient prefers not to take    | 25  | 17.6|
| Adherence-patient cannot swallow/administer medication | 3   | 2.1 |
| Adherence-cost                           | 9   | 6.0 |
| Cost-effective medication available       | 7   | 77.8|
| Cost-patient cannot afford medication product | 2   | 22.2|

Note: The pharmacy quality alliance framework divides medication therapy problems (MTPs) into four broad categories of medication related needs—Indication, Effectiveness, Safety, and Adherence—each of which is further divided into MTP categories and MTP rationales. MTP rationales are italicized and listed under the appropriate MTP category.
more than one disease state for 63 (62.4%) patients. The average number of disease states for which MTPs were identified was 2 (SD = 1.12).

A summary of the MTPs is listed in Table A1, and the types of interventions implemented are listed in Table A2. Interventions listed in Table A2 did not require primary care provider approval prior to implementation. Only those interventions that were accepted by the patient are included. MTPs and associated interventions may be counted more than once in some cases, such as continued issues with adherence despite interventions to resolve adherence problems.

### TABLE A2  Interventions implemented to address medication therapy problems

| Intervention                        | N   | %    |
|-------------------------------------|-----|------|
| Total                               | 683 | 100  |
| Counsel patient                     | 205 | 30.0 |
| Increase dose                       | 186 | 27.2 |
| Initiate medication                 | 115 | 16.8 |
| Switch medication                   | 56  | 8.2  |
| Discontinue medication              | 49  | 7.2  |
| Decrease dose                       | 35  | 5.1  |
| Switch formulation                  | 15  | 2.2  |
| Switch time of administration       | 10  | 1.5  |
| Increase frequency of administration| 6   | 0.9  |
| Monitor                             | 4   | 0.6  |
| Decrease frequency of administration| 2   | 0.3  |

Note: All interventions listed did not require primary care provider consent as pharmacist interventions for medication adjustments were pre-approved at the time of referral. All interventions listed were accepted by the patient prior to implementation.

### APPENDIX B

**Reasons for administrative withdrawal**

Patients were administratively withdrawn from the study under the following circumstances:

- The patient missed three appointments during the study period;
- The pharmacist was unable to schedule an appointment within 30 days of a missed appointment;
- The patient did not complete a minimum of three visits within the 6-month study period or the third appointment did not occur at least 30 days prior to the ideal study close out date;
- The patient was no longer being managed by a Henry J. Austin Health Center (HJAHC) primary care provider (PCP) for the referred medical condition; or
- The patient became pregnant at any point during the study.

The total full-time equivalent of clinical pharmacists at HJAHC was 1.0 during this study. The clinical pharmacists had other responsibilities to HJAHC in addition to providing chronic disease management (CDM) as part of this study, and the entire 1.0 full-time equivalent was not dedicated to this study. Therefore, to allow the pharmacists to spend more time on delivering CDM and limit the time spent by the pharmacists in following up with patients who were not engaged in the study (eg, those who missed multiple appointments, did not re-schedule missed appointments, and did not complete a minimum of three appointments), the pharmacists were permitted to administratively withdrawal patients under several circumstances. To ensure the pharmacists were able to proactively make prescriptive changes to those medications for the referred diseases, patients who were no longer managed by a HJAHC PCP for the condition were administratively withdrawal. Finally, due to the variable effect of pregnancy on disease control, the researchers allowed the pharmacists to remove any patient who became pregnant during the study. However, no participant was withdrawal from the study for this reason.
### Data-collection forms

**Patient-reported baseline demographic form**

- **Gender:** Please Specify Your Gender (choose one answer)
  - [ ] Male
  - [ ] Female
  - [ ] Decline to Answer

**When were you born?** (indicate the month, day and year that you were born)

[ ] American Indian or Alaska Native
[ ] Asian
[ ] Black or African American
[ ] Native Hawaiian
[ ] Other Pacific Islander
[ ] White
[ ] Other

**What is your ethnicity?** (choose one answer)

- [ ] Hispanic/Latino
- [ ] Not Hispanic/Latino
- [ ] Decline to Answer

**Do you have any of the following medical conditions?** (check all that apply and indicate the number of years that you have had each disease, if known)

- [ ] Myocardial Infarction
- [ ] Angina
- [ ] Congestive Heart Failure
- [ ] Peripheral Vascular Disease
- [ ] Cerebrovascular Disease
- [ ] Dementia
- [ ] COPD (Chronic Obstructive Pulmonary Disorder)
- [ ] Connective Tissue Disease
- [ ] Peptic Ulcer Disease
- [ ] Diabetes Mellitus
- [ ] Moderate to Severe Chronic Kidney Disease
- [ ] Hemiplegia
- [ ] Amputation
- [ ] Blindness
- [ ] Leukemia
- [ ] Malignant Lymphoma
- [ ] Solid Tumor
- [ ] Liver Disease
- [ ] HIV/AIDS (Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome)
- [ ] Depression
- [ ] Anxiety
- [ ] Schizophrenia
- [ ] Bipolar Disorder
- [ ] Insomnia

(Continues)
Self-Rated Health
In general, would you say your health is... (circle one number)

| Rating   | Code |
|----------|------|
| Excellent| 1    |
| Very good| 2    |
| Good     | 3    |
| Fair     | 4    |
| Poor     | 5    |

Health Care Utilization

1. In the past 6 months, how many times did you visit a physician? Do not include visits while in the hospital or to a hospital emergency room. Fill in with “0” or another number. ______ times

2. In the past 6 months, how many times did you go to a hospital emergency room? Fill in with “0” or another number. ______ times

3. How many different times did you stay in a hospital overnight or longer in the past 6 months? Fill in with “0” or another number. ______ times

4. How many total nights did you spend in the hospital in the past 6 months? Fill in with “0” or another number. ______ nights

Patient Experience with Medical Provider Survey
Please choose the medical profession that best describes your current primary care provider. If you do not know, ask the pharmacist for help.

Medical Provider:

- Physician
Physician Assistant
Nurse Practitioner
Advanced Practice Nurse
Pharmacist

Patient Experience with Medical Provider Survey

Please answer each of the following questions. Think of your medical provider when you answer the questions. This information will remain confidential.

1. How often does the medical provider explain things in a way that is easy to understand?
   ☐ Never ☐ Sometimes ☐ Usually ☐ Always

2. How often does the medical provider listen carefully to you?
   ☐ Never ☐ Sometimes ☐ Usually ☐ Always

3. How often does the medical provider ask you to describe how you follow their instructions?
   ☐ Never ☐ Sometimes ☐ Usually ☐ Always

4. Has the medical provider talked with you about, or helped you make specific goals for your health?
   ☐ Yes ☐ No

5. Has the medical provider asked you if there was a period of time when you felt sad, empty, or depressed?
   ☐ Yes ☐ No

6. Has the medical provider talked to you about, or offered to talk to you about, a personal or family problem, alcohol or drug use, or mental and emotional illness?
   ☐ Yes ☐ No

7. How would you rate your experience with your medical provider?
   ☐ Poor ☐ Fair ☐ Good ☐ Very Good ☐ Excellent

8. Of the questions listed above, identify the three that are most important to you by putting the number of the questions in the boxes below.

   [ ]
   [ ]
   [ ]
Healthcare Professional-Reported Clinical Data Form

Referred disease state:

Discipline of referring team member:

Primary clinical outcome measure identified as:

Result of primary clinical outcome measure:

What is the patient's weight?

____________ (kg)

What is the patient's height?

____________ (inches)

What is the patient's BMI?

____________ (kg/m²)

What is the patient's systolic blood pressure?

____________ (mm Hg)

What is the patient's diastolic blood pressure?

____________ (mm Hg)

Is the patient currently taking one or more drugs for the management of primary referred disease state? (choose one; if “Yes,” then choose a corresponding year when the patient first started to use any agent for the management of hypertension, if known)

☐ Yes Year: __

If yes, how many?

☐ No

What best describes the patient's smoking status? (choose one answer)

☐ Never smoked

☐ Current smoker

☐ Former smoker

Has the patient ever participated in a smoking cessation program? (choose one; if “Yes,” then indicate the patient's smoking status after completion of the program)

☐ Yes

If yes, how would you describe the patient's smoking status after completion of the program?

☐ Quit smoking ☐ Quit and restarted ☐ Never quit

☐ No

How often does the patient report having a drink containing alcohol? (choose one answer)

☐ Never

☐ Monthly or less

☐ 2-4 times a month

☐ 2-3 times a week

☐ 4 or more times a week

How many standard drinks containing alcohol does the patient report having on a typical day? (choose one answer)

☐ 0

☐ 1 or 2

☐ 3 or 4

☐ 5 or 6
☐ 7 to 9
☐ 10 or more

How often does the patient report having six or more drinks on one occasion? (choose one answer)

☐ Never
☐ Less than monthly
☐ Monthly
☐ Weekly
☐ Daily or almost daily