

An academic-community collaboration to deliver medication therapy management (MTM) services to patients living in rural counties of a Southwestern State

Abstract

Background: Patients living in rural communities often experience pronounced health disparities, have a higher prevalence of diabetes and hypertension, and poorer access to care compared to urban areas. To address these unmet healthcare service needs, an established, academic-based MTM provider created a novel, collaborative program to provide comprehensive, telephonic services to patients living in rural (blinded) counties.

Objective: This study assessed the program effectiveness and described differences in health process and outcome measures (e.g., clinical outcomes, gaps in care for prescribed medications, medication-related problems) between individuals residing in different rural-urban commuting area (RUCA) groups (urban, micropolitan, and small town) in rural (blinded) counties.

Methods: Subjects eligible for inclusion were 18 years or older with diabetes and/or hypertension, living in rural (blinded) counties. Data were collected on: demographic characteristics, medical conditions, clinical values, gaps in care, medication-related problems (MRPs), and health promotion guidance. Subjects were analyzed using three intra-county RUCA levels (i.e., urban, micropolitan, and small town).

Results: A total of 384 patients were included from: urban (36.7%), micropolitan (19.3%) and small town (44.0%) areas. Positive trends were observed for clinical values, gaps in care, and MRPs between initial and follow-up consultations. Urban dwellers had significantly lower average SBP values at follow-up than those from small towns ($p < 0.05$). A total of 192 MRPs were identified; 75.0% were resolved immediately or referred to providers and 16.7% were accepted by prescribers.

Conclusion: This academic-community partnership highlights the benefits of innovative collaborative programs, such as this, for individuals living in underserved, rural areas.

Key words: Collaboration; Diabetes; Hypertension; Medication therapy management; Rural health

Background

Patients living in rural communities often experience pronounced health disparities. These communities also have a higher proportion of older adults and impoverished residents¹. Additionally, their demographic, environmental, economic and social characteristics differ from urban centers, contributing to health problems². Moreover, the prevalence of diabetes and hypertension is higher in rural areas compared to urban areas. Individuals living in rural areas have a greater likelihood of having diabetes than those in urban areas³. For example, estimates from the 2013 Behavioral Risk Factor Surveillance System (BRFSS) reported a prevalence of 12.0% for diabetes in rural areas versus 10.4% in urban areas; and the prevalence for hypertension was 38.1% in rural areas versus 32.6% in urban areas⁴. Rural health stakeholders recently ranked diabetes as one of the top three healthcare challenges facing rural areas in the United States (US)⁵. Often these residents are at a higher risk for chronic diseases, face health workforce recruitment and retention challenges, have decreased access to hospitals and other medical facilities, and experience shorter overall life expectancies^{2,6-7}. Furthermore, rural patients are at increased risk for adherence-related treatment issues due to geographic barriers, lack of transportation to healthcare facilities, and lack of healthcare providers⁸⁻⁹. Concentrated efforts are needed to address this gap in access to and provision of healthcare services for rural-dwelling patients.

The definition of the term 'rural' varies as individuals, government agencies, and funders often define the term differently when setting thresholds for program eligibility. Rural may be defined using legal definitions, such as that provided by the (blinded) state statute¹⁰. Another method is the rural-urban commuting area (RUCA) codes, using census data to classify each zip code. RUCA codes can be aggregated in many different ways, depending on the needs of the user, and have been widely used for health policy and research. Categorizing individuals by RUCA code is useful in identifying differences in trends between

urban- and rural-dwelling patients regarding their medication optimization, healthcare utilization and health outcomes¹¹⁻¹³.

Medication therapy management (MTM), defined by the American Pharmacists Association, is “a service or group of services that optimize therapeutic outcomes for individual patients”¹⁴. Medicare Part D sponsors must offer MTM services to all eligible beneficiaries¹⁵, yet each sponsor can determine how these services are provided to patients (e.g., telephonic, face-to-face, or both)¹⁶.

While MTM services improve patients’ health measures and reduce healthcare costs¹⁷⁻²⁰, challenges remain that limit their scope, reach and effectiveness²¹.

While somewhat indirect, patients and prescribers play critical roles in the acceptance and provision of MTM services. Many patients have reservations about pharmacists performing roles other than dispensing medications, i.e., providing MTM services²². This may explain why only about 11% of eligible beneficiaries accept MTM services²³. Moreover, completion rates for comprehensive medication reviews (CMRs), the initial step in this multi-step MTM process¹⁴, are low (23.8%-49.8%)²⁴. Furthermore, prescriber acceptance rates of pharmacists’ MTM recommendations vary widely (14.1%-60%)²⁵⁻²⁷, perhaps due to their lack of awareness regarding these services²⁸. To address the challenges surrounding MTM acceptance, other researchers have evaluated: improving strategies or promotional approaches, establishing stricter eligibility criteria, varying levels of MTM services to improve efficacy, or integrating more targeted programs into clinics^{24,29-31}.

To address this gap in unmet healthcare service needs, an established, academic-based MTM sponsor created a novel, collaborative program with independent retail and community health center pharmacies to provide comprehensive, telephonic services to patients living in rural (blinded) counties (as defined by (blinded) state statutes)¹⁰. The use of three intra-county RUCA levels (i.e., urban, micropolitan, and small town) allowed for comparisons

between degrees of rurality within population centers in counties designated as rural by the state of (blinded). The objective of this study was to describe differences in health process and outcome measures (e.g., clinical outcomes, gaps in care for prescribed medications, medication-related problems) between individuals residing in different RUCA groups (urban, micropolitan, and small town) in rural (blinded) counties, and to assess the program effectiveness.

Methods

Study design and collaborators. This study used a pre-post design to assess the effect of this collaborative MTM program on the health process and outcome measures of rural (blinded) patients. An academic-based MTM provider partnered with five rural community sites: three independent retail pharmacies; one pharmacy at a Federally Qualified Health Center; and one Rural Health Clinic pharmacy. The participating sites signed formal agreements with the MTM provider that outlined their specific roles and responsibilities for the project. The selected pharmacy sites were located in rural (blinded) counties, as defined by the (blinded) statute (A.R.S. § 11-806). These specific pharmacy partners were selected given their long-standing relationships with the academic institution as well as their ability to target socioeconomically underserved areas to address health disparities as defined by the Centers for Disease Control and Prevention³². The University of (blinded) Institutional Review Board approved this study.

Patient eligibility and enrollment. Eligible participants included those: receiving care at one of the community partner sites; aged 18 years or older; diagnosed with diabetes mellitus and/or hypertension; and living in rural (blinded) counties. Participants were recruited and enrolled by personnel at the community partner sites in person or via telephone. The MTM provider also furnished flyers for dissemination via mail and e-mail and

periodically conducted telephonic recruitment. Once a patient agreed to participate in the program, community site personnel completed a patient registration form and sent it to the MTM provider. The MTM pharmacist then contacted the patient to provide telephonic services from a centralized, academic site. The same board-certified pharmacist provided the MTM service to all study participants. All participants were informed of the program and given the option to participate or not.

MTM services. The university-based provider integrated the American Pharmacists Association's Core Elements of an MTM Service Model¹⁴ during service provision. The MTM pharmacist provided comprehensive services, including an initial patient consultation and a CMR, during which patients were always asked about all prescribed, non-prescription, and complementary medications as well as medications recommended/prescribed by all of their other providers. Thereafter, the MTM pharmacist sent patient recommendations or referrals to the community partner sites (i.e., community pharmacist and/or prescriber).

Patients were deemed high risk, for study purposes, if they had any of the following: Hemoglobin A1c >7%, average fasting blood glucose (FBG) level >130mg/dL, ≥ 2 episodes of hypoglycemia, presence of diabetic complications, missing preventive screenings, blood pressure above individualized goal, uncontrolled respiratory symptoms, confusion regarding inhaler use, fluid overload symptoms, missing a fluid management plan, and medication non-adherence³³⁻³⁹. Based on patient risk level, MTM pharmacists conducted follow-up consultations, at 30-days (high-risk patients) or at 90-days (all other patients), to ensure that their recommendations were addressed appropriately by the retail pharmacists or prescribers. MTM pharmacists conducted additional follow-up consultations as necessary. If the patient was unreachable, the MTM pharmacist made recommendations directly to community partner site staff, based on available information (e.g., site-provided medication list, or data review from electronic health record).

Staff at the community partner sites included medical assistants, pharmacists, or prescribers, depending on the site. Their role was to discuss recommendations made by the MTM pharmacist with the patients and conduct periodic reviews of medication history to assess recommendation outcomes. Community health workers (CHWs), were utilized at one site. Their role was to make a home visit during the initial consultation and CMR to: assist with the medication reconciliation, ensure patient understanding, and document any recommendations made.

Data collection. Demographic information was collected for: gender, age, ethnicity, race, and medical conditions. Patients who had a CHW present at the initial consultation and individuals who were deemed high risk also were recorded.

Clinical data, including laboratory results and self-monitoring information, were collected at the initial and follow-up consultations for: systolic and diastolic blood pressure (SBP and DBP), hemoglobin A1c (HbA1c), fasting blood glucose (FBG), and postprandial glucose (PPG). Laboratory results (when available) were obtained from the medical record by the MTM pharmacist or community partner site staff, or directly from patients in the remaining situations.

Gaps in care were identified dichotomously (i.e., gap or no gap) as cases where an individual should have had a prescription for certain drug classes (statins, beta blockers, rescue inhalers, and inhaled corticosteroids) based on respective national consensus guidelines, yet did not (i.e., the individuals needed additional therapy)³³⁻³⁹. Presence of a statin (3-hydroxy-3-methylglutaryl- coenzyme A reductase inhibitor) was assessed for patients with diabetes and atherosclerotic cardiovascular disease while presence of a beta-adrenergic blocker was assessed for patients with reduced ejection fraction heart failure and in post-myocardial infarction patients. Inhaled beta-2 adrenergic agonist presence (such as an albuterol inhaler) was assessed for patients with asthma and those with chronic obstructive

disease while presence of an inhaled corticosteroid was assessed in patients with asthma. These four classes were chosen as they represent treatments for common prevalent chronic conditions and have clinical guidelines to support their appropriate use. If an individual had a gap in recommended care, after taking into account the holistic needs of the patient e.g., medication history, allergies, comorbidities, etc., a facsimile was sent to the prescriber to alert them where appropriate. At the follow-up consult, the pharmacist assessed if the gap in care had been rectified.

Data also were collected on medication-related problems (MRPs) whereby the patient's entire medication profile was taken into account including: unnecessary drug therapy (therapy duplications) identified and resolved; different drugs needed (drug-disease and drug-drug interactions), as well as dose-related safety concerns identified, referred, and accepted by the prescriber; adverse drug reactions identified and referred to prescriber; and high-risk medications (e.g., Beers list of medications to avoid in the elderly) identified, referred, and accepted by the prescriber for seniors (>65 years)⁴⁰. The MTM pharmacist followed a protocol delineating various actionable items and the criteria that deemed it as appropriate or inappropriate to take action.

Data collected on health promotion guideline adherence included reporting of: hypoglycemic event education; missing preventative screenings (e.g., daily foot exams and finger-stick fasting blood sugar for diabetic patients); medication utilization concerns (open text for any medication utilization concern reported, e.g., not taking medication as prescribed, inappropriate use or dosing of medications, delays in refilling medications); adherence issues (defined according to responses to the self-report question: do you miss a dose more than 6 times in 30 days?); administration errors identified and corrected; referrals made to various healthcare professionals or programs (e.g., diabetes education, dietary consultation, smoking cessation program, and use of CHWs); and vaccination recommendations (i.e., for influenza,

pneumococcal, shingles).

Finally, data were collected for: the initial and follow-up consultation dates and time spent on the initial, pre- and post-CMR. Additionally, patient-reported levels of comfort managing their chronic diseases was collected before and after the CMR using the following question: “How comfortable are you with management of your chronic diseases?”. Response options included: “very comfortable”, somewhat comfortable”, somewhat uncomfortable”, very uncomfortable”.

Data analysis. Study subjects were organized into one of three intra-county RUCA groups: urban (RUCA codes 1-3; Metropolitan area core with high or low commuting), micropolitan (RUCA codes 4-6; primary traffic flow through an urban cluster or low or high commuting), or small town (RUCA codes 7-10; small town core with flow within an urban cluster or high or low commuting to a small urban cluster). The most recently available RUCA codes were employed for this study, based on the 2010 census data. That is, all subjects lived in rural (blinded) counties as defined by the (blinded) statute (A.R.S. § 11-806)¹⁰. However, within these counties there were urban, micropolitan and small town areas per the RUCA code definition⁴¹.

Participants who were lost to follow-up were excluded from the analysis. Differences between initial and follow-up clinical values (laboratory results and self-monitoring data) were calculated by subtracting one value from the other. Differences between the initial and follow-up consultation dates were calculated, and the mean follow-up time was calculated for each group.

Chi-square or Fisher’s exact tests were used to compare unpaired nominal data. Post-hoc tests were conducted where necessary and Bonferroni corrections were applied in cases of multiple tests to decrease the possibility of type I errors. ANOVA and Tukey’s honestly significant difference tests were used as appropriate to evaluate changes in interval level data.

An alpha of 0.05 was selected a priori. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

Results

Demographic characteristics. A total of 384 individuals were included in this study. The majority of subjects were female (n=252, 65.6%), white (n=280, 72.9%) and non-Hispanic (n=201, 52.3%). The most common age category observed was for 65-74 years old (n=127, 33.1%). Most patients had hypertension (n=358, 93.2%) or diabetes mellitus type II (n=286, 74.5%) or both (n=265, 69.0%), based on the eligibility criteria. Post-hoc testing indicated that there were several instances of significant differences between the three RUCA groups for certain age groups, ethnicity status, and all medical conditions except hypertension. Almost half of the patients were considered high risk (n=186, 48.4%), with significantly fewer of these individuals residing in urban versus micropolitan areas ($p<0.001$) within rural counties. CHWs were present at the initial consultation for 45 subjects, all of whom were residing in urban areas (RUCA codes 1-3) within the rural counties. Further details are provided in Table 1.

Clinical data. Mean follow-up laboratory values and self-monitoring data were typically lower than those documented at the initial consultation. However, the only statistically significant difference was for the mean average SBP value ($p=0.0263$); urban-residing individuals had significantly lower mean average SBP values at follow-up compared to those living in small towns ($p<0.05$) within the rural counties. See Table 2 for further details.

Gaps in care and need for additional therapy based on national consensus guidelines. Pharmacists recommended that prescribers add a statin for 57 (21.8%) patients; of those, 19 (33.3%) additions were identified at follow-up. Adding a beta-blocker was

recommended for 13 (20.6%) patients, yet only two additions (15.4%) were present at follow-up. Recommendations were made for adding a rescue inhaler for seven (7.9%) patients; three additions (42.9%) were identified at follow-up. None of the 13 inhaled corticosteroid recommendations were present at follow-up. See Table 3 for further details.

Medication-related problems (MRPs). A total of 23 (6.0%) patients had an unnecessary drug therapy, identified as a therapy duplication, and 82.6% of these were resolved at the initial consultation. In terms of cases where different drugs were needed, fifteen patients (3.9%) had drug-disease interactions and significantly fewer of these individuals resided in small towns (n=3) versus micropolitan areas (n=7, p=0.02) within the rural counties. Three (50.0%) of the six drug-disease interactions referred to the physician were accepted. Thirty-one (8.1%) patients with drug-drug interactions and thirty-three (8.6%) patients with dose-related safety concerns were identified. Four (40%) of the ten drug-drug interactions and eight (28.6%) of the 28 dose-related safety concerns referred to the physician were accepted. Fifty-one (13.3%) patients with adverse drug reactions (ADRs) were identified and resolved at the initial consultation. Thirty-nine (20.5%) patients with high-risk medications were identified in the older adult (>65 years) population; 30 (76.9%) were referred to the provider and 30.0% were accepted. No further significant differences were present between RUCA groups. See Table 4 for further details.

Health promotion. Of the 283 patients with diabetes, 83 (21.6%) received glycemic event education. Utilization concerns were identified in 106 (27.6%) patients, and adherence issues (dose missed >6 times in 30 days) were identified in 39 (10.2%) patients. Administration errors were identified and corrected in three patients in the small-town group. A total of 123 (32.0%) patients were missing preventative screenings with significantly more of these individuals residing in micropolitan (48.6%) versus urban areas (24.1%, p=0.0002) and small towns (31.4%, p=0.01) within the rural counties.

Referrals to other healthcare professions or programs. Patients were referred to various other professionals or programs, including: nutritionists or dietitians (n=6, 1.6%), endocrinologists (n=4, 1.0%), diabetes educators (n=4, 1.0%), primary care providers (n=3, 0.8%), smoking cessation programs (n=14, 3.6%), CHW (n=6, 1.6%), or others (n=5, 1.3%). Significantly more individuals living in micropolitan (12.2%) versus urban areas (2.1%, $p=0.002$) and small towns (1.2%, $p=0.0002$) within the rural counties were referred to a smoking cessation program. All six of the CHW referrals were to individuals in the urban group.

Vaccination recommendations. During the initial consultation, MTM providers recommended influenza (n=137, 46.4%), pneumococcal (n=193, 56.3%), and shingles (n=197, 76.7%) vaccines as appropriate. Significantly more individuals in the urban (89.4%) versus micropolitan (75.6%, $p=0.04$) and small town (68.7%, $p=0.0004$) groups within the rural counties received a recommendation for a shingles vaccination at the initial consult. See Table 5 for more details.

Follow-up time. The mean follow-up period was 101.4 days (standard deviation, $SD=37.2$) in the urban, 87.8 ($SD=36.7$) in the micropolitan, and 96.2 ($SD=34.4$) in small town groups within the rural counties, respectively. There were significant differences between the groups ($p=0.0310$) with longer periods between follow-up for those in the urban group versus micropolitan group ($p<0.05$) within the rural counties.

Pharmacists' time spent on CMRs. Data were available for the time spent on CMRs for 365 individuals. Most CMRs took 16-30 minutes to complete (n=172, 47.1%) followed by 31-45 minutes (n=114, 31.2%), with fewer CMRs in the <15-minute (n=39) and >45 minutes (n=40) categories. There were no significant differences between groups.

Patients' level of comfort managing chronic diseases. A total of 250 patients were asked how they felt about managing their chronic disease before the CMR. Most reported

being very comfortable (n=116, 46.4%) or somewhat comfortable (n=116, 46.4%). Post CMR, of the total of 176 patients responding to the same question, the majority felt very comfortable (n=117, 66.5%) or somewhat comfortable (n=58, 33.0%). No significant differences existed between RUCA groups based on level of rurality.

Discussion

These study findings provide evidence demonstrating the potential benefit of this pharmacist-delivered, collaborative MTM program targeting residents of rural counties. First, in general, there were significantly more individuals with chronic medical conditions in the micropolitan and small-town groups compared to their urban counterparts within rural counties. This pattern was similar for high-risk patients, further demonstrating the need for such a program to provide MTM services to individuals living in rural areas. Second, ninety recommendations were made to add a medication in accordance with national guidelines for the rural patient sample. Furthermore, over 200 therapy duplications, drug-disease interactions, drug-drug interactions, dose-related safety concerns, adverse drug reactions, and high-risk medications in the elderly were identified for this rural sample. Identification of this magnitude of issues among this sample of 384 individuals was quite concerning from a clinical standpoint, yet suggests the scale of healthcare benefits that may be realized if similar numbers of recommendations were identified and acted upon if this program were offered to larger, rural populations. Previous evaluations of novel pharmacist-provided MTM services have identified similar numbers of interventions made by pharmacists⁴². Although our intention was for this service to improve health outcomes, a 2015 meta-analysis found that MTM interventions can reduce some medication-related problems but may not improve health outcomes. Further work is therefore necessary to make sure such interventions are able to elicit the desired outcomes.⁴³

Recommendations for vaccinations varied considerably depending on the type of vaccine. Many patients were current with their influenza vaccines, yet approximately 30% received a recommendation for the vaccination. Fewer individuals had current pneumococcal vaccines and fewer still had up-to-date shingles vaccines. Interestingly, a significantly greater proportion of individuals were up-to-date with their shingles vaccines in the micropolitan and small town groups compared to the urban group, which highlights the notion that this service can benefit individuals living in urban centers as well.

There was only one instance of a statistically significant improvement in clinical values measured between baseline and follow up, i.e., urban-residing individuals had significantly lower mean average SBP values at follow-up compared to those living in small towns ($p < 0.05$). The authors recognize that interventions to improve diabetes and hypertension are often multifaceted (e.g., medications, lifestyle), thus this program only addresses the medication-related perspective of improving diabetes and/or hypertension control. This suggests that this process-oriented service is not improving outcomes as desired, and perhaps other approaches such as a collaborative practice agreement (CPA) could be used to improve outcomes.⁴⁴

One of the most concerning findings was that the number of pharmacists' recommendations accepted or acted upon by providers was generally low, yet ranged considerably from 0% to 100%. Previous studies have also identified this trend. For example, Doellner et al. found that prescribers accepted 20% of pharmacists' recommendations to initiate a statin, and 59% of recommendations to discontinue a high-risk medication⁴⁵. Axon et al. also reported that pharmacists' recommendations were inconsistently acted upon, and found that communication preferences were an important component for physician acceptance⁴⁶. Therefore, further investigation is warranted to better understand the reasons why physicians sometimes fail to act on pharmacists' recommendations. Without buy-in and

action from physicians to address medication issues, the recommendations' made by pharmacists are likely to have a limited impact on health outcomes and overall health.

Self-reported medication adherence among this sample was relatively high (89.8%), but the MTM pharmacist was unable to investigate adherence in detail due to time constraints. Further work into medication adherence measures is therefore warranted.

This study also tracked the time for each pharmacist consultation to provide an estimate of the time spent with the individual patients. While most consultations took less than 45 minutes to complete, one tenth (11%) lasted longer. The length of the consultation was carefully balanced to allow the pharmacist to conduct a comprehensive medication review and address any issues identified, while also being respectful of the patient's time. However, it is possible that some participants, particularly older adults, may have found it challenging to concentrate on the details of the conversation for longer periods of time. This program was limited to patients with diabetes and/or hypertension, however the more lengthy consultations might be attributable to those individuals with other complex medical conditions and medication-related issues, requiring the pharmacist's attention and additional time. Another possible explanation is that these patients were more engaged in their own healthcare and may have taken the opportunity to discuss management of their condition based on the pharmacist's immediate availability, particularly given the well documented health workforce shortages in rural areas.⁴⁷ While diabetes and hypertension were the focus of the current study, these patients received a comprehensive medication review from the MTM pharmacist. However, future work could include expansion of service to patients with other chronic diseases and their associated medications.

For this project, the pharmacist-delivered medication therapy management (MTM) provided was reimbursed through the contract. Reimbursement for MTM services provided is an important consideration as the time spent by pharmacists providing services can vary

between patients, particularly when the pharmacist has other competing tasks to accomplish. However, it is feasible that these billable, clinical services are reimbursable through chronic condition management (CCM) codes. Another alternative is to bill for services using the Current Procedural Terminology (CPT)-specific codes for MTM services. Relevant codes include: 99605 for initial consultations limited to 15 minutes; 99606 for follow-up consultations limited to 15 minutes; and 99607 for an additional 15 minutes when billed in tandem with either an initial (99605) or follow-up (99606) consultation.

This study utilized telephonic consultations to conduct comprehensive medication reviews. The main advantage of this approach is the ability to reach rural patients in their own communities and provide access to healthcare services, thus not requiring them to travel elsewhere (sometimes long distances) to receive care. Alternatives such as video-conferencing technology may enable the sharing of images such as medication bottles and labels. However, this would require the patient to have access to the Internet services, amenities that may be more limited or nonexistent in some rural areas. If they do have Internet access, they may incur additional data fees as a result, potentially creating a financial hardship for some of these individuals.

There were limitations associated with this study. First, defining rural populations can present challenges given the variety of definitions that exist; however, RUCA coding is a commonly used method for categorizing rurality and using these codes aligned with our study aims. Second, only specific disease-state parameters were available. Some clinical measures were self-reported by patients when the information was unavailable in their health record, and thus, may provide inaccuracies and/or inconsistencies in the data. Socioeconomic data that may help explain differences between groups also were unavailable. Third, the community partner sites were responsible for participant recruitment and that may have led to respondent bias. Likewise, self-selection bias may have occurred if more highly motivated

individuals chose to participate in the study. However, self-selection should not have influenced the safety and preventative health findings observed in the study, as they were independent of the patient motivation. Fourth, the pre-post study design lacked a control group so it was impossible to investigate differences between those who received and those who did not receive MTM. Finally, many individuals referred to this service were ultimately ineligible to participate, and a further group of individuals were lost to follow-up (i.e., completed an initial CMR yet lacked a follow-up consultation for an unknown reason); the characteristics of these individuals could have been considerably different from those of the actual participants. It is also important to note that descriptive data relating to non-diabetes and non-hypertensive conditions should not be interpreted as a population prevalence as only diabetic and/or hypertensive patients were sampled. These findings may not be generalizable to other rural communities.

Conclusion. This evaluation of a collaborative partnership between an academic-based MTM provider and community pharmacies highlights the benefits of programs such as these for individuals living in rural areas, and offers a successful model for other researchers to consider. The authors recommend expansion of this MTM service to additional rural locations and evaluation of this expanded service as future research. It is possible that a similar workflow and focused, interprofessional communication could be achieved with more diverse populations and in other settings. While pharmacists identified over 200 medication-related problems, variation existed in the extent that providers accepted these recommendations, suggesting the need for expanded efforts geared towards provider outreach and improving acceptance of the pharmacist's recommendations.

References

1. Institute of Medicine (IOM). Merchant J, Coussens C, Gilbert D. (eds). Rebuilding the Unity of Health and the Environment in Rural America. Washington DC: The National Academies Press; 2006. Available at: <https://www.nap.edu/catalog/11596>. Accessed July 5, 2018
2. Moy E, Garcia MC, Bastian B, et al. Leading Causes of Death in Nonmetropolitan and Metropolitan Areas — United States, 1999–2014. *Morbidity and Mortality Weekly Report (MMWR) Surveillance Summaries*. 2017;66(No. SS-1):1–8.
3. Towne SD, Bolin J, Ferdinand A, et al. Assessing diabetes and factors associated with foregoing medical care among persons with diabetes: Disparities facing American Indian/Alaska native, black, Hispanic, low income, and southern adults in the U.S. (2011–2015). *International Journal of Environmental Research and Public Health*. 2017;14(5):E464.
4. Shaw KM, Theis KA, Self-Brown S, et al. Chronic Disease Disparities by County Economic Status and Metropolitan Classification, Behavioral Risk Factor Surveillance System, 2013. *Preventing Chronic Disease*. 2016;13(E119):1-12.
5. Bolin JN, Bellamy GR, Ferdinand AO, et al. Rural healthy people 2020: new decade, same challenges. *The Journal of Rural Health*. 2015;31(3):326-33.
6. Bauerlein V. Rural hospitals feel the pinch: financially strapped facilities squeezed further by Medicare changes, dwindling government subsidies. *The Wall Street Journal*. May 11, 2014. Available at: <https://www.wsj.com/articles/rural-hospitals-feel-pinch-1399852667>. Accessed January 8, 2018.
7. Singh GK, Siahpush M. Widening rural-urban disparities in life expectancy, U.S., 1969-2009. *American Journal of Preventative Medicine*. 2014;46(2):19-29.
8. Martin MY, Kim Y, Kratt P, et al. Medication Adherence Among Rural, Low-Income Hypertensive Adults: A Randomized Trial of a Multimedia Community-Based Intervention. *American Journal of Health-System Pharmacy*. 2011;25(6):372-378.

9. Young HN, Kanchanasuwan S, Cox ED, et al. Barriers to medication use in rural underserved patients with asthma. *Research in Social and Administrative Pharmacy*. 2015;11(6):909–914.
10. Arizona State Legislature. Rural health professions program; definition. Arizona Revised Statue A.R.S. §15-1754. Available at:
<https://www.azleg.gov/%20viewdocument/?docName=http://www.azleg.gov/ars/15/01754.htm>. Accessed July 16, 2018
11. Hart LG, Larson EH, Lishner DM. Rural definitions for health policy and research. *American Journal of Public Health*. 2005;95(7):1149-1155.
12. Chan L, Hart LG, Goodman DC. Geographic access to health care for rural Medicare beneficiaries. *National Rural Health Association*. 2006;22(2):140-146.
13. Rural Health Research Center. Rural-Urban Commuting Area Codes (RUCAs). Available at:
<http://depts.washington.edu/uwruca/index.php>. Accessed May 29, 2018
14. American Pharmacists Association, National Association of Chain Drug Stores Foundation. Medication therapy management in pharmacy practice: core elements of an MTM service model (version 2.0). *Journal of the American Pharmacists Association*. 2008;48(3):341-353.
15. Medicare Prescription Drug, Improvement, and Modernization Act of 2003. 1st ed. 108th Cong. 2004. Available at: <https://www.congress.gov/bill/108th-congress/house-bill/1>. Accessed January 8, 2018.
16. Centers for Medicare & Medicaid Services. 2016 Medicare Part D medication therapy management (MTM) programs. Fact sheet. Summary of 2016 programs. Available at:
<https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovContra/Downloads/CY2016-MTM-Fact-Sheet.pdf>. Accessed January 8, 2018.

17. Crano CW, Buntin BA, Christensen DB. The Asheville project: long-term clinical and economic outcomes of a community pharmacy diabetes care program. *Journal of the American Pharmacists Association*. 2003;43(2):173-184.
18. Isetts BJ, Schondelmeyer SW, Artz MB, et al. Clinical and economic outcomes of medication therapy management services: the Minnesota experience. *Journal of the American Pharmacists Association*. 2008;48(2):203-214.
19. Ward MA, Xu Y. Pharmacist-provided telephonic medication therapy management in an MAPD plan. *American Journal of Managed Care*. 2011;17(10):399-409.
20. Ramalho de Oliveira D, Brummel AR, Miller DB. Medication therapy management: 10 years of experience in a large integrated health care system. *Journal of Managed Care Pharmacy*. 2010;16(3):185-195.
21. Oladapo AO, Rascati KL. Review of survey articles regarding medication therapy management (MTM) services/programs in the United States. *Journal of Pharmacy Practice*. 2012;25(4):457-470.
22. Smith M, Cannon-Breland ML, Spiggle S. Consumer, physician, and payer perspectives on primary care medication management services with a shared resource pharmacists network. *Research in Social and Administrative Pharmacy*. 2014;10(3):539-553.
23. Pearson CF. Few Medicare beneficiaries receive comprehensive medication review services. 2014. Available at: <http://avalere.com/expertise/managed-care/insights/few-medicare-beneficiaries-receive-comprehensivemedication-management-serv>. Accessed June 14, 2018.
24. Miller DE, Roane TE, Salo JA, et al. Evaluation of comprehensive medication review completion rates using 3 patient outreach models. *Journal of Managed Care and Specialty Pharmacy*. 2016;22(7):796-800.

25. Hurwitz JT, Grizzle AJ, Augustine J, et al. Accepting medication therapy management recommendations to add ACEIs or ARBs in diabetes care. *Journal of Managed Care and Specialty Pharmacy*. 2016;22(1):40-48.
26. Perera PN, Guy MC, Sweaney AM, et al. Evaluation of prescriber responses to pharmacist recommendations communicated by fax in a medication therapy management program (MTMP). *Journal of Managed Care Pharmacy*. 2011;17(5):345-354.
27. Michaels NM, Jenkins GF, Pruss DL, et al. Retrospective analysis of community pharmacists' recommendations in the North Carolina Medicaid medication therapy management program. *Journal of the American Pharmacists Association*. 2010;50(3):347-353.
28. McGrath SH, Snyder M, Duenas GG, et al. Physician perceptions of pharmacist-provided medication therapy management: qualitative analysis. *Journal of the American Pharmacists Association*. 2010;50(1):67-71.
29. Huet AL, Frail CK, Lake LM, et al. Impact of passive and active promotional strategies on patient acceptance of medication therapy management services. *Journal of the American Pharmacists Association*. 2015;55(2):178-181.
30. Christensen DB. Evaluation of a pilot medication therapy management project within the North Carolina state health plan. *Journal of the American Pharmacists Association*. 2007;47(4):471-483.
31. Rosenthal M, Holmes E, Banahan B. Making MTM implementable and sustainable in community pharmacy: is it time for a different game plan? *Research in Social and Administrative Pharmacy*. 2016;12(3):523-528.
32. U.S. Department of Health and Human Services. The Secretary's Advisory committee on National Health Promotion and Disease Prevention Objectives for 2020. Phase I report: recommendations for the framework and format of Healthy People 2020. October 28, 2008.

Available at: https://www.healthypeople.gov/sites/default/files/PhaseI_0.pdf. Accessed July 16, 2018.

33. American Diabetes Association. Standards of medical care in diabetes–2014. *Diabetes Care*. 2014;37(Suppl 1):S14-S80.
34. Stone NJ, Robinson JG, Lichtenstein AH, et al. 2013 ACC/AHA guideline on the treatment of blood cholesterol to reduce atherosclerotic cardiovascular risk in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Journal of the American College of Cardiology*. 2014;63(25 Pt B):2889-2934.
35. Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Journal of the American College of Cardiology*. 2013;62(16):e147-239.
36. O’Gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Journal of the American College of Cardiology*. 2013;61(4):485-510.
37. Amsterdam EA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non–ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Journal of the American College of Cardiology*. 2014;64(24):e139-e228.
38. Global Initiative for Chronic Obstructive Lung Disease. GOLD 2017 global strategy for the diagnosis, management, and prevention of COPD. Available at: <http://goldcopd.org/gold-2017-global-strategy-diagnosis-management-prevention-copd/>. Accessed January 8, 2018.

39. Global Initiative for Asthma. 2017 GINA report. Global strategy for asthma management and prevention. Available at: <http://ginasthma.org/2017-ginareport-global-strategy-for-asthma-management-and-prevention/>. Accessed January 8, 2018.
40. The American Geriatrics Society 2015 Beers Criteria Update Expert Panel. American Geriatrics Society 2015 Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults. *Journal of the American Geriatrics Society*. 2015;63(11):2227-2246.
41. United States Department of Agriculture: Economic Research Service. Rural-Urban Commuting Area Codes. Available at: <https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx#U20K1F50H0A> Accessed May 29, 2018
42. Taylor AM, Bingham J, Schussel K, et al. Integrating innovative telehealth solutions into an interprofessional team-delivered chronic care management pilot program. *Journal of Managed Care Pharmacy*. 2018;24(8):813-818.
43. Viswanathan M, Kahwati LC, Golin CE, et al. Medication therapy management interventions in outpatient settings: a systematic review and meta-analysis. *JAMA Internal Medicine*. 2015;175(1):76-87.
44. Centers for Disease Control and Prevention. Collaborative Practice Agreements and Pharmacists Patient Care Services. Available at: https://www.cdc.gov/dhds/pubs/docs/Translational_Tools_Pharmacists.pdf Accessed June 9, 2020
45. Doellner JF, Dettloff RW, DeVuyst-Miller S, et al. Prescriber acceptance rate of pharmacists' recommendations. *Journal of the American Pharmacists Association*. 2017;57(3S):S197-S202.
46. Axon DR, Lim RHM, Lewis PJ, et al. Junior doctors' communication with hospital pharmacists about prescribing: findings from a qualitative interview study. *European Journal of Hospital Pharmacy*. 2018;25(5):257-261.

47. MacDowell M, Glasser M, Fitts M, et al. A national view of rural health workforce issues in the USA. *Rural and Remote Health*. 2010;10(3):1531.

Table 1. Demographic Characteristics of Study Participants by Rural-Urban Commuter Area (RUCA) Code

Characteristic	Urban N (%)	Micropolitan N (%)	Small town N (%)	Total N (%)	p value
N	N=141	N=74	N=169	N=384	
Gender					
Male	41 (29.1)	26 (35.1)	65 (38.5)	132 (34.4)	0.22
Female	100 (70.9)	48 (64.9)	104 (61.5)	252 (65.6)	
Age					
18-49	15 (10.6)	8 (10.8)	11 (6.5)	34 (8.9)	<0.001*
50-59	38 (27.0)	21 (28.4)	24 (14.2)	83 (21.6)	
60-64	24 (17.0)	22 (29.7)	31 (18.3)	77 (20.1)	
65-74	49 (34.8)	14 (18.9)	64 (37.9)	127 (33.1)	
≥75	15 (10.6)	9 (12.2)	39 (23.1)	63 (16.4)	
Ethnicity					
Hispanic	109 (77.3)	7 (9.5)	35 (20.7)	151 (39.3)	<0.001*
Non-Hispanic	24 (17.0)	62 (83.8)	115 (68.1)	201 (52.3)	
Did not disclose	8 (5.7)	5 (6.8)	19 (11.2)	32 (8.3)	
Race					
White	106 (75.2)	58 (78.4)	116 (68.6)	280 (72.9)	0.22
Other [†]	35 (24.8)	16 (21.6)	53 (31.4)	104 (27.1)	
Medical conditions					
Diabetes Mellitus Type 2	93 (66.0)	69 (93.2)	124 (73.4)	286 (74.5)	<0.0001*
Hypertension	126 (89.4)	71 (96.0)	161 (95.3)	358 (93.2)	0.07
Asthma	11 (7.8)	22 (29.7)	30 (17.8)	63 (16.4)	<0.001*
Chronic Obstructive Pulmonary Disease (COPD)	5 (3.6)	18 (24.3)	21 (12.4)	44 (11.5)	<0.0001*
Heart Failure	7 (5.0)	15 (20.3)	16 (9.5)	38 (9.9)	0.002*
Atrial fibrillation	4 (2.8)	9 (12.2)	20 (11.8)	33 (8.6)	0.009*
Atherosclerotic cardiovascular disease	19 (13.5)	25 (33.8)	49 (29.0)	93 (24.2)	0.0007*
High-risk patient	54 (38.3)	48 (64.9)	84 (49.7)	186 (48.4)	0.001*

Urban = RUCA 1-3; micropolitan = RUCA 4-6; small town = RUCA 7-10.

[†] Other includes: African American, American Indian/Alaska Native, Asian, Pacific Islander, Other, or not disclosed.

High-risk patients included those having any of the following: Hemoglobin A1c >7%; average fasting blood glucose level (FBG) >130mg/dL; frequent hypoglycemia; presence of diabetic complications; missing preventive screenings; blood pressure not at individualized goal; uncontrolled respiratory symptoms; confusion regarding inhaler use; fluid overload symptoms; missing fluid management plan, and medication non-adherence.

*Significant difference between RUCA groups for some age groups ($p < 0.0017$), ethnicity ($p < 0.0056$), medical conditions ($p < 0.017$) and high-risk patients ($p < 0.001$).

Table 2. Clinical values (laboratory results and self-report data) at baseline, 30- or 90-day follow-up by Rural-Urban Commuter Area (RUCA) Code

Clinical Values	Urban Mean (SD)		Micropolitan Mean (SD)		Small town Mean (SD)		p value
	Initial consult	Change	Initial consult	Change	Initial consult	Change	
HbA1c percent (n=90)	7.6% (1.3%)	-0.3% (0.7%)	7.1% (0.8%)	0.1% (1.0%)	7.4% (1.6%)	-0.2% (1.1%)	0.38
Average FBG (n=228)	132.6 (42.9)	-13.3 (44.5)	132.1 (37.5)	-7.6 (33.7)	130.2 (41.8)	-5.9 (31.7)	0.40
Average PPG (n=54)	152.0 (36.3)	-8.6 (25.2)	175.1 (42.3)	-12.4 (33.4)	173.2 (40.7)	-17.9 (38.2)	0.67
Average SBP (n=179)	133.8 (18.0)	-8.0 (17.9)	134.8 (21.2)	-5.4 (16.6)	129.3 (12.6)	-0.6 (15.0)	0.03*
Average DBP (n=162)	77.8 (9.6)	-2.8 (9.7)	77.8 (19.6)	-4.1 (15.2)	75.9 (9.2)	-3.2 (8.4)	0.87

Urban = RUCA 1-3; micropolitan = RUCA 4-6; small town = RUCA 7-10.

SD=standard deviation; HbA1c=hemoglobin A1c; FBG=fasting blood glucose;

PPG=postprandial glucose; SBP=systolic blood pressure; DBP=diastolic blood pressure

Significance tested between initial and follow-up consultation

*Significant difference between urban and small town groups ($p < 0.05$)

Table 3. Gaps in Care Representing Need for Additional Therapy Based on National Consensus Guidelines by Rural-Urban Commuter Area (RUCA) Code

When appropriate...	Urban N (%)	Micropolitan N (%)	Small town N (%)	Total N (%)	p value
Statin	N=83	N=61	N=118	N=262	
Present at initial consultation	63 (75.9)	45 (73.8)	97 (82.2)	205 (78.2)	0.36
Not present at initial consultation – faxed prescriber	20 (24.1)	16 (26.2)	21 (17.8)	57 (21.8)	
Present after recommendation	8 (40.0)	3 (18.8)	7 (33.3)	18 (31.6)	0.39
Beta blocker	N=13	N=19	N=31	N=63	
Present at initial consultation	10 (76.9)	18 (94.7)	22 (71.0)	50 (79.4)	0.13
Not present at initial consultation – faxed prescriber	3 (23.1)	1 (5.3)	9 (29.0)	13 (20.6)	
Present after recommendation	0	0	2 (22.2)	2 (15.4)	1.00
Rescue inhaler	N=15	N=32	N=42	N=89	
Present at initial consultation	13 (86.7)	29 (90.6)	40 (95.2)	82 (92.1)	0.52
Not present at initial consultation – faxed prescriber	2 (13.3)	3 (9.4)	2 (4.8)	7 (7.9)	
Present after recommendation	2 (100)	0	1 (50.0)	3 (42.9)	0.14
Inhaled corticosteroid	N=10	N=21	N=30	N=61	
Present at initial consultation	10 (100)	14 (66.7)	24 (80.0)	48 (78.7)	0.12
Not present at initial consultation – faxed prescriber	0	7 (33.3)	6 (20.0)	13 (21.3)	
Present after recommendation	0	0	0	0	-

Urban = RUCA 1-3; micropolitan = RUCA 4-6; small town = RUCA 7-10.

Table 4. Medication-Related Problems (MRPs) identified by Rural-Urban Commuter Area (RUCA) Code

Individuals with...	Urban N (%)	Micropolitan N (%)	Small town N (%)	Total N (%)	p value
N	N=141	N=74	N=169	N=384	
Unnecessary drug therapy					
Therapy duplications					
Identified at initial consult	4 (2.8)	8 (10.8)	11 (6.5)	23 (6.0)	0.06
Resolved at initial consult	3 (75.0)	6 (75.0)	10 (90.9)	19 (82.6)	0.48
Different drug needed					
Drug-disease interactions					
Identified at initial consult	5 (3.5)	7 (9.5)	3 (1.8)	15 (3.9)	0.02*
Faxed to clinic/provider	2 (40.0)	4 (57.1)	0	6 (40.0)	0.33
Accepted by MD	1 (50.0)	2 (50.0)	0	3 (50.0)	1.00
Drug-drug interactions					
Present at initial consultation	8 (5.7)	9 (12.2)	14 (8.3)	31 (8.1)	0.25
Faxed to clinic/provider	1 (12.5)	3 (33.3)	6 (42.9)	10 (32.3)	0.39
Accepted by MD	1 (100.0)	2 (66.7)	1 (16.7)	4 (40.0)	0.19
Dose related safety concerns					
Present at initial consultation	6 (4.3)	7 (9.5)	20 (11.8)	33 (8.6)	0.06
Faxed to clinic/provider	6 (100.0)	6 (85.7)	16 (80.0)	28 (84.8)	0.80
Accepted by MD	2 (33.3)	3 (50.0)	3 (18.8)	8 (28.6)	0.38
Adverse Drug Reactions					
Identified and referred to provider at initial consultation	14 (9.9)	13 (17.6)	24 (14.2)	51 (13.3)	0.26
High risk medications in elderly patients (>65 years) (N=190)					
Identified at initial consultation	12 (18.8)	8 (34.8)	19 (18.4)	39 (20.5)	0.20
Referred to MD	11 (91.7)	6 (75.0)	13 (68.4)	30 (76.9)	0.36
Accepted by MD	4 (36.3)	2 (25.0)	3 (23.1)	9 (30.0)	0.88

Urban = RUCA 1-3; micropolitan = RUCA 4-6; small town = RUCA 7-10.

MD=medical doctor

High-risk medications for patients >65 years of age determined using Beer's criteria

*Significant difference between micropolitan and small town groups (p=0.02).

Table 5. Vaccination Recommendations Made to Patients by Rural-Urban Commuter Area (RUCA) Code

Vaccine recommendations	Urban N (%)	Micropolitan N (%)	Small town N (%)	Total N (%)	p value
Influenza					
Initial consultation	N=137	N=73	N=166	N=376	
Up to date	83 (60.6)	53 (72.6)	103 (62.1)	239 (63.6)	0.20
Recommended	54 (39.4)	20 (27.4)	63 (38.0)	137 (36.4)	
Follow-up consultation	N=53	N=18	N=61	N=132	
Up to date	8 (15.1)	1 (5.6)	13 (21.3)	22 (16.7)	0.27
Recommended	45 (84.9)	17 (94.4)	48 (78.7)	110 (83.3)	
Pneumococcal					
Initial consultation	N=118	N=69	N=156	N=343	
Up to date	50 (42.4)	35 (50.7)	65 (41.7)	150 (43.7)	0.42
Recommended	68 (57.6)	34 (49.3)	91 (58.3)	193 (56.3)	
Follow-up consultation	N=67	N=32	N=88	N=187	
Up to date	20 (29.9)	8 (25.0)	16 (18.2)	44 (23.5)	0.23
Recommended	47 (70.2)	24 (75.0)	72 (81.8)	143 (76.5)	
Shingles					
Initial consultation	N=85	N=41	N=131	N=257	
Up to date	9 (10.6)	10 (24.4)	41 (31.3)	60 (23.3)	<0.01*
Recommended	76 (89.4)	31 (75.6)	90 (68.7)	197 (76.7)	
Follow-up consultation	N=76	N=31	N=88	N=195	
Up to date	17 (22.4)	3 (9.7)	10 (11.3)	30 (15.4)	0.09
Recommended	59 (77.6)	28 (90.3)	78 (88.6)	165 (84.6)	

Urban = RUCA 1-3; micropolitan = RUCA 4-6; small town = RUCA 7-10.

Denominators for percentage calculations based on column sample size

*Significant difference between urban and micropolitan groups ($p=0.04$) and urban and small town groups ($p=0.0004$).