Maintenance of Clinical Endpoints After Discharge from a Pharmacist-Managed Risk Reduction Clinic at a Veterans Affairs Medical Center

Christina H. Sherrill, PharmD; Angela Pentecost, PharmD, BCACP; and Emily E. Wood, PharmD

ABSTRACT

BACKGROUND: Diabetes, dyslipidemia, and hypertension are complex chronic disease states that often require close monitoring and frequent follow-up to achieve and maintain therapeutic control as determined by hemoglobin A1c (A1c), low-density lipoprotein (LDL), and blood pressure (BP). At the Charles George Veterans Affairs Medical Center (CGVAMC), physicians may refer their patients to the on-site pharmacist-managed Risk Reduction Clinic (RRC). Patients are discharged from the RRC once patient-specific therapeutic goals have been met for diabetes, dyslipidemia, and/or hypertension. This study investigated the change in A1c, LDL, and systolic blood pressure (SBP) after discharge from the CGVAMC RRC.

OBJECTIVES: To investigate (a) how clinical endpoints for diabetes, dyslipidemia, and hypertension change after discharge from the pharmacist-managed RRC at the CGVAMC; (b) the factors associated with worsening of monitoring parameters; and (c) the frequency of reconsultation to the RRC.

METHODS: In this single-center retrospective quality management study, patients were included if they had a completed consultation to the CGVAMC RRC between August 11, 2008, and January 1, 2011, for the management of type 2 diabetes, dyslipidemia, and/or hypertension. Patients were included if they were discharged from the RRC prior to October 1, 2011, due to goal attainment. Furthermore, it was required that patients have A1c, LDL, and SBP measurements, as applicable based on diagnoses, at least yearly during the first 2 years following discharge. Patients were excluded if they were discharged for any reason other than goal attainment or if they were followed by a specialty clinic related to the RRC, including the Diabetes PharmD, Diabetes MD, MIDAS (group diabetes), or MAGIC (group dyslipidemia) clinics. Data collection included patient demographics; date of and indication for consultation to the RRC; date of first RRC visit; date of discharge from the RRC; number of visits to the RRC; A1c, LDL, SBP, and weight at consultation to the RRC, at discharge, and during the 2 years following discharge from the RRC; and date of and indication for reconsultation to the RRC, as applicable. Two-tailed paired t-tests were used to compare A1c, LDL, and SBP at discharge from the RRC to A1c, LDL, and SBP during the follow-up period. Two-tailed unpaired t-tests were performed to determine which variables were associated with changes in the monitoring parameters after discharge from the RRC.

RESULTS: One hundred forty-nine patients were included in this study. For all patients with a diagnosis of diabetes ($N=82$), A1c rose from 6.49% to 6.79% ($P<0.001$) during the first year and to 7.04% ($P<0.001$) during the second year following discharge. For patients diagnosed with dyslipidemia ($N=137$), LDL rose after discharge from 81.5 mg/dL to 90.8 mg/dL ($P<0.001$) and to 90.9 mg/dL ($P<0.001$), respectively. For patients diagnosed with hypertension ($N=132$), SBP rose from 126.2 mm Hg to 131.5 mm Hg ($P<0.001$) and to 133.9 mm Hg ($P<0.001$), respectively. An

increase in A1c after discharge was associated with lower discharge A1c ($P=0.014$), higher consultation weight ($P=0.009$), and higher discharge weight ($P=0.042$). A rise in LDL was correlated to higher consultation LDL ($P=0.006$), while higher SBP was associated with lower discharge SBP ($P<0.001$). Twelve percent of patients were reconsulted to the RRC.

CONCLUSIONS: A1c, LDL, and SBP rose after discharge from the pharmacist-managed risk reduction clinic, but these changes may not have been clinically significant based on the low reconsultation rate and values remaining close to generally accepted therapeutic goals. Patients likely to benefit from extending RRC services past goal attainment include those with higher A1c and LDL at the time of consultation and those with higher weight. As a result of this study, recommendations have been made to consider following up every 3-4 months for 2-3 additional visits for patients with baseline A1c $>8\%$ and LDL >115 mg/dL and those with weight >220 pounds prior to discharging them from the CGVAMC RRC. Furthermore, we believe that all patients could benefit from extending follow-up to 6 months for 1-2 additional visits or as needed after their therapeutic goals have been reached.

J Manag Care Spec Pharm. 2016;22(1):14-20

Copyright © 2016, Academy of Managed Care Pharmacy. All rights reserved

What is already known about this subject

- Uncontrolled diabetes, dyslipidemia, and hypertension may lead to long-term complications, such as myocardial infarction, cerebrovascular accident, retinopathy, nephropathy, and neuropathy.
- Only about half of patients reach their hemoglobin A1c (A1c), low-density lipoprotein (LDL), or blood pressure (BP) goals, and less than 20% achieve all 3 goals.
- Clinical pharmacists can improve patient care in the ambulatory care setting by providing chronic disease state management.

What this study adds

- This study demonstrates that overall, A1c, LDL, and systolic BP rose after discharge from the pharmacist-managed Risk Reduction Clinic (RRC), but these changes may not have been clinically significant based on the low reconsultation rate and the fact that levels remained close to generally accepted therapeutic goals.
- This quality management study indicates that patients likely to benefit from extending Charles George Veterans Affairs Medical Center RRC services past goal attainment include those with higher A1c and LDL at the time of consultation and those with higher weight.

Diabetes, dyslipidemia, and hypertension are complex chronic disease states that often require close monitoring and frequent follow-up in order to help patients achieve optimal therapeutic control. It is important that patients maintain control of these disease states so as to prevent or delay long-term complications, such as myocardial infarction, cerebrovascular accident, retinopathy, nephropathy, and neuropathy.¹ Hemoglobin A1c (A1c), low-density lipoprotein (LDL), and systolic blood pressure (SBP) have been described as the best predictors of clinical outcomes for these disease states.¹⁻³ Until recently, practice guidelines have recommended therapeutic goals of A1c < 7.0%, LDL < 100 milligrams per deciliter (mg/dL), and BP < 140/80 millimeters of mercury (mm Hg) for most patient with diabetes.¹ However, individualization of patient care may lead to more or less stringent goals based on aspects such as a patient's age, life expectancy, overall state of health, comorbidities, patient motivation, and risk of adverse effects.^{1,4} In a study conducted between 1988 and 2010, only about half of patients were able to reach their goal A1c, LDL, or SBP, and less than 20% achieved all 3 goals.⁵

In recent years, pharmacists have taken a more active role in the ambulatory care setting by working with physicians and other health care professionals as part of the patient-centered medical home model.^{6,7} At the Charles George Veterans Affairs Medical Center (CGVAMC) in Asheville, North Carolina, pharmacists designated as clinical pharmacy specialists (CPSs) have been granted authority to manage the chronic disease states of diabetes, dyslipidemia, and hypertension as a supplement to the care patients receive from their primary care physicians (PCPs). PCPs may request a risk reduction consult for the management of patients with type 2 diabetes, dyslipidemia, and/or hypertension. Risk reduction consults are used to schedule patients into either the Risk Reduction Clinic (RRC) or one of the Primary Care PharmD clinics. Both of these types of clinics follow the same standards of practice and are managed by the same CPSs. For the purposes of this study, both types of clinics will be referred to as "the RRC." The RRC is operated by CPSs who provide frequent follow-up (i.e., visits every 4-12 weeks) with individualized treatment plans to manage the aforementioned disease states. CPSs utilize evidence-based medicine and current practice guidelines to aid patients in reaching goals, including patient-specific targets for A1c, LDL, and SBP. The CPSs are equipped to assess disease state control, adjust medication regimens (including initiating and discontinuing medications), order labs, make referrals as appropriate, and educate/counsel patients. Although the PCP may denote a certain indication for the consultation (i.e., diabetes, dyslipidemia, and/or hypertension), the CPSs typically assess and manage all 3 chronic diseases in the RRC. The effectiveness of a pharmacist-managed risk reduction clinic within a Veterans Affairs medical center has been validated and is described elsewhere.⁸

Once patients are considered to have reached their therapeutic goals for these chronic disease states, they are discharged from the RRC. At the time that this study was conducted, standard goals commonly used in the RRC were A1c < 7.0%, LDL < 100 mg/dL, and SBP < 140/80 mm Hg; however, individualized goals may have differed due to the nature of the

patient population served, as previously outlined. Once discharged from the RRC, patients revert back to being followed by their PCP for management of these disease states, usually at intervals of every 6-12 months. If a patient's PCP deems it necessary, he or she may refer the patient back to the RRC for further management of the aforementioned disease states. There is currently no standardized protocol for referrals. One study in a similar setting investigating "time to failure" found that after discharge from a cardiovascular risk reduction clinic, patients were able to maintain diabetes and dyslipidemia goals for approximately 21 months after discharge. Maintenance of hypertension goals was less durable with increases after about 6 months. Of note, this study did not differentiate between patients discharged due to goal attainment and those discharged for other reasons, such as nonadherence.⁹

The primary objective of this study was to investigate how clinical endpoints for diabetes, dyslipidemia, and hypertension change during the first 2 years following discharge from the CGVAMC RRC. Secondly, this study aimed to identify patient-specific factors associated with worsening in the clinical endpoints for these disease states and to determine how often patients were reconsulted to the RRC within 2 years after discharge.

Methods

This single-center retrospective chart review was approved by the local institutional review board and research and development committee. Patients were included if they had a completed consultation to the CGVAMC RRC between August 11, 2008, and January 1, 2011, for the management of type 2 diabetes, dyslipidemia, and/or hypertension. Patients must have been discharged from the RRC prior to October 1, 2011, due to goal attainment. Furthermore, it was required that patients have A1c, LDL, and SBP measurements, as applicable based on diagnoses, at least yearly during the first 2 years following discharge. Patients were excluded if they were discharged for any reason other than goal attainment (e.g., nonadherence, unwillingness to initiate medications necessary to achieve goals, death, or relocation) or if they were followed by any other specialty clinic related to the RRC, including the Diabetes PharmD, Diabetes MD, MIDAS (group diabetes), or MAGIC (group dyslipidemia) clinics.

A report was generated of completed consultations to the RRC between August 11, 2008, and January 1, 2011. August 11, 2008, was the date on which the first RRC consult available via the computer-generated report was placed, and the date of January 1, 2011, was chosen in an attempt to allow adequate time for a patient to be followed in the RRC prior to being discharged. Patients with a discharge date prior to October 1, 2011, were included in the study to allow for a 2-year follow-up period prior to data collection, which was approved to begin in October 2013. A patient's discharge date was determined by reviewing RRC progress notes in the computerized patient record system (CPRS), which is the electronic medical record system used by the Department of Veterans Affairs. All eligible patients from the computerized report were included in this study.

Data collection included patient demographics (i.e., age at discharge, sex, race, diagnoses); date of and indication for

consultation to the RRC; date of first RRC visit; date of discharge from the RRC; number of visits in the RRC; A1c, LDL, SBP, and weight at consultation to the RRC, at discharge, and during the 2 years following discharge from the RRC; and date of and indication for reconsultation to the RRC, as applicable. All data presented in this paper were retrieved from Veterans Affairs medical records as available in the CPRS.

The specific diagnoses recorded were diabetes, dyslipidemia (including hypercholesterolemia and hyperlipidemia), and hypertension, as well as coronary artery disease, retinopathy, nephropathy, neuropathy, history of myocardial infarction, and history of cerebrovascular accident. Diagnoses were obtained directly from the "Problems" tab in the CPRS.

If a patient did not have an A1c measurement prior to RRC consultation (i.e., newly diagnosed diabetes), the A1c value on the date of first RRC visit was used. In an attempt to limit confounding factors, such as acute illness, and to capture patients' data in their usual state of health for these chronic conditions, only SBP and weight measured in conjunction with (i.e., on the same day as) an A1c and/or LDL laboratory draw were utilized for this study, in addition to those measured on the dates of consultation to or discharge from the RRC. If, however, SBP and weight data were unavailable during one or more of the time periods (i.e., initial consult, discharge, 0-12 months of follow-up, or 12-24 months of follow-up) according to the above criteria, those measured on the same day as an annual PCP visit or RRC visit were used.

Monitoring parameters for the primary disease states (i.e., A1c, LDL, and SBP) were grouped into 12-month time intervals following discharge from the RRC (i.e., 0-12 months and 12-24 months) and were compared with the parameter value at the time of discharge from the RRC. If there was more than one value during either 12-month interval, an average of those values was used for analysis. Patients were grouped for analysis based on consultation for each of the 3 disease states and also for diagnosis of each disease state. Patients were excluded from the diagnosis-specific analysis if they did not have the pertinent endpoint data at the time of consultation and/or discharge. Two-tailed paired t-tests were used to compare A1c, LDL, and SBP at discharge from the RRC to A1c, LDL, and SBP during the 2 time intervals after discharge.

To determine which variables were associated with worsening of the monitoring parameters after discharge from the RRC, 12 distinct univariate analyses were conducted to assess whether there was a statistically significant difference in changes in A1c, LDL, and SBP during the follow-up period between patients in the upper 50th percentile versus those in the lower 50th percentile for each of the 3 parameters and for weight, both at the time of consultation and at discharge. The analyses served to answer the following questions: Is an increase in A1c during the follow-up period associated with higher or lower A1c at consultation, higher or lower A1c at discharge, higher or lower weight at consultation, and/or higher or lower weight at discharge? Is an increase in LDL during the follow-up period associated with higher or lower LDL at consultation, LDL at discharge, weight at consultation, and/or weight at discharge? Is an increase in SBP during the follow-

up period associated with higher or lower SBP at consultation, SBP at discharge, weight at consultation, and/or weight at discharge? A 2-tailed unpaired t-test was performed for each of the 12 analyses in order to identify which variables were associated with statistically significant changes in the monitoring parameters after discharge from the RRC.

Statistical significance was defined as $P < 0.05$. Descriptive statistics were used to assess the incidence and time pattern of reconsultation to the RRC.

Results

A list of 1,163 completed consultations was generated. Forty-four of these (3.8%) were duplicates (i.e., patients with multiple consults), leaving 1,119 individual patients to review for inclusion/exclusion criteria. Nine hundred seventy patients (86.7%) did not meet the prespecified criteria. Forty-two percent of these were excluded due to not being discharged (many of these patients had not yet met therapeutic goals and were still enrolled in the RRC, while others were lost to follow-up); 21% were excluded because they had insufficient data available or a follow-up period of less than 2 years; 17% were discharged from the RRC for a reason other than goal attainment; and 20% were excluded for other reasons, including enrollment in a related specialty clinic or referral to the RRC for an indication other than diabetes, dyslipidemia, or hypertension. Consequently, a total of 149 patients (13.3%) were included in this study (Figure 1).

Baseline characteristics are summarized in Table 1. The typical patient was a Caucasian male aged 65 years (mean age 65.4 years, 88.6% Caucasian, 95.6% male). Dyslipidemia was the most common disease state in this patient population, followed by hypertension and then diabetes. Eleven patients (7.4%) had a diagnosis of only 1 of the 3 disease states; 57 (38.3%) had 2 disease states; and 81 (54.4%) had a diagnosis of all 3. Dyslipidemia alone was the most common indication for consultation to the RRC, followed by diabetes. Only 1 patient was specifically consulted for all 3 disease states. Patients were followed in the RRC for an average of 4.8 visits over 9.5 months.

Results for the primary objective are represented in Figure 2 and the Appendix (available in online article) and are organized by patients who were specifically consulted for each disease state and those who simply had a diagnosis of the disease states. For patients consulted to the RRC for diabetes management, either alone or in combination with the other 2 disease states ($n = 69$), A1c rose after discharge from 6.51% to 6.81% during the first year ($P < 0.001$) and to 7.05% during the second year after discharge ($P < 0.001$). For all patients included in the study with a diagnosis of diabetes ($n = 82$), A1c rose after discharge from 6.49% to 6.79% ($P < 0.001$) and then to 7.04% ($P < 0.001$).

Patients consulted to the RRC for dyslipidemia management ($n = 87$) saw a rise in LDL after discharge from 85.5 mg/dL to 97.2 mg/dL during the first year ($P < 0.001$), which remained unchanged through the second year after discharge. For all patients with a diagnosis of dyslipidemia ($n = 137$), LDL rose after discharge from 81.5 mg/dL to 90.8 mg/dL ($P < 0.001$) and then to 90.9 mg/dL in the second year ($P < 0.001$).

Conversely, SBP did not significantly change after discharge for patients consulted to the RRC for hypertension

Maintenance of Clinical Endpoints After Discharge from a Pharmacist-Managed Risk Reduction Clinic at a Veterans Affairs Medical Center

FIGURE 1 Trial Profile

TABLE 1 Baseline Characteristics

Age in years, mean [SD]	65.4	[8.7]
Male sex, n (%)	143	(95.6)
Ethnicity, n (%)		
Caucasian	132	(88.6)
African American	13	(8.7)
American Indian	1	(0.7)
Unknown	3	(2.0)
Diagnoses, n (%)		
Dyslipidemia	145	(97.3)
Hypertension	132	(88.6)
Diabetes	91	(61.1)
Coronary artery disease	55	(36.9)
Neuropathy	31	(20.8)
Cerebrovascular accident	17	(11.4)
Retinopathy	15	(10.1)
Nephropathy	8	(5.4)
Myocardial infarction	1	(0.7)
Reason for consultation, n (%)		
Dyslipidemia	68	(45.6)
Diabetes	55	(36.9)
Dyslipidemia and diabetes	11	(7.4)
Dyslipidemia and hypertension	7	(4.7)
Hypertension	5	(3.4)
Hypertension and diabetes	2	(1.3)
All 3 disease states	1	(0.7)
Number of RRC visits, mean [SD]	4.8	[2.5]
Months followed in RRC, mean [SD]	9.5	[6.0]

RRC=Risk Reduction Clinic; SD=standard deviation.

management (n=15). SBP increased from 132.2 mm Hg at discharge to 133.2 mm Hg through the first year (P=0.814) and remained unchanged through the second year after discharge. For all patients included in the study with a diagnosis of hypertension (n=132), SBP rose after discharge from 126.2 mm Hg to 131.5 mm Hg (P<0.001) and then to 133.9 mm Hg (P<0.001).

Of note, not all patients had diagnosis-specific parameters available at consultation and at discharge. For this reason, 9 patients were excluded from the diagnosis-specific analysis for A1c, and 8 patients were excluded from the diagnosis-specific analysis for LDL. All patients with a diagnosis of hypertension had all applicable SBP measurements and were included in the above analysis.

Although not the primary objective, it should be noted that all analyzed groups yielded a statistically significant improvement in endpoints during enrollment in the RRC (i.e., from consultation to the RRC to discharge from the RRC). At the 2-year follow-up mark, endpoints remained lower than those at the time of consultation for all analyses except for the analysis of all patients with a diagnosis of hypertension.

The results for the first of the secondary objectives are presented in Table 2. Worsening of A1c during the follow-up period was associated with lower A1c at discharge (P=0.014), higher weight at consultation (P=0.009), and higher weight at discharge (P=0.042). A rise in LDL was correlated to higher LDL at consultation (P=0.006), and worsening SBP was seen in patients with lower SBP at discharge (P<0.001). While the other analyses did not yield statistically significant results, it should be noted that higher A1c at consultation was associated

with a trend toward worsening A1c (P=0.083), lower LDL at discharge and higher weight at both consultation and discharge were associated with trends toward increased LDL (P=0.970, 0.953, and 0.470, respectively), and lower SBP at consultation and higher weight at both consultation and discharge were associated with trends toward increased SBP (P=0.516, 0.537, and 0.300, respectively).

Eighteen patients (12.1%) were reconsulted to the RRC during the 2-year follow-up period, and two-thirds of those were reconsulted for the same indication(s) as noted on the initial consultation. For those who were reconsulted to the RRC during the 2-year follow-up period, the average time to reconsultation was 12.8 months.

Discussion

This study was intended to be a quality management assessment to determine whether clinical endpoints could be maintained in patients with diabetes, dyslipidemia, and/or hypertension after discharge from the pharmacist-managed RRC within the CGVAMC and to identify patients who may benefit from continued management within the facility's RRC. The hope is that the results of this study will be used to further develop clinical practices at the CGVAMC facility to continually meet the health care needs of patients.

Maintenance of Clinical Endpoints After Discharge from a Pharmacist-Managed Risk Reduction Clinic at a Veterans Affairs Medical Center

FIGURE 2 Mean Changes in Clinical Endpoints

P Values	Patients Consulted for DM	All Patients with DM	Patients Consulted for DLD	All Patients with DLD	Patients Consulted for HTN	All Patients with HTN
Consultation to discharge	<0.001	<0.001	<0.001	<0.001	0.012	<0.001
Discharge to 0-12 months	<0.001	<0.001	<0.001	<0.001	0.814	<0.001
Discharge to 12-24 months	<0.001	<0.001	<0.001	<0.001	0.855	<0.001

Note: For complete results of the primary objective, see the Appendix (available in online article).

A1c = hemoglobin A1c; DLD = dyslipidemia; DM = diabetes mellitus; HTN = hypertension; LDL = low-density lipoprotein; mg/dL = milligram per deciliter; mm Hg = millimeter of mercury; SBP = systolic blood pressure.

While there are limited data regarding maintenance of clinical endpoints after discharge from similar pharmacist-managed clinics, most currently available published studies focus on the ability of patients to maintain standardized therapeutic goals rather than assess how these clinical endpoints change over time. For example, one recently published article found that 64% of patients were able to maintain A1c below 9% after discharge from a pharmacist-managed diabetes clinic.¹⁰ The specific aim of the aforementioned clinic was to aid patients in achieving A1c values below 9%, but this is not the case for all clinics or for all patients. With increasing emphasis on individualization of patient goals, particularly for diabetes management, the “one size fits all” mindset is becoming less germane, especially in an elderly population with multiple comorbidities, such as that found in many Veterans Affairs medical centers.¹¹ We believe that assessing the trends and degree of change in clinical endpoints may be especially beneficial in this patient population.

Analysis of the primary objective revealed that clinical endpoints for diabetes, dyslipidemia, and hypertension worsen over time after a patient is discharged from a clinic specializing in the management of such disease states. This was true for all groups of patients except those specifically consulted for hypertension management, who did not see a statistically significant rise in SBP during the follow-up period. While these changes in A1c, LDL, and SBP for most patient populations analyzed were statistically significant, the low reconsultation rate may suggest that these changes were not considered to be clinically significant by the patients’ PCPs. Furthermore, although endpoints did rise after discharge, they remained at or close to generally accepted therapeutic goals and well below endpoints measured at the time of referral to the RRC.

One possible cause for the worsening of clinical endpoints after discharge is the decreased level of accountability as patients transition from being seen as often as every 4 weeks to only visiting the primary care setting as infrequently as every 12 months or more. When blood glucose readings, for example, are not being requested as often, patients may overlook the value of self-monitoring and become disconnected from the idea of managing and taking responsibility for their own health. Furthermore, as patients are seen on a less frequent basis, major changes in health status, such as acute illness or changes in medications affecting the 3 studied disease states, may not be realized as readily; as such, control of these chronic disease states may worsen.

The findings regarding patient-specific factors associated with worsening of clinical endpoints may help to target patient populations that could benefit from continued management in the RRC after goal attainment, possibly with a series of 2-3 visits every 3-4 months rather than being discharged from the clinic altogether. According to statistically significant analyses and nonstatistically significant trends in data, such patients may include those with higher A1c (>8%) and LDL (>115 mg/dL) at consultation and patients with higher weight (>220 lb). A similar study suggested “booster interventions” to improve maintenance of clinical endpoints after discharge from an RRC for patients with higher clinical endpoints at the time of consultation. This study also found that weight, as reflected by body mass index, was related to A1c worsening after discharge.⁹

It should be recognized that patients who achieved A1c and SBP values lower than current guideline recommendations experienced a more pronounced worsening in those endpoints

Maintenance of Clinical Endpoints After Discharge from a Pharmacist-Managed Risk Reduction Clinic at a Veterans Affairs Medical Center

TABLE 2 Association of Patient-Specific Factors with Worsening of Endpoints After Discharge

	Comparison Group Ranges		Endpoint Change After Discharge [SD]				P Value
	Low Group	High Group	Low Group		High Group		
Diabetes results							
A1c at consultation (%)	6.0-7.9	8.1-14.2	+0.36	[0.93]	+0.70	[0.79]	0.083
A1c at discharge (%)	5.7-6.5	6.7-7.3	+0.71	[0.94]	+0.25	[0.61]	0.014
Weight at consultation (lb)	148.0-221.2	226.1-366.0	+0.29	[0.86]	+0.80	[0.84]	0.009
Weight at discharge (lb)	151.6-210.8	223.0-342.0	+0.34	[0.89]	+0.75	[0.84]	0.042
Dyslipidemia results							
LDL at consultation (mg/dL)	28-114	115-227	+3.4	[24.9]	+15.3	[31.8]	0.006
LDL at discharge (mg/dL)	44-79	81-143	+10.7	[19.3]	+10.6	[35.7]	0.970
Weight at consultation (lb)	138.0-210.0	210.8-366.0	+9.6	[24.4]	+9.9	[30.5]	0.953
Weight at discharge (lb)	137.3-213.8	213.9-350.8	+8.01	[25.4]	+11.5	[29.6]	0.470
Hypertension results							
SBP at consultation (mm Hg)	85-133	134-199	+8.7	[18.3]	+6.7	[20.0]	0.516
SBP at discharge (mm Hg)	95-126	128-156	+16.1	[16.4]	+0.1	[18.5]	<0.001
Weight at consultation (lb)	138.0-211.8	215.0-366.0	+6.5	[20.6]	+8.6	[18.0]	0.537
Weight at discharge (lb)	133.2-214.5	216.1-350.8	+6.1	[20.2]	+9.6	[18.2]	0.300

A1c = hemoglobin A1c; lb = pound; LDL = low-density lipoprotein; mg/dL = milligram per deciliter; mm Hg = millimeter of mercury; SBP = systolic blood pressure; SD = standard deviation.

after discharge. While these changes in A1c and SBP after discharge were statistically significant, they may not have been clinically significant, as it is difficult to determine how many patients would still have been considered "at goal" for diabetes and hypertension, respectively, according to the individualized care the patients received after discharge. It should also be noted that patients are assessed for stability prior to being discharged from the RRC, so these lower values for A1c and SBP should be reflective of appropriate control rather than incidences of hypoglycemia or hypotension, respectively.

Although this study was not intended to evaluate the impact that a pharmacist-managed RRC has on therapeutic endpoints during enrollment, these results certainly support the existing data regarding the benefits of utilizing clinical pharmacists for chronic disease state management. As noted in Figure 2 and the Appendix, all analyses yielded statistically and clinically significant decreases (i.e., improvements) in endpoints from consultation to discharge from the RRC.

Lastly, with recent changes to clinical guidelines for the management of dyslipidemia and hypertension, it may be expected that fewer patients would be referred to the RRC, as guidelines have become somewhat more straightforward with a shift in focus to target statin doses rather than LDL and generally recommending higher BP goals.^{12,13} Further studies are needed to assess the impact of the new guidelines on pharmacist-managed clinics, such as the one described in this article.

Limitations

These data represent a predominantly older Caucasian male population at a single site, which limits generalizability. Patients consulted for hypoglycemia, medication intolerance, and triglyceride management were included in the data analysis, which may cause the findings of this study to seem more conservative due to the specific measures (or lack thereof)

being evaluated. Furthermore, patients who had attained therapeutic goals but preferred to continue enrollment in the RRC and those followed in the RRC for greater than 38 months were inherently excluded from this study. Lastly, there is no standard follow-up procedure for endpoint monitoring or visit frequency once patients revert back to having their PCP manage their chronic disease states; thus, it is difficult to directly compare the clinical outcomes between the services provided.

Conclusions

The results of this investigation indicate that A1c, LDL, and SBP increase after discharge from the pharmacist-managed RRC at the CGVAMC; however, these changes in endpoints may not be clinically significant based on the low reconsultation rate and the fact that although endpoints did rise after discharge, they remained at or close to generally accepted therapeutic goals. Additionally, this study supports the benefit of utilizing clinical pharmacy services in the ambulatory care setting by demonstrating that overall, clinical endpoints are sustained well below the levels at initial consultation even 2 years after discharge from the clinic. Patients who are particularly likely to benefit from extending RRC services past goal attainment include those with higher A1c and LDL at the time of consultation and those with higher weight; as such, recommendations have been made to consider following up every 3-4 months for 2-3 additional visits for patients with A1c greater than 8% and LDL exceeding 115 mg/dL at the time of consultation and for those with weight above 220 lb prior to discharging them from the CGVAMC RRC. Furthermore, we believe that all patients could benefit from extending follow-up to 6 months for 1-2 additional visits or as needed after their therapeutic goals have been reached. We believe that these actions could assist in maximizing therapeutic impact while optimizing pharmacy resources prior to discharging patients from the CGVAMC RRC.

Maintenance of Clinical Endpoints After Discharge from a Pharmacist-Managed Risk Reduction Clinic at a Veterans Affairs Medical Center

Authors

CHRISTINA H. SHERRILL, PharmD, is Assistant Professor of Ambulatory Care, Department of Clinical Sciences, High Point University School of Pharmacy, High Point, North Carolina. ANGELA PENTECOST, PharmD, BCACP, is Clinical Pharmacy Specialist, Department of Pharmacy, and EMILY E. WOOD, PharmD, is Rural Health Clinical Pharmacist, Departments of Primary Care and Pharmacy, Charles George Veterans Affairs Medical Center, Asheville, North Carolina.

AUTHOR CORRESPONDENCE: Christina H. Sherrill, PharmD, Assistant Professor of Ambulatory Care, Department of Clinical Sciences, High Point University School of Pharmacy, One University Pkwy., High Point, NC 27268. Fax: 336.888.6394; E-mail: csherril@highpoint.edu.

DISCLOSURES

The authors of this study have no actual or potential conflicts of interest to report, and no funding was required in the preparation of this manuscript. This material is the result of work supported with resources and the use of facilities at the Charles George Veterans Affairs Medical Center. The contents do not represent the views of the Department of Veterans Affairs or the U.S. government.

This work has been presented at the Charles George Veterans Affairs Medical Center 2014 Residency Research Conference, the Charles George Veterans Affairs Medical Center 2014 Research Retreat, the 2014 American College of Clinical Pharmacy Virtual Poster Symposium, and Baystate Health Renal Rounds. This manuscript had not been accepted for publication or published previously and is not under consideration by any other publication. At the time of this study, Sherrill was a Pharmacy Resident at the Charles George Veterans Affairs Medical Center, Asheville, North Carolina.

Study concept and design were contributed by Sherrill, Pentecost, and Wood. Data collection was conducted by Sherrill, with interpretation primarily by Sherrill. Sherrill wrote the manuscript, which was revised by Sherrill, Pentecost, and Wood.

ACKNOWLEDGMENTS

The authors would like to thank Ralph Lugo, PharmD, for statistical guidance and Jonathan N. Wood, PharmD, and Jeff L. Domingus, DO, for editorial assistance.

REFERENCES

1. American Diabetes Association. Standards of medical care in diabetes—2013. *Diabetes Care*. 2013;36(Suppl 1):S11-S66. Available at: http://care.diabetesjournals.org/content/36/Supplement_1/S11.full.pdf. Accessed October 24, 2015.
2. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third report of the national cholesterol education program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III) final report. *Circulation*. 2002;106(25):3143-421. Available at: <http://circ.ahajournals.org/content/106/25/3143.full.pdf>. Accessed October 24, 2015.
3. Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*. 2003;42(6):1206-52. Available at: <http://hyper.ahajournals.org/content/42/6/1206.full.pdf>. Accessed October 24, 2015.
4. Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycemia in type 2 diabetes: a patient-centered approach. *Diabetes Care*. 2012;35(6):1364-79. Available at: <http://care.diabetesjournals.org/content/35/6/1364.full.pdf>. Accessed October 24, 2015.
5. Stark Casagrande S, Fradkin JE, Saydah SH, Rust KF, Cowie CC. The prevalence of meeting A1c, blood pressure, and LDL goals among patients with diabetes, 1988-2010. *Diabetes Care*. 2013;36(8):2271-79. Available at: <http://care.diabetesjournals.org/content/36/8/2271.full.pdf>. Accessed October 24, 2015.
6. Choe HM, Farris HB, Stevenson JG, et al. Patient-centered medical home: developing, expanding, and sustaining a role for pharmacists. *Am J Health Syst Pharm*. 2012;69(12):1063-71. Available at: <http://c.ymcdn.com/sites/www.copharm.org/resource/resmgr/imported/PCMH%20Role%20for%20Pharmacists%20Michigan%202012.pdf>. Accessed October 24, 2015.
7. Smith M, Bates DW, Bodenheimer T, Cleary PD. Why pharmacists belong in the medical home. *Health Aff (Millwood)*. 2010;29(5):906-13. Available at: <http://content.healthaffairs.org/content/29/5/906.full.pdf>. Accessed October 24, 2015.
8. Taveira TH, Wu WC, Martin OJ, Schleinitz MD, Friedmann P, Sharma SC. Pharmacist-led cardiac risk reduction model. *Prev Cardiol*. 2006;9(4):202-08. Available at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1520-037X.2006.05339.x/pdf>. Accessed October 24, 2015.
9. Pirraglia PA, Taveira TH, Cohen LB, Dooley AG, Wu WC. Maintenance of cardiovascular risk goals in veterans with diabetes after discharge from a cardiovascular risk reduction clinic. *Prev Cardiol*. 2009;12(1):3-8. Available at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1751-7141.2008.00017.x/pdf>. Accessed October 24, 2015.
10. Anicete C, Kapadia S, Patel M, Tardi A. Evaluation of glycemic control maintenance in veterans discharged from a pharmacist-managed diabetes clinic. *Fed Pract*. 2013;30(12):33-37. Available at: <http://www.fedprac.com/uploads/media/030120033.pdf>. Accessed October 24, 2015.
11. Agha Z, Lofgren RP, VanRuiswyk JV, Layde PM. Are patients at Veterans Affairs medical center sicker? A comparative analysis of health status and medical resource use. *Arch Intern Med*. 2000;160(21):3252-57. Available at: <http://archinte.jamanetwork.com/article.aspx?articleid=485566>. Accessed October 24, 2015.
12. Stone NJ, Robinson J, 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. *Circulation*. 2014;129(25 Suppl 2):S1-45. Available at: http://circ.ahajournals.org/content/129/25_suppl_2/S1.full.pdf. Accessed October 24, 2015.
13. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guidelines for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA*. 2014;311(5):507-20. Available at: <http://jama.jamanetwork.com/article.aspx?articleid=1791497>. Accessed October 24, 2015.

**Maintenance of Clinical Endpoints After Discharge from a Pharmacist-Managed
Risk Reduction Clinic at a Veterans Affairs Medical Center**

APPENDIX Mean Changes in Clinical Endpoints

Endpoint Averages	Consult-Specific Data		Diagnosis-Specific Data	
Diabetes results				
N (% of total population)	69	(46.3)	82	(55.0)
A1c at consultation, % [SD]	8.58	[1.50]	8.28	[1.56]
A1c at discharge, % [SD]	6.51	[0.37]	6.49	[0.38]
Change, consultation to discharge [SD]	-2.07	[1.59]	-1.79	[1.61]
P value	<0.001		<0.001	
A1c 0-12 months, % [SD]	6.81	[0.61]	6.79	[0.60]
Change, discharge to 0-12 months [SD]	+0.30	[0.49]	+0.30	[0.47]
P value	<0.001		<0.001	
A1c 12-24 months, % [SD]	7.05	[0.76]	7.04	[0.85]
Change, discharge to 12-24 months [SD]	+0.54	[0.78]	+0.55	[0.88]
P value	<0.001		<0.001	
Dyslipidemia results				
N (% of total population)	87	(58.4)	137	(91.9)
LDL at consultation, mg/dL [SD]	133.0	[43.7]	116.3	[45.8]
LDL at discharge, mg/dL [SD]	85.5	[17.7]	81.5	[18.3]
Change, consultation to discharge [SD]	-47.5	[37.4]	-34.8	[38.9]
P value	<0.001		<0.001	
LDL 0-12 months, mg/dL [SD]	97.2	[30.4]	90.8	[28.5]
Change, discharge to 0-12 months [SD]	+11.7	[25.1]	+9.3	[24.4]
P value	<0.001		<0.001	
LDL 12-24 months, mg/dL [SD]	97.2	[33.5]	90.9	[31.1]
Change, discharge to 12-24 months [SD]	+11.7	[31.3]	+9.4	[27.3]
P value	<0.001		<0.001	
Hypertension results				
N (% of total population)	15	(10.1)	132	(88.6)
SBP at consultation, mm Hg [SD]	143.7	[12.6]	133.0	[17.9]
SBP at discharge, mm Hg [SD]	132.2	[10.1]	126.2	[12.4]
Change, consultation to discharge [SD]	-11.5	[15.5]	-6.8	[19.1]
P value	0.012		<0.001	
SBP 0-12 months, mm Hg [SD]	133.2	[13.4]	131.5	[14.3]
Change, discharge to 0-12 months [SD]	+1.0	[15.4]	+5.3	[15.5]
P value	0.814		<0.001	
SBP 12-24 months, mm Hg [SD]	133.2	[15.5]	133.9	[16.4]
Change, discharge to 12-24 months [SD]	+1.0	[19.8]	+7.7	[19.2]
P value	0.855		<0.001	

A1c = hemoglobin A1c; LDL = low-density lipoprotein; mg/dL = milligram per deciliter; mm Hg = millimeter of mercury; SBP = systolic blood pressure; SD = standard deviation.