Effect of a Multidisciplinary-Assisted Resident Diabetes Clinic on Resident Knowledge and Patient Outcomes

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Abstract

Background Despite the rising prevalence of diabetes, there is a paucity of diabetes curricula in residency training. The multidisciplinary diabetes team approach is underused in residency education.

Objective To assess the feasibility of an innovative multidisciplinary resident diabetes clinic (MRDC) in enhancing (1) resident diabetes knowledge via a Diabetes Awareness Questionnaire, and (2) subsequent process and patient outcomes in patients with diabetes via a Diabetes Practice Behavior Checklist.

Methods From October 2008 to February 2010, 14 internal medicine residents managed patients with uncontrolled diabetes in a weekly half-day MRDC for 1 month (total 4–5 half-day sessions/resident), with a collaborative team of internists, diabetes educators, an endocrinologist, and a pharmacist. The curriculum included didactic sessions, required readings, and patient-specific case discussions. A 20-question Diabetes Awareness Questionnaire was administered to each resident prerotation and postrotation. Records of 47 patients with diabetes in the residents' own continuity clinics (not the MRDC) were audited 6 months before and after the MRDC for Diabetes Practice Behavior Checklist measures (glycated hemoglobin, blood pressure, low-density lipoprotein cholesterol, retinal referral, foot exam, microalbumin screen). Pre-MRDC and post-MRDC data were compared via paired *t* test.

Results The MRDC residents exhibited a modest increase in mean (SD) scores on the Diabetes Awareness Questionnaire (before, 8.2 [2.8]; after, 10.9 [2.8]; $P = .02$) and a modest mean (SD) performance increase in overall process outcomes from the Diabetes Practice Behavior Checklist (before, 74% [18%]; after, 84% [18%]; $P = .004$). No improvements occurred in patient outcomes.

Conclusions Multidisciplinary diabetes teaching may be useful in fostering certain resident knowledge and performance measures but may not alter clinical outcomes. Further large-scale, longitudinal studies are needed to understand the effect of our curriculum on residents' diabetes knowledge and future practice behavior.

Editor's Note: The online version of this article contains the Diabetes Awareness Questionnaire and Diabetes Practice Behavior Checklist used in this study.

Introduction

With the escalating cost[1] and prevalence of diabetes,[2] more attention on diabetes management has been directed toward residents-in-training as the new primary care workforce.[3] Survey studies reveal residents have negative attitudes[4–6] and lack knowledge or comfort in managing diabetes.[3,7–9] Lack of structured education, time constraints, and patient-faculty-resident inertia are well-cited barriers.[4,10–12] Diabetes management remains suboptimal in large, university-affiliated residency programs,[13,14] with 60% of patients not achieving glycated hemoglobin (A1c),

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BOX Multidisciplinary-Assisted Resident Diabetes Clinic Standardized Enhancements

- Interactive, 30-minute preclinic diabetes-related lectures by the endocrinologist or certified diabetes educator
- Preclinic medical record review of patients in the multidisciplinary resident diabetes clinic by the endocrinologist for patient-specific recommendations
- Real-time pharmacists and certified diabetes educator involvement at patient visits
- Postclinic "wrap-up sessions" with the endocrinologist and internal medicine attending for patient-specific case discussions
- Discussion of 2 required, evidence-based readings[24,25]

low-density lipoprotein cholesterol (LDL-C), or blood pressure (BP) goals.[13] Studies show improved patient outcomes during the educational interventions,[15–17] but few studies used multidisciplinary teaching or examined subsequent patient care by residents after intervention completion.[18] The need for multidisciplinary approaches in residency education has been advocated in diabetes management.[19–23] Yet, diabetes team-based teaching remains underused in residency education.

Our pilot study assessed the feasibility of an innovative multidisciplinary-assisted resident diabetes clinic (MRDC) on (1) enhancing resident knowledge and subsequent practice behaviors on diabetes management before and after MRDC exposure, and (2) improving future patient and process outcomes among patients with diabetes managed by postgraduate year (PGY)-1 and PGY-2 internal medicine (IM) residents subsequently in their own continuity clinics before and after MRDC exposure.

Methods

Study Design

Our pilot study (October 2008 to January 2010) incorporated a formal multidisciplinary team into the preexisting, weekly resident diabetes clinic to become an innovative MRDC. Multidisciplinary team experts included certified diabetes educators, IM attendings, pharmacists, an endocrinologist, and the IM residency clinic director. This MRDC group developed a formal diabetes curriculum within the University of Florida IM residency program. The study was approved by the University of Florida Institutional Review Board.

Participants

Physician participants were PGY-1 and PGY-2 categorical IM residents in academic years 2007–2009 who had continuity clinics at least 6-months before and 6-months after their MRDC rotation. The PGY-3 IM residents were excluded.

Medical records were reviewed for patient and process outcomes from diabetic patients in the residents' own continuity clinics (not in the MRDC). Studies have already shown subspecialty assistance improves clinical outcomes in specialized clinics.[4,6] Patient eligibility included adults with diabetes mellitus diagnoses (type 1, type 2, or secondary diabetes) managed by PGY-1 and PGY-2 residents in their continuity clinics for at least 6 months before and after the residents' MRDC rotation. The only exclusion criterion for patients was pregnancy.

Multidisciplinary-Assisted Resident Diabetes Clinic (BOX)

The prestudy resident diabetes clinic was a weekly, half-day rotation during residents' 1-month ambulatory block. Each resident managed 5 patients with diabetes at 30-minute intervals per clinic. Preceptors were general IM attendings.

Each resident attended 1 afternoon MRDC session per week for 1 month during his or her ambulatory rotation, for a total of 4 to 5 half-day MRDC-sessions per resident. After that 1-month rotation, the resident returned to managing his or her continuity clinic patients. Patients were screened by study investigators during their scheduled visits in the residents' continuity clinics (not in the MRDC), and if eligible, their records were audited retrospectively by a fourth-year medical student and a PGY-3 IM resident who were not study subjects.

Using the cost-allocation method for cost analysis, the MRDC budget and accounting systems were allocated based on direct cost of employee services availed and clinic resources/space occupied.

Evaluation of Resident Knowledge and Practice Behaviors

For resident knowledge, a 20-question Diabetes Awareness Questionnaire (DAQ) (provided as online supplemental material) was administered to residents immediately before and immediately after their MRDC rotation.

For resident practice behaviors, a Diabetes Practice Behavior Checklist (DPBC) (provided as online supplemental material) was used for medical record reviews of 9 process outcomes 6 months before and 6 months after MRDC intervention: frequency of A1c, BP, LDL-C monitoring; retinal referral; monofilament exam; microalbumin screening; tobacco cessation counseling; aspirin coaching; and diet-exercise education. Calculation of total DPBC scores is described in the statistical analysis.

The DAQ and the DPBC were modified from peer-reviewed publications measuring knowledge and practice behaviors. We used a multiple-choice format to ease data extraction and to ensure reproducibility on repeated applications of the measure. The experts who composed our DAQ have extensive educational backgrounds to ensure contents were representative of knowledge expected at the residency level. The DPBC was adapted from the American Diabetes Association, the

TABLE 1 **Percentage of Process Outcomes Performed Before and After Exposure to the Multidisciplinary-Assisted Resident Diabetes Clinic (MRDC)**

Process Outcomes	Before MRDC, mean (SD)	After MRDC, mean (SD)	*P* Value
Frequency of A1c checks	71.11 (0.29)	89.26 (0.27)	.005
Frequency of BP checks	99.00 (0.07)	100.00 (0.00)	.32
Frequency of LDL-C checks	82.61 (0.38)	88.89 (0.32)	.69
Frequency of microalbumin:creatinine ratio checks	48.89 (0.51)	62.22 (0.49)	.18
Frequency of retinal referral	53.33 (0.50)	66.67 (0.48)	.18
Frequency of foot monofilament exam	55.56 (0.50)	75.56 (0.43)	.03
Frequency of diet and exercise education	51.11 (0.51)	68.89 (0.47)	.03
Frequency of tobacco cessation counseling	33.00 (0.58)	100.00 (0.00)	.18
Frequency of aspirin prescription	47.00 (0.50)	63.00 (0.49)	.007
Overall composite score	74.00 (0.18)	84.50 (0.18)	.004

Abbreviations: A1c, test for glycated hemoglobin; BP, blood pressure; LDL-C, low-density lipoprotein cholesterol.

National Diabetes Quality Improvement Alliance, and the Diabetes Quality Improvement Project.

Patient Outcomes

Three patient outcomes measures were analyzed, 1 value each at 6 months before and 6 months after MRDC intervention: A1c, BP, and LDL-C levels.

Statistical Analysis

The DAQ scores were totaled for each resident, and the number was treated as a continuous variable. Numeric data for individual components of the DPBC were converted into proportions by dividing the count of the number of patients (or events) correctly managed by the number of patients (or events) seen by the resident and were then treated as continuous variables. Patient outcomes were treated as continuous variables. Means are reported with standard deviation. To compare before and after MRDC variables, paired *t* test was used; data were used only if there were matching pre-MRDC and post-MRDC values per variable.

Results

Fourteen of 26 residents (54%) completed the study (16 were eligible [62%]; 2 [8%] were excluded due to incompletion of their MRDC rotation from back-up coverage).

The MRDC residents demonstrated an increase in DAQ scores from a mean (SD) of 8.2 (2.8) pre-MRDC to 10.9 (2.8) post-MRDC ($P = .02$; Cohen *d* effect-size = 0.96). Residents acquired a greater knowledge of diabetes therapy goals and insulin regimens. Examples included A1c and BP goals and the composition of 75% insulin lispro protamine suspension/25% insulin lispro injection (rDNA origin) (Humalog Mix 75/25, Eli Lilly and Company, Indianapolis, IN). Persistently low-scoring questions involved specific details on diabetes treatment rather than general diabetes care. Examples included carbohydrate amounts needed for hypoglycemia treatment and estimated average glucose equivalent to an A1c.

The overall mean (SD) percentage of process outcomes performed on the DBPC increased from 74% (18%) before MRDC to 84% (18%) after MRDC ($P = .004$; Cohen *d* effect-size = 0.55). There was a statistically significant improvement in 4 process outcomes performed: frequency of A1c checks, foot exams, diet-exercise education, and aspirin prescription (TABLE 1).

Medical records of 47 patients with diabetes in the residents' continuity clinics were reviewed. Baseline means were A1c, 7.3%; LDL-C, 91 mg/dL; and BP, 138/76 mm Hg. Total outpatient visits before versus after MRDC intervention did not differ (~1 visit/intervention). There was no significant difference in all 3 patient outcome measures before and after MRDC exposure for all cohorts (TABLE 2).

Discussion

Our pilot study on an innovative MRDC demonstrates modest improvements in resident knowledge and performances of certain process outcomes but had no effect on clinical outcomes in their primary care patients with diabetes.

This pilot curriculum has unique and exportable features. First, its design focused on the sustainability of resident knowledge, practice behaviors, and quality of

TABLE 2 **Patient Outcomes Before and After Exposure to the Multidisciplinary-Assisted Resident Diabetes Clinic (MRDC)**

	All Patients With Diabetes, n = 47			Patients With Uncontrolled Diabetes, n = 21		
Patient Outcomes	**Before MRDC, mean (SD)**	**After MRDC, mean (SD)**	***P* Value**	**Before MRDC, mean (SD)**	**Post-MRDC, mean (SD)**	***P* Value**
A1c, %	7.32 (1.42)	7.28 (1.24)	.87	8.30 (1.27)	7.58 (1.17)	.08
LDL-C, mg/dL	90.76 (29.05)	86.70 (26.34)	.34	99.93 (27.65)	90.00 (24.91)	.62
Systolic BP, mm Hg	138.39 (16.83)	132.61 (22.74)	.14	139.55 (18.20)	135.00 (23.24)	.36
Diastolic BP, mm Hg	75.95 (11.60)	75.68 (12.06)	.88	76.05 (13.37)	75.86 (12.79)	.94

Abbreviations: A1c, test for glycated hemoglobin; BP, blood pressure; LDL-C, low-density lipoprotein cholesterol.

patient care after MRDC intervention. This is important because residents, as future providers of chronic disease care, will face limited diabetes subspecialty management after graduation. Previous publications focus on reminders to physicians during the intervention.[26–28] These studies do not demonstrate true multidisciplinary teaching or assess sustainability of practice behaviors after the intervention. Second, our MRDC included interactive resident teaching and feedback, fostering stakeholder buy-in and driving curriculum improvement. Our MRDC rotation is popular, often requested by residents during their ambulatory block. A nephrologist has joined the multidisciplinary team. Plans are underway to incorporate the DBPC checklist into our electronic health record as diabetes clinical reminders.

Each team member at the Association of American Medical Colleges–defined fiftieth salary percentile expended 0.05 full-time equivalent (FTE) per resident. Clinic costs involved overhead at $43/patient/visit and rent at $7500/y. Accounting for 4 FTEs ($27 050/y) and clinic expenses ($18 250/y), the total MRDC operating cost calculates to $3236/resident/y. Patient billings from the MRDC covered internists' salaries. The endocrinologist's FTE was funded initially by a grant but was self-donated thereafter.

Our study has several limitations. One is the low DAQ mean score, further dampened by its administration immediately before and after rotation. This may be secondary to the short, 1-month MRDC rotation or to knowledge deficits in specific diabetes topics, which entail further reading or clinical exposure beyond this pilot curriculum. Second are the inherent system constraints beyond the scope of this pilot. Some patients with diabetes lacked timely laboratory work or follow-up in the residents' continuity clinic because of clinic cancellations, access issues, and no-shows. Third is the potential bias in data abstraction by individuals aware of the study timeline. Fourth is that our DAQ and DPBC have not been validated. The literature showed only 1 DAQ with validity measurements,[29] written in open-text format. Fifth is the low number of total MRDC residents (ie, 4 experts teaching 1 resident/mo in constrained clinic space), limiting its cost-effectiveness. This should not preclude others from involving more residents per rotation, thus, decreasing FTE costs. It is worth noting that our intervention required a strong partnership and time commitment between our specialists and generalists in a large, academic setting; treating complex patients with overwhelming poverty and poor health literacy. This setting may not be generalizable to private primary care practices or community-based residency programs. A final limitation is the lack of a control group. Residents may have acquired diabetes knowledge and practice behaviors over time in residency. We propose future studies of this pilot intervention using a larger subject sample with a control group. Future curricula should allow for longitudinal training and target teaching to specific diabetes topics.

Conclusion

Our MRDC innovation has the potential to improve certain process outcomes and residents' diabetes knowledge. This curriculum provides one model of diabetes care redesign and team-based education for residency program directors to pilot in their own institutions. Our pilot study prompts the need for a longitudinal, multi-institutional, randomized-controlled trial that addresses patient outcomes, residents' diabetes knowledge, and future practice behaviors.

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