Older Adults Reporting More Diabetes Mellitus Care Have Greater 9-Year Survival

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OBJECTIVES: To determine whether receiving more recommended diabetes mellitus (DM) care processes (tests and screenings) would translate into better 9-year survival for middle-aged and older adults.

DESIGN: Longitudinal mortality analysis using the Health and Retirement Study Diabetes Mailout Survey.

SETTING: Health and Retirement Study (HRS).

PARTICIPANTS: Individuals aged 51 and older (n = 1,879; mean age 68.8 ± 8.7, 26.5% aged ≥75) with self-reported DM who completed the Diabetes Mailout Survey and the core 2002 HRS survey.

MEASUREMENTS: A composite measure of five self-reported diabetes mellitus care process measures were dichotomized as greater (3–5 processes) versus fewer (0–2 processes) care processes provided. Cox proportional hazards models were used to test relationships between reported measures and mortality, controlling for sociodemographic characteristics, function, comorbidities, geriatric conditions, and insulin use.

RESULTS: Prevalence of self-reported care processes was 80.1% for glycosylated hemoglobin test, 75.9% for urine test, 67.5% for eye examination, 67.7% for aspirin counseling, and 48.2% for diabetes education. In 9 years, 32.1% respondents died. Greater care correlated with 24% lower risk of dying (adjusted hazard ratio = 0.76, 95% confidence interval = 0.64–0.91) at 9-year follow up. When respondents were age-stratified (≥75 vs <75) longer survival was statistically significant only in the older age group.

CONCLUSION: Although it is not possible to account for differences in adherence to care that may also affect survival, this study demonstrates that monitoring of and counseling about types of DM care processes are associated with long-term survival benefit even in individuals aged 75 and older with DM. **J Am Geriatr Soc 63:2455–2462, 2015.**

Key words: diabetes mellitus; older adults; process of care measures; quality of care

Diabetes mellitus (DM) disproportionately affects older adults. In 2010, 27% of U.S. residents aged 65 and older had DM, versus 8% of the overall U.S. population.[1] Evidence suggests that cardiovascular complications of DM can be reduced or delayed with optimal DM care,[2] but care of individuals with DM aimed at preventing complications has been inconsistent and suboptimal.[3,4] In addition, the benefits of current standard DM care remains inconclusive for older adults, particularly after age 75.

Healthcare performance measures can be grouped broadly into two types: those based on recommended care processes (whether or not providers performed care, e.g., measuring serum glycosylated hemoglobin (HbA1c and lipids, screening for retinopathy, diet counseling, examining feet) and intermediate care outcomes (whether targets were met for glycosylated HbA1c, blood pressure, or lipid levels). Performance of DM care processes and care outcomes has improved nationally over the past decade.[5–8] Recent research suggests that overly aggressive goals for intermediate outcomes in older adults may result in unintended harms (e.g., hypoglycemia) that outweigh long-term cardiovascular benefits,[9–11] but whether providing care processes is associated with similar harm in very old adults has not been well studied, and it is not known which older adults with comorbidities might benefit from risk factor control.[12] No studies have directly addressed whether delivery of more recommended DM care processes is associated with longer survival.

This study of DM care processes examined middle-aged to older participants from the nationally representative Health and Retirement Study (HRS) and tested whether those who reported receiving more recommended

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DM care processes had longer long-term survival than those who reported receiving fewer and whether the association differed between those younger than 75 and those aged 75 and older.

METHODS

This was a 9-year follow-up study using the 2003 Diabetes Mailout Survey data, a supplemental survey to the 2002 core Health and Retirement Study (HRS). The HRS[13] is a biennial health interview of community-dwelling older adults living in the United States. The HRS is sponsored by the National Institute on Aging and conducted by the Institute for Social Research at the University of Michigan. Respondents are surveyed every 2 years in person or by telephone even if living in a residential facility. If an individual is unable to complete the survey, a proxy completes it for him or her. To ensure the representativeness of the population surveyed, African-American and Hispanic adults are oversampled. In contrast to most care processes studies using health system data, the HRS Diabetes Mailout Survey is independent of participants' health insurance status.

Data from the 1,879 respondents aged 51 and older with self-reported DM who completed the Diabetes Mailout Survey and the core 2002 HRS survey were analyzed. The HRS includes complete linkage with mortality data in the National Death Index on all respondents through the end of 2010, which is included in the 2013 Cross-Wave Tracker File. The HRS survival data are therefore completely ascertained (no loss to follow-up).

The Behavioral Sciences Committee institutional review board at the University of Michigan approved the HRS. The New York University School of Medicines institutional review board exempted the current study from review. HRS data contain no unique identifiers and are publicly available.

Outcome Measure

The outcome was time to death for each respondent, calculated as the time from the date of participation in the 2002 core interview to the date of death. Because the analyses included mortality data through December 31, 2010, participants were censored if they were still alive on January 1, 2011. None of the censorings were due to dropout because there are complete data for survival outcomes in the HRS.

Process of Care Measures

In the Diabetes Mailout Survey, each respondent was asked whether they had received any of six DM care processes in the past year: a glycosylated hemoglobin (HbA1c) test, a urine test, a DM eye examination, aspirin counseling, DM education, and lipid profile test.

Four of the measures (HbA1c testing, urine test, eye examination, DM education) were part of the initial Diabetes Quality Improvement Program (DQIP) measure set in the late 1990s[3] and recommended as part of the 2015 American Diabetes Association (ADA) standards of medical care guidelines for diabetes mellitus,[2] endorsed by the National Quality Forum (NQF).[14] Although now controversial, aspirin use counseling was widely recommended in 2003,[3,4,6] including by the ADA for primary cardiovascular prevention for adults with DM aged 30 and older.[15]

Although self-report of lipid profile was part of the Diabetes Mailout Survey, this measure was not included in the current analysis because of missing data in 10.0% of the study population (vs <5% of for the other five measures). Other DQIP, NQF, and ADA measures such as annual foot examination and vaccinations[2,3,14] were not asked about in the Diabetes Mailout Survey.

If the respondent answered that they received the DM care process, that item was counted as one care process provided. Although the number of missing responses was low (<5% for any single care process question), to reduce bias and produce the most-conservative results, all missing responses were presumed as not provided for that particular care process (contributed a count of 0 toward the total care process score). Therefore, each respondent was considered as being eligible for five total care processes for this analysis. The provided care processes out of a total five possible were summed, and then the respondents were classified into two groups according to median total count: those who received fewer (0–2 care processes) versus those who received more recommended DM care processes (3–5 care processes).

Covariables

Baseline sociodemographic and health characteristics of the respondents were assessed according to their answers to the HRS 2003 Diabetes Mailout Survey and 2002 core interview (Table 1). Sociodemographic characteristics included age, race (white vs all others), sex, education (<high school vs ≥high school), marriage status (single vs married), and net worth (<$50,000 vs ≥$50,000). Functional limitations were measured according to self-reported number of activity of daily living (ADL; bathing, walking, dressing, eating, transferring, toileting) and instrumental activity of daily living (IADL; meal preparation, shopping for groceries, managing medications, making telephone calls, managing finances) limitations. Participants who had difficulty with one or more ADLs or IADLs were defined as having functional limitations. Total Illness Burden Index (TIBI), a composite score (range 0–100) based on self-reported symptoms and DM-related complications developed for the HRS, was used to measure DM severity and general medical comorbidity.[16–18] The Diabetes Mailout Survey captured insulin use. Five geriatric conditions (as dichotomous variables) were asked about in the core interview: one or more injurious falls requiring medical care in the past 2 years, urinary incontinence during the past 12 months, pain that is troublesome, poor or fair vision, and poor or fair hearing. The sixth geriatric condition, cognitive impairment, was measured using the modified Telephone Interview for Cognition Survey (TICS-m). Respondents with scores of 11 points or lower on the 27-item TICS-m, a cutoff score that identifies mild through advanced stages of cognitive impairment, were determined to have cognitive impairment.[19] TICS-m includes multiple domains of immediate and delayed recall, working memory and mental processing speed. The presence of each of

Table 1. Characteristics of Respondents According to Number of Process-of-Care Measures

Characteristic	All, N = 1,879	0–2 Process-of-Care Measures, n = 493	3–5 Process-of-Care Measures, n = 1,386	*P*-Value: 0–2 Measures vs 3–5 Measures
Age, mean±SD	68.8 ± 8.7	69.2 ± 9.3	68.7 ± 8.4	.03
51–64	646 (34.4)	177 (35.9)	469 (33.8)	
65–74	735 (39.1)	169 (34.3)	566 (40.8)	
≥ 75	498 (26.5)	147 (29.8)	351 (25.4)	
Female, n (%)	984 (52.4)	277 (56.2)	707 (51.0)	
Race, n (%)				
White	1,288 (68.5)	322 (65.3)	966 (69.7)	.5
Black	367 (19.5)	97 (19.7)	270 (19.5)	
Hispanic	201 (10.7)	64 (13.0)	137 (9.9)	
Other	23 (1.2)	10 (2.0)	13 (0.9)	
Education, n (%)				
<12th grade	659 (35.1)	211 (42.8)	448 (32.3)	<.001
12th grade	621 (33.1)	150 (30.4)	471 (34.0)	
>12th grade	595 (31.7)	131 (26.6)	464 (33.5)	
Married, n (%)	1,251 (66.6)	302 (61.3)	949 (68.5)	.004
Net worth, $, n (%)				
<$50,000	601 (32.0)	195 (39.6)	406 (29.3)	<.001
$50,000–534,999	1,044 (55.6)	248 (50.3)	796 (57.4)	
≥$535,000	234 (12.5)	50 (10.1)	184 (13.3)	
Number of activity of daily living difficulties, n (%)				
0	1,413 (75.2)	359 (72.8)	1,054 (76.1)	.09
1–3	389 (20.7)	106 (21.5)	283 (20.4)	
4–6	77 (4.1)	28 (5.7)	49 (3.5)	
Number of instrumental activity of daily living difficulties, n (%)				
0	1,508 (80.3)	79.7% (n = 393)	1,115 (80.5)	.07
1–2	251 (13.4)	59 (12.0)	192 (13.9)	
3–5	118 (6.3)	41 (8.3)	77 (5.6)	
Total Illness Burden Index, mean±SD	36.0 ± 18.9	34.1 ± 18.5	36.7 ± 19.0	.009
Geriatric conditions, n (%)				.02
Injurious falls	117 (6.2)	30 (6.1)	87 (6.3)	.88
Cognitive impairment	525 (27.9)	170 (34.5)	355 (25.6)	<.001
Pain	687 (36.6)	171 (34.7)	516 (37.2)	.33
Urinary incontinence	399 (21.2)	106 (21.5)	293 (21.1)	.85
Hearing impairment	462 (24.6)	122 (24.8)	340 (24.5)	.89
Visual impairment	519 (27.6)	166 (33.7)	353 (25.5)	<.001
Insulin use, n (%)	411 (21.9)	77 (15.6)	334 (24.1)	<.001
Alive in 2010	1,275 (67.9)	317 (64.3)	958 (69.1)	.05

SD = standard deviation.

the six geriatric condition variables was counted for each respondent, resulting in a score representing each respondent's burden of geriatric conditions.

Statistical Analyses

All analyses were performed using Stata version 13 (Stata Corp., College Station, TX). Standard descriptive statistical techniques were used to determine the prevalence of process measures and sociodemographic and health covariates in the study sample and differences in these characteristics between respondents with and without missing information for each process-of-care measure variable. Visual inspection of unadjusted Kaplan-Meier survivor curves was used to confirm that the proportional hazard assumption was satisfied over the 9 years of follow-up. The survival analysis was performed using a Cox proportional hazards model comparing respondents provided with more recommended care (3–5 care processes) with those provided with less recommended care (0–2 care processes), with time until death as the dependent variable. Covariates (age, sex, education, marriage status, net worth, functional limitations, TIBI, insulin use, geriatric conditions) were added in separately to assess confounding between care process scores and time until death. Only covariates with $P < .10$ in the univariate analyses between the two groups were selected for inclusion in subsequent multivariable modeling.

Table 2 shows the adjusted models and covariates used in the analysis. Sensitivity analyses were performed using the total care process scores as a continuous variable rather than a dichotomous grouping in the multivariable model. Whether the results were sensitive to a higher cutoff was also tested using differently defined higher- and lower-scoring groups (0–3 vs 4–5 care processes provided). Lastly, a separate survival analysis was performed on the entire sample stratified according to age (<75 vs ≥75).

RESULTS

Table 1 shows the demographic characteristics and health status of the two groups of respondents stratified according

Table 2. Cox Proportional Hazard Model

Variable	Model 1, n = 1,879	Model 2, n = 1,879	Model 3, n = 1,875	Model 4, n = 1,873	Model 5, n = 1,865
	Hazard Ratio (95% Confidence Interval)				
Process-of-care measures[a]	0.82 (0.69–0.98)[b]	0.84 (0.70–0.997)[b]	0.87 (0.73–1.03)	0.84 (0.70–1.00)[b]	0.76 (0.64–0.91)[b]
Age					
65–74		1.65 (1.31–2.07)[b]	1.61 (1.28–2.03)[b]	1.62 (1.29–2.04)[b]	1.70 (1.35–2.15)[b]
≥ 75		4.31 (3.47–5.35)[b]	4.10 (3.29–5.12)[b]	3.90 (3.12–4.87)[b]	4.53 (3.59–5.72)[b]
Female			0.73 (0.61–0.87)[b]	0.70 (0.60–0.84)[b]	0.69 (0.57–0.82)[b]
<High school education			1.19 (1.00–1.41)[b]	1.10 (0.93–1.31)	1.03 (0.86–1.23)
Single			1.28 (1.06–1.54)[b]	1.24 (1.03–1.50)[b]	1.26 (1.04–1.51)[b]
Net worth, $					
<50,000			1.70 (1.24–2.33)[b]	1.43 (1.04–1.97)[b]	1.29 (0.93–1.78)
50,000–534,999			1.46 (1.09–1.96)[b]	1.42 (1.07–1.90)[b]	1.35 (1.00–1.80)[b]
≥1 activities of daily living				1.30 (1.07–1.58)[b]	1.14 (0.93–1.40)
≥1 instrumental activities of daily living				1.99 (1.63–2.43)[b]	1.82 (1.49–2.24)[b]
Geriatric conditions					1.01 (0.93–1.09)
Uses insulin					1.21 (1.00–1.46)[b]
Total Illness Burden Index					1.01 (1.01–1.02)[b]

Model 1: unadjusted.
Model 2: adjusted for age.
Model 3: adjusted for age, demographic characteristics, socioeconomic status (SES).
Model 4: adjusted for age, demographic characteristics, SES, functional health.
Model 5: adjusted for age, demographic characteristics, SES, functional health, comorbidities, insulin use.
[a] Glycosylated hemoglobin test, urine test, eye examination, aspirin counseling, and diabetes mellitus education (0 = 0–2, 1 = 3–5).
[b] $P < .05$.

to high and low care process scores. At baseline, the mean age was 68.8 ± 8.7, 52.4% were female, 68.5% were white, and 21.9% were taking insulin. The prevalence of self-reported process of care measures were 80.1% for HbA1c test, 75.9% for urine test, 67.5% for eye examination, 67.7% for aspirin counseling, and 48.2% for DM education. Of the 1,879 participants, 73.8% reported receiving three to five process measures.

Those reported receiving more care processes (3–5 care processes) were more likely to be younger (68.7 ± 8.4 vs 69.2 ± 9.3, $P = .03$), be male (49.0% vs 43.8%, $P = .05$), be married (68.5% vs 61.3%, $P = .004$, have graduated from high school (67.5% vs 57.0%, $P \leq .001$), have higher net worth (≥$50,000: 70.7% vs 60.4%, $P \leq .001$), and use insulin (24.1% vs 15.6%, $P \leq .001$) and less likely to be cognitively (25.6% vs 34.5%, $P \leq .001$) or visually (25.5% vs 33.7%, $P \leq .001$) impaired. Those with more care processes also had fewer of the six geriatric conditions (mean 1.40, 95% confidence interval (CI) = 1.33–1.46 vs mean 1.56, 95% CI = 1.44–1.67, $P = .02$) but a higher TIBI score (mean 36.7, 95% CI = 17.7–55.6 vs mean 34.1, 95% CI = 15.5–52.6, $P = .009$).

Time to death or right censoring ranged from 0.25 to 9.08 years. In 9 years (2002–11), 32.1% (n = 604) of respondents died. Those with better care were more likely to be alive at the end of the study period (January 1, 2011) (69.1% vs 64.3%, $P = .05$). Figure 1 shows the unadjusted survival analysis curves for the two groups, which were found to be statistically significantly different according to the log rank test ($P = .02$). Before adjusting for covariates, the group that received more recommended care processes was less likely to die (hazard ratio (HR) = 0.82, 95% CI = 0.69–0.98). For 14 of 1,879 respondents (0.7%), one or more covariables were missing, so the final multivariable analysis was performed on 1,865 respondents with complete information (Figure 2). After inclusion of covariates that were significant in bivariate analysis (in Model 5, which adjusted for age, sex, marital status, net worth, education, physical function, geriatric conditions, TIBI, and insulin use) respondents with more care processes were even less likely to die (HR = 0.76, 95% CI = 0.64–0.91) (Table 2).

When the final multivariable model was stratified according to age (≥ 75 vs <75), 57.2% of respondents in the older group and 23.1% in the younger group had died. The effect of being in the group receiving greater DM care

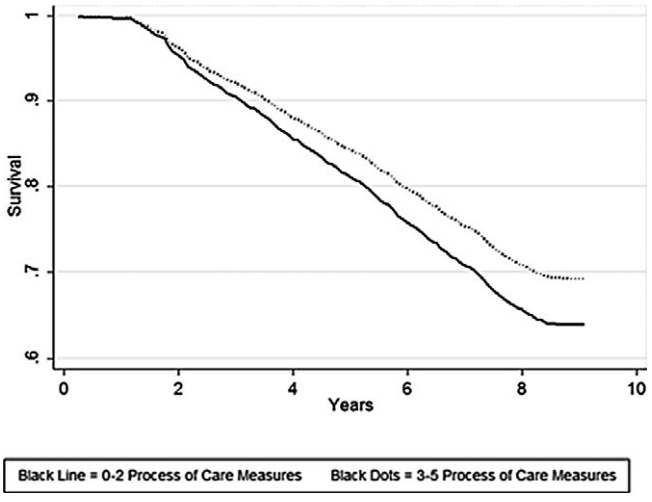

Figure 1. Cox proportional hazards regression: unadjusted survival probability of older adults with diabetes mellitus in the sample.

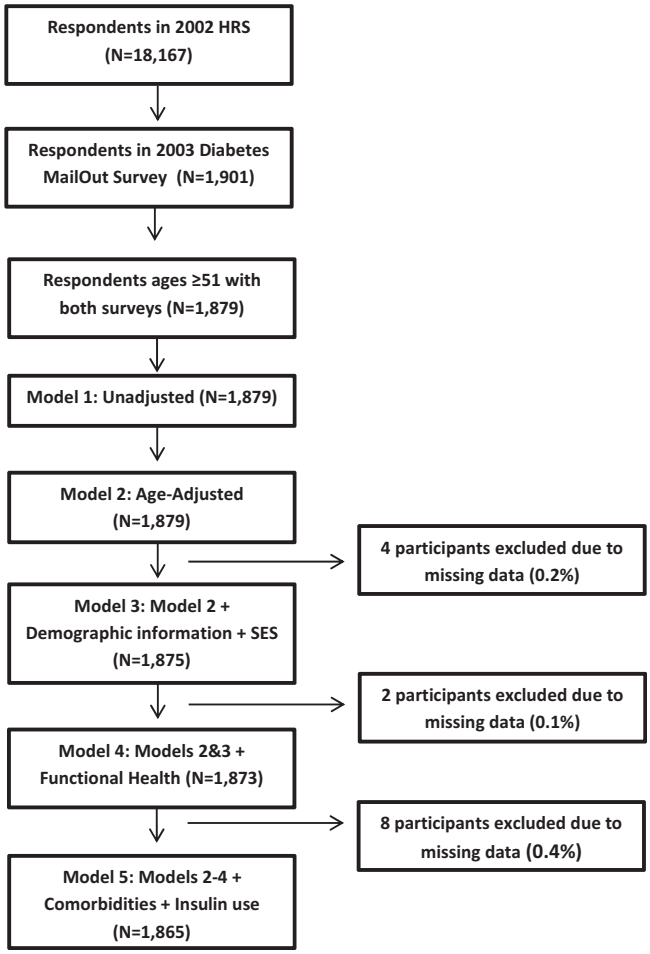

Figure 2. : Flow of data from the Health and Retirement Study (HRS) core interview: 2002 to final analytical sample. SES = socioeconomic status.

processes was stronger and more statistically significant in the older group (HR = 0.72, 95% CI = 0.55–0.93) than in the younger group (HR = 0.84, 95% CI = 0.65–1.09) (Table 3). Sensitivity analyses using process-of-care measures as a continuous variable in the multivariable model and different dichotomized care process groups (0–3 vs 4–5 measures) gave comparable findings.

DISCUSSION

DM care process measures were developed to improve the quality of DM care and to improve health outcomes.[3] In this nationally representative sample of middle-aged and older Americans with DM, respondents who reported receiving more of five selected DM care process measures had significantly better survival over 9 years of follow-up than those who received fewer. This association was independent of age, sex, socioeconomic status, demographic characteristics, functional health, geriatric conditions, insulin use, and DM illness burden. More importantly, it was demonstrated in a relatively small subsample of older respondents aged 75 and older that basic, nonaggressive care processes such as counseling and monitoring are not harmful and seem to be associated with benefit.

These results focus on DM monitoring and counseling-type care processes, rather than achievement of intermediate outcomes such as glycemic targets. The care processes studied are distinct from those recommended to achieve glycemic targets, such as prescribing hypoglycemic and antihypertensive medications.[7–10,20] Therefore, these results do not contradict recent research suggesting that aggressive glycemic and blood pressure control in older adults appear to have diminishing marginal benefits than more-modest targets and may even cause harm.[21–23]

These results should be viewed in light of prior research on the long-term outcomes of care processes provided to

Table 3. Cox Proportional Hazard Model Stratified According to Age

	<75		≥ 75	
	Model 1, n = 1,381	Model 5, n = 1,372	Model 1, n = 498	Model 5, n = 493
Variable	Hazard Ratio (95% Confidence Interval)			
Process-of-care measures[a]	0.88 (0.69–1.13)	0.84 (0.65–1.09)	0.82 (0.64–1.06)[b]	0.72 (0.55–0.93)[b]
Female		0.64 (0.51–0.82)[b]		0.69 (0.52–0.90)[b]
<High school education		1.14 (0.89–1.45)		0.98 (0.76–1.28)
Single		1.31 (1.01–1.70)[b]		1.27 (0.96–1.67)
Net worth, $				
<50,000		1.10 (0.71–1.70)		1.31 (0.81–2.12)
50,000–534,999		1.11 (0.75–1.65)		1.50 (0.97–2.32)
≥1 activities of daily living		1.17 (0.87–1.57)		1.06 (0.79–1.41)
≥1 instrumental activities of daily living		1.63 (1.21–2.21)[b]		1.92 (1.45–2.54)[b]
Geriatric conditions		1.02 (0.91–1.13)		1.05 (0.95–1.17)
Uses insulin		1.19 (0.92–1.54)		1.16 (0.88–1.53)
Total Illness Burden Index		1.02 (1.01–1.02)[b]		1.01 (1.00–1.02)[b]

Model 1: unadjusted.

Model 5: adjusted for age, demographic characteristics, socioeconomic status, functional health, comorbidities.

[a]Glycosylated hemoglobin test, urine test, eye examination, aspirin counseling, and diabetes mellitus education (0 = 0–2, 1 = 3–5).

[b]$P < .05$.

younger adults with DM. A systematic review[24] examining care processes for adults with DM, many on a practice systems level, found no association with hospitalizations, vascular complications, or death. The authors concluded that there is insufficient evidence that DM process measures, particularly those focused on tests performed, predict outcomes.[24] Two large observational studies based in Italy have focused on composite scores of DM care. The first, a study of more than 3,000 individuals from 101 DM clinics in Italy, found no relationship between a comprehensive set of care processes measured in medical record review and 5-year survival.[25] The second was a study of more than 5,000 patients in 62 clinics that found that better care processes were associated with less risk of cardiovascular events over a median follow-up of 28 months,[26] although the results were not statistically significant for survival.

In contrast, the current results found a relationship with survival, possibly because of the older age of the sample, which would have resulted in greater mortality in general, thereby affording better power for detecting associations. One other study of older adults, the Assessing the Care of Vulnerable Elders study, also reported that composite care process measures (including but not limited to DM care processes) measured using chart review in older U.S. community-dwelling adults in primary care were associated with short-term survival and better functional status,[27,28] independent of age at baseline.

The currently endorsed NQF comprehensive DM care measures apply only until the age of 75,[14] consistent with the upper age limit of many clinical trials,[29] but the heterogeneity of older adults with DM and implications for appropriateness of care has received increasing attention.[9] Guidelines such as those that the American Geriatrics Society and the ADA endorse support customize glycemic and blood pressure targets according to an older individual's functional status and life expectancy.[2,9] The current study findings suggest that this approach may also feasibly be extended for DM care process measures. There continued to be a survival benefit associated with monitoring and counseling-type processes after age 75, possibly because of greater mortality in general in older adults, with age therefore resulting in greater power to detect a benefit in older than in younger participants. Therefore, for people aged 75 and older with functional independence and a reasonable life expectancy, the current results suggest that providing these types of less-burdensome care processes may be appropriate.

This study has notable strengths. Because the HRS is U.S. population based, rather than conducted in a particular healthcare setting or health insurance plan, the results offer a perspective that prior studies could not. In addition, it was possible to control for aspects of illness that many other studies cannot, including functional status, two types of comorbidity (TIBI, count of geriatric conditions), cognitive status, and socioeconomic status. Because care processes are unlikely ever to be studied in a controlled trial, population-based observational studies are necessary, but most datasets do not include any of these covariables. The opportunity to follow older adults longitudinally for 9 years is also unique in this field.

Although a statistical association was found between providing recommended care and survival, these results do not suggest a mechanism. The relationship may be related to unmeasured individual characteristics or behaviors or how physicians provide care to specific individuals. It is possible that less care is a marker for other prognostic factors, such as poorer adherence to recommended care or poor access to care, which are known to be associated with poor glycemic and blood pressure control.[30] Although these factors were not directly measured in this study, adjustment for demographic characteristics and socioeconomic status should partially account for these differences. Physicians may be providing more care to people who appear healthier or more functionally independent beyond what could be controlled for with the data available. Alternatively, some individuals with chronic disease receive more care presumably because of more-frequent interactions with physicians,[31] and the current study data are consistent with this.

Common confounders of process and outcome, namely income, education, the TIBI (a measure of comorbidity and symptoms), and functional status, were included in the analyses. Such measures were previously found to predict survival,[32,33] although it is likely that clinical or social complexity was undermeasured. There are further unmeasured confounders that deserve future research. For instance, the care process measures may have indirectly accounted for individuals' access to care, self-efficacy or better self-care, and adherence to care, which may have been the reason for longer survival. A previous study has shown that the number of DM care processes may be associated with satisfaction measures and self-rated quality of DM care,[20] which could in turn influence survival. Future studies examining access to care, self-efficacy, self-care, and adherence and their relationship with process measures and survival are needed.

This study has several other limitations. First, the analysis was limited to adults who self-reported their diagnosis of DM and number of process-of-care measures received. Problems with self-reported data include recall bias and social-desirability bias. Although medical records, which are considered to be a more accurate way to capture care processes, were not available, the study sheds some light on self-perceived receipt of care. Interview is considered to be a valid way to capture counseling-type care processes.[34] Second, the analysis included the five process measures that were reliably available in the HRS data, and did not include several important measures of DM quality of care such as foot examinations, smoking cessation counseling, vaccinations, and blood pressure and lipid targets.[2,3,14] Furthermore, the HRS question for proteinuria was worded simply to facilitate respondent comprehension as a "urine test," thereby potentially introducing misclassification if respondents recalled any other urine test mistakenly for urine protein testing. It is unlikely that this misclassification would have biased the results because sicker individuals with need for other types of urine tests would not be expected to have better survival. Third, over the past 2 decades, process-of-care measures have evolved. In 2003, when the HRS Mailout Survey was performed, the recommendation from the ADA was to consider aspirin therapy for primary cardiovascular prevention in "high-risk adults" with DM, which included anyone aged 30 and older,[15] but the ADA now recommends aspirin for primary cardiovascular prevention for those with high car-

diovascular risk profiles aside from age,[2] and the American Geriatrics Society has recommended caution because of insufficient evidence supporting aspirin for primary cardiovascular prevention.[9] Despite current uncertainty, in 2003, aspirin counseling was recommended[15] and therefore reflects quality care as part of DM care processes at that time. Fourth, the survey measured care processes delivered at only one point in time (1 year before the mailout), so it was presumed that the effect on survival did not vary with time over the next 9 years. Quality of care may change, for example, as a result of interventions designed to reduce variation in care by targeting individuals receiving the worst care, but it is likely that any such secular changes would result in less variation in the predictor variable and therefore bias the results toward finding no difference. Finally, this study was not designed to study the association between each individual care process and survival. Composite scores, the combination of measures, have been thought to be more reliable than single measures,[6] but it is possible that different methods of composite scores would give different results. Nevertheless, sensitivity analyses using different composite cut points of 0 to 3 versus 4 to 5 measures and using care processes as a continuous variable resulted in similar findings. Nevertheless, the results should not be interpreted as evidence in support of any particular care process.

In conclusion, in a nationally representative sample, individuals receiving better DM care as measured according to receipt of care processes had better survival, and this association was observable even in individuals aged 75 and older. Current care process measures end eligibility at age 75, but this study suggests that further research is needed to consider whether some older adults with reasonable life expectancies should continue to receive certain care process measures. The current findings suggest that age alone should not exclude older adults with DM from having their quality of DM counseling and monitoring assessed.

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