Variation in Treatment Preferences and Care Goals Among Older Diabetes Patients and Their Physicians

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Abstract

Background—Older persons with diabetes are heterogeneous with respect to life expectancy and frailty, and new guidelines recommend individualizing care.

Objectives—1) To describe variation in the preferences of older diabetic patients regarding aggressiveness of glycemic control and avoiding diabetic complications. 2) To determine correlates of patient preferences and physician treatment goals. 3) To assess whether physicians' goals were consistent with their patients' preferences.

Research Design—Cross-sectional surveys and chart reviews in urban academic clinics.

Subjects—473 diabetic patients 65 years or older; 64 physicians.

Measures—Patient preferences (utilities on a scale from 0-1, 0=death, 1=perfect health) for diabetic complications and intensity of treatment; physician target treatment goals and ratings of aggressiveness of approach.

Results—80% of the patients were African-American, 63% were women, average age was 73.7 ± 5.9 years and 26% expected to live 5 years or less. Patient preferences/utilities showed significant variation: blindness 0.39 (SD 0.32), lower leg amputation 0.45 (0.34), conventional treatment 0.76 (0.27), intensive insulin treatment 0.64 (0.32). Physicians' hemoglobin A1c goal was $\leq 7\%$ in 69% of patients. Greater estimated patient life expectancy was consistently associated with higher patient utilities and was associated with physicians' willingness to use aggressive treatments. Physicians' treatment goals and approaches were associated with patients' utilities for treatment.

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Conclusions—Older patients vary greatly in their preferences regarding diabetic complications and treatments. Acknowledging patient preferences, along with life goals and prognostic data, may improve quality of treatment decisions.

Keywords

diabetes; aging; preferences; utilities

In the United States, approximately 13% of people 60 years or older have known diabetes, and about 6% have undiagnosed diabetes.[1,2] Currently 40% of persons with type 2 diabetes are 65 years or older, and diabetes is expected to increase in prevalence as the population ages.[3] A particularly vexing problem is that little evidence exists to guide the management of older persons with diabetes, who characteristically have shorter life expectancies and frequently have more competing comorbidities than younger persons with diabetes.[4,5] In addition, the elderly population is heterogeneous with respect to prognosis, life expectancy, severity of illness, comorbidities, social support, and possibly patient preferences.[6] Until recently, scant attention has been paid to whether care of older persons with diabetes should differ from that of younger persons.

In 2003, the California Healthcare Foundation and American Geriatrics Society released the first guideline to emphasize the importance of individualizing care for older persons with diabetes.[7] The American Diabetes Association endorsed this guideline and has increasingly devoted commentary to the care of the elderly in its standards of medical care. In 2007, the ADA acknowledges the diversity of the elderly population and recommends that active, cognitively intact persons with life expectancy of 10 or more years should be encouraged to adhere to standard glycemic targets, while those patients with advanced complications, limited lifespan, or major cognitive or functional impairment might have less intensive goals.[8]

A key challenge for caring for older persons with diabetes is that there is frequently considerable uncertainty about how to best make treatment decisions for a given patient. Some decisions are fairly straightforward. For example, an otherwise healthy older person with a long life expectancy would be likely to benefit from an aggressive treatment approach to prevent the microvascular and macrovascular complications of diabetes, while a patient with metastatic cancer or advanced dementia and short life expectancy might be less likely to benefit.[9] However, many older patients with diabetes have a much less clear prognostic picture.

In clinical settings, shared decision-making models of the patient-provider encounter might be useful for enhancing simultaneous consideration of scientific evidence, clinical judgment, and patient preferences.[10] Management of older persons with diabetes has largely relied on extrapolating scientific evidence from younger persons and using clinical judgment, with less attention given to assessing and incorporating patient preferences. Understanding patient preferences may be particularly useful clinically among patients for whom scientific evidence is lacking and clinical judgment is difficult. Effective doctor-patient communication and incorporation of patient preferences are likely to be important components of the decision-making process that could help ensure that all older patients receive the treatment approach that is optimal for them as individuals. Unfortunately, little is known about how older diabetic patients assess different possible disease complications and treatment approaches, whether certain traits serve as reliable proxies for patient preferences, and the degree to which physicians individualize their care approaches.

Therefore, we aimed to: 1) describe variation in the preferences of older patients with diabetes regarding aggressiveness of glycemic control and avoiding the microvascular and macrovascular complications of diabetes, 2) determine whether sociodemographic and clinical

factors were correlated with these patient preferences and physician treatment goals, and 3) assess whether physicians' treatment goals were consistent with their patients' preferences.

Methods

Study Population

We studied patients 65 years or older with diabetes and their physicians at the general internal medicine, geriatrics, and endocrinology clinics of the X between December 2000 and January 2003. Patients were identified prior to a clinic visit through the medical center's scheduling software, and a diabetes diagnosis was confirmed through the medical record. After enrolling approximately 350 patients, we targeted patients of physicians who had less than the average number of enrolled patients per physician at the time. We telephoned 1,067 potentially eligible participants of whom 694 (65%) answered the telephone. Of these 694 contacted patients, 607 (87%) agreed to participate in the interview, 35 patients declined outright to participate, and 87 deferred to be contacted at another clinic visit. Of the 607 patients scheduled for an interview, 52 did not show up at the designated interview time. Thus, 555 (80%) of approached patients were enrolled and completed the interview. Seventy-seven of 79 eligible attending physicians agreed to participate in the study: Sixty-four physicians (15 endocrinologists, 39 general internists, 10 geriatricians) completed surveys for 473 patients who constituted the final study sample. The study was approved by the X Institutional Review Board.

Patient Survey

We assessed health status with a global health perception question on a 5-point Likert scale (Excellent…Poor),[11] the Medical Outcomes Study Short Form 12 (SF-12),[12] and the Katz Index of Activities of Daily Living.[13]

We assessed patient utilities for diabetic complications and treatments with the time trade-off method and visual analog scale.[14-16] We use the time trade-off as a preference-based measure of health-related quality of life.[17] The time trade-off method is based on a theoretical utility model that specifies lifetime utility as the product of quality of life (h) between 0 (death) and 1 (perfect health) multiplied by the duration of life (t). The time trade-off method offers a subject two alternatives, each of which would be a certainty as opposed to a gamble:

1. state i for time T (life expectancy of an individual with the chronic condition) followed by death, yielding lifetime utility = h_i*T;

2. in perfect health for time t < T followed by death, yielding lifetime utility = $1*t$.

The subject is given a series of questions where time t is changed using the ping pong method until the subject is indifferent between the two choices, when presumably $h_i*T = 1*t$.[18] Thus, the preference value for state i is represented by $h_i = t/T$. We asked time trade-off questions for the diabetic complications blindness ("to live with blindness from diabetes"), renal failure requiring dialysis, and lower leg amputation. We also asked time trade-off questions for descriptions of conventional diabetes therapy (check glucose few times per week; might take pills to lower glucose or might take insulin once a day), intensive diet therapy (strict diabetic diet that limits the number of concentrated sweets), intensive pill therapy (2 pills and periodic blood checks), and intensive insulin therapy (2 shots of insulin per day, check home glucose few times a day, severe hypoglycemic event every 2 years). For example, "Which of the following would you prefer: Live with intensive insulin treatment for 10 years, Live in perfect health for 9 years, No preference because these seem about the same to you." For the treatment utility questions, the subjects were asked to consider how the therapy would affect their daily lives and not consider the long-term effects of the treatments.

Physician Survey

For each interviewed patient, we distributed a one-page survey after the visit to the physician primarily responsible for his or her diabetes care. The physician was instructed to answer the survey for each individual patient and not his or her approach to diabetes care in general. The survey asked physicians to identify specific hemoglobin A1c, systolic blood pressure, and LDL cholesterol treatment goals for the particular patient. The physicians were also asked to rate the importance for each particular patient of preventing acute symptoms, preventing microvascular and macrovascular complications, and avoiding burdens of treatment, respectively, on a 5-choice scale from "extremely important" to "very unimportant." Finally, the physician was asked to state the most aggressive hypoglycemic treatment he or she would consider in the particular patient given the overall goals, as well as to estimate the number of years the patient would live and to report how many years they had been taking care of the patient.

Chart Review

We reviewed medical records for information including comorbid illnesses and laboratory values.[19] On a 10% re-review of medical records to assess inter-rater reliability, the kappa scores were 0.92 for HbA1c and 0.75 for systolic blood pressure levels.

Data Analysis

Separate logistic and ordinal logistic regression analyses were conducted to assess the associations of 1) patient utilities for complications and treatment choices with patient demographic and clinical characteristics, 2) physician goals and preferences for the patient's treatment with patient characteristics and 3) physician goals and preferences for the patient's treatment with patient utilities for complications and treatment choices.[20,21] Adjustment for physician specialty and duration of the patient-physician relationship were evaluated when modeling physician goals and preferences. For analysis, patient time trade-off utilities were collapsed into ordinal categories with three levels. Levels were chosen to correspond as nearly as possible to tertiles of the empirical distributions while maintaining comparability by specifying a single set of levels for complications (< 0.10, $0.10 - 0.50$, >0.50) and another for treatment options (< 0.55, $0.55 - 0.90$, > 0.90). The association between patient time trade-off utilities and patient characteristics was analyzed using ordinal logistic regression with robust standard errors to account for clustering of patients within physicians; the proportional odds assumption was tested. For analysis, physicians' preferences for preventing symptoms and treatment burden, measured on a 5-point Likert scale, were dichotomized as 'very or extremely important' versus lower ratings; treatment aggressiveness was dichotomized as two or more insulin shots per day versus less intensive treatments, and treatment goals were dichotomized according to whether they coincided with standard guidelines. Dichotomized physician treatment goal and preference outcomes were analyzed using mixed logistic regression, with physician as a random effect to incorporate correlation due to clustering of patients within physicians.[22,23] Covariates were modeled as categorical factors, except for the SF-12 mental and physical component scores, which were entered as continuous covariates. Levels of covariates were collapsed when indicated by the model fit (i.e., their coefficients were similar in magnitude and did not differ significantly from each other). Univariate models were fit first to estimate bivariate associations between outcomes and predictors. Multivariable regression models then were fit to evaluate simultaneously the factors associated with patient utilities and physician treatment goals and preferences, using backward selection with variables that were significant at $p < 0.20$ in univariate models entered as candidate covariates. Analyses were conducted in Stata 9.2.[24]

Results

Patient Population

Of the 473 patients, 80% were African-American, 63% were women, 71% graduated from high school, and the average age was 73.7 ± 5.9 years. Over 99% of the patients had type 2 diabetes, and the average duration of diabetes was 13.2 ± 10.4 years (Table 1). Forty-four percent assessed their health as fair or poor, 23% had one or more deficiencies in their Katz Activities of Daily Living. Thirty-six percent used insulin, and 46% had at least one diabetic complication. Twenty-six percent expected to live 5 years or less. Sixty-two percent of the patients were cared for by an internist alone, 24% by an endocrinologist alone or in conjunction with an internist, 14% by a geriatrician or geriatrician plus others.

Patient Utilities and Preferences

Patients generally felt that diabetic complications would significantly affect their quality of life with average time trade-off utilities of blindness 0.39 (SD 0.32), renal failure requiring dialysis 0.36 (0.31), and leg amputation 0.45 (0.34). On average, leg amputation was not thought to be as severe as blindness (p<0.001) and dialysis was considered most severe (p<0.001 vs. amputation, p=0.047 vs. blindness). However, as can be seen by the large standard deviations as well as the graphical display of the distributions in Figure 1, wide variation exists in the utilities different patients place on these diabetic complications. Patients noted that treatments could also adversely affect quality of life as indicated by their time trade-off utilities, with a larger decrement for intensive insulin treatment (p<0.001 vs. each other treatment): conventional treatment 0.76 (0.27), intensive dietary treatment 0.76 (0.28), intensive pill treatment 0.77 (0.27), intensive insulin treatment 0.64 (0.32). The distributions in Figure 1 again show the wide variation in patient ratings of the utility of these treatment approaches. Utilities also showed wide variation within strata defined by demographic and clinical characteristics of patients.

Associations of Patient Utilities with Patient Demographic and Clinical Characteristics

In univariate analysis, patients who expected to live longer were more likely to rate all diabetic complications (blindness, leg amputation, kidney failure) and treatment regimens (conventional, intensive pill, intensive insulin) that were assessed closer to perfect health – as were younger patients, except for intensive pill therapy (Table 2). Patients with annual income exceeding $50,000 had higher utilities for all three complications and for conventional treatment, compared to those at the lowest income level (< $10,000). Having completed high school was marginally but consistently associated with higher utilities for all treatment approaches. Patient utilities for complications showed no significant associations with any of the clinical factors considered. In contrast, patients with no ADL limitations were more likely to have higher utility for intensive pill therapy compared to those with 2 or more ADL deficiencies, with a similar trend for conventional treatment and intensive insulin therapy. Utilities for intensive insulin therapy were related to the greatest number of patient factors. Life expectancy and income were consistent multivariate predictors of patient utilities for complications and treatment approaches (Table 2 and footnote explanation).

Physician Treatment Goals

Physicians estimated that nearly a third of the patients had a life expectancy of 5 years or less, a more pessimistic prognostication than their patients' assessment (26%). Physicians aimed for a HbA1c $\leq$ 7% in 69% of their patients, systolic blood pressure $\leq$ 130 mm Hg in 70%, and LDL cholesterol $\leq$ 100 mg/dL in 82% (Table 3). The goal of preventing acute symptoms was thought to be extremely important 49% of the time. In contrast, the longer-term goal of preventing microvascular and macrovascular complications was thought extremely important

in 29% of patients and very important in 44% of patients. Avoiding the burdens of treatment was thought extremely important in 18% of patients and somewhat important or unimportant in 35%. When asked what is the most aggressive hypoglycemic treatment they would consider for the particular patient, physicians stated oral hypoglycemic agents or 1 shot of insulin per day ± oral agents in 36%, 2 shots of insulin per day in 47% and 3 shots of insulin per day in 17%.

Physician treatment goals differed by specialty, with endocrinologists and general internists significantly more likely than geriatricians to rate preventing micro/macrovascular symptoms very or extremely important (OR 4.68, p<0.001) and to select target HbA1c ≤ 7% (OR 7.74, p = 0.002) and target systolic blood pressure ≤ 130 mm Hg (OR 8.28, p = 0.02). Endocrinologists were significantly more likely than either geriatricians or general internists to consider 2 or more insulin shots per day for their patients (OR=5.42, p = 0.001). Physician responses did not vary from early to later patients, as would occur if experience influenced their responses.

Association of Physician Treatment Goals with Patient Characteristics

The most consistent univariate correlate of more aggressive physician goals and treatment preferences was longer life expectancy (Table 3), followed by younger age. Estimates of patient life expectancy by both physicians and patients were associated with physician attitudes towards the importance of achieving specific treatment goals (Figure 2). Life expectancy was also the most powerful independent correlate in multivariate analysis (Table 3 and footnote explanation). Physicians were also more likely to choose more aggressive treatment goals and approaches for healthier patients – as assessed by diabetic complications, SF-12 physical health score, Charlson Comorbidity Index, ADL deficiencies, or needing help. Willingness to prescribe 2 or more insulin shots per day was also associated with longer duration of diabetes. In contrast to correlates of more aggressive treatment goals and preferences, importance to physicians of preventing treatment burden was positively associated with shorter life expectancy, being older, and having any diabetic complication, one or more ADL deficiencies, or higher Charlson Comorbidity Index, and marginally with needing help. Importance of preventing microvascular and macrovascular complications was associated with the greatest number of patient characteristics, followed by treatment burden, willingness to prescribe 2 or more insulin shots per day, and target HbA1c ≤ 7%. Physician goals were not associated with duration of the relationship between patient and physician. Neither duration of patient-physician relationship nor physician specialty modified the associations between physician goals and patient characteristics.

Association of Physician Treatment Goals with Patient Utilities for Diabetic Treatments and Complications

Physicians' ratings of the importance of preventing microvascular and macrovascular complications and treatment burden were significantly associated with patients' utilities for treatment, and marginally associated with their utilities for lower leg amputation (Table 3). Specifically, physicians were more likely to rate preventing complications as very or extremely important among patients who considered conventional treatment or intensive pill treatment closer to perfect health. Physicians were more likely to aim for HbA1c ≤ 7% among patients with higher utilities for amputation or conventional treatment. In contrast, physicians' ratings of the importance of preventing treatment burden were inversely related to patient utilities for all three treatment approaches, and marginally so to patient utilities for amputation. These associations often remained significant in multivariate analysis (Table 3 and footnote explanation). No other significant associations between aggressiveness of treatment and patient utilities were observed. Associations between physician goals and patient utilities were not modified by physician specialty or duration of the physician-patient relationship.

Patient versus Physician-Level Variation

Most physicians with two or more patients in the study differentiated between their patients by selecting a range of values for estimated patient life expectancy (96%), importance of preventing micro- and macrovascular complications (94%), and most aggressive treatment they would consider (91%). A large majority differentiated with respect to importance of preventing acute symptoms (78%) and treatment burden (78%), and targeted HbA1c (82%) and systolic blood pressure (78%). However, over half (55%) selected 100 mg/dL as target LDL cholesterol value for all of their patients. As expected, dichotomized responses (e.g., target HbA1c ≤ 7%) were less heterogeneous and the estimated within-physician correlation in mixed logistic regression analysis was substantial, ranging from 0.21 for importance of preventing micro- and macrovascular complications to 0.65 for target systolic blood pressure (Table 3). Few physicians had patients with homogeneous clinical characteristics.

Discussion

California Healthcare Foundation / American Geriatrics Society and American Diabetes Association guidelines are major advances from earlier care recommendations that did not acknowledge the special considerations of older persons nor the heterogeneity of the geriatric population.[7,8] The individualization of care of older persons with diabetes is a logical principle and a shared decision-making approach between clinician and patient should be part of this process.[10] However, how the clinician should actually operationalize individualization of care for his or her older patients remains challenging.[25]

Acknowledging patient treatment preferences is believed to be an important element in determining the ideal treatment plan for individual patients but little is known about such preferences. Prior studies have assessed preferences/utilities in diabetic patients [26-35] but few have compared utilities of patients to those of physicians. On a population level, Landy et al. found that physicians gave lower time trade-off values to diabetic states compared to persons with diabetes who rated the same states.[36] Heisler et al. asked diabetic patients and their physicians to rank their top three priorities for biomedical treatment goals and strategies, and found that overall agreement between them was low.[37]

Our study adds important information by describing variation in the preferences and approaches of older diabetic patients and their own physicians. We incorporate subjective expected utility theory and examine the concordance of their views. Several important points are apparent. First, much variation exists in the utilities patients place on different diabetic complications and styles of treatment. It is striking how a complication such as lower leg amputation can vary so widely in how patients rate it. Of note, treatments such as insulin are thought by patients to have significant adverse effects on quality of life. Thus, the nature, potential burdens, and patient perceptions of different treatment options should be openly discussed.

Second, expected life expectancy and age are the most powerful independent correlates of patient utilities for diabetic complications and treatments, suggesting that on average patients are incorporating global prognosis into their preferences as recommended by the new geriatric guidelines. However, the association of income greater than $50,000 with higher utilities for diabetic complications and the trend for high school graduation to be correlated with higher utilities for treatment approaches raise the possibility of differential understanding and impact of complications and treatments by socioeconomic status. More research needs to explore these possible disparities in older diabetic persons. In addition, the wide variation within strata defined by demographic and clinical characteristics of patients supports the importance of actively discussing preferences with patients as opposed to using relatively crude proxy traits to assume patients' wishes. Interestingly, life expectancy as measured by patients is correlated

with their utilities, but life expectancy as estimated by physicians is not. Patients generally are more optimistic regarding life expectancy than physicians. In contrast, physician treatment goals are correlated with estimates of patient life expectancy by both patient and physician.

Third, even though this is an elderly patient population, clinicians most commonly aim for the standard American Diabetes Association target goals of glycemic, blood pressure, and cholesterol control, and there are relatively few instances where clinicians aim for less intensive targets. For many older patients with diabetes, the standard American Diabetes Association targets are probably a reasonable default. However, in cases where the treatment regimen becomes onerous, has significant side effects, affects quality of life adversely, or is unlikely to significantly alter quality or quantity of life, striving for the standard targets may be problematic.[10]

Fourth, physicians' treatment goals and approaches were associated with patients' utilities for treatment. These correlations as well as the association between physician-estimated life expectancy and patient treatment attitudes suggest that physicians in our study generally have a good understanding of their patients in formulating their management approaches or possibly have influenced their patients' beliefs. These findings are consistent with physicians practicing according to the basic principles of the geriatric diabetes care guidelines. Conversely, the relatively high percentages of physicians aiming for intensive treatment targets raises the questions of whether they are truly individualizing care and engaging in shared decision making. Moreover, the traditional focus of diabetes management is on risk factor control and prevention of complications, even though other goals such as independence may be most valued by older persons.[38] The shared decision-making process might improve by also including discussion of overall life goals, better prognostic data, and consideration of patient preferences towards different treatment approaches and diabetic complications.

Our study has several limitations. Patient utilities provide information suggesting what patients might be expected to do based on a set of theoretical assumptions about their preferences and behaviors chosen rationally to realize those preferences. However, what patients actually do may depend on other factors, such as costs or departures from "rational" decisions.[39] Another limitation of our study is that it examines only a single predominantly African-American, urban population at an academic center. Our study examines patient utilities and physician preferences at one time point and does not incorporate long-term benefits and costs of different treatment approaches, for example as modeled in cost-effectiveness analysis.[40,41] Incorporating utilities into a decision-analytic cost-effectiveness framework might help clarify why variations in some utilities have little effect on overall patient preferences among treatments. In addition, the order in which questions were asked to patients could affect results, and we do not have actual disease severity information on visual impairment and amputation, nor data on physician characteristics. Nonetheless, our study is one of the first to examine the concordance of patient and physician preferences in the care of older persons with diabetes, and is useful for exploring challenges in operationalizing geriatric-specific diabetes guidelines.[42]

Older diabetic patients with multiple comorbidities are complex and frequently a poor fit for clinical practice guidelines designed for younger people. Geriatric-specific diabetes guidelines are an advance, but often difficult to operationalize. A shared decision-making process that incorporates scientific evidence, clinical judgment, and patient preferences may enhance the likelihood that care approaches are optimal for individuals. Decision aids or computer support to elicit patient preferences and utilities and provide better prognostic data may be avenues to improve the doctor-patient encounter and shared decision-making process within the time constraints of the office visit.[43-45]

Acknowledgements

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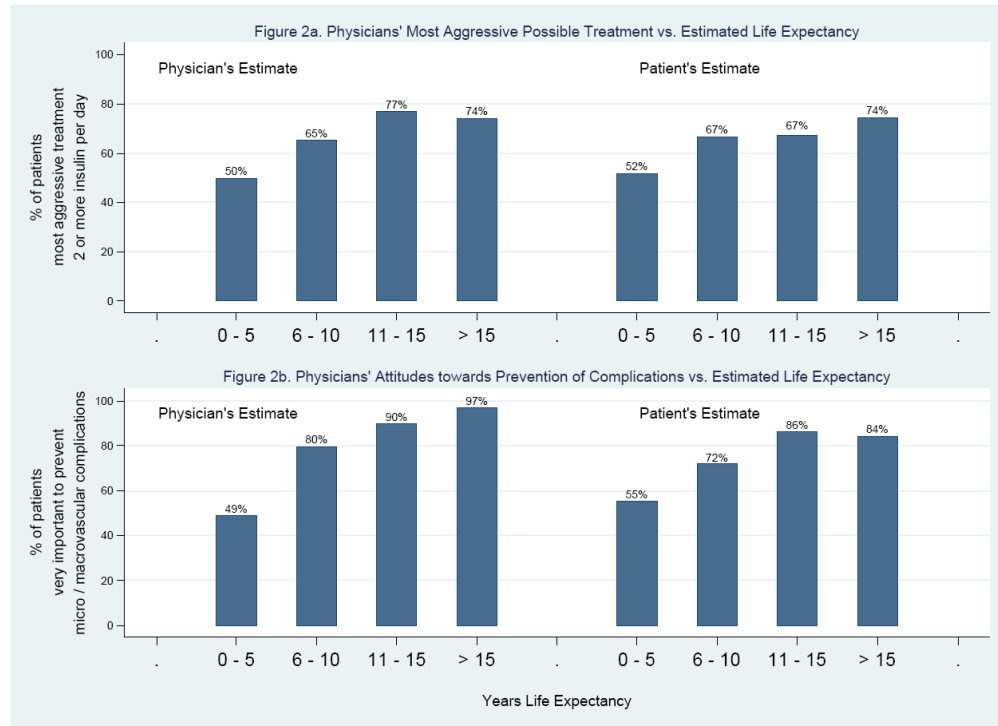
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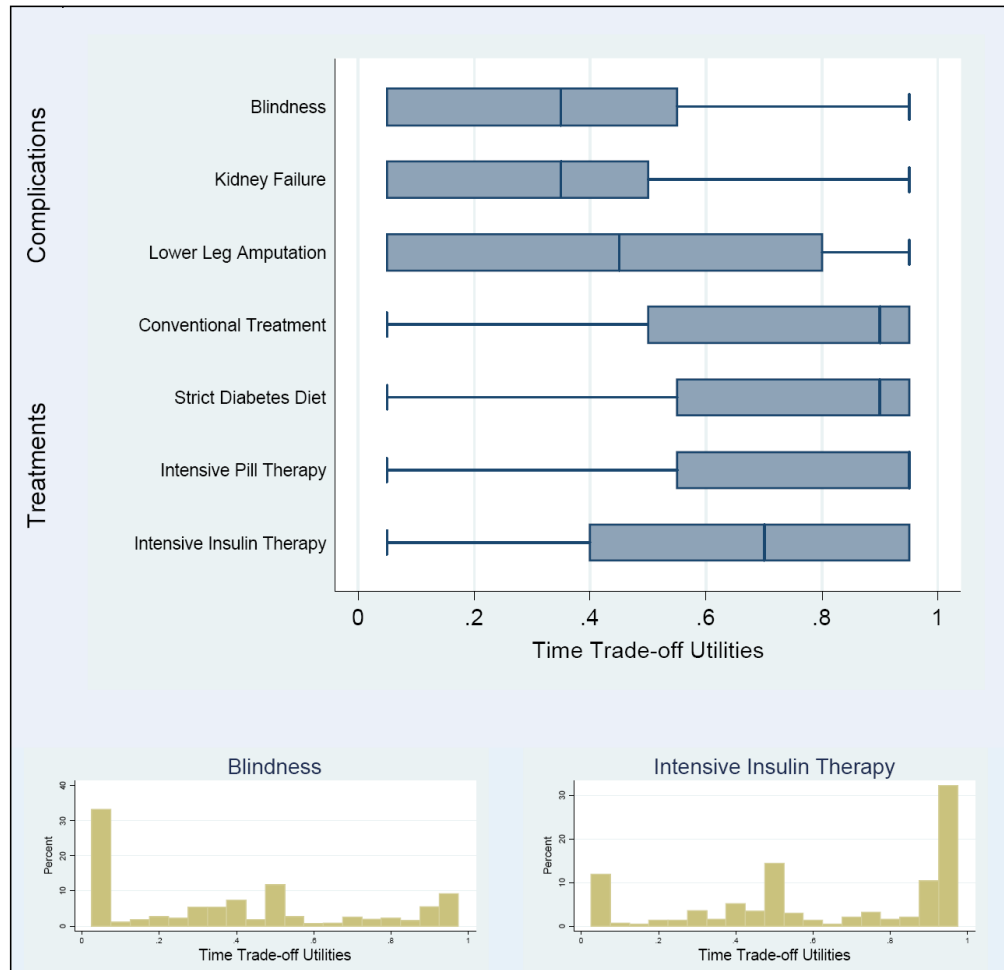
Figure 1. Patient Utilities for Diabetic Complications and Treatments
Boxplots of time trade-off utilities (TTOs) for diabetes complications and treatments reveal broad patterns of their distributions, which facilitates comparison. The detailed features in the histograms for blindness and intensive insulin therapy are typical of the TTO distributions for diabetes complications and treatments, respectively. The fact that utilities of 0 and 1 were not observed is an artifact of the algorithm for eliciting them. In the boxplots, the vertical line within the box represents the median value, and the edges of the box are the first and third quartiles. The lines extending from the edges of the box end at the last value within 1.5 times the interquartile range (third minus first quartile) from the edge of the box. Any values beyond this distance are considered outliers and are plotted individually.

Figure 2a. Physicians' Most Aggressive Possible Treatment vs. Estimated Life Expectancy

Figure 2b. Physicians' Attitudes towards Prevention of Complications vs. Estimated Life Expectancy

Figure 2.
Physician Goals and Attitudes vs. Patient Life Expectancy

Table 1

Patient Characteristics (%[1]) N = 473

Sociodemographic Characteristics		Charlson Comorbidity Index	
Female	63	0	18
Age, yrs (Mean [SD])	73.7 (5.9)	1	24
African-American	80	2	24
Education		≥3	34
< High School	29	Cardiovascular Risk Factors	
High School graduate	27	Hypertension	89
> High School	44	Hyperlipidemia	52
Income		Smoking	
< $10,000	23	Current	8
$10,001-$25,000	25	Former	37
$25,001-$50,000	24	None	55
>$50,000	12	Alcohol abuse	7
Did not know/Refused	16	Prior Cardiovascular Events	
Marital Status		Myocardial Infarction	12
Married or Living as if Married	44	Heart Failure	18
Divorced/Separated/Widowed	52	Cerebrovascular Disease	17
Single (Never married)	4	Body Mass Index (Mean [SD])	30.1 (6.4)
Could use more help with daily tasks	33	Health Status/Functional Status	
Clinical Characteristics		General health perception	
Type 2 diabetes	99.8	Excellent/Very good	19
Duration of diabetes, yrs (Mean [SD])	13.2 (10.4)	Good	37
Diabetic Complications		Fair/Poor	44
Nephropathy	19	Katz Index of ADLs[2]	
Creatinine > 4.0 mg/dL	3		
Neuropathy	22	0	77
Peripheral vascular disease	19	1	15
Retinopathy	14	≥ 2	8
Any of the above	46	SF-12 (Mean [SD])	
Uses Insulin	36	Physical	37.5 (6.4)
Number of doses of insulin per day		Mental	49.9 (6.8)
1	25	Life Expectancy[3]	
2	70	≤ 5 years	26
≥ 3	5	6-10 years	32
Frequency of Home Blood Glucose Monitoring		11-15 years	21
2x per day or more	40	> 15 years	21
1x per day	31		
< 1x per day	29		

[1] Percentage totals may differ from 100% due to rounding.

[2] ADLs = Activities of daily living

[3] Life expectancy was estimated by patients in the patient interview.

Table 2

Relationship of Patient Time Trade-off Utilities for Complications and Treatment Choices to Patient Characteristics: Ordinal Logistic Regression Analysis [1,2,3]

	Dependent Variables: Patient Time Trade-off Utilities (TTOs)					
	TTOs for Complications			TTOs for Treatment Approaches		
	Living with Lower Leg Amputation[4]	Living with Blindness[4]	Living with Kidney Failure[4]	Conventional Treatment[5]	Intensive Pill Therapy[5]	Intensive Insulin Therapy[5]
TTO Mean ± SD	**0.45 ± 0.34**	**0.39 ± 0.32**	**0.36 ± 0.31**	**0.76 ± 0.27**	**0.77 ± 0.27**	**0.64 ± 0.32**
Life Expectancy	odds ratios (95% confidence intervals)					
Patient's Estimate, yrs						
0 – 5	1.00	1.00	1.00	1.00	1.00	1.00
6 – 10	1.94 (1.28, 2.95)	1.84 (1.19, 2.85)	1.43 (1.02, 2.00)	2.25 (1.38, 3.67)	1.51 (0.91, 2.49)	1.47 (0.95, 2.25)
11 – 15	3.66 (2.21, 6.05)	3.12 (1.79, 5.45)	2.34 (1.27, 4.30)	3.76 (2.06, 6.87)	2.50 (1.53, 4.08)	1.98 (1.25, 3.14)
> 15	4.13 (2.52, 6.79)	4.80 (2.83, 8.16)	3.04 (1.68, 5.48)	3.27 (1.96, 5.48)	2.29 (1.32, 3.96)	2.56 (1.67, 3.93)
	√ p < 0.0001	√ p < 0.0001	√ p = 0.002	√ p < 0.0001	√ p = 0.001	√ p = 0.0002
Demographic Characteristics	odds ratios (95% confidence intervals)					
Age, yrs						
65 – 69		1.00	1.00	1.00		1.00
70 – 74		0.76 (0.52, 1.13)	0.70 (0.46, 1.06)	0.89 (0.64, 1.24)		0.82 (0.62, 1.09)
75 – 79		0.45 (0.26, 0.79)	0.52 (0.30, 0.87)	0.59 (0.38, 0.90)		0.62 (0.41, 0.93)
≥ 80		0.34 (0.20, 0.59)	0.38 (0.20, 0.71)	0.52 (0.31, 0.89)		0.50 (0.31, 0.80)
		p = 0.0003	p = 0.02	p = 0.03		p = 0.004
Male						1.53 (1.04, 2.25)
						p = 0.03
Married					1.56 (1.13, 2.14)	
					√ p = 0.007	

Dependent Variables: Patient Time Trade-off Utilities (TTOs)

	TTOs for Complications			TTOs for Treatment Approaches		
	Living with Lower Leg Amputation[4]	Living with Blindness[4]	Living with Kidney Failure[4]	Conventional Treatment[5]	Intensive Pill Therapy[5]	Intensive Insulin Therapy[5]
TTO Mean ± SD	**0.45 ± 0.34**	**0.39 ± 0.32**	**0.36 ± 0.31**	**0.76 ± 0.27**	**0.77 ± 0.27**	**0.64 ± 0.32**
Education ≥ High School				1.52 (0.98, 2.35) $p = 0.06$	1.40 (0.97, 2.02) $p = 0.07$	1.43 (0.97, 2.10) (✓) $p = 0.07$
Household Income, $						
< 10 K	1.00	1.00	1.00			
10 – 25 K	0.83 (0.53, 1.28)	1.03 (0.61, 1.76)	0.78 (0.50, 1.23)	1.45 (0.88, 2.39)		
25 – 50 K	0.96 (0.64, 1.43)	0.85 (0.55, 1.30)	0.74 (0.47, 1.15)	1.54 (0.99, 2.40)		
> 50 K	2.45 (1.60, 3.74)	1.93 (1.16, 3.22)	1.69 (1.03, 2.77)	2.25 (1.30, 3.88)		
	✓ $p < 0.0001$	✓ $p = 0.002$	✓ $p = 0.0001$	$p = 0.03$		
Clinical Characteristics			odds ratios (95% confidence intervals)			
Any Diabetic Complication						1.39 (1.01, 1.89) (✓) $p = 0.04$
SF-12 Physical				1.04 (1.02, 1.07) ✓ $p = 0.001$	1.03 (1.00, 1.05) $p = 0.07$	
ADL Deficiencies						
0				1.00	1.00	1.00
1				0.85 (0.49, 1.47)	1.09 (0.65, 1.84)	0.76 (0.48, 1.21)
2 – 6				0.45 (0.22, 0.92)	0.33 (0.15, 0.72)	0.38 (0.16, 0.89)
				$p = 0.09$	✓ $p = 0.01$	$p = 0.07$
Diabetes Duration, yrs						

Dependent Variables: Patient Time Trade-off Utilities (TTOs)

	TTOs for Complications			TTOs for Treatment Approaches		
	Living with Lower Leg Amputation[4]	Living with Blindness[4]	Living with Kidney Failure[4]	Conventional Treatment[5]	Intensive Pill Therapy[5]	Intensive Insulin Therapy[5]
TTO Mean ± SD	**0.45 ± 0.34**	**0.39 ± 0.32**	**0.36 ± 0.31**	**0.76 ± 0.27**	**0.77 ± 0.27**	**0.64 ± 0.32**
0 – 5						1.00
6 – 10						0.73 (0.45, 1.19)
11 – 15						0.89 (0.49, 1.62)
> 15						1.25 (0.83, 1.88)
						✓ p = 0.01

Univariate ordinal logistic regression of time trade-off utility on patient characteristics, with robust standard errors to incorporate clustering of patients within physicians.

Empty cells in the table correspond to non statistically significant associations.

None of the patient time trade-off utilities were significantly associated with race/ethnicity, wealth, needing help, or the Charlson Comorbidity Index.

[4] Time trade-off utility categories for complications (approximate tertiles) : (i) < 0.10, (ii) .010 – 0.50, (iii) > 0.50

[5] Time trade-off utility categories for treatments (approximate tertiles) : (i) < 0.55, (ii) 0.55 – 0.90, (iii) > 0.90

Significant in multivariate model; (✓) indicate marginal significance (p ≤ 0.07 in all cases).

Table 3

Relationship of Physician Treatment Goals and Approaches to Patient Characteristics and Patient Time Trade-off Utilities: Univariate Mixed Logistic Regression Analysis [1, 2, 3]

Dependent Variables: Physician Responses for Each Individual Patient

	Prevention very or extremely important		Treatment Burden	Would consider Prescribing 2 or more Insulin shots per day[4]	Target Treatment Goals		
	Acute Symptoms	Micro/macro-vascular Complications			HbA1c ≤ 7%	Systolic Blood Pressure ≤ 130 mm Hg	LDL Cholesterol ≤ 100 mg/dL
Overall Percent	87%	73%	65%	64%	69%	70%	82%
Life Expectancy			odds ratios (95% confidence intervals)				
Physician Estimate, yrs							
0 – 5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6 – 10	2.12 (0.85, 5.26)	5.72 (3.19, 10.3)	0.49 (0.27, 0.90)	1.87 (1.09, 3.21)	2.64 (1.46, 4.76)	2.30 (1.20, 4.41)	2.79 (1.40, 5.56)
> 10	0.76 (0.29, 2.00)	24.3 (9.19, 64.4))	0.21 (0.10, 0.43)	4.05 (1.94, 8.45)	5.72 (2.44, 13.4)	1.79 (0.78, 4.09)	6.92 (2.33, 20.5)
	(✓) p = 0.09	✓ p < 0.0001	✓ p = 0.0002	✓ p = 0.0007	✓ p = 0.0001	✓ p = 0.04	✓ p = 0.001
Patient Estimate, yrs							
0 – 5	1.00	1.00	1.00	1.00	1.00		1.00
6 – 10	1.70 (0.67, 4.36)	2.40 (1.35, 4.29)	0.81 (0.42, 1.56)	2.09 (1.14, 3.83)	2.55 (1.32, 4.93)		0.79 (0.37, 1.68)
> 10	3.36 (1.26, 8.96)	5.13 (2.81, 9.36)	0.53 (0.29, 0.97)	2.64 (1.48, 4.71)	2.20 (1.20, 4.02)		1.87 (0.85, 4.11)
	p = 0.053	✓ p < 0.0001	p = 0.10	p = 0.003	p = 0.01		(✓) p = 0.06
Demographic Characteristics			odds ratios (95% confidence intervals)				
Age, yrs							
65 – 69	1.00		1.00	1.00	1.00	1.00	1.00
70 – 74	0.60 (0.30, 1.20)		2.30 (1.21, 4.39)	0.62 (0.34, 1.15)	1.37 (0.71, 2.64)	0.57 (0.27, 1.18)	0.78 (0.32, 1.91)
75 – 79	0.30 (0.15, 0.57)		1.71 (0.89, 3.28)	0.63 (0.33, 1.19)	0.75 (0.39, 1.46)	0.45 (0.21, 0.97)	0.31 (0.13, 0.73)
≥ 80	0.07 (0.03, 0.16)		3.43 (1.53, 7.68)	0.25 (0.12, 0.53)	0.44 (0.21, 0.94)	0.27 (0.12, 0.65)	0.17 (0.06, 0.45)
	p < 0.0001		p = 0.01	p = 0.005	p = 0.03	p = 0.02	p = 0.001
Male							3.35 (1.59, 7.08)

Dependent Variables: Physician Responses for Each Individual Patient

	Prevention very or extremely important		Treatment Burden	Would consider Prescribing 2 or more Insulin shots per day[4]	HbA1c ≤7%	Target Treatment Goals	
	Acute Symptoms	Micro/macro-vascular Complications				Systolic Blood Pressure ≤130 mm Hg	LDL Cholesterol ≤100 mg/dL
Overall Percent	87%	73%	65%	64%	69%	70%	82%
Married		1.96 (1.22, 3.13) p = 0.005				1.83 (1.04, 3.20) √ p = 0.03	√ p = 0.002
High School Education	2.07 (0.95, 4.49) (√) p = 0.07						
Wealth < $10,000					0.51 (0.29, 0.89) √ p = 0.02		
Clinical Characteristics			odds ratios (95% confidence intervals)				
Needs Help	0.38 (0.18, 0.82) √ p = 0.01	0.42 (0.26, 0.70) p = 0.0007	1.70 (0.97, 2.96) p = 0.06	0.59 (0.36, 0.96) (√) p = 0.03	0.44 (0.26, 0.76) p = 0.003		
Any Diabetic Complication		0.63 (0.40, 0.99) p = 0.047	1.95 (1.17, 3.26) p = 0.01				
SF-12 Physical		1.04 (1.00, 1.08) p = 0.04					
ADL Deficiencies							
0	1.00	1.00	1.00		1.00		
1 – 2	0.38 (0.16, 0.90)	0.81 (0.46, 1.44)	1.21 (0.65, 2.23)		0.54 (0.29, 1.02)		
3 – 6	0.61 (0.10, 3.72) p = 0.08	0.22 (0.07, 0.67) p = 0.02	7.40 (1.62, 33.7) p = 0.03		0.28 (0.08, 1.03) p = 0.04		

Dependent Variables: Physician Responses for Each Individual Patient

	Prevention very or extremely important		Treatment Burden	Would consider Prescribing 2 or more Insulin shots per day[4]	Target Treatment Goals		
	Acute Symptoms	Micro/macro-vascular Complications			HbA1c ≤ 7%	Systolic Blood Pressure ≤ 130 mm Hg	LDL Cholesterol ≤ 100 mg/dL
Overall Percent	87%	73%	65%	64%	69%	70%	82%
Charlson Comorbidity Index							
1		1.00	1.00	1.00		1.00	
2 – 3		0.69 (0.35, 1.36)	0.66 (0.34, 1.29)	0.66 (0.34, 1.28)		0.37 (0.17, 0.81)	
≥ 4		0.35 (0.18, 0.71)	1.90 (0.92, 3.93)	0.39 (0.19, 0.77)		0.58 (0.26, 1.29)	
		p = 0.004	√ p = 0.002	p = 0.02		√ p = 0.04	
Diabetes Duration, yrs							
0 – 5				1.00			
6 – 10				1.02 (0.55, 1.92)			
11 – 15				2.85 (1.35 6.01)			
> 15				1.79 (0.98, 3.26)			
				√ p = 0.02			
Time Tradeoff Utilities			odds ratios (95% confidence intervals)				
Lower Leg Amputation[5]							
< 0.10		1.00	1.00		1.00		
0.10 – 0.50		1.74 (0.98, 3.10)	1.05 (0.56, 1.99)		2.25 (1.19, 4.23)		
> 0.50		1.89 (1.05, 3.41)	0.53 (0.28, 1.01)		1.81 (0.97, 3.37)		
		p = 0.07	((√)) p = 0.06		√ p = 0.03		
Conventional Treatment[6]							
< 0.55		1.00	1.00		1.00		
0.55 – 0.90		1.71 (0.92, 3.20)	0.39 (0.19, 0.80)		0.59 (0.29, 1.19)		
> 0.90		2.40 (1.35, 4.27)	0.47 (0.24, 0.93)		1.35 (0.70, 2.60)		
		p = 0.01	((√)) p = 0.03		√ p = 0.03		

Dependent Variables: Physician Responses for Each Individual Patient

	Prevention very or extremely important		Treatment Burden	Would consider Prescribing 2 or more Insulin shots per day[4]	Target Treatment Goals		
	Acute Symptoms	Micro/macro-vascular Complications			HbA1c $\leq 7\%$	Systolic Blood Pressure ≤ 130 mm Hg	LDL Cholesterol ≤ 100 mg/dL
Overall Percent	**87%**	**73%**	**65%**	**64%**	**69%**	**70%**	**82%**
Intensive Pill Treatment[6]							
<0.55		1.00	1.00				
0.55 – 0.90		2.03 (1.05, 3.90)	0.38 (0.18, 0.80)				
>0.90		2.09 (1.18, 3.69)	0.38 (0.19, 0.75)				
		✓ P = 0.03	((✓)) p = 0.01				
Intensive Insulin Treatment[6]							
<0.55			1.00				
0.55 – 0.90			0.52 (0.28, 0.99)				
>0.90			0.53 (0.29 0.94)				
			((✓)) p = 0.045				
Intra-cluster correlation (range over models)	0.59 – 0.63	0.21 – 0.28	0.50 – 0.54	0.35 – 0.37	0.38 – 0.45	0.63 – 0.65	0.50 – 0.55

[1] Univariate mixed logistic regression of physician response on patient characteristics and time trade-off utilities, with physician entered as a random effect.

[2] Empty cells in the table correspond to non statistically significant associations.

[3] None of the physician goals and preferences were associated with patient race/ethnicity, income, SF12 – mental, or patient time trade-off utilities for blindness or kidney failure.

[4] N = 461; excludes 12 patients in 'other' category

[5] Time trade-off utility categories for complications (approximate tertiles) : (i) < 0.10, (ii) 0.10 – 0.50, (iii) > 0.50

[6] Time trade-off utility categories for treatments (approximate tertiles) : (i) < 0.55, (ii) 0.55 – 0.90, (iii) > 0.90

✓ Significant in multivariate model; (✓) indicates marginal significance (p ≤ 0.07 in all cases); ((✓)) indicates any one of the covariates marked in this way may be included with life expectancy and Charlson Comorbidity Index in the model – no 2 patient utilities are significant together.