SUPPLEMENTARY DATA

Supplementary Table 1. RECODe equations for nephropathy and retinopathy outcomes.

	Nephropathy						**Retinopathy**				
	Microalbuminuria (n = 1551)	Macroalbuminuria (n = 627)	Renal failure or end-stage renal disease (n = 292)	Doubling of serum creatinine or >20 mL/min per 1.73 m^2 decrease in eGFR (n = 5910)	Macroalbuminuria, renal failure, end-stage renal disease, doubling of serum creatinine, or >20 mL/min per 1.73 m^2 decrease in eGFR (n = 6195)	Microalbuminuria, macroalbuminuria, renal failure, or end-stage renal disease (n = 2321)	Photocoagulation or vitrectomy (n = 901)	Cataract extraction (n = 1476)	Three-line reduction in visual acuity (n = 3559)	Severe vision loss (n=776)	Photocoagulation or vitrectomy, or severe vision loss (n=1468)
Demographics											
Age, years											
	0.021143	0.007328	-0.019380	0.012220	0.011629	0.019788	-0.003326	0.074570	0.014520	0.022850	0.00969
Women											
	0.169556	0.273800	-0.011290	-0.604600	-0.561432	0.103898	0.171867	0.275100	0.076000	0.226400	0.22558
Ethnicity											
Black											
	-0.008046	-0.005558	-0.088120	0.346100	0.295581	-0.026498	0.056551	-0.249600	-0.106500	-0.167700	-0.06502
Hispanic or Latino											
	0.173419	0.356300	0.233800	-0.136000	-0.091476	0.240117	..	..	..	..	..
Clinical features											
Tobacco smoking, current											
	0.283616	0.100100	0.148300	-0.086750	-0.066906	0.265233	..	..	..	..	..
Systolic blood pressure, mm Hg											
	0.003336	-0.001006	0.003027	0.008283	0.008876	0.001202	0.012279	0.001460	0.001382	0.008243	0.01090
Cardiovascular disease history											
	0.223121	0.255700	-0.021640	0.195600	0.190118	0.180532	0.283503	0.180200	-0.040920	0.112700	0.21863
Drug use											

SUPPLEMENTARY DATA

Blood pressure- lowering drugs											
	0.283715	0.241800	-0.079520	0.148600	0.185833	0.294526	0.206905	0.104200	-0.018820	0.063930	0.18019
Oral diabetes drugs											
	0.065839	0.090150	-0.125600	0.116100	0.081336	0.047868	-0.407463	-0.166700	-0.060020	-0.234900	-0.31715
Anticoagulants											
	0.421991	0.010910	0.031990	0.047880	0.014983	0.422579	..	..	..	..	..
Biomarkers											
HbA1c, %											
	0.138465	0.096390	0.136900	0.102900	0.103644	0.133572	0.223394	0.096590	0.093460	0.144900	0.17249
Total cholesterol, mg/dL											
	0.000337	0.000094	-0.001112	0.000106	0.000642	0.000381	-0.001407	-0.001036	-0.000473	-0.000168	-0.00106
HDL cholesterol, mg/dL											
	-0.009697	-0.011350	0.006289	-0.005896	-0.005206	-0.006485	0.011805	0.007315	0.001521	0.005447	0.00845
Serum creatinine, mg/dL											
	0.670258	1.149000	0.860900	-3.411000	-2.898928	0.460670	0.815822	0.283500	0.065860	0.694700	0.84481
Urine albumin:creatinine ratio, mg/g											
	..	0.013350	0.000362	0.000208	..	..	..	0.000159	0.000157	0.000199	..

The 10-year risk of an outcome can be computed as 1 – λ^exp(Σ(β×x) – mean(Σ(β × x))), where β are the equation coefficients and x are the values for each covariate for an individual patient within the cohort under study. λ values for the most clinically relevant outcomes of renal failure or end-stage renal disease and severe vision loss are: 0·973 for renal failure or end-stage renal disease, and 0·921 for vision loss, and corresponding values of mean(Σ(β×x)) were 0·23 for renal failure or end-stage renal disease, and 4·56 for vision loss. For example, a 60-year old white man with systolic blood pressure 140 mm Hg, without history of cardiovascular disease, not on any medications, and with HbA1c of 8% (64 mmol/mol), total cholesterol of 190 mg/dL (4.9 mmol/L), HDL of 50mg/dL (1.3 mmol/L), serum creatinine 1·1 mg/dL (97.2 micromol/L) and urine microalb:creatinine ratio of 10 mg/g (1.13 mg/mmol) would have a risk of renal failure/end-stage renal disease of 1-0.973^exp(-0.01938x60+0.003027x140+0.1369x8-0.001112x190+0.006289x50+0.8609x1.1+0.000362x10-0.23) = 0.085 or a 8.5% 10-year risk, where 0.23 is the mean(Σ(β×x)). People without a known covariate can have the associated term omitted from the equations to enable calculation of risk without the missing data. RECODe=Risk Equations for Complications of type 2 Diabetes.

SUPPLEMENTARY DATA

Supplementary Table 2. RECODe equations for cardiovascular disease outcomes.

Demographics	ASCVD (n=1053)	MI (fatal or nonfatal; n=880)	Stroke (fatal or nonfatal; n=197)	CHF (n=454)	CVD mortality (n=332)	All-cause mortality (n=719)
Age, years	0.034210	0.043630	0.028960	0.052680	0.055010	0.067030
Women	-0.167200	-0.206600	-0.032610	0.252900	-0.305600	-0.152900
Ethnicity						
Black	-0.118700	-0.116300	0.271600	-0.049690	0.079670	-0.023930
Clinical features						
Tobacco smoking, current	0.151000	0.235800	0.166500	0.290500	-0.057640	0.539900
Systolic blood pressure, mm Hg	0.000074	-0.005143	0.016590	0.001217	-0.003936	-0.002988
History of cardiovascular disease	0.778400	0.961800	0.413800	1.007000	1.016000	0.588800
Drug use						
Blood pressure-lowering drugs	0.055790	-0.124800	0.159800	0.638900	-0.157700	0.087760
Statins	-0.033610	0.046990	-0.188700	-0.117500	-0.204500	-0.268100
Anticoagulants	0.252400	0.544000	-0.138700	0.736500	0.694600	0.403600
Biomarkers						
HbA1c, %	0.171600	0.213500	0.336500	0.209200	0.245400	0.165900
Total cholesterol, mg/dL	0.001929	0.000188	0.001710	-0.001358	-0.001266	-0.000948
HDL cholesterol, mg/dL	-0.008370	-0.013580	-0.006392	-0.017580	-0.010810	-0.004378
Serum creatinine, mg/dL	0.435500	0.080270	0.595500	0.821400	0.455400	0.359700
Urine albumin:creatinine ratio, mg/g	0.000333	0.000421	0.000302	0.000414	0.000469	0.000389

The 10-year risk of each outcome can be computed as 1–lambda^exp(Σ(β × x) – mean(Σ(β × x))), where beta are the equation coefficients and x are the values for each covariate for an individual patient within the cohort under study. Lambda values were 0·85 for ASCVD, 0·93 for fatal or nonfatal MI, 0·98 for fatal or nonfatal stroke, 0·96 for CHF, 0·97 for cardiovascular mortality, and 0·93 for all-cause mortality, and mean(Σ(β × x))) values were 3·65 for ASCVD, 2·92 for fatal or nonfatal MI, 6·96 for fatal or nonfatal stroke, 5·15 for CHF, 3·97 for CVD mortality, and 4·66 for all-cause mortality in the validation study. For example, a 60-year old white man with systolic blood pressure 140 mm Hg, without history of CVD, not on any medications, and with HbA1c of 8%, total cholesterol of 190 mg/dL (4.9 mmol/L), HDL of 50mg/dL (1.3 mmol/L), serum creatinine 1·1 mg/dL (97.2 micromol/L), and urine microalbumin:creatinine ratio of 10 mg/g (1.13 mg/mmol), would have an all-cause mortality risk of 1–0·93^exp(6·703e–02 × 60–2·988e–03 × 140 + 1·659e–01 × 8–9·478e–04 × 190–4·378e–03 × 50 + 3·597e–01 × 1·1 + 3·889e–04 × 10–4·66)=0·09, or 9% 10-year risk, where 4·66 is the mean(Σ(β × x)). People without a known covariate can have the associated term omitted from the equations to enable calculation of risk without the missing data. An online risk calculator is available in both SI and US or conventional units.25 RECODe=Risk Equations for Complications of type 2 Diabetes. ASCVD=atherosclerotic cardiovascular disease (nonfatal or fatal myocardial infarction or stroke). MI=myocardial infarction. CHF=congestive heart failure. CVD=cardiovascular disease.

SUPPLEMENTARY DATA

Supplementary Table 3. Baseline characteristics of the ACCORD trial participants included for derivation of RECODe equations (*N* = 9,635, 2001-2009), and of the DPPOS study (*N* = 1,018, 1996-2001) and Look AHEAD study (*N* = 4,760, 2001-2012) participants included for previous validation of RECODe equations.[11]

	Included sample, No. (%)		
	ACCORD (*N* = 9,635)	**DPPOS (*N* = 1,018)**	**Look AHEAD (*N* = 4,760)**
Demographics			
Age, mean (SD), y	62.8 (6.7)	50.9 (8.0)	58.9 (6.7)
Women	3,662 (38.0)	680 (66.8)	2,784 (58.5)
Race/ethnicity			
Black race	1,834 (19.0)	244 (24.0)	776 (16.3)
Hispanic or Latino ethnic group	678 (7.0)	175 (17.2)	670 (14.1)
Clinical features			
Tobacco smoking, current	1,179 (12.2)	52 (5.1)	202 (4.2)
Systolic blood pressure, mean (SD), mmHg	136.5 (17.1)	123.7 (14.0)	129.0 (17.1)
Cardiovascular disease history	3,437 (35.7)	12 (1.2)	665 (14.0)
Medication utilization			
Blood pressure treatment	8,109 (84.2)	770 (75.6)	3,410 (71.6)
Oral diabetes medication (including metformin)	8,024 (83.3)	336 (33.0)	3,246 (68.2)
Statin use	6,148 (63.8)	721 (70.8)	2,142 (45.0)
Anticoagulant use	303 (3.1)	N/A	N/A
Biomarkers			
Haemoglobin A1c, mean (SD), %	8.3 (1.1)	6.1 (0.7)	7.3 (1.2)
Total cholesterol, mean (SD), mmol/L [mg/dL]	4.7 (1.1) [183.2 (41.7)]	5.1 (1.1) [196.0 (43.7)]	5.0 (1.0) [191.4 (37.3)]
Direct high-density lipoprotein cholesterol, mean (SD), mmol/L [mg/dL]	1.1 (0.3) [41.8 (11.6)]	1.2 (0.3) [46.0 (12.3)]	1.1 (0.3) [43.5 (11.9)]
Serum creatinine, mean (SD), μmol/L [mg/dL]	78.6 (17.7) [0.9 (0.2)]	70.7 (17.7) [0.8 (0.2)]	70.7 (17.7) [0.8 (0.2)]
Urine albumin/creatinine ratio, mean (SD), mg/mmol [mg/g]	11.3 (40.8) [99.2 (359.4)]	N/A	4.9 (22.9) [43.1 (201.5)]

N/A = not available in the dataset

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Supplementary Table 4. Reclassification table. The table compares risk predictions from RECODe equations to predictions of older risk equations from the UK Prospective Diabetes Study Outcomes Model 2 (UKPDS OM2). The table shows how many people with and without observed events were correctly and incorrectly classified as high or low risk by the older UKPDS OM2 risk equations and by the newer RECODe risk equations in MESA (2000-2012, N = 1,555 persons with type 2 diabetes) and JHS (2000-2012, N = 1,746 persons with type 2 diabetes).

	MESA % (N reclassified/N per outcome)				**JHS % (N reclassified/N per outcome)**			
Outcome	Without outcome		With outcome		Without outcome		With outcome	
Reclassification	Incorrectly classified as high-risk by UKPDS and correctly reclassified as low-risk by RECODe	Correctly classified as low-risk by UKPDS but incorrectly reclassified as high-risk by RECODe	Incorrectly classified as low-risk by UKPDS and correctly reclassified as high-risk by RECODe	Correctly classified as high-risk by UKPDS and incorrectly reclassified as low-risk by RECODe	Incorrectly classified as high-risk by UKPDS and correctly reclassified as low-risk by RECODe	Correctly classified as low-risk by UKPDS but incorrectly reclassified as high-risk by RECODe	Incorrectly classified as low-risk by UKPDS and correctly reclassified as high-risk by RECODe	Correctly classified as high-risk by UKPDS and incorrectly reclassified as low-risk by RECODe
Nephropathy	240 of 369 (65%)	236 of 643 (37%)	1 of 1 (100%)	1 of 5 (20%)	458 of 473 (97%)	0 of 633 (0%)	1 of 1 (100%)	1 of 2 (50%)
Retinopathy	28 of 32 (88%)	5 of 952 (1%)	1 of 31 (3%)	1 of 2 (50%)	17 of 27 (63%)	5 of 96 (5%)	3 of 17 (18%)	1 of 12 (8%)
	178 of 829 (21%)	6 of 89 (7%)	1 of 3 (33%)	1 of 81 (1%)	27 of 936 (3%)	0 of 3 (0%)	0 of 0 (0%)	1 of 110 (1%)
MI	261 of 933 (28%)	2 of 32 (6%)	0 of 0 (0%)	1 of 37 (3%)	78 of 978 (8%)	0 of 3 (0%)	0 of 0 (0%)	0 of 68 (0%)
Stroke	169 of 730 (23%)	50 of 230 (22%)	2 of 3 (67%)	6 of 39 (15%)	151 of 979 (15%)	16 of 19 (84%)	3 of 3 (100%)	1 of 48 (2%)
CHF	195 of 520 (38%)	121 of 438 (28%)	6 of 11 (55%)	3 of 33 (9%)	77 of 740 (10%)	59 of 77 (77%)	26 of 32 (81%)	6 of 200 (3%)
vs ACC/AHA PCEs								
ASCVD	110 of 563 (20%)	77 of 355 (22%)	9 of 13 (69%)	6 of 71 (8%)	69 of 831 (8%)	48 of 108 (44%)	1 of 1 (100%)	1 of 109 (1%)

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Supplementary Table 5. TRIPOD Checklist: Prediction Model Validation

Section/Topic	Item	Checklist Item	Page
Title and abstract			
Title	1	Identify the study as developing and/or validating a multivariable prediction model, the target population, and the outcome to be predicted.	1
Abstract	2	Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions.	2-3
Introduction			
Background and objectives	3a	Explain the medical context (including whether diagnostic or prognostic) and rationale for developing or validating the multivariable prediction model, including references to existing models.	3-4
	3b	Specify the objectives, including whether the study describes the development or validation of the model or both.	4
Methods			
Source of data	4a	Describe the study design or source of data (e.g., randomized trial, cohort, or registry data), separately for the development and validation data sets, if applicable.	5
	4b	Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up.	5-6
Participants	5a	Specify key elements of the study setting (e.g., primary care, secondary care, general population) including number and location of centres.	5-6
	5b	Describe eligibility criteria for participants.	5-6
	5c	Give details of treatments received, if relevant.	5-6
Outcome	6a	Clearly define the outcome that is predicted by the prediction model, including how and when assessed.	6-7
	6b	Report any actions to blind assessment of the outcome to be predicted.	N/A
Predictors	7a	Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured.	7
	7b	Report any actions to blind assessment of predictors for the outcome and other predictors.	N/A
Sample size	8	Explain how the study size was arrived at.	7-8
Missing data	9	Describe how missing data were handled (e.g., complete-case analysis, single imputation, multiple imputation) with details of any imputation method.	8
Statistical analysis methods	10c	For validation, describe how the predictions were calculated.	8-9
	10d	Specify all measures used to assess model performance and, if relevant, to compare multiple models.	8-9
	10e	Describe any model updating (e.g., recalibration) arising from the validation, if done.	N/A
Risk groups	11	Provide details on how risk groups were created, if done.	N/A
Development vs. validation	12	For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors.	eTable 3
Results			
Participants	13a	Describe the flow of participants through the study, including the number of participants with and without the outcome and, if applicable, a summary of the follow-up time. A diagram may be helpful.	10, Table 2
	13b	Describe the characteristics of the participants (basic demographics, clinical features, available predictors), including the number of participants with missing data for predictors and outcome.	8, Table 1
	13c	For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome).	eTable 3
Model performance	16	Report performance measures (with CIs) for the prediction model.	10-12
Model-updating	17	If done, report the results from any model updating (i.e., model specification, model performance).	N/A
Discussion			
Limitations	18	Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data).	15
Interpretation	19a	For validation, discuss the results with reference to performance in the development data, and any other validation data.	14
	19b	Give an overall interpretation of the results, considering objectives, limitations, results from similar studies, and other relevant evidence.	16-17
Implications	20	Discuss the potential clinical use of the model and implications for future research.	17
Other information			
Supplementary	21	Provide information about the availability of supplementary resources, such as study protocol,	Appe

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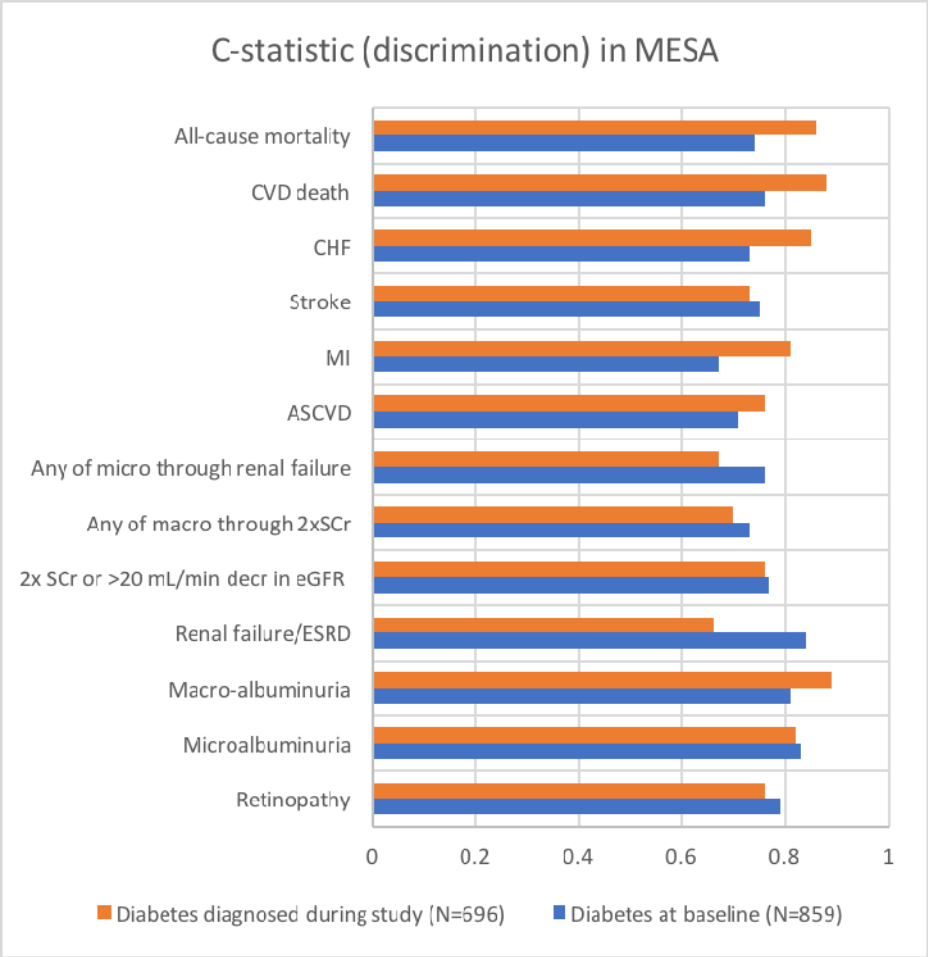
information		Web calculator, and data sets.	ndix
Funding	22	Give the source of funding and the role of the funders for the present study.	2, 18

Supplementary Figure 1. Comparison of discrimination and calibration among subjects with diabetes at baseline study enrollment versus diagnosed with diabetes during study period.

(A)



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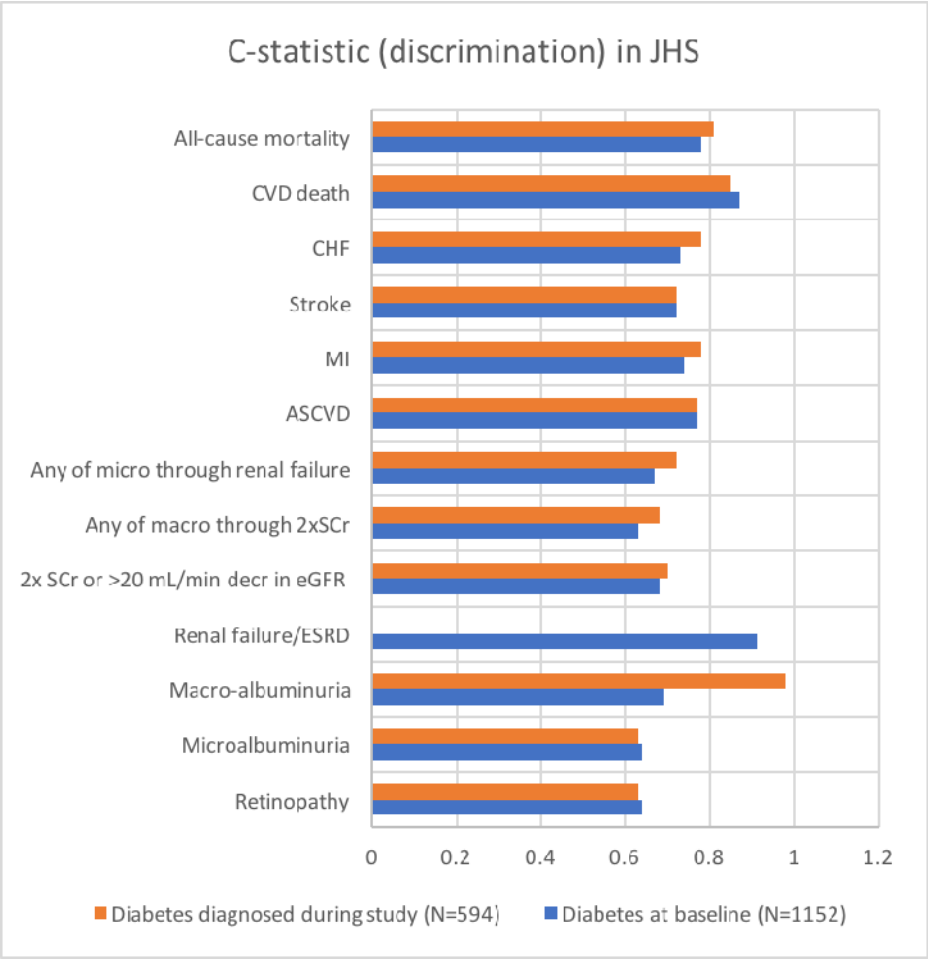
(B)



SUPPLEMENTARY DATA

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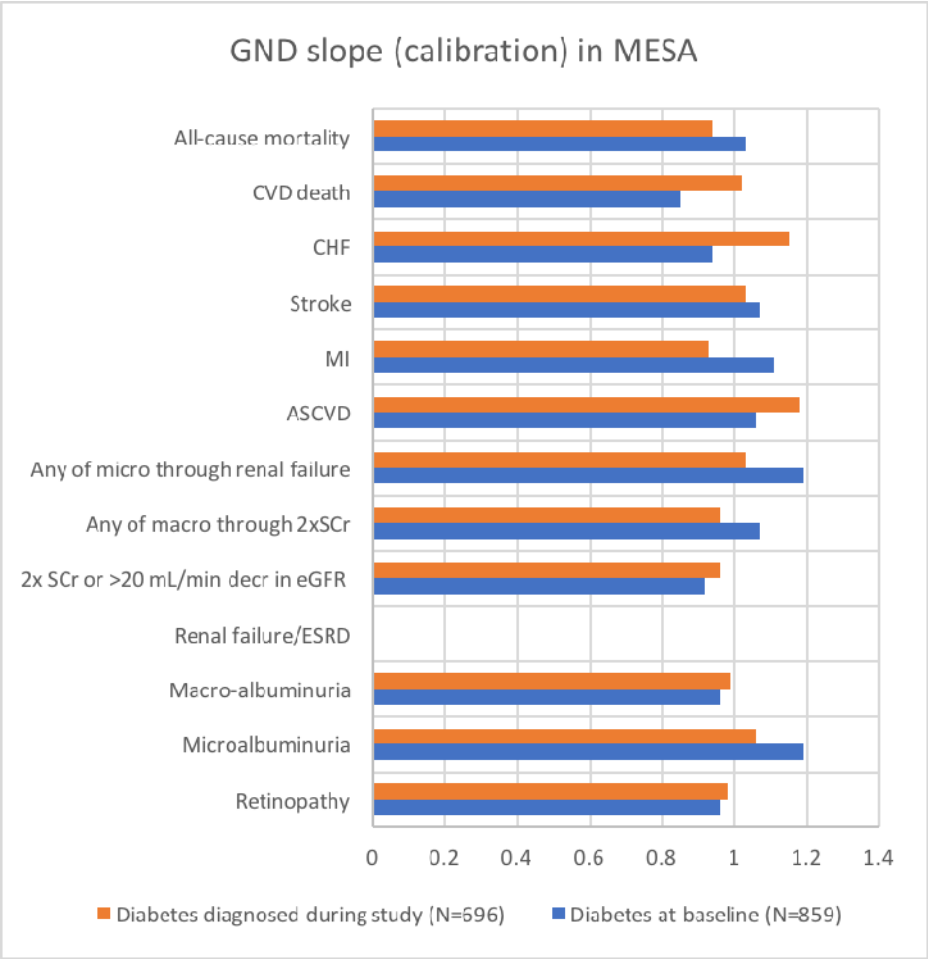

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(D)