

Appendix A

Data creation timeline

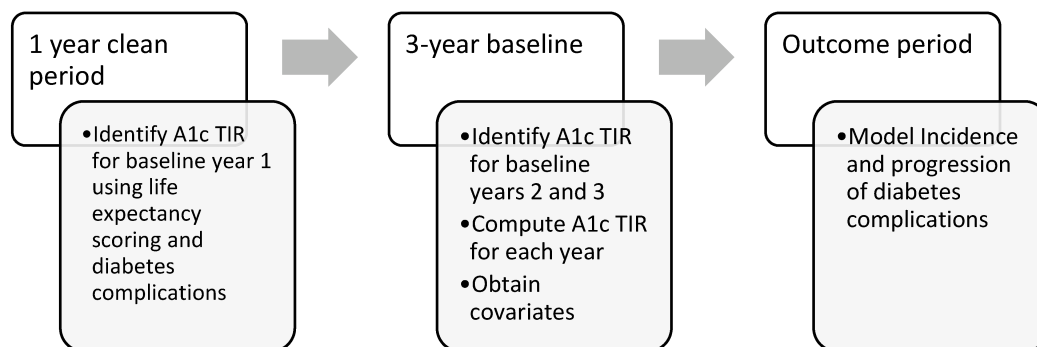


Table B1: Unadjusted Hazard Ratios of A1c time in range (TIR) predicting incident microvascular complications

	Microvascular (N=74,016)	Retinopathy (N=235,580)	Neuropathy (N=222,274)	Nephropathy (N=168,616)
Main predictor				
A1c TIR				
80%-100% (ref.)				
60%-<80%	1.17* (1.13 – 1.21)	1.21* (1.17 – 1.25)	1.25* (1.22 – 1.28)	1.21* (1.18 – 1.24)
40%-<60%	1.22* (1.18 – 1.26)	1.32* (1.28 – 1.36)	1.32* (1.28 – 1.35)	1.30* (1.27 – 1.34)
20%-<40%	1.28* (1.24 – 1.32)	1.32* (1.29 – 1.36)	1.36* (1.33 – 1.40)	1.34* (1.31 – 1.37)
0-<20%	1.30* (1.27 – 1.33)	1.27* (1.24 – 1.30)	1.36* (1.33 – 1.39)	1.37* (1.35 – 1.40)

Note: * indicates p<.05.

Table B2: Unadjusted Hazard Ratios of A1c time in range (TIR) predicting incident macrovascular complications

	Macrovascular (N=89,625)	Cardiovascular (N=122,135)	Cerebrovascular (N=277,234)	Peripheral vascular (N=228,583)
Main predictor				
A1c TIR				
60%-<80%	1.18* (1.15 – 1.21)	1.18* (1.15 – 1.21)	1.25* (1.21 – 1.29)	1.38* (1.34 – 1.42)
40%-<60%	1.21* (1.17 – 1.24)	1.22* (1.19 – 1.26)	1.38* (1.35 – 1.42)	1.51* (1.47 – 1.56)
20%-<40%	1.29* (1.26 – 1.33)	1.34* (1.31 – 1.38)	1.43* (1.39 – 1.47)	1.61* (1.56 – 1.65)
0-<20%	1.34* (1.31 – 1.38)	1.42* (1.38 – 1.45)	1.54* (1.50 – 1.58)	1.69* (1.65 – 1.74)

Note: * indicates p<.05.

Table B3: Hazard Ratios of A1c time in range (TIR) quintiles predicting incident microvascular and macrovascular diabetes complications

Microvascular composite (N=74,016)		Macrovascular composite (N=89,625)	
A1c TIR	HR (95% CI)	A1c TIR	HR (95% CI)
80.64-100% (ref.)		80.55-100%(ref.)	
50.14-80.63%	1.04* (1.01 – 1.07)	52.79-80.54%	1.04* (1.02 – 1.07)
24.93-50.13%	1.02 (.99 – 1.05)	27.85-52.78%	1.04* (1.01 – 1.07)
2.55-24.92%	1.05* (1.02 – 1.08)	2.83-27.84%	1.05* (1.02 – 1.08)
0-2.54%	1.05* (1.02 – 1.08)	0-2.74%	1.10* (1.06 – 1.13)
A1c SD	1.01 (.98 – 1.03)	A1c SD	1.01 (.99 – 1.03)
A1c Mean	1.09* (1.08 – 1.11)	A1c Mean	1.05* (1.04 – 1.06)

Notes: * indicates $p < .05$; TIR= Time in Range; N=number; SD=standard deviation; HR=Hazard Ratio; CI=95% Confidence Interval.

Table B4: Hazard Ratios of A1c time in range (TIR) with categorical mean A1c predicting incident microvascular and macrovascular diabetes complication

Microvascular composite (N=74,016)		Macrovascular composite (N=89,625)	
A1c TIR	HR (95% CI)	A1c TIR	HR (95% CI)
80-100% (ref)	1.00	80-100% (ref)	1.00
60-80%	1.05* (1.01 – 1.09)	60-80%	1.06* (1.02 – 1.10)
40-60%	1.01 (.97 – 1.05)	40-60%	1.02 (.99 – 1.06)
20-40%	1.03 (.99 – 1.07)	20-40%	1.06* (1.02 – 1.10)
0-20%	1.04* (1.01 – 1.18)	0-20%	1.07* (1.04 – 1.11)
A1c SD	1.00 (.99 – 1.00)	A1c SD	1.00 (.99 – 1.00)
A1c Mean		A1c Mean	
<6.5%	.94* (.92 - .96)	<6.5%	1.00 (.97 – 1.02)
6.5 – 7.0% (ref)	1.00	6.5 – 7.0% (ref)	1.00
7.0 – 8.0%	1.05* (1.02 – 1.07)	7.0 – 8.0%	1.03* (1.01 – 1.06)
8.0 – 9.0%	1.12* (1.08 – 1.17)	8.0 – 9.0%	1.10* (1.06 – 1.14)
> 9.0%	1.27* (1.19 – 1.36)	> 9.0%	1.25* (1.19 – 1.32)

Notes: * indicates p<.05; TIR= Time in Range; N=number; SD=standard deviation

Appendix C1: Cox Proportional Hazard Model Predicting Incident Microvascular Complication during follow-up period (N=74,016)

Parameters	Hazard Ratio	95% Confidence Interval	P Value
Patient A1c TIR (ref=80-100%)			
60-80%	1.03*	(1.00 - 1.07)	0.04
40-60%	1.02	(0.99 - 1.05)	0.29
20-40%	1.03	(1.00 - 1.06)	0.10
0-20%	1.04*	(1.02 - 1.08)	<.001
Sex (ref=Female)	0.91*	(0.85 - 0.98)	0.02
Race/Ethnicity (ref=White)			
Black	1.06	(1.02 - 1.10)	<.001
Hispanic	1.02	(0.95 - 1.10)	0.53
Asian	0.94	(0.81 - 1.09)	0.43
Other	0.95	(0.87 - 1.03)	0.21
Age at Follow-up (ref=68-72)			
73-76	1.08*	(1.06 - 1.11)	<.001
77-81	1.16*	(1.13 - 1.19)	<.001
82-105	1.32*	(1.28 - 1.36)	<.001
Service-connected Disability (ref=No)	1.13*	(1.11 - 1.15)	<.001
Copayment Required (ref=No)	0.97*	(0.95 - 0.99)	<.001
Marital Status (ref=Married)			
Divorced/Separated	1.04*	(1.01 - 1.06)	0.01
Widowed	1.07*	(1.04 - 1.10)	<.001
Other	1.02	(0.98 - 1.07)	0.27
Provider Type (ref=Physician)			
Physician Assistant/Nurse Practitioner	0.97*	(0.95 - 0.99)	<0.001
Other	1.00	(0.95 - 1.06)	0.92
Provider is Primary Care Physician (ref=No)	0.96*	(0.94 - 0.98)	<.001
Provider % of Other Patients Time in Range ^b	1.00*	(1.00 - 1.00)	0.02
Provider's % of Other Patients' A1c Tests $\geq 9\%$ ^b	1.00*	(1.00 - 1.01)	<.001

Parameters	Hazard Ratio	95% Confidence Interval	P Value
Provider's % of Other Patients' LDL > 100 mg/dL ^b	1.00	(1.00 – 1.00)	0.59
Provider's % of Other Patients' Blood Pressure > 140/90 mm Hg ^b	1.00	(1.00 – 1.00)	0.48
Number of A1c tests during the baseline	1.02*	(1.01 - 1.02)	<.001
Standard deviation of All A1c tests during the baseline	1.01	(0.98 - 1.03)	0.62
Average of all A1c tests during the baseline	1.09*	(1.08 - 1.11)	<.001
Tobacco Use	1.04*	(1.02 – 1.07)	<.001
Diabetes: Type I	1.05	(.94 – 1.08)	0.35
Diabetes Complication Severity Index Score	1.05	(1.04 - 1.06)	<.001
Albumin/Creatinine Ratio (Urine) (ref: <30 mg/g)			
30-300	2.98	(0.42 – 21.25)	0.28
>300	1.01	(0.98 – 1.04)	0.48
Missing	1.01	(0.97- 1.05)	0.30
LDL (ref: <100 mg/dL) ^c			
100-159	0.99	(0.97 - 1.01)	0.41
>=160	1.00	(0.90 - 1.10)	0.97
Missing	1.03	(0.88 - 1.20)	0.74
HDL (ref: <40 mg/dL) ^c			
40-60	0.96*	(0.94 - 0.98)	<.001
>60	0.98	(0.94 - 1.02)	0.26
Missing	1.12	(0.93 - 1.35)	0.22
Creatinine (ref: <0.6 mg/dL)			
0.6-1.2	0.89	(0.61 - 1.31)	0.56
>1.2	1.46	(1.00 - 2.14)	0.05
Missing	0.97	(0.66 - 1.43)	0.88
Albumin (ref: <3.5 g/dL)			
>=3.5	0.94*	(0.89 - 0.99)	0.03
Missing	0.91*	(0.86 - 0.97)	0.00
BMI (ref: 18.5-24.9 kg/m ²) ^c			

Parameters	Hazard Ratio	95% Confidence Interval	P Value
<18.5	0.82	(0.63 - 1.07)	0.14
25-29.9	1.01	(0.98 - 1.04)	0.53
30-39.9	1.06*	(1.03 - 1.10)	<.001
>=40	1.19*	(1.13 - 1.26)	<.001
Missing	1.04	(0.99 - 1.09)	0.12
Triglycerides (ref: <200 mg/dL)			
>=200	1.09	(1.06 - 1.11)	<.001
Missing	0.87	(0.67 - 1.15)	0.34
Blood Pressure Systolic (ref: <140 mm Hg)			
140-179	1.11*	(1.09 - 1.13)	<.001
>=180	1.18	(0.85 - 1.64)	0.32
Missing	1.88*	(1.11 - 3.19)	0.02
Medications: (ref=No)			
Alpha-glucosidase Inhibitors	1.00	(0.93 - 1.09)	0.96
Biguanides	1.09*	(1.07 - 1.11)	<.001
Insulin	1.18*	(1.14 - 1.21)	<.001
Multidrug	1.01	(0.93 - 1.10)	0.79
Sulfonylureas	1.06*	(1.04 - 1.08)	<.001
Thiazolidinediones	0.97	(0.94 - 1.00)	0.06
Medication Adherence: Any Diabetes Medications with Proportion of Days Covered >=80% (ref: <80%)			
Congestive heart failure	1.08*	(1.05 - 1.11)	<.001
Cardiac arrhythmias	1.06*	(1.03 - 1.08)	<.001
Valvular disease	1.07*	(1.04 - 1.10)	<.001
Pulmonary Hypertension	1.03	(0.98 - 1.08)	0.32
Peripheral Vascular Disorders	1.08*	(1.05 - 1.11)	<.001
Uncomplicated Hypertension	1.17*	(1.13 - 1.21)	<.001
Complicated Hypertension	1.05*	(1.01 - 1.09)	0.01
Paralysis	1.03	(0.96 - 1.12)	0.40

Parameters	Hazard Ratio	95% Confidence Interval	P Value
Other neurological disorders	1.05*	(1.01 - 1.09)	0.01
Pulmonary circulation disorders	1.09*	(1.07 - 1.11)	<.001
Hypothyroidism	1.03*	(1.00 - 1.05)	<0.05
Liver Disease	1.10*	(1.06 - 1.15)	<.001
Peptic ulcer disease	1.04	(1.00 - 1.10)	0.08
Human immunodeficiency virus	1.21	(0.91 - 1.61)	0.18
Lymphoma	1.08	(0.99 - 1.17)	0.09
Metastatic Cancer	1.19*	(1.10 - 1.29)	<.001
Tumor	1.05*	(1.03 - 1.08)	<.001
Rheumatoid arthritis/collagen vascular disease	1.14*	(1.09 - 1.19)	<.001
coagulopathy	1.06*	(1.02 - 1.10)	<.001
Obesity	1.04*	(1.02 - 1.06)	<.001
Weight loss	1.07*	(1.03 - 1.12)	<.001
Fluid and electrolyte disorders	1.08*	(1.05 - 1.11)	<.001
Blood loss anemia	1.04	(0.97 - 1.12)	0.24
Anemia	1.10*	(1.06 - 1.14)	<.001
Alcohol abuse	1.02	(0.96 - 1.11)	0.33
Drug abuse	1.04	(0.96 - 1.11)	0.36
Psychosis	1.03	(0.98 - 1.08)	0.29
Depression	1.08*	(1.06 - 1.11)	<.001

^a Model is also controlled for the following variables: the VA medical center, the calendar quarter a patient entered their outcome period, and number of days used to calculate the provider A1c TIR to adjust for the provider caseload assigned.

^b We excluded the individual's own values in the following calculations of provider characteristics: Provider's Other Patients Time in Range, Provider's % of Other Patients' A1c Tests $\geq 9\%$, Provider's % of Other Patients' LDL > 100 mg/dL, and Provider's % of Other Patients' Blood Pressure $> 140/90$ mm Hg.

^c BMI = Body Mass Index. LDL = Low-Density Lipoproteins. HDL = High-Density Lipoproteins.

Appendix C2: Cox Proportional Hazard Model Predicting Incident Macrovascular Complication during follow-up period (N=89,625)

Parameters	Hazard Ratio	95% Confidence Interval	P Value
Patient A1c TIR (ref=80-100%)			
60-80%	1.05*	(1.02-1.08)	<.001
40-60%	1.03	(1.00-1.06)	0.07
20-40%	1.05*	(1.02-1.08)	<.001
0-20%	1.08*	(1.05-1.11)	<.001
Sex (ref=Female)	0.87*	(0.81-0.93)	<.001
Race/Ethnicity (ref=White)			
Black	0.86*	(0.84-0.89)	<0.001
Hispanic	0.93*	(0.87-0.99)	0.03
Asian	0.93*	(0.82-1.06)	0.26
Other	0.85	(0.79-0.91)	<.001
Age at Follow-up (ref=68-72)			
73-76	1.16*	(1.14-1.19)	<.001
77-81	1.32*	(1.29-1.35)	<.001
82-105	1.70*	(1.65-1.75)	<.001
Service-connected Disability (ref=No)	1.04*	(1.02-1.06)	<.001
Copayment Required (ref=No)	.97*	(0.96-0.99)	0.01
Marital Status (ref=Married)			
Divorced/Separated	1.04*	(1.01-1.06)	<.001
Widowed	1.04*	(1.01-1.07)	<.001
Other	1.06*	(1.02-1.10)	<.001
Provider Type (ref=Physician)			
Physician Assistant/Nurse Practitioner	1.01	(0.99-1.03)	0.35
Other	1.01	(0.95-1.07)	0.76
Provider is Primary Care Physician (ref=No)	0.96*	(0.93-0.98)	<0.001
Provider % of Other Patients Time in Range ^b	1.00	(1.00-1.00)	0.45

Parameters	Hazard Ratio	95% Confidence Interval	P Value
Provider's % of Other Patients' A1c Tests $\geq 9\%$ ^b	1.00*	(1.00-1.00)	0.04
Provider's % of Other Patients' LDL > 100 mg/dL ^b	1.00*	(1.00-1.00)	<0.05
Provider's % of Other Patients' Blood Pressure > 140/90 mm Hg ^b	1.00	(1.00-1.00)	0.18
Number of A1c tests during the baseline	1.00	(1.00-1.01)	0.49
Standard deviation of All A1c tests during the baseline	1.00	(0.98-1.03)	0.75
Average of all A1c tests during the baseline	1.05*	(1.04 - 1.06)	<.001
Tobacco use	1.15*	(1.12 – 1.17)	<.001
Diabetes Type I	1.01	(.93 – 1.10)	0.85
Diabetes Complication Severity Index Score	1.09*	(1.08-1.10)	<.001
Albumin/Creatinine Ratio (Urine) (ref: <30 mg/g)			
30-300	1.15*	(1.12-1.19)	<.001
>300	1.42*	(1.32-1.53)	<.001
Missing	1.11*	(1.08-1.14)	<.001
LDL (ref: <100 mg/dL) ^c			
100-159	1.04*	(1.02-1.06)	<.001
≥ 160	1.21*	(1.11-1.31)	<.001
Missing	0.99	(0.86-1.13)	0.84
HDL (ref: <40 mg/dL) ^c			
40-60	0.73	(0.94-0.97)	<0.001
>60	0.73	(0.94-1.01)	0.31
Missing	0.71	(0.92-1.30)	0.33
Creatinine (ref: <0.6 mg/dL)			
0.6-1.2	0.73	(0.48-1.11)	0.14
>1.2	0.73	(0.48-1.11)	0.14
Missing	0.72	(0.47-1.09)	0.12
Albumin (ref: <3.5 g/dL)			
≥ 3.5	0.86	(0.82-0.90)	<.001
Missing	0.85	(0.81-0.90)	<.001

Parameters	Hazard Ratio	95% Confidence Interval	P Value
BMI (ref: 18.5-24.9 kg/m ²) ^c			
<18.5	1.23	(0.99 -1.48)	0.06
25-29.9	0.98	(0.95-1.01)	0.17
30-39.9	1.07*	(1.04-1.11)	<.001
>=40	1.30*	(1.24-1.37)	<.001
Missing	1.04	(1.00-1.09)	0.08
Triglycerides (ref: <200 mg/dL)			
>=200	1.06*	(1.04-1.08)	<.001
Missing	1.15	(0.90-1.46)	0.27
Blood Pressure Systolic (ref: <140 mm Hg)			
140-179	1.09*	(1.07-1.11)	<.001
>=180	1.25	(0.96-1.62)	0.10
Missing	1.10	(0.66-1.82)	0.73
Medications: (ref=No)			
Alpha-glucosidase Inhibitors	1.01	(0.95-1.07)	0.75
Biguanides	0.99	(0.97-1.01)	0.21
Insulin	1.12*	(1.10-1.15)	<.001
Multidrug	0.94	(0.87-1.02)	0.14
Sulfonylureas	1.02	(1.00-1.04)	0.09
Thiazolidinediones	0.97*	(0.95-1.00)	0.02
Medication Adherence: Any Diabetes Medications with Proportion of Days Covered >=80% (ref: <80%)	0.96*	(0.94-0.98)	<.001
Cardiac arrhythmias	1.17*	(1.14-1.20)	<.001
Valvular disease	1.30*	(1.26-1.35)	<.001
Pulmonary Hypertension	1.13*	(1.05-1.21)	<.001
Uncomplicated Hypertension	1.11*	(1.08-1.15)	<.001
Complicated Hypertension	1.08*	(1.05-1.12)	<.001
Paralysis	1.25*	(1.14-1.36)	<.001
Other neurological disorders	1.25*	(1.20-1.30)	<.001

Parameters	Hazard Ratio	95% Confidence Interval	P Value
Pulmonary circulation disorders	1.22*	(1.20-1.25)	<.001
Hypothyroidism	1.02*	(0.99-1.04)	0.22
Renal Failure	0.94*	(0.91-0.97)	<.001
Liver Disease	1.05*	(1.01-1.10)	0.02
Peptic ulcer disease	1.04	(0.99-1.09)	0.10
Human immunodeficiency virus	1.14	(0.91-1.43)	0.26
Lymphoma	1.14*	(1.05-1.23)	<.001
Metastatic Cancer	1.12*	(1.05-1.21)	<.001
Tumor	1.02*	(1.00-1.05)	0.02
Rheumatoid arthritis/collagen vascular disease	1.20*	(1.15-1.25)	<.001
Coagulopathy	1.11*	(1.05-1.16)	<.001
Obesity	1.03*	(1.01-1.06)	<.001
Weight loss	1.13*	(1.09-1.18)	<.001
Fluid and electrolyte disorders	1.07*	(1.04-1.09)	<.001
Blood loss anemia	1.05	(0.97-1.13)	0.23
Anemia	1.10*	(1.06-1.13)	<.001
Alcohol abuse	1.06*	(1.01-1.10)	<.001
Drug abuse	1.11*	(1.04-1.18)	<.001
Psychosis	1.16*	(1.11-1.22)	<.001
Depression	1.09*	(1.06-1.11)	<.001

^a Model is also controlled for the following variables: the VA medical center, the calendar quarter a patient entered their outcome period, and number of days used to calculate the provider A1c TIR to adjust for the provider caseload assigned.

^b We excluded the individual's own values in the following calculations of provider characteristics: Provider's Other Patients Time in Range, Provider's % of Other Patients' A1c Tests $\geq 9\%$, Provider's % of Other Patients' LDL > 100 mg/dL, and Provider's % of Other Patients' Blood Pressure $> 140/90$ mm Hg.

^c BMI = Body Mass Index. LDL = Low-Density Lipoproteins. HDL = High-Density Lipoproteins.

Appendix C3 Incremental risk discrimination statistics.

Microvascular composite

Model	c-statistic	AIC	BIC
1. A1c mean only	0.6092	1100806	1103036
2. A1c SD only	0.6083	1100974	1103203
3. A1c TIR only	0.6075	1101039	1103296
4. A1c mean + SD	0.6093	1100807	1103046
5. A1c mean + SD + TIR	0.6093	1100805	1103080

Macrovascular composite

Model	c-statistic	AIC	BIC
1. A1c mean only	0.6078	1223416	1225691
2. A1c SD only	0.6075	1223484	1225760
3. A1c TIR only	0.6075	1223474	1225778
4. A1c mean + SD	0.6079	1223417	1225702
5. A1c mean + SD + TIR	0.6080	1223389	1225711

Note. AIC = Akaike's Information Criteria; BIC = Bayesian Information Criteria; SD = standard deviation; TIR = time within range

Appendix D**Adjusted Hazard Ratios of A1c time in range (TIR) predicting progression of microvascular and macrovascular complications among prevalence sample**

	Retinopathy (N=110,144)	Nephropathy (N=98,402)	Cardiovascular (N=89,149)	Cerebrovascular (N=11,046)	Peripheral vascular (N=97,775)
Main predictor					
A1c TIR					
80%-100% (ref.)					
60%-<80%	1.03 (.95 – 1.11)	1.03 (.99 – 1.08)	1.02 (.98 – 1.06)	1.14 (.97 – 1.35)	.99 (.92 – 1.07)
40%-<60%	1.00 (.92 – 1.07)	1.06* (1.02 – 1.10)	.99 (.95 – 1.03)	1.11 (.95 – 1.30)	1.01 (.94 – 1.09)
20%-<40%	.97 (.90 – 1.04)	1.05* (1.01 – 1.09)	1.03 (.99 – 1.06)	1.08 (.93 – 1.26)	1.00 (.93 – 1.08)
0-<20%	1.06 (.99 – 1.14)	1.08* (1.04 – 1.12)	1.07* (1.04 – 1.11)	1.13 (.98 – 1.30)	1.07* (1.00 – 1.14)
A1c SD	.99 (.95 – 1.03)	1.04* (1.01 – 1.06)	1.05* (1.02 – 1.07)	.95 (.87 – 1.04)	1.02 (.98 – 1.06)
A1c Mean	1.11* (1.09 – 1.13)	1.05* (1.04 – 1.06)	1.05* (1.04 – 1.06)	1.11* (1.06 – 1.15)	1.15* (1.13 – 1.17)

Notes: * indicates p<.05; TIR= Time in Range; N=number; SD=standard deviation