

SUPPLEMENTAL MATERIAL

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Supplemental Appendix.

There were 62 health care organizations (HCOs) with patient data in OptumLabs® Data Warehouse (OLDW) from 2013. Seven HCOs were excluded for having <5% available serum creatinine or blood pressure measurements. Five additional HCOs were excluded for having fewer than 100 patients with eGFR <60 ml/min/1.73 m². Eighteen additional HCOs had fewer than 50 end-stage kidney disease events, for a total of 32 HCOs with a total of 1,205,921 covered patients. Patients were followed for up to five years. Median patient follow-up varied from HCO to HCO, with the majority of participants undergoing administrative censoring rather than development of ESKD or mortality (see Supplemental Table 2).

Supplemental Table 1. Sensitivity analysis of baseline characteristics of patients with eGFR <60 ml/min/1.73 m², by health system center, in confirmed eGFR <60 ml/min/1.73 m²

Center ID	N	Age (mean, SD)	% Female	eGFR (mean, SD)	% Diabetes	% Hypertension
1	12151	72 (9)	60.0	47 (10)	43.9	88.8
2	21096	75 (9)	62.6	46 (10)	37.9	89.4
3	9947	73 (9)	63.2	47 (10)	34.8	77.5
4	12328	74 (9)	61.2	46 (11)	39.6	88.2
5	8940	74 (9)	58.8	48 (10)	38.8	85.3
6	60219	72 (10)	61.1	47 (10)	31.8	71.2
7	6558	74 (9)	61.7	46 (10)	38.3	91.4
8	3596	72 (9)	59.0	45 (11)	52.1	93.3
9	7744	65 (11)	51.7	49 (10)	38.2	81.8
10	44544	72 (10)	60.4	47 (11)	43.4	90.3
11	3600	63 (11)	55.8	44 (12)	66.4	90.8
12	12765	73 (9)	62.1	47 (11)	37.3	86.9
13	13165	73 (9)	59.9	48 (10)	47.4	88.5
14	10887	72 (11)	57.3	46 (12)	35.4	73.8
15	7601	76 (8)	55.8	46 (11)	37.1	88.7
16	6224	75 (10)	55.6	44 (11)	41.7	77.2
17	29179	73 (10)	61.3	46 (11)	40.1	85.4
18	11191	72 (10)	59.3	44 (12)	33.2	82.7
19	7902	73 (10)	50.8	46 (11)	33.0	73.0
20	23256	74 (9)	62.2	47 (10)	42.2	91.4
21	10069	72 (12)	57.0	43 (13)	2.4	3.4
22	7856	72 (10)	59.1	45 (12)	41.4	84.9
23	13537	74 (8)	58.4	48 (10)	34.5	78.0
24	25871	72 (10)	59.9	48 (10)	33.2	80.4
25	9473	73 (9)	61.9	46 (11)	35.7	87.4
26	6998	72 (10)	54.7	43 (13)	27.3	49.4
27	16784	72 (10)	59.9	46 (11)	38.2	83.6
28	16736	72 (11)	59.4	45 (11)	33.9	72.4
29	6229	74 (9)	63.2	47 (10)	38.6	79.9
30	14728	73 (9)	59.9	46 (11)	40.2	83.8
31	11199	73 (10)	60.8	47 (11)	23.7	56.9
32	12998	73 (10)	55.2	46 (12)	7.6	17.4
33	6430	74 (9)	61.9	46 (11)	32.6	64.5
34	4386	68 (13)	53.5	46 (12)	35.5	73.1
35	70572	73 (9)	61.7	47 (10)	37.5	87.0
36	62404	73 (10)	58.9	46 (12)	26.4	57.3
37	7897	71 (11)	57.1	44 (13)	39.5	75.7
38	9287	75 (9)	58.0	47 (10)	45.2	90.4
39	7912	71 (11)	58.3	44 (12)	8.5	16.8
Total	634259	73 (10)	59.8	46 (11)	35.0	76.3

Supplemental Table 2. Incidence of ESKD and death, by center

Center ID	N	ESKD events	Mean follow-up	ESKD incidence per 1000 person-years	Death incidence per 1000 person-years
1	18273	665	4.9 (2.0)	7.48 (6.93-8.08)	54.69 (53.18-56.25)
2	28690	516	3.4 (1.4)	5.31 (4.87-5.79)	97.37 (95.45-99.34)
3	14560	238	4.1 (1.8)	3.97 (3.50-4.51)	72.37 (70.26-74.55)
4	17833	417	3.2 (1.3)	7.23 (6.57-7.96)	83.34 (81.02-85.72)
5	12342	247	5.0 (2.0)	4.02 (3.55-4.56)	51.29 (49.53-53.12)
6	83266	2346	5.3 (1.9)	5.36 (5.14-5.58)	57.64 (56.92-58.37)
7	9309	172	4.4 (1.2)	4.19 (3.61-4.87)	44.51 (42.50-46.61)
8	10160	291	4.2 (2.3)	6.83 (6.09-7.66)	73.16 (70.69-75.72)
9	16463	234	2.4 (1.1)	5.95 (5.23-6.76)	41.56 (39.61-43.61)
10	65990	2135	3.9 (1.5)	8.35 (8.00-8.71)	66.44 (65.44-67.45)
11	6239	612	3.2 (2.0)	30.27 (27.96-32.76)	21.60 (19.74-23.64)
12	17078	475	4.9 (1.8)	5.70 (5.21-6.23)	25.63 (24.57-26.74)
13	16794	319	5.2 (1.8)	3.67 (3.29-4.09)	55.64 (54.07-57.24)
14	20977	350	3.0 (2.1)	5.56 (5.01-6.18)	128.86 (126.09-131.70)
15	12442	364	2.8 (1.3)	10.47 (9.45-11.60)	18.87 (17.50-20.35)
16	11396	395	3.3 (2.4)	10.49 (9.50-11.57)	164.04 (160.05-168.13)
17	44092	1210	3.8 (1.6)	7.27 (6.87-7.69)	67.91 (66.67-69.17)
18	15774	425	4.5 (2.1)	6.00 (5.45-6.60)	69.17 (67.26-71.13)
19	13057	479	4.7 (2.0)	7.77 (7.11-8.50)	39.75 (38.20-41.37)
20	32055	853	4.8 (2.1)	5.50 (5.14-5.88)	66.12 (64.86-67.41)
21	21408	653	3.5 (2.4)	8.65 (8.01-9.34)	123.65 (121.20-126.16)
22	14068	737	4.5 (2.2)	11.65 (10.84-12.52)	69.08 (67.09-71.12)
23	17831	676	4.7 (2.1)	8.15 (7.55-8.78)	46.84 (45.39-48.34)
24	38390	632	3.7 (1.4)	4.44 (4.11-4.80)	41.60 (40.56-42.67)
25	14967	540	4.6 (2.1)	7.85 (7.21-8.54)	62.35 (60.54-64.22)
26	12122	1132	3.8 (2.4)	24.65 (23.25-26.13)	103.87 (101.06-106.75)
27	23954	1071	4.9 (2.1)	9.04 (8.51-9.60)	69.79 (68.28-71.32)
28	28114	808	4.9 (2.2)	5.92 (5.53-6.35)	91.81 (90.15-93.50)
29	10281	201	4.5 (2.3)	4.39 (3.82-5.04)	78.07 (75.56-80.66)
30	23110	590	4.4 (2.0)	5.82 (5.37-6.31)	64.91 (63.36-66.49)
31	18669	483	4.8 (1.8)	5.44 (4.97-5.94)	64.30 (62.63-66.01)
32	22847	407	4.0 (2.5)	4.48 (4.06-4.93)	97.03 (95.01-99.10)
33	9443	270	4.2 (2.3)	6.76 (6.00-7.61)	95.32 (92.35-98.39)
34	7591	405	4.0 (2.2)	13.32 (12.09-14.69)	68.37 (65.51-71.36)
35	103583	2714	4.8 (2.1)	5.44 (5.24-5.65)	64.47 (63.77-65.18)
36	104536	3759	4.3 (2.3)	8.41 (8.14-8.68)	77.60 (76.79-78.42)
37	11916	1042	4.1 (2.3)	21.38 (20.12-22.72)	82.04 (79.61-84.55)
38	12583	234	4.7 (2.1)	3.95 (3.48-4.49)	77.09 (74.86-79.38)
39	14096	556	4.2 (2.2)	9.32 (8.58-10.13)	84.86 (82.54-87.23)
Total	976299	29653	4.3 (2.1)	7.05 (6.97-7.13)	69.28 (69.02-69.53)

Supplemental Table 3. Sensitivity analysis, proportion with ACR testing according to “look-back” window, in confirmed eGFR <60 ml/min/1.73 m²

Center ID	N	ACR within 1 year	ACR within 2 years	ACR within 3 years
1	12151	2731 (22.5)	3547 (29.2)	3944 (32.5)
2	21096	3500 (16.6)	4528 (21.5)	4979 (23.6)
3	9947	1934 (19.4)	2319 (23.3)	2505 (25.2)
4	12328	1965 (15.9)	2471 (20.0)	2716 (22.0)
5	8940	1336 (14.9)	2092 (23.4)	2543 (28.5)
6	60219	13609 (22.6)	17015 (28.3)	17564 (29.2)
7	6558	827 (12.6)	1025 (15.6)	1054 (16.1)
8	3596	440 (12.2)	549 (15.3)	608 (16.9)
9	7744	1779 (23.0)	2132 (27.5)	2262 (29.2)
10	44544	6647 (14.9)	8828 (19.8)	9953 (22.3)
11	3600	1113 (30.9)	1432 (39.8)	1592 (44.2)
12	12765	2683 (21.0)	3463 (27.1)	3815 (29.9)
13	13165	1954 (14.8)	2503 (19.0)	2728 (20.7)
14	10887	1930 (17.7)	2463 (22.6)	2843 (26.1)
15	7601	1354 (17.8)	1608 (21.2)	1748 (23.0)
16	6224	1112 (17.9)	1443 (23.2)	1573 (25.3)
17	19179	6168 (21.1)	7329 (25.1)	7795 (26.7)
18	11191	982 (8.8)	1314 (11.7)	1413 (12.6)
19	7902	659 (8.3)	841 (10.6)	887 (11.2)
20	23256	6005 (25.8)	7108 (30.6)	7450 (32.0)
21	10069	1230 (12.2)	1629 (16.2)	1876 (18.6)
22	7856	536 (6.8)	678 (8.6)	727 (9.3)
23	13537	9919 (73.3)	10535 (77.8)	10653 (78.7)
24	25871	2542 (9.8)	3307 (12.8)	3932 (15.2)
25	9473	1919 (20.3)	2257 (23.8)	2342 (24.7)
26	6998	1233 (17.6)	1356 (19.4)	1356 (19.4)
27	16784	2464 (14.7)	3086 (18.4)	3373 (20.1)
28	16736	1828 (10.9)	2038 (12.2)	2085 (12.5)
29	6229	817 (13.1)	866 (13.9)	866 (13.9)
30	14728	1726 (11.7)	1898 (12.9)	1901 (12.9)
31	11199	719 (6.4)	801 (7.2)	825 (7.4)
32	12998	2566 (19.7)	3083 (23.7)	3393 (26.1)
33	6430	893 (13.9)	1088 (16.9)	1176 (18.3)
34	4386	705 (16.1)	933 (21.3)	1053 (24.0)
35	70572	10753 (15.2)	13478 (19.1)	14496 (20.5)
36	62404	7741 (12.4)	9190 (14.7)	10062 (16.1)
37	7897	1207 (15.3)	1537 (19.5)	1601 (20.3)
38	9287	2824 (30.4)	3354 (36.1)	3648 (39.3)
39	7912	1359 (17.2)	1604 (20.3)	1632 (20.6)
Total	634259	111709 (17.6)	136728 (21.6)	146969 (23.2)

Supplemental Table 4. Cross classification of risk categories by the 3-variable KFRE and the 4-variable KFRE, by event status and 2- and 5-year time horizon, in groups 1 (available ACR), 2 (available PCR), and 3 (available dipstick).

Two-Year ESKD	KFRE 3-var, 2y risk	Group 1: KFRE 4-var, 2y risk				Group 2: KFRE 4-var, 2y risk				Group 3: KFRE 4-var, 2y risk			
		< 10%	10-19%	20-39%	40% +	< 10%	10-19%	20-39%	40% +	< 10%	10-19%	20-39%	40% +
Events	< 10%	1018	156	44	0	11728	230	28	0	1168	54	0	0
	10-19%	180	149	258	45	949	482	212	17	273	154	95	0
	20-39%	64	138	305	437	189	293	404	161	215	179	296	90
	40% +	<11	38	82	692	12	27	76	289	28	117	263	750
Non-events	< 10%	173817	1243	140	0	192	38	<11	0	333471	492	0	0
	10-19%	3565	1297	766	59	46	59	62	<11	7078	1415	318	0
	20-39%	709	655	668	423	27	55	121	103	2464	1164	1083	167
	40% +	55	163	224	649	<11	<11	37	268	214	674	927	1478
Meta-analyzed NRI		0.139 (0.108, 0.171)				0.099 (0.057, 0.140)				-0.179 (-0.211, -0.146)			
Events/Non-Events NRI		0.127 (0.094, 0.159)		0.013 (0.011, 0.016)		0.037 (-0.009, 0.082)		0.058 (0.044, 0.073)		-0.209 (-0.241, -0.177)		0.029 (0.025, 0.033)	
Meta-analyzed IDI		0.055 (0.046, 0.065)				0.049 (0.040, 0.058)				-0.051 (-0.058, -0.044)			

Five-year ESKD	KFRE 3-var, 5y risk	Group 1: KFRE 4-var, 5y risk				Group 2: KFRE 4-var, 5y risk				Group 3: KFRE 4-var, 5y risk			
		< 23%	23-42%	43-71%	72% +	< 23%	23-42%	43-71%	72% +	< 23%	23-42%	43-71%	72% +
Events	< 23%	3318	546	150	0	458	87	27	0	3004	169	<11	0
	23-42%	382	335	536	109	107	129	144	17	556	326	204	0
	43-71%	107	205	433	676	32	75	191	176	291	309	433	185
	72% +	11	40	94	912	<11	13	40	354	<11	151	266	1181
Non-events	< 23%	170139	1386	211	<11	11164	303	31	0	330055	773	<11	0
	23-42%	3281	1253	738	106	797	448	229	28	7077	1487	485	0
	43-71%	523	570	564	436	126	245	344	195	2015	1219	1095	273
	72% +	37	135	214	599	<11	21	57	277	72	653	810	1521
Meta-analyzed NRI		0.159 (0.137, 0.180)				0.136 (0.105, 0.168)				-0.124 (-0.147, -0.101)			
Events/Non-Events NRI		0.147 (0.125, 0.169)		0.012 (0.010, 0.023)		0.098 (0.069, 0.128)		0.035 (0.020, 0.050)		-0.149 (-0.169, -0.123)		0.020 (0.017, 0.023)	
Meta-analyzed IDI		0.065 (0.058, 0.073)				0.061 (0.052, 0.070)				-0.039 (-0.045, -0.032)			

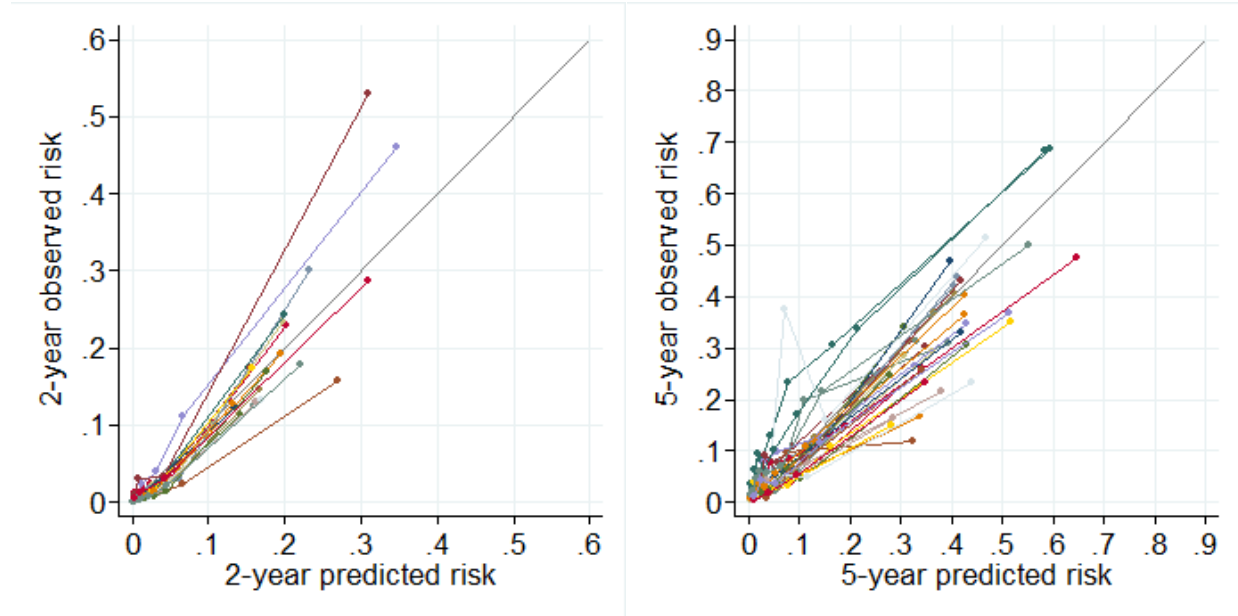
Supplemental Table 5. Meta-analyzed difference in c-statistic between 3- and 4-variable equation in groups 1, 2, and 3 within stage G3 and stage G4-5 CKD.

Meta-analyzed difference in C-statistic	G3	G4-5
Group 1: KFRE 4-var vs. 3-var ACR	0.080 (0.073, 0.086)	0.040 (0.034, 0.046)
Group 2: KFRE 4-var vs. 3-var PCR	0.057 (0.037, 0.078)	0.022 (0.013, 0.031)
Group 3: KFRE 4-var vs. 3-var dipstick	0.026 (0.018, 0.033)	0.022 (0.017, 0.028)

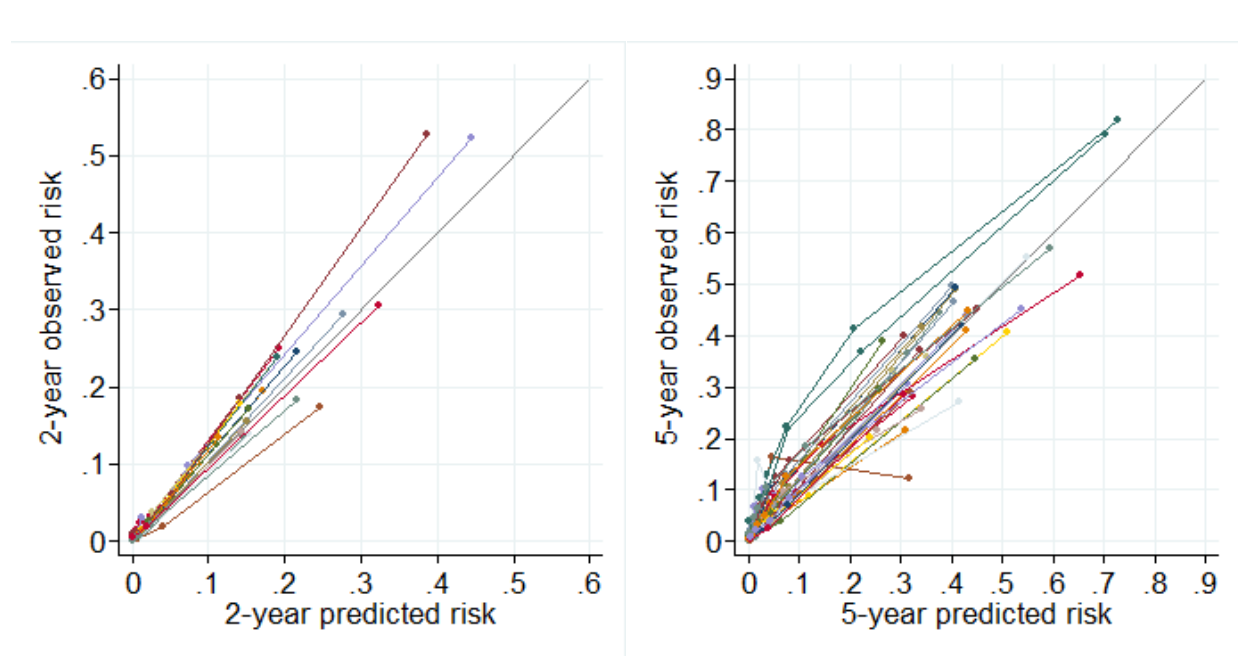
Group 1, available ACR test. Group 2, available PCR, but no available ACR. Group 3, available urine dipstick protein level measurement, but no available ACR or PCR. G3: eGFR between 30 and 59 ml/min/1.73 m². G4-5: eGFR <30 ml/min/1.73 m².

Supplemental Figure 1. Calibration plot. Patients with ACR testing (group 1) within 3 years, 2-year and 5-year 3-variable and 4-variable KFRE.

3-variable KFRE

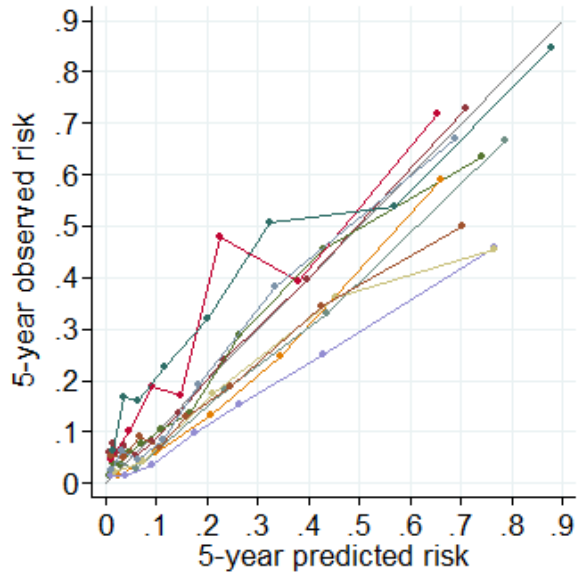
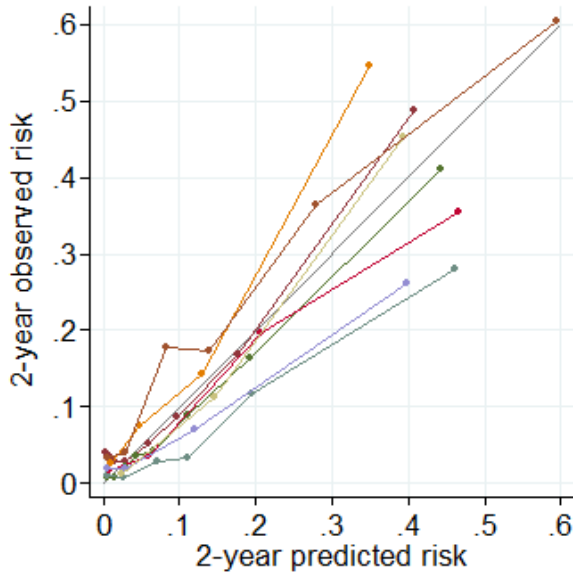


4-variable KFRE

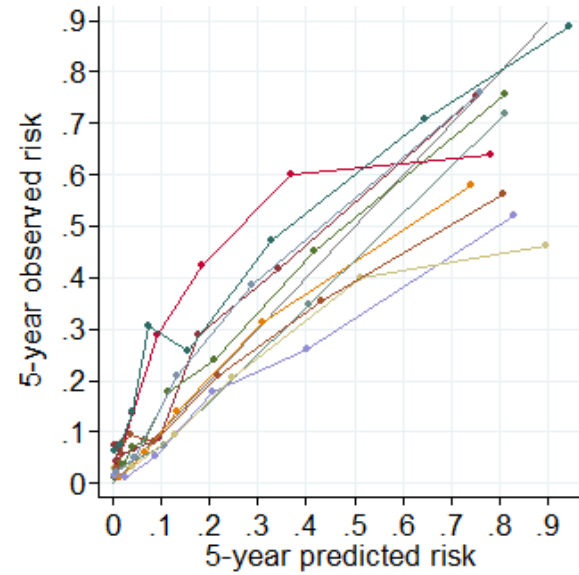
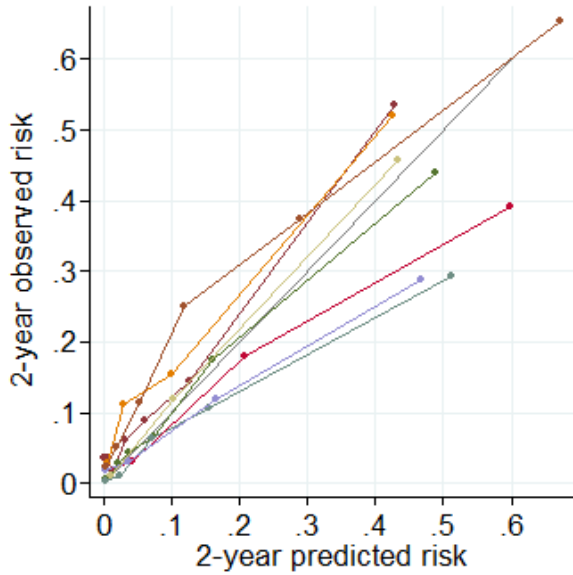


Supplemental Figure 2. Calibration plot. Patients with PCR testing (group 2) within 3 years, 2-year and 5-year 3-variable and 4-variable KFRE.

3-variable KFRE

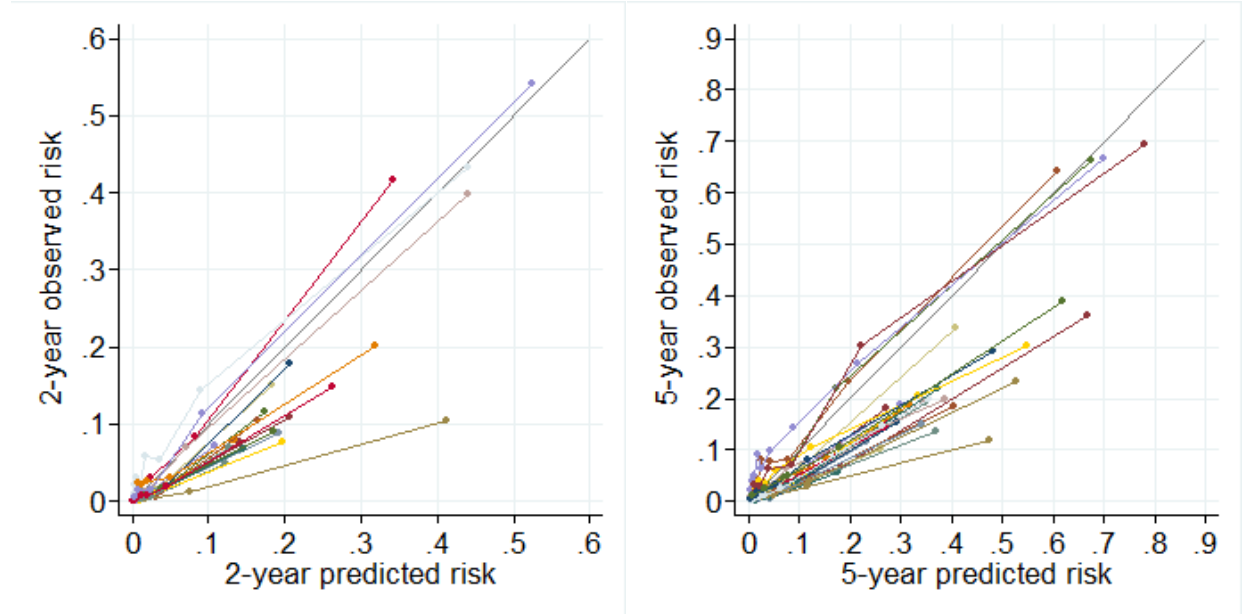


4-variable KFRE

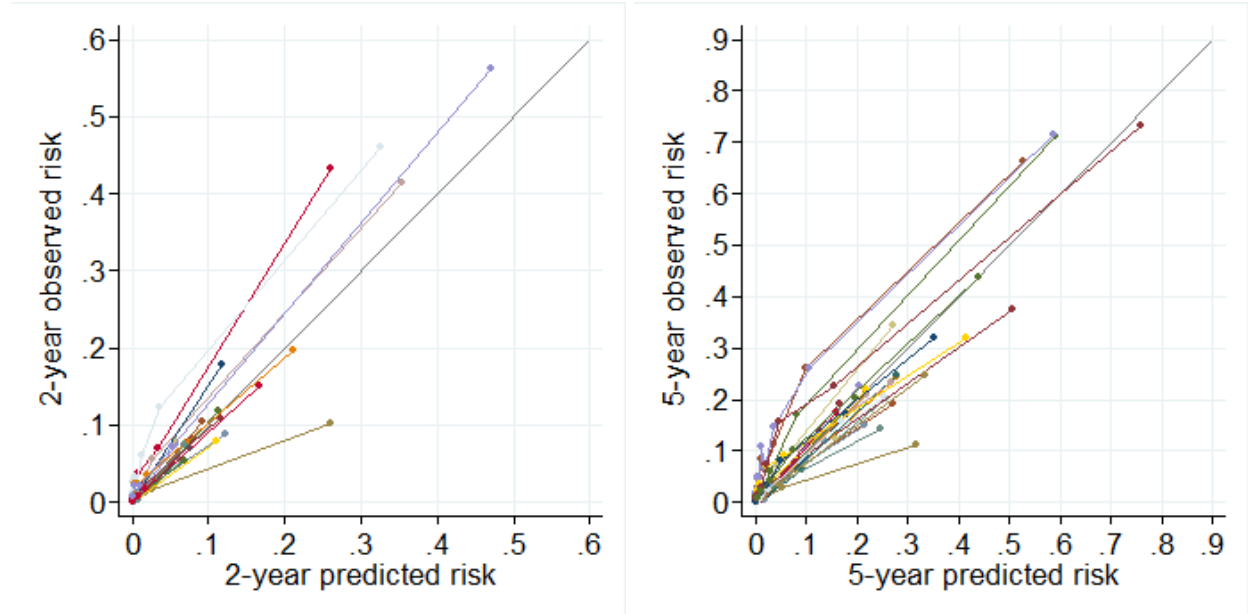


Supplemental Figure 3. Calibration plot. Patients with dipstick protein testing (group 3) within 3 years, 2-year and 5-year 3-variable and 4-variable KFRE.

3-variable KFRE



4-variable KFRE



Supplemental Figure 4. Calibration plot. Patients without albuminuria testing (group 4) within 3 years, 2-year and 5-year 3-variable KFRE.

