Supplementary Material

Figure S1. Kidney transplant recipient cohort creation.

Figure S2. Chronic kidney disease cohort creation.

Table S1. STROBE checklist.

Table S2. Databases and coding definitions for inclusion/exclusion criteria, baseline characteristics, and outcome measurements.

Table S3. Baseline characteristics of kidney transplant recipients with a failing graft and non-transplant patients with chronic kidney disease at the time of cohort entry prior to matching.

Figure S1. Kidney transplant recipient cohort creation.

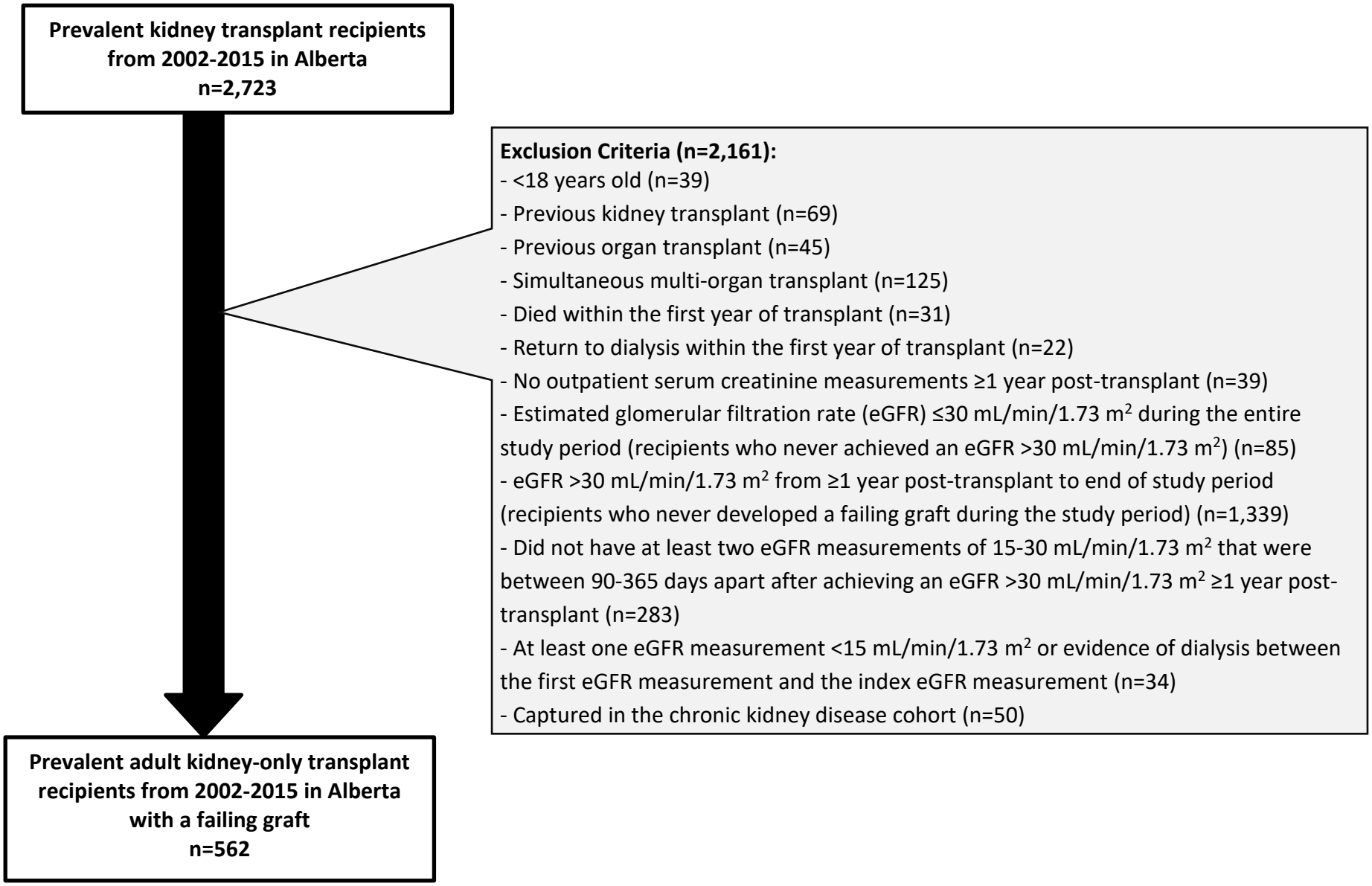

Figure S2. Chronic kidney disease cohort creation.

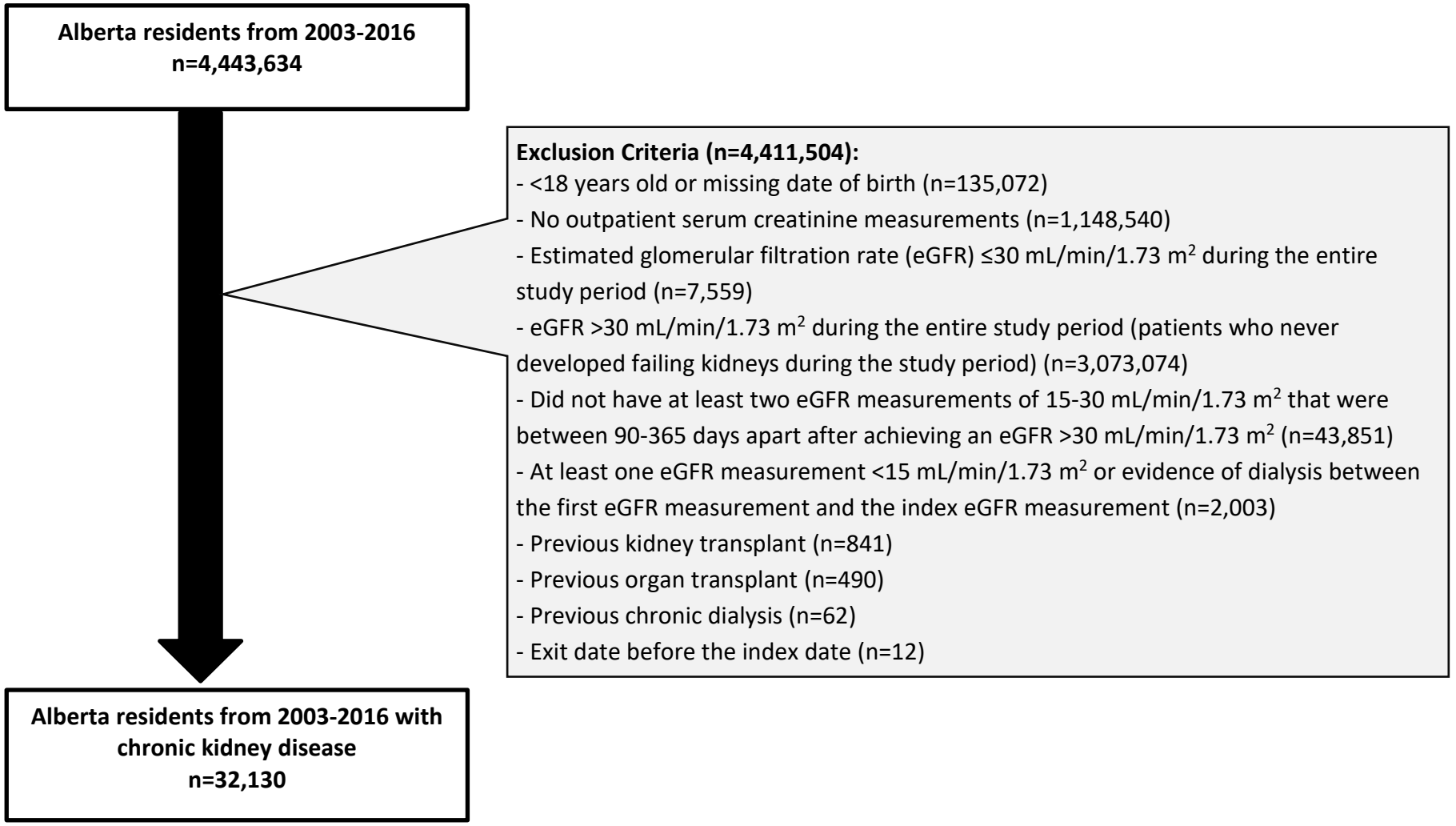

Table S1. STROBE checklist.[44]			
	Item	**Recommendation**	**Section**
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Title
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction
Methods			
Study design	4	Present key elements of study design early in the paper	Methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods Figure 1
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Methods Figure S1, S2
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Methods
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods Table S2
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods Table S2
Bias	9	Describe any efforts to address potential sources of bias	Methods
Study size	10	Explain how the study size was arrived at	Methods
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Methods
		(b) Describe any methods used to examine subgroups and interactions	Methods
		(c) Explain how missing data were addressed	Methods
		(d) If applicable, explain how loss to follow-up was addressed	Methods
		(e) Describe any sensitivity analyses	Not Applicable

Table S1. STROBE checklist (continued).			
	Item	**Recommendation**	**Section**
Results			
Participants	13	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Results Figure S1, S2
		(b) Give reasons for non-participation at each stage	Results
		(c) Consider use of a flow diagram	Figure S1, S2
Descriptive data	14	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	Results Table 1, S3
		(b) Indicate number of participants with missing data for each variable of interest	Methods Table S3
		(c) Summarise follow-up time (e.g. average and total amount)	Results
Outcome data	15	Report numbers of outcome events or summary measures over time	Results Table 2
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g. 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results
		(b) Report category boundaries when continuous variables were categorized	Results
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Results
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Funding

Table S2. Databases and coding definitions for inclusion/exclusion criteria, baseline characteristics, and outcome measurements.			
Variable	**Database**	**Codes**	
Inclusion Criteria			
Kidney transplantation	NARP, SARP	Variables: Modality = Transplant, Incident = 1, Numinctrans = 1, Transdate1 = Date of first transplant	
Laboratory investigation	AKDN	Serum creatinine	
Exclusion Criteria			
Age	AH	Population Registry	
Kidney transplantation (prior to May 2002)	NARP, SARP (since 2001)	Variable: Trans2001	
	AH (since 1994)	CCI code: 1PC85 ICD-9-CM: 5569 CCP codes: 67.4, 67.59, 67.5	
Other organ transplant	AH	Pancreas transplant	CCI: 1OJ85 ICD-9-CM: 528 (includes 5280, 5281, 5282, 5283, 5284, 5285, 5286) CCP: 64.8
		Liver transplant	CCI: 1OA85 ICD-9-CM: 505 (includes 5051, 5059) CCP: 62.49, 62.4
		Bowel transplant	CCI: 1NK85, 1NP85 ICD-9-CM: 4697 CCP: 58.99
		Multi-visceral transplant	CCI: 1HY85, 1OK85 ICD-9-CM: 336 CCP: 45.6
		Lung transplant	CCI: 1GR85, 1GT85 ICD-9-CM: 335 (includes 3350, 3351, 3352) CCP: 45.5
		Heart transplant	CCI: 1HZ85 ICD-9-CM: 3751 CCP: 49.5
Mortality	AH	Alberta Vital Statistics	
Dialysis	NARP, SARP	Variable: Dialinit & Prevmod = Transplant: Date of dialysis initiation <1 year after transplant date	
Laboratory investigation	AKDN	Serum creatinine	

Table S2. Databases and coding definitions for inclusion/exclusion criteria, baseline characteristics, and outcome measurements (continued).			
Variable	**Database**	**Codes**	
Baseline Characteristics - Demographics			
Age, Sex, SES, Urban	AH	Population Registry	
Baseline Characteristics – Kidney-related Characteristics			
Distance to transplant center	AH	The Manhattan distance between the postal code of the participant's residence and the postal code of the nearest transplant facility was estimated using the Haversine formula	
Site/Year of transplantation	NARP, SARP	Variable: Program	
Laboratory investigation	AKDN	Serum creatinine	
		Albuminuria: Defined by ACR, PCR, or urine dipstick based on outpatient random spot urine measurements. Measurements were categorized as none/mild (A1: dipstick negative/trace, PCR <15 mg/mmol, ACR <30 mg/g), moderate (A2: dipstick 1+, PCR 15-50 mg/mmol, ACR 30-300 mg/g), or severe/nephrotic (A3/A4: dipstick 2+ to 4+, PCR >51mg/mmol, ACR >301 mg/g).[10,30–32] ACR was the primary measure of albuminuria, and if unavailable, was supplemented with PCR. When both ACR and PCR were unavailable, urine dipstick was used. All outpatient ACR or PCR measurements or urine dipsticks in the 90-days before the index eGFR were used to establish baseline albuminuria. For those with multiple albuminuria measurements, we used the median value rounded down to the nearest category.	
Baseline Co-morbidities	**Database**	**Codes**	**Validation**
Hypertension[20,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 401-405 ICD-10: I10-I13, I15	ICD-9-CM: Sn 79%, PPV 95% ICD-10: Sn 68%, PPV 93%
Diabetes mellitus[19]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 250 ICD-10: E10-E14	ICD-9-CM: Sn 86%, PPV 80%
Myocardial infarction[46]	AH	1 hospitalization: ICD-9-CM: 410 ICD-10: I21, I22	ICD-9-CM: Sn 89%, PPV 89%
Percutaneous coronary intervention[47]	AH	CCI: 1IJ50, 1IJ54GQAZ, 1IJ57GQ, 1IL35 CCP: 51.59C, 51.59D, 51.59E, 51.59F	CCI: PPV 94-96%
Coronary artery bypass graft[47]	AH	CCI: 1IJ76 CCP: 48.11, 48.12, 48.13, 48.14, 48.15, 48.19	CCI: PPV 97-98%

Table S2. Databases and coding definitions for inclusion/exclusion criteria, baseline characteristics, and outcome measurements (continued).			
Baseline Co-morbidities	**Database**	**Codes**	**Validation**
Heart failure[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428 ICD-10: I09.9, I25.5, I42.0, I42.5-I42.9, I43, I50	ICD-9-CM: Sn 72%, PPV 91% ICD-10: Sn 69%, PPV 90%
Atrial fibrillation[48]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9 CM: 427.3 ICD-10: I48.0	ICD-9-CM: Sn 84%, PPV 89%
Stroke/Transient ischemia attack[49]	AH	1 most responsible or post-admittance hospitalization or 1 claim or 1 most emergency department ACCS: ICD-9-CM: 362.34, 430, 431, 433, 434, 435, 436 ICD-10: G45, H34.0, I60, I61, I63, I64	ICD-9-CM: PPV 90% ICD-10: PPV 92%
Peripheral vascular disease[50]	AH	1 hospitalization or 1 claim or 1 ACCS: ICD-9-CM: 440.2 ICD-10: I70.2	ICD-9-CM: Sn 77%, PPV 94%
Chronic pulmonary disease (including asthma)[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 416.8, 416.9, 490-505, 506.4, 508.1, 508.8 ICD-10: I27.8, I27.9, J40-J47, J60-J67, J68.4, J70.1, J70.3	ICD-9-CM: Sn 55%, PPV 92% ICD-10: Sn 53%, PPV 91%
Peptic ulcer disease[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 531-534 ICD-10: K25-K28	ICD-9-CM: Sn 37%, PPV 84% ICD-10: Sn 40%, PPV 77%
Mild liver disease[17,20]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7 ICD-10: B18.x, K70.0-K70.3, K70.9, K71.3-K71.5, K71.7, K73.x, K74.x, K76.0, K76.2-K76.4, K76.8, K76.9, Z94.4	ICD-9-CM: Sn 38%, PPV 80% ICD-10: Sn 41%, PPV 85%
Moderate/Severe liver disease[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 456.0-456.2, 572.2-572.8 ICD-10: I85.0, I185.9, I186.4, I198.2, K70.4, K71.1, K72.1, K72.9, K76.5, K76.6, K76.7	
Dementia[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 290, 294.1, 331.2 ICD-10: F00-F03, F05.1, G30, G31.1	ICD-9-CM: Sn 32%, PPV 96% ICD-10: Sn 67%, PPV 93%

Table S2. Databases and coding definitions for inclusion/exclusion criteria, baseline characteristics, and outcome measurements (continued).			
Variable	**Database**	**Codes**	**Validation**
Lymphoma[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 200-202, 203.0, 238.6 ICD-10: C81-C85, C88, C90.0, C90.2, C96	 ICD-9-CM: Sn 66%, PPV 73% ICD-10: Sn 63%, PPV 79%
Solid tumor without metastasis[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 140-172, 174-195 ICD-10: C00-C26, C30-C34, C37-C41, C43, C45-C58, C60-C76, C97	 ICD-9-CM: Sn 44%, PPV 57% ICD-10: Sn 46%, PPV 59%
Cancer, metastatic[17,45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 196-199 ICD-10: C77-C80	 ICD-9-CM: Sn 83%, PPV 89% ICD-10: Sn 81%, PPV 87%
HIV/AIDS[45]	AH	1 hospitalization or 2 claims in 2 years or less: ICD-9-CM: 042-044 ICD-10: B20-B22, B24	 ICD-9-CM: Sn 25%, PPV 100% ICD-10: Sn 100%, PPV 100%
Variable	**Database**	**Codes**	
Outcomes			
Mortality	AH	Alberta Vital Statistics	
Genitourinary	AH	ICD-10: N00-N99	
Cardiovascular	AH	ICD-10: I00-I99	
Infection	AH	ICD-10: A00-A99, B00-B99	
Cancer	AH	ICD-10: C00-C97, D00-D48	
Endocrine	AH	ICD-10: E00-E90	
Respiratory	AH	ICD-10: J00-J99	
Gastrointestinal	AH	ICD-10: K00-K93	
Abbreviations: ACCS, Ambulatory Care Classification System; ACR, albumin-creatinine ratio; AH, Alberta Health; AIDS, acquired immunodeficiency syndrome; AKDN, Alberta Kidney Disease Network; CCI, Canadian Classification of Health Interventions; CCP, Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures; HIV, human immunodeficiency virus; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10, International Statistical Classification of Diseases, Tenth Revision; NARP, Northern Alberta Renal Program; PCR, protein-creatinine ratio; PPV, positive predictive value; SARP, Southern Alberta Renal Program; SES, socio-economic status; Sn, sensitivity.			

Table S3. Baseline characteristics of kidney transplant recipients with a failing graft and non-transplant patients with chronic kidney disease at the time of cohort entry prior to matching.[a]			
Characteristic	**Failing Graft (n=562)**	**Chronic Kidney Disease (n=32,130)**	**Standardized Difference[b]**
Age, years	55.8 [45.0 to 64.6]	79.0 [69.8 to 85.6]	163.5
>65 years	136 (24)	26,705 (83)	146.4
Women	226 (40)	17,318 (54)	27.7
Socio-economic status[c]			
Lowest quintile	139 (25)	9,390 (29)	10.1
Second quintile	152 (27)	7,530 (23)	8.3
Middle quintile	91 (16)	6,038 (19)	6.8
Fourth quintile	69 (12)	4,205 (13)	2.4
Highest quintile	91 (16)	3,908 (12)	11.6
Missing	20 (4)	1,059 (3)	1.4
Urban residence[d]	485 (86)	27,873 (87)	1.3
Missing	2 (0)	123 (0)	0.4
Distance to transplant center, km[e]	24.7 [13.3 to 155.8]	25.7 [12.3 to 177.6]	8.5
<50 km	359 (64)	18,440 (57)	13.3
50.1-150 km	61 (11)	3,967 (12)	4.7
150.1-300 km	68 (12)	4,887 (15)	9.1
>300 km	74 (13)	4,836 (15)	5.4
Northern Alberta recipient	364 (65)	N/A	N/A
Year of transplant			
1994-2000	197 (35)	N/A	N/A
2001-2007	214 (38)	N/A	N/A
2008-2015	58 (10)	N/A	N/A
Missing	93 (17)	N/A	N/A
Transplant to index date, years	6.9 [3.7 to 10.6]	N/A	N/A
Index date			
2002-2006	194 (35)	6,620 (21)	31.5
2007-2011	196 (35)	11,399 (35)	1.3
2012-2017	172 (31)	14,111 (44)	27.8
Index eGFR, mL/min/1.73 m^2	26.8 [24.3 to 28.5]	26.5 [23.5 to 28.5]	9.4
26-30	387 (69)	20,688 (64)	9.5
21-25	128 (23)	8,413 (26)	7.9
15-20	47 (8)	3,029 (9)	3.7
Index albuminuria			
None/Mild	172 (31)	8,946 (28)	6.1
Moderate	146 (26)	3,473 (11)	39.9
Severe	218 (39)	3,647 (11)	66.7
No measurement	26 (5)	16,064 (50)	118.3
Co-morbidities[f]			
Hypertension	360 (64)	25,981 (81)	38.3
Diabetes mellitus	200 (36)	14,715 (46)	20.9

Myocardial infarction	39 (7)	2,653 (8)	5.0
PCI/CABG	25 (4)	1,580 (5)	2.2
Heart failure	64 (11)	11,574 (36)	60.5
Atrial fibrillation	35 (6)	6,750 (21)	44.1
Stroke/TIA	43 (8)	4,453 (14)	20.1
Peripheral vascular disease	46 (8)	4,790 (15)	21.2
Chronic pulmonary disease	73 (13)	8,113 (25)	31.6
Peptic ulcer disease	18 (3)	1,352 (4)	5.3
Liver disease	17 (3)	530 (2)	9.1
Dementia	8 (1)	3,697 (12)	41.9
Lymphoma	10 (2)	601 (2)	0.7
Cancer (non-metastatic)	41 (7)	4,408 (14)	21.1
Cancer (metastatic)	3 (1)	938 (3)	18.4
HIV/AIDS	2 (0)	24 (0)	6.1

Data is presented as number (%) or as median [interquartile range].

[a] The time of cohort entry is the date of the second of two eligible eGFR measurements.

[b] Standardized differences provide a measure of the difference between groups divided by the pooled standard deviation; >10% is interpreted as a meaningful difference between the groups.

[c] Income was categorized according to fifths of average neighborhood income (1=low, 5=high).

[d] Urban indicates a population >10,000 or a population >1,000 with population density >400/km^2.

[e] Values >500 km were imputed as 500 km.

[f] Assessed by the presence of diagnostic or procedural codes in the 3 years prior to the index date, based on validated algorithms, where applicable (**Table S2**).

Abbreviations: AIDS, acquired immunodeficiency syndrome; CABG, coronary artery bypass graft; eGFR, estimated glomerular filtration rate; HIV, human immunodeficiency virus; N/A, not applicable; PCI, percutaneous coronary intervention; TIA, transient ischemic attack.