Online Supplementary File

Item S1: STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Check
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**X**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**X**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**X**
Objectives	3	State specific objectives, including any prespecified hypotheses	**X**
Methods			
Study design	4	Present key elements of study design early in the paper	**X**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**X**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	**X**
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	**Not Applicable**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**X**
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	***X***
Bias	9	Describe any efforts to address potential sources of bias	**X**
Study size	10	Explain how the study size was arrived at	**X**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**X**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**X**
		(*b*) Describe any methods used to examine subgroups and interactions	**X**
		(*c*) Explain how missing data were addressed	**X**
		(*d*) If applicable, explain how loss to follow-up was addressed	**X**
		(*e*) Describe any sensitivity analyses	**X**
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**X**
		(b) Give reasons for non-participation at each stage	**X**
		(c) Consider use of a flow diagram	**X**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**X**
		(b) Indicate number of participants with missing data for each variable of interest	**X**
		(c) Summarise follow-up time (eg, average and total amount)	**X**
Outcome data	15*	Report numbers of outcome events or summary measures over time	**X**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	**X**

		interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	**X**
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	**Not Applicable**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	**X**
Discussion			
Key results	18	Summarise key results with reference to study objectives	**X**
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	**X**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**X**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**X**
Other information			**X**
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	**X**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Item S2: Description of Databases

These data sets are held securely in a linked, de-identified form and analyzed at the Institute for Clinical Evaluative Sciences. The Canadian Organ Replacement Registry (CORR) is a national registry, administered by the Canadian Institute for Health Information (CIHI).The CORR collects and records the incidence, prevalence, treatment changes, and outcomes of all chronic dialysis and solid organ transplant patients in Canada. Data is collected by voluntary completion of survey forms for each patient at dialysis initiation and at yearly follow-up. The CIHI administered Discharge Abstract Database (CIHI-DAD) records detailed diagnosis and procedural information on all hospitalizations in Ontario. Up to 25 unique diagnostic and 20 procedural codes can be assigned to each hospitalization. The Ontario Health Insurance Plan (OHIP) database contains health claims for inpatient and outpatient physician services. The Registered Persons Database (RPDB) of Ontario has demographic and vital status information on all residents who have ever been issued a health card and has an accuracy of 99% for identifying demographic data.

Item S3: Methods and Results for Sensitivity Analysis

Methods: We conducted four additional analyses were performed to test the robustness of our findings. First, some reports consider a three month period of nephrology care prior to hemodialysis start to be insufficient for appropriate assessment and creation of an AV-access. Therefore, in the first analysis we examined outcomes of patients that had at least 6 months of nephrology follow-up prior to initiating hemodialysis. We used the K/DOQI Clinical Guidelines recommendation for interval follow-up for patients with chronic kidney disease[21]. We defined nephrology follow-up as a patient having 3 or more nephrology visits in the previous five years (with first visit ≥6 months prior to HD start) and at least 2 visits were in the year prior to hemodialysis start [21]. In the second analysis, we removed patients that had an acute kidney injury in the six months prior to hemodialysis start because this could have led to a "crash start". In the third analysis, we removed patients that may be considered "too ill" to have or benefit from an AV-access creation. We identified patients with an ESKD comorbidity index ≥7 and excluded these patients. We repeated this analysis excluding patients with an ESKD comorbidity index ≥5. Finally, we conducted a complete-case analysis excluding those with missing data; to ensure no spurious results were obtained during the imputation technique.

Results: We redefined late nephrology referral to having seen a nephrologist at least 6 months prior to starting dialysis. Compared to those with more than 6 months of nephrology care, the odds ratio for patients having and AV-access creation prior to hemodialysis initiation with at least 6 months nephrology care prior to hemodialysis changed from 0.18 (in the main analysis) to 0.44 (95% CI 0.41 to 0.48; all other covariates remained materially the same [**Table S2**]). In the second sensitivity analysis, we found no difference in the direction of the effect for all risk factor when we removed patients that had an acute kidney injury (N=4,805) in the six months prior to starting hemodialysis. In the third analysis, when we removed patients who may have been considered poor candidate for an AV-access creation (ESKD index ≥5). The exclusion of those patients had no significant statistical effect on our results. Finally, there were no differences between our primary analysis and complete case analysis removing all patients with missing variables.

Table S1: Baseline conditions and their associated billing, diagnostic, and/or procedural codes

Variable	Data Source	Validity (best algorithm)
Demographics		
Date of Birth	**RPDB:** Yes	**RPDB**[1] Accuracy: 98%
Death Date	**RPDB:** Yes	**RPDB**[1] Accuracy: 98%
Sex	**RPDB:** Yes	**RPDB**[1] SN: 98.5%, SP:99%
Race	**CORR:** Yes	**CORR**[2] Accuracy: 58%
Rural Status	**RPDB:** Yes	No Validation
Acute Dialysis Start [a]	**CCI:** 1PZ21HQBR, 1PZ21HPD4 **CCP:** 5195, 6698 **OHIP fee codes:** R849, G323, G866, G330, G331, G093, G095, G294, G295	No Validation
Acute Kidney Injury	**ICD9:** 584 **ICD10:** N17	**ICD 10** SN: 36%; SP:92%
Primary etiology of ESKD diagnosis		Overall Accuracy: 71%
Diabetes	**CORR:** Yes	**CORR**[2] Accuracy: 78%
Glomerulonephritis	**CORR:** Yes	**CORR**[2] Accuracy: 83%
Polycystic kidney disease	**CORR:** Yes	**CORR**[2] Accuracy: 89%
Hypertension	**CORR:** Yes	**CORR**[2] Accuracy: 67%
Body mass index	**CORR:** Initial height and weight at dialysis start	No Validation
Comorbidities		
Diabetes mellitus	**CORR:** Yes	**CORR**[2] SN: 86%, SP: 97%
Congestive heart failure	**CORR:** No **ICD9:** 425, 428, 5184, 514, 9971 **CCP:** 4960, 4961, 4962, 4963, 4964 **ICD10:** I255, I42, I43, I50, J81 **CCI:** 1HP53, 1HP55 **OHIP diagnostic code:** 428 **OHIP fee codes:** R701, R702, Z429	No Validation
Arrhythmia	ICD 9: 4261, 4262, 4263, 4264, 4265, 4266, 4267, 4268, 4269, 427, 7850, ICD 10: I48, I44, I45, I47, I4900, I4901, I491, I492, I493, I494, I498, I499, R000 R001 **Presence of Above Arrhythmia code with either a:** **Pacemaker: CCP:** 4971, 4972, 4973, 0345, 0346, 0347, 0348, 0349, 4987 **CCI:** 1H237, 1HD53GRJA, 1HD54GRJA, 1HZ53GRNK, 1HZ53GRNL, 1HZ53GRNM, 1HZ54LANJ, 2HZ07NK, 1HZ07NL, 2HZ07NM, 1HZ53GRFR, 1HZ53LAFR, 1HZ53SYFR, 1HD55, 1HZ09, 1HZ55, 2HZ24 **OHIP fee codes:** G303, Z433, Z434, Z435, Z444, Z445, Z446, R752, Z412, Z428, E628, G176, G177, G115 **OR Implantable cardioverter-defibrillator** **OHIP fee codes:** G317, G321, R753, R761 **CCI:** 1HZ53HAFS, 1HZ53LAFS, 1HZ53SYFS, 1HZ55GPFS, 1HZ55LAFS, 1HZ55QAFS, 2HZ07FS, 2HZ07NR, 1HZ53GRFS	No Validation

	CCP: 4974, 4988	
Acute myocardial infarction	**CORR:** Yes **ICD9:** 410 **ICD10:** I21, I22	**CORR**[2] SN: 62%, SP: 94%, PPV: 75% **ICD9**[3] SN: 89% , PPV: 89% **ICD10**[4] SN: 89%, PPV: 87%
Coronary artery disease (CABG/PCI)	**CORR:** Yes **CCP:** 4802, 4803, 4809, 4811-4819 **CCI:** 1IJ50, 1IJ76 **OHIP fee codes:** Z434, R742, R743	**CORR**[2] SN: 69%, SP: 97%, PPV: 77% **CCP&CCI**[4,5] SN: 99%, SP: 100% , PPV>98%
Peripheral vascular disease	**CORR:** Yes **ICD9**: 4402, 4408, 4409, 5571, 4439, 4440 **ICD10**: I700, I702, I708, I709, I731, I738, I739, K551 **CCP**: 5125, 5129, 5014, 5016, 5018, 5028, 5038 **CCI**: 1KA76, 1KA50, 1KE76, 1KG26, 1KG50, 1KG57, 1KG76MI, 1KG87	**CORR**[2] SN: 47%, SP: 96%, PPV: 72%
Cerebrovascular disease	**CORR:** Yes **ICD9:** 431, 432.9, 434x, 436 **ICD10:** I61, I62, I63, I64	**CORR**[2] SN: 59%, SP: 96%, PPV: 72% **ICD9**[6] PPV: 79-88% **ICD10**[4] SN: 75-81%, PPV: 69%-87%
Cancer	**CORR:** Yes **ICD9:** V10, 140-165, 170-176, 179, 180-194, 1950-1955, 1958, 19-198, 1990, 1991, 2000-2002, 2008, 2010-2012, 2014-2017, 2019, 2020, 2026, 2028, 2029, 203-208, 230-234 **ICD10:** 80003, 80006, 80013, 80023, 80033, 80043, 80102, 80103, 80106, 80113, 80123, 80203, 80213, 83123, 87202, 87203, 959, 965-971, 980, 982, 984-991, 993, C00-C26, C30-C34, C37-C41, C43-C85, C90-C97, D00-D09 **OHIP diagnostic codes:** 140-165, 170-175, 179-208	**CORR**[2] **Malignancy** SN: 66%, SP: 99%, PPV: 90%
Lung disease (COPD)	**CORR:** Yes **ICD9**: 491-496, 500-505, 5064, 5069, 5081, 515-517, 5185, 5188, 5198, 5199, 4168, 4169 **ICD10**: I272-I279, J40-J47, J60-J68, J701, J703, J704, J708, J709, J82, J84, J92, J941, J949, J953, J961, J969, J984, J988, J989, J99 **OHIP diagnostic codes:** 491-494, 496, 501, 502, 515, 518, 519, J889, J689	**CORR**[2] SN: 60%, SP: 96%, PPV: 67%
Liver Dysfunction	**CORR:** No **ICD9:** 570, 5711-5716, 5718, 5719, 5722, 5723, 5724, 5728, 5730, 4560, 4561, 4562, 571 **ICD10:** K701, K702, K703, K704, K709, K742, K71, K720, K721, K729, K730, K731, K732, K738, K739, K740, K741, K743, K744, K745, B150, B180, B181, B182, B188, B189, B190, B199, B162, K761, K766, K767, K768, I850, I859, K746, K760, B160, K778, B162 **CCP:** 623, 624, 6691 **CCI:** 1OA85LAXXK, 1OA85VCXXK, 1OA85WLXXJ, 1OA85WLXXK **OHIP diagnostic codes:** 571, 573	No Validation
Dementia	**CORR:** No **ICD9:** 290,2941,3312 **ICD10:** F00, F01, F02, F03, F051, G30, G311	No Validation

	OHIP diagnostic codes: 290, 331, 797	
Other serious illness [b]	**CORR:** Yes	**CORR**[2] SN: 22%, SP: 93%, PPV 30%
Smoking	**CORR:** Yes	**CORR**[2] SN: 54%, SP: 95%, PPV 66%
Adapted-ESKD Comorbidity Index	Calculated based on comorbidities	Not Applicable
Location of dialysis treatments		
Acute care hospital	**CORR:** Yes	No Validation
Community centre	**CORR:** Yes	No Validation
Home hemodialysis	**CORR:** Yes	No Validation
Transplant waitlist	**CORR:** Yes	No Validation
Assistance/ care with dialysis treatments		
Total care	**CORR:** Yes	No Validation
Limited self-care	**CORR:** Yes	No Validation
Total self-care	**CORR:** Yes	No Validation
Laboratory value [c]		
Albumin, g/dL	**CORR:** Yes	No Validation
Hemoglobin, g/dL	**CORR:** Yes	No Validation
eGFR [d], ml/min/1.73 m^2	**CORR:** Yes	No Validation
Late referral [e]	**CORR:** Yes	No Validation
Early initiation [f]	**CORR:** Yes	No Validation

CORR=Canadian Organ Replacement Register; CCI=Canadian Classification of Health Interventions; CCP=Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures; ICD=International Classification of Diseases; OHIP=Ontario Health Insurance Plan; RPDB: Registered Persons Database; CABG=Coronary artery bypass graft; PCI=Percutaneous coronary intervention; SN=Sensitivity; SP=Specificity; PPV=Positive predictive value

(a) Having a dialysis treatment as an inpatient in the two weeks prior to hemodialysis start
(b) Other Serious Illness that may shorten life expectancy less than 5 years
(c) Last lab values prior to starting hemodialysis
(d) eGFR, estimated glomerular filtration rate, calculated using creatinine level at the last lab value prior to hemodialysis start and using the CKD-EPI Chronic Kidney Disease Epidemiology Collaboration) formula
(e) Late referral defined as first seen by a nephrologist less than 90 days prior to initiation of dialysis
(f) early initiation defined as eGFR >10.5 ml/min/1.73 m2 at the start of dialysis

1. Quinn RR, Laupacis A, Austin PC, et al. Using administrative datasets to study outcomes in dialysis patients: a validation study. *Med Care*. 2010;48(8):745–50. doi:10.1097/MLR.0b013e3181e419fd.
2. Moist LM, Richards HA, Miskulin D, et al. A Validation Study of the Canadian Organ Replacement Register. *Clin J Am Soc Nephrol*. 2011;6(4):813–818. doi:10.2215/CJN.06680810.
3. Austin PC, Daly P a., Tu J V. A multicenter study of the coding accuracy of hospital discharge administrative data for patients admitted to cardiac care units in Ontario. *Am Heart J*. 2002;144(2):290–296. doi:10.1067/mhj.2002.123839.
4. Juurlink D, Preyra C, Croxford R, et al. *Canadian Institute for Health Information Discharge Abstract Database : A Validation Study*. Toronto, Ontario; 2006.
5. Richards J, Brown A, Homan C. The data quality study of the Canadian discharge abstract database. Proceedings of Statistics Canada Symposium 2001 – Achieving data quality in a statistical agency: A methodological perspective. 2001.
6. Liu L, Reeder B, Shuaib A, Mazagri R. Validity of stroke diagnosis on hospital discharge records in Saskatchewan, Canada: implications for stroke surveillance. *Cerebrovasc Dis*. 1999;9(4):224–30. doi:15960.

Table S2: Covariates associated with the likelihood of AV access creation prior to hemodialysis start among patients with at least 6 months of pre-dialysis nephrology care (adjusting for correlated outcomes within each dialysis facility)

Variable	Level	Adjusted Odds ratio	95% CI
Age group (Years)	<65	1.00	Reference
	65-74	1.25	1.13, 1.37
	75-84	1.19	1.07, 1.32
	85+	0.85	0.71, 1.02
Sex	Male	1.30	1.21, 1.41
Race	Asian	0.95	0.80, 1.12
	Black	0.80	0.67, 0.96
	Other	0.96	0.85, 1.09
	Unknown	1.06	0.89, 1.28
	White	1.00	Reference
Body mass index (kg/m^2)	<18.5	0.82	0.65, 1.03
	18.5-24.9	1.00	Reference
	25-29.9	1.24	1.12, 1.38
	>30	1.49	1.34, 1.65
Year of dialysis start	2001-2003	1.00	Reference
	2004-2006	0.72	0.66, 0.80
	2007-2010	0.44	0.39, 0.48
Lab Values [a]	Hemoglobin	1.21	1.18, 1.25
	Albumin	1.66	1.54, 1.82
Primary etiology of ESKD diagnosis	Diabetes	1.32	1.14, 1.53
	Glomerulonephritis	1.00	Reference
	Polycystic kidney disease	2.59	2.08, 3.23
	Renal vascular disease	0.89	0.77, 1.03
	Other	0.60	0.51, 0.70
	Unknown	0.64	0.55, 0.76
ESKD comorbidity index [b]	0	1.00	Reference
	1	1.34	1.06, 1.69
	2	1.03	0.88, 1.21
	3	0.89	0.75, 1.06
	4	0.85	0.72, 1.00
	5	0.88	0.74, 1.03
	6	0.87	0.73, 1.04
	7+	0.59	0.51, 0.69
Late referral [c]	Yes	0.44	0.41, 0.48
Rural resident	Yes	0.77	0.68, 0.87

(a) Last lab values prior to starting hemodialysis

(b) The ESKD comorbidity index is a modified Charlson weighted score based on the history of the following comorbidities: congestive heart failure, peripheral vascular disease, cerebral vascular disease, dementia, chronic lung disease, rheumatological, peptic ulcer disease, diabetes, diabetes with complications, moderate/severe liver disease, metastatic disease, leukemia, lymphoma.

(c) Late referral was defined as the complementary definition of early referral. Early referral is defined as having seen a nephrologist for the first time at least 6 months prior to hemodialysis start as well as having at least 3 nephrology visits in the 5 years prior with 2 or more visits in the year prior to hemodialysis start.

ESKD=End-stage kidney disease; CI=Confidence interval