Validation of kidney transplantation using administrative data

Ngan N Lam¹², Eric McArthur³, S Joseph Kim³⁴ and Gregory A Knoll⁵⁶

Abstract

Background: Administrative data are increasingly being used to assess outcomes in kidney transplant recipients.

Objective: To assess the validity of transplant data in healthcare administrative databases compared to the reference standard of information collected directly from transplant centres.

Design: Retrospective cohort study.

Setting: One of three major transplant centres in Ontario (Toronto General Hospital, University Hospital – London, and Ottawa Hospital).

Patients: Recipients who received a kidney-only transplant between 2008 and 2011.

Measurements: For each data source, we identified kidney transplants performed. We calculated the sensitivity and positive predictive value (PPV) of the administrative data for the reference standard data.

Methods: The data collected from transplant centres were compared with data from the Canadian Organ Replacement Register (CORR) database, a hospital procedural code from the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD), and provincial physician billing claims from the Ontario Health Insurance Plan (OHIP) database.

Results: During the study period, the three centres reported a total of 1112 kidney transplants performed. The probability of identifying kidney transplant recipients in CORR, CIHI, and OHIP, given they were identified by the transplant centres (sensitivity), was 96%, 98%, and 98% respectively. The probability that the database code correctly identified a transplant recipient (positive predictive value) in CORR, CIHI, and OHIP was 98%, 98%, and 96% respectively.

Limitations: We validated the information from 2008 to 2011 and cannot attest to the reliability of the data beyond the study period. Specifically, we would not regard this as evidence that applies to the earlier years, shortly after the inception of the databases. Secondly, we were unable to distinguish between first and repeat transplantation.

Conclusions: Codes in CORR, CIHI, and OHIP each operate well in the detection of kidney transplant recipients. These data sources can be used to efficiently identify and follow kidney transplant recipients for post-transplant outcomes.

Keywords: Administrative data, Canadian Organ Replacement Register (CORR), Kidney transplantation, Validation study

* Correspondence: nlam5@uwo.ca

¹Department of Medicine, Division of Nephrology, Western University, London, Ontario, Canada

²Department of Epidemiology and Biostatistics, Western University, London, Ontario, Canada

Full list of author information is available at the end of the article

© 2015 Lam et al; licensee BioMed Central. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.
Abrégé

Contexte: L’utilisation des données administratives tend à se développer dans l’évaluation des résultats chez les greffés du rein.

Objectifs: Évaluer la validité des données sur les greffes contenues dans les bases de données administratives en santé, en les comparant aux informations suivant les normes de référence recueillies directement dans les services de transplantations.

Type d’étude: Étude rétrospective de cohorte.

Contexte: Trois des trois grands services de transplantations de l’Ontario (le Toronto General Hospital, le University Hospital de London et l’Hôpital d’Ottawa).

Participants: Des receveurs qui ont été greffés uniquement du rein entre 2008 et 2011.

Mesures: Nous avons ciblé des greffes qui ont été effectuées pour chacune des sources de données. Nous avons calculé la sensibilité et la valeur prédictive positive (VPP) des données administratives pour les normes de référence en matière d’informations.

Méthodes: Les données recueillies des services de transplantations ont été comparées à celles contenues dans la base de données du Registre canadien des insuffisances et des transplantations d’organes (RCITO), dans un code procédural hospitalier de la Base de données sur les congés des patients de l’Institut canadien d’information sur la santé (BDCP-ICIS), et aux demandes d’indemnisations pour la facturation par les médecins contenues dans la base de données du Régime d’assurance-maladie de l’Ontario (RAMQ).

Résultats: Au cours de l’étude, les trois centres ont fait état d’un total de 1112 greffes rénales. Les probabilités d’identifier les receveurs de greffes rénales au RCITO, à l’ICIS et à la RAMQ, considérant qu’ils ont été identifiés par les services de transplantations (sensibilité), étaient respectivement de 96%, de 98%, et de 98%. Les probabilités que le code de la base de données identifie correctement un receveur de greffe (valeur prédictive positive) au RCITO, à l’ICIS et à la RAMQ étaient respectivement de 98%, de 98%, et de 96%.

Limites de l’étude: Nous avons validé l’information de 2008 à 2011, mais ne pouvons attester de la validité des données au-delà de cette période. Plus précisément, l’étude ne pourrait constituer une preuve s’appliquant aux années antérieures, qui suivent de près la mise en place des bases de données. De plus, nous n’avons pas été en mesure de faire une distinction entre les greffes uniques et les greffes répétées.

Conclusions: Les codes du RCITO, de l’ICIS et de la RAMQ sont utiles à la détection des receveurs de greffes. Ces sources de données peuvent être utilisées pour identifier efficacement et retrouver les receveurs de greffes à des fins de suivi de l’issue des greffes.

What was known before
To identify kidney transplant recipients using administrative databases, information can be obtained from a national transplant registry (Canadian Organ Replacement Register [CORR]), from a hospital procedural code (Canadian Institute for Health Information Discharge Abstract Database [CIHI-DAD]), from a provincial physician billing claim (Ontario Health Insurance Plan [OHIP]), or directly from the transplant centres.

What this adds
The probability of identifying kidney transplant recipients in CORR, CIHI, and OHIP, given they were identified by the transplant centres (sensitivity), was 96%, 98%, and 98% respectively. The probability that the database code correctly identified a transplant recipient (positive predictive value) in CORR, CIHI, and OHIP was 98%, 98%, and 96% respectively.
Health Network, Toronto; and The Ottawa Hospital, Ottawa) provided information on their kidney transplant activity from January 1, 2008 to December 31, 2011. These data were linked to national and provincial healthcare databases at the Institute for Clinical Evaluative Sciences (ICES) using each patient’s encrypted healthcard number. Recipients of simultaneous multi-organ transplants, including kidney-pancreas transplants, were excluded. Information from the transplant centres was considered to be the reference standard. These data were compared to information on KTR in three different healthcare administrative databases. The CORR collects information on all Canadians receiving renal replacement therapy, including dialysis and kidney transplantation. The CIHI Discharge Abstract Database (CIHI-DAD) contains information on diagnostic and procedural information during hospital admissions. The OHIP database contains fee-for-service physician billing claims for both inpatient and outpatient physician services. The codes used to identify KTR from each of the databases are summarized in Table 1.

For each data source, we compared the number of kidney transplants reported during the study period. We determined the probability of identifying KTR in CORR, CIHI, and OHIP given they were identified by the transplant centres (sensitivity), and the probability the codes in CORR, CIHI, and OHIP correctly identified KTR (positive predictive value [PPV]). For the transplants captured by both the transplant centres and the database, the median absolute difference between the recorded transplant dates was 0 days (interquartile range, IQR, 0 to 0) for CORR, 1 day (IQR 0 to 1) for CIHI, and 0 days (IQR 0 to 0) for OHIP.

Discussion
Provincial and national administrative databases can be used to efficiently follow KTR for post-transplant outcomes provided such databases accurately identify KTR. In this study, three administrative databases, CORR, CIHI, and OHIP, successfully identified most KTR transplanted in the province of Ontario from January 1, 2008 to December 31, 2011.

Moist et al. previously performed a validation study of dialysis patients captured in CORR compared to manual chart review and found that demographic information, such as age and sex, had 97% agreement, race had 58% agreement, and primary renal disease had 71% agreement [4]. Co-morbid conditions had sensitivities ranging from 47% (for peripheral vascular disease) to 89% (for hypertension), where the reference standard was patient chart review. The current study extends the validation of the CORR database by assessing the accuracy of the

Table 1 Administrative database codes used to identify kidney transplant recipients

| Database | Kidney transplant code | Description |
|----------|------------------------|-------------|
| CORR     | Treatment code: 171    | Acute care hospital, Transplantation, Total care |
|          | Transplanted organ type code: |
|          | 10                     | Kidney/Dialysis |
|          | 11                     | Kidney – Left |
|          | 12                     | Kidney – Right |
|          | 18                     | Kidney – One |
|          | 19                     | Kidney – Two |
| CIHI     | CCI code: 1PC85        | Transplant, kidney |
| OHIP     | Fee code: S435         | Kidney transplant |
|          | S434                   | Kidney re-transplant |

Abbreviations: CCI, Canadian Classification of Health Interventions; CIHI, Canadian Institute for Health Information; CORR, Canadian Organ Replacement Register; OHIP, Ontario Health Insurance Plan.
kidney transplant data. To our knowledge, the validation of kidney transplant codes using CIHI or OHIP has not been previously reported. It is reassuring that all three databases had high sensitivity and positive predictive value when compared to the data collected by transplant centres.

There are potential reasons to explain some discrepancies in the information between the transplant centres and the various databases. CORR receives transplantation information from the transplant centres and from provincial organ procurement agencies. There is the possibility of under-reporting by the transplant centres to CORR. Similarly, the hospital-based intervention code from CIHI is abstracted by medical coders who are trained to assign standardized codes on the basis of physician-recorded diagnoses and procedures in a patient’s medical chart [5]. In contrast, the information contained in the OHIP database is from physician billing claims and an over-reporting of cases may have occurred if physicians mistakenly used codes intended for either living donor nephrectomy, kidney auto-transplantation, or the transplantation of other organs.

There are limitations to this study. Although three major transplant centres in Ontario provided centerspecific data on their kidney transplant activity, we did not have information from the other three adult transplant centres (Kingston, Hamilton, Toronto – St. Michael’s Hospital). We do not anticipate that the lack of data from these centres would have significantly changed our results. We also validated the information from 2008 to 2011 and, thus, cannot attest to the reliability of the data beyond the study period, particularly in the earlier years at the inception of the databases. For example, CORR began collecting information on organ failure in 1981 and the completeness of the kidney transplant data has likely improved since that time.

Conclusions

The results of this study suggest that the CORR, CIHI, and OHIP databases have high sensitivity and positive predictive value in identifying KTR compared to information from the transplant centres. These databases can be reliably used to conduct comparative effectiveness and health services research that require the accurate determination of KTR at the population level.

Consent

The Institute for Clinical Evaluative Sciences (ICES) is a designated prescribed entity under Section 45 of the Personal Health Information Protection Act (PHIPA), and as such the need for patient consent is waived.

Abbreviations

CCI: Canadian Classification of Health Interventions; Cl: Confidence interval; CIHI: Canadian Institute for Health Information; CIHI-DAD: Canadian Institute for Health Information – Discharge Abstract Database; CORR: Canadian Organ Replacement Register; ICES: Institute for Clinical Evaluative Sciences; IQR: Interquartile range; KTR: Kidney transplant recipients; OHIP: Ontario Health Insurance Plan; PPV: Positive predictive value.

Competing interests

The authors declare that they have no competing interests.

Authors’ contributions

NNL, SJK, and GAK conceived of the study and participated in its design and coordination. NNL drafted the manuscript. EM provided analytic and statistical support. All authors read and approved the final manuscript.

Acknowledgements

This project was conducted at the Institute for Clinical Evaluative Sciences (ICES) Western Site. ICES is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care. ICES Western is funded by an operating grant from the Academic Medical Organization of Southwestern Ontario. This project was conducted with members of the provincial ICES Kidney, Dialysis and Transplantation Research Program (www.ices.on.ca) which receives programmatic grant funding from the Canadian Institutes of Health Research. NNL was supported by the Clinical Investigator Program at Western University and by a Kidney Research Scientist Core Education and National Training Program (KRESCENT) postdoctoral fellowship award. The opinions, results, and conclusions reported in this article are those of the authors and are independent of the funding sources. The funding sources did not influence any aspect of this study. We thank Dr. Amit Garg for his input and support on this project.

Author details

1Department of Medicine, Division of Nephrology, Western University, London, Ontario, Canada. 2Department of Epidemiology and Biostatistics, Western University, London, Ontario, Canada. 3Institute for Clinical Evaluative Sciences (ICES), Ontario, Canada. 4Department of Medicine, Division of Nephrology, University of Toronto, Toronto, Ontario, Canada. 5Department of Medicine, Division of Nephrology, Kidney Research Centre, Ottawa, Ontario, Canada. 6Clinical Epidemiology Program, Ottawa Health Research Institute, Ottawa, Ontario, Canada. 7London Kidney Clinical Research Unit, Room ELL-117, Westminster Tower, London Health Sciences Centre, 800 Commissioners Road East, London, Ontario N6A 4G5, Canada.

Received: 8 January 2015 Accepted: 23 March 2015 Published online: 18 May 2015

Table 2 Accuracy of kidney transplant information captured in CORR, CIHI, and OHIP compared to information obtained directly from transplant centres (where the latter served as the reference standard)

| Database            | Total number of transplants identified | Sensitivity (95% Cl) | Positive predictive value (95% Cl) |
|---------------------|---------------------------------------|----------------------|-----------------------------------|
| Transplant Centres  | 1112                                  | -                    | -                                 |
| CORR                | 1082                                  | 96% (94% to 97%)     | 98% (98% to 99%)                  |
| CIHI                | 1105                                  | 98% (97% to 99%)     | 98% (97% to 99%)                  |
| OHIP                | 1132                                  | 98% (97% to 99%)     | 96% (95% to 97%)                  |

Abbreviations: Cl, confidence interval; CIHI, Canadian Institute for Health Information; CORR, Canadian Organ Replacement Register; OHIP, Ontario Health Insurance Plan.
References
1. Young A, Kim SJ, Speechney MR, Huang A, Knoll GA, Prasad GVR, et al. Accepting kidneys from older living donors: impact on transplant recipient outcomes. Am J Transplant. 2011;11:743–50.
2. Jiang Y, Villeneuve PJ, Schaubel D, Mao Y, Rao P, Morrison H. Long-term follow-up of kidney transplant recipients: comparison of hospitalization rates to the general population. Transplant Res. 2013;2:15. doi:10.1186/2047-1440-2-15.
3. Villeneuve PJ, Schaubel DE, Fenton SS, Shepherd FA, Jiang Y, Mao Y. Cancer incidence among Canadian kidney transplant recipients. Am J Transplant. 2007;7:941–8.
4. Moist LM, Richards HA, Miskulin D, Lok CE, Yeates K, Garg AX, et al. A validation study of the Canadian Organ Replacement Register. Clin J Am Soc Nephrol. 2011;6:813–8.
5. Garg AX, Nevis IF, McArthur E, Sontrop JM, Koval JJ, Lam NN, et al. Gestational hypertension and preeclampsia in living kidney donors. N Engl J Med. 2015;372:124–33.