

# Perioperative Outcomes Following Kidney-Pancreas Transplantation in Alberta, Canada: Research Letter

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Danielle E. Fox<sup>1</sup> , Robert R. Quinn<sup>1,2</sup>, Paul E. Ronksley<sup>1</sup> ,  
Tyrone G. Harrison<sup>1,2</sup> , Hude Quan<sup>1,3</sup>, David Bigam<sup>4</sup>,  
A. M. James Shapiro<sup>4</sup>, Rachel Jeong<sup>2</sup>, and Ngan N. Lam<sup>1,2</sup> 

## Abstract

**Background:** Simultaneous kidney-pancreas transplantation (SPK) has benefits for patients with kidney failure and type I diabetes mellitus, but is associated with greater perioperative risk compared with kidney-alone transplantation. Postoperative care settings for SPK recipients vary across Canada and may have implications for patient outcomes and hospital resource use.

**Objective:** To compare outcomes following SPK transplantation between patients receiving postoperative care in the intensive care unit (ICU) compared with the ward.

**Design:** Retrospective cohort study using administrative health data.

**Setting:** In Alberta, the 2 transplant centers (Calgary and Edmonton) have different protocols for routine postoperative care of SPK recipients. In Edmonton, SPK recipients are routinely transferred to the ICU, whereas in Calgary, SPK recipients are transferred to the ward.

**Patients:** 129 adult SPK recipients (2002-2019).

**Measurements:** Data from the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) were used to identify SPK recipients (procedure codes) and the outcomes of inpatient mortality, length of initial hospital stay (LOS), and the occurrence of 16 different patient safety indicators (PSIs).

**Methods:** We followed SPK recipients from the admission date of their transplant hospitalization until the first of hospital discharge or death. Unadjusted quantile regression was used to determine differences in LOS, and age- and sex-adjusted marginal probabilities were used to determine differences in PSIs between centers.

**Results:** There were no perioperative deaths and no major differences in the demographic characteristics between the centers. The majority of the SPK transplants were performed in Edmonton ( $n = 82$ , 64%). All SPK recipients in Edmonton were admitted to the ICU postoperatively, compared with only 11% in Calgary. There was no statistically significant difference in the LOS or probability of a PSI between the 2 centers (LOS for Edmonton vs Calgary: 16 vs 13 days,  $P = .12$ ; PSIs for Edmonton vs Calgary: 60%, 95% confidence interval [CI] = 0.50-0.71 vs 44%, 95% CI = 0.29-0.59,  $P = .08$ ).

**Limitations:** This study was conducted using administrative data and is limited by variable availability. The small sample size limited precision of estimated differences between type of postoperative care.

**Conclusions:** Following SPK transplantation, we found no difference in inpatient outcomes for recipients who received routine postoperative ICU care compared with ward care. Further research using larger data sets and interventional study designs is needed to better understand the implications of postoperative care settings on patient outcomes and health care resource utilization.

## Abrégé

**Contexte:** La double transplantation rein-pancréas (DTRP) présente des bienfaits pour les patients atteints à la fois d'insuffisance rénale et de diabète de type I, mais elle est associée à un plus grand risque de complications périopératoires que la transplantation rénale seule. Les paramètres de soins postopératoires pour les patients ayant subi une DTRP varient à travers le Canada et peuvent avoir des répercussions sur l'évolution de l'état de santé des patients et sur l'utilisation des ressources hospitalières.



**Objectifs:** Comparer les résultats des patients recevant des soins postopératoires, soit à l'unité de soins intensifs (USI), soit à l'étage, après une double transplantation rein-pancréas.

**Type d'étude:** Étude de cohorte réalisée à partir des données administratives de santé.

**Cadre:** Les deux centres de transplantation de l'Alberta (Calgary et Edmonton) disposent de protocoles différents en ce qui concerne les soins postopératoires courants prodigués aux receveurs d'une DTRP. À Edmonton, ces patients sont systématiquement transférés à l'USI; tandis qu'à Calgary, ils sont transférés à l'étage.

**Sujets:** L'étude porte sur 129 adultes ayant reçu une DTRP (2002-2019).

**Mesures:** Les données de la Base de données sur les congés des patients de l'Institut canadien d'information sur la santé (ICIS-BDCP) ont été utilisées pour recenser les receveurs d'une DTRP (codes d'intervention) et colliger les résultats quant à la mortalité en cours d'hospitalisation, la durée du séjour initial (DSI) et l'occurrence de 16 différents indicateurs de sécurité des patients (ISP).

**Méthodologie:** Nous avons suivi les receveurs d'une DTRP de la date de leur admission pour la greffe jusqu'au jour de leur premier congé de l'hôpital ou jusqu'à leur décès. Les différences entre les deux centres en ce qui concerne le DSI ont été établies à l'aide d'une régression par quantile non corrigée, et par probabilités marginales ajustées en fonction de l'âge et du sexe pour les ISP.

**Résultats:** Aucun décès périopératoire n'est survenu et aucune différence majeure n'a été observée entre les centres quant aux caractéristiques démographiques. La majorité des interventions ont été effectuées à Edmonton (n = 82; 64 %). Tous les receveurs d'une DTRP à Edmonton ont été admis à l'USI après la chirurgie, contre seulement 11 % à Calgary. Aucune différence statistiquement significative n'a été observée quant à la durée du séjour (DSI à Edmonton par rapport à Calgary : 16 jours c. 13 jours, p = 0,12) ou à la probabilité d'un ISP (ISP à Edmonton : 60 %; IC 95 % : 0,50-0,71 contre ISP à Calgary : 44 %; IC 95 % : 0,29-0,59, p = 0,08) entre les deux centres.

**Limites:** L'étude a été réalisée à partir des données administratives et est limitée par la disponibilité des variables. La faible taille de l'échantillon limite la précision des différences estimées entre les types de soins postopératoires.

**Conclusion:** Après une double transplantation rein-pancréas, nous n'avons observé aucune différence entre les résultats des patients ayant reçu les soins postopératoires courants à l'USI et ceux des patients les ayant reçus à l'étage. Des études interventionnelles utilisant de plus grands ensembles de données sont nécessaires pour mieux comprendre l'incidence des soins postopératoires sur les résultats des patients et sur l'utilisation des ressources en santé.

## Keywords

Alberta, kidney-pancreas transplantation, intensive care unit, center-variation, postoperative management

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## Introduction

For patients with kidney failure and type I diabetes mellitus, simultaneous kidney-pancreas transplantation (SPK) obviates the need for blood sugar monitoring and insulin requirements in addition to the known benefits of kidney transplantation.<sup>1</sup> Compared with kidney-alone transplantation, SPK transplantation is associated with higher perioperative morbidity and mortality.<sup>1</sup> As a result, some transplant centers routinely admit all SPK recipients to the intensive care unit (ICU) postoperatively for close monitoring of potential complications. However, there is center-level variability in the location of postoperative care, as other centers transfer their SPK recipients to a step-down unit or to the

ward after the patient is stabilized in the recovery room. Whether this variation in practice affects perioperative outcomes is currently unknown. To inform this practice, we compared 2 transplant centers in Alberta, Canada, that have different policies for the setting of postoperative care (ICU vs ward) of SPK recipients.

## Methods

### Study Design, Setting, and Data Sources

We performed a retrospective, population-based cohort study using the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) to compare 2

<sup>1</sup>Department of Community Health Sciences, University of Calgary, AB, Canada

<sup>2</sup>Cumming School of Medicine, Division of Nephrology, University of Calgary, AB, Canada

<sup>3</sup>Center for Health Informatics, University of Calgary, AB, Canada

<sup>4</sup>Department of Surgery, Division of Transplantation, University of Alberta, Edmonton, Canada

### Corresponding Author:

Ngan N. Lam, Health Research Innovation Centre, University of Calgary, 3230 Hospital Drive Northwest, Calgary, AB T2N 4Z6, Canada.  
Email: ngan.lam@ucalgary.ca

transplant centers in Alberta, Canada (the University of Alberta Hospital in Edmonton and the Foothills Medical Centre in Calgary). Baseline characteristics, covariate information, and outcome data from CIHI-DAD were ascertained using diagnostic and procedural codes based on the *International Classification of Diseases, 10th Revision (ICD-10)*.<sup>2</sup> We followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology)/RECORD (REporting of studies Conducted using Observational Routinely-collected health Data) guidelines for conducting and reporting observational studies using administrative health data (Supplemental Table S1).

### Population

We identified all adult patients ( $\geq 18$  years old) who received an SPK transplant between 2002-2019 in Alberta, Canada, based on the presence of any single code for a multi-organ SPK transplant or a combination of codes for kidney transplant and pancreas transplant (Supplemental Table S2). Repeat kidney transplant recipients were excluded as this requires a different surgical approach<sup>1</sup> and postoperative management and outcomes may differ. We compared recipients transplanted in Edmonton, where the protocol is to transfer all recipients to the ICU postoperatively, with recipients transplanted in Calgary, where recipients are transferred to the ward postoperatively, unless ICU admission is medically indicated. We collected baseline characteristics at the time of admission, including age, sex, and location (urban vs rural, based on postal code). The updated Charlson Comorbidity Index and Score was used to identify comorbidities and has been validated in the kidney transplant recipient population.<sup>3</sup>

### Outcomes

The outcomes included inpatient mortality, length of initial hospital stay in days (LOS), and the occurrence of a patient safety indicator (PSI). Patient safety indicators identify the occurrence of an adverse event during hospital admission. We screened for the occurrence of any 1 of 16 PSIs developed by Southern et al<sup>4</sup> (Supplemental Table S3).

### Statistical Analysis

The SPK recipients were followed from the admission date of the initial transplant hospitalization until the first of hospital discharge or death. Baseline characteristics and outcomes were analyzed using a combination of parametric and nonparametric tests determined by the underlying distribution of the data. Differences in baseline characteristics between recipients from Edmonton or Calgary were estimated using standardized differences in proportions and standardized mean differences due to the variation in sample

size between groups.<sup>5</sup> Descriptive statistics (counts and proportions) were used to identify the number and type of PSIs at each site. Unadjusted quantile regression was used to determine differences in LOS. Age- and sex-adjusted marginal probabilities were estimated to determine differences in PSIs between sites. No missing data were identified as all chosen baseline covariates and outcome measures are routinely collected in Alberta.<sup>6</sup> Effect sizes  $> 0.5$  (medium effect size) or 2-tailed  $P$ -values  $< .05$  were considered statistically significant. Data analysis was conducted using STATA version 15 (StataCorp. 2017; Statacorp LLC, College Station, Texas).

### Results

A total of 131 SPK transplant recipients were identified between April 1, 2002, and July 1, 2019. Two were excluded as it was their second kidney transplant, resulting in 129 being included in the study, the majority of which were performed in Edmonton ( $n = 82$ , 64%). The mean age of the cohort was 41 (SD = 7) years, and Edmonton had a higher proportion of male recipients compared with Calgary (62% vs 43%, standard difference = 0.40) (Table 1). As expected, 100% of the SPK recipients in Edmonton were admitted to the ICU following surgery compared with only 11% in Calgary (standardized difference = 4.1).

There were no perioperative deaths in our cohort or statistically significant difference in LOS between Edmonton and Calgary (16 vs 13 days,  $P = .12$ ). A total of 175 PSIs were identified, with 1.38 per person in Edmonton and 1.32 per person in Calgary. The most common PSIs in both Edmonton and Calgary were hospital-acquired infections (25% vs 18%), surgical complications (16% vs 18%), and hemorrhagic events (16% vs 15%) (Supplemental Table S3). The age- and sex-adjusted marginal probabilities of having a PSI were also not statistically different between centers (Edmonton vs Calgary: 60%, 95% confidence interval [CI] = 0.50-0.71 vs 44%, 95% CI = 0.29-0.59,  $P = .08$ ).

### Discussion

Despite differences in postoperative care settings, we found that the outcomes for SPK recipients were similar between 2 transplant centers in Alberta. In Edmonton, all SPK recipients were admitted to the ICU, as per protocol, whereas only 1 in 10 SPK recipients were admitted to the ICU in Calgary. Although there was a trend toward longer LOS in Edmonton compared with Calgary (16 vs 13 days), this was not statistically significant. Also, there was no statistical difference in the marginal probabilities of PSIs between sites.

Protocols that bypass routine ICU admissions have been shown to be safe and feasible for liver transplant recipients,

**Table 1.** Baseline Characteristics and Outcomes in SPK Transplant Recipients Stratified by Center.

	Total N = 129	Calgary n = 47	Edmonton n = 82	Standardized difference <sup>a</sup>
<b>Baseline characteristics</b>				
Age, years, mean (SD)	40.8 (7.2)	39.7 (6.6)	41.4 (7.4)	0.24
Male, n (%)	71 (55)	20 (43)	51 (62)	0.40
Rural, n (%)	13 (10)	2 (4)	11 (13)	0.33
Charlson Comorbidity Score, mean (SD)	3.5 (1.0)	3.3 (1.0)	3.6 (1)	0.30
ICU admission, n (%)	87 (67)	5 (11)	82 (100)	4.1
				<i>P</i> -value
<b>Outcomes</b>				
Inpatient mortality, n (%)	—	0	0	NA
Length of stay, median (95% CI)	—	13 (10.0-16.0)	16 (13.7-18.3)	0.12
PSI, probability (95% CI) <sup>b</sup>	—	0.44 (0.29-0.59)	0.60 (0.50-0.71)	0.08

Note. Few comorbidities were identified due to the use of a single database; thus, additional comorbidities were not reported. SPK = simultaneous kidney-pancreas; ICU = intensive care unit; NA = not applicable; CI = confidence interval; PSI = patient safety indicator.

<sup>a</sup>Effect sizes of 0.2, 0.5, and 0.8 represent small, medium, and large effect sizes, respectively.

<sup>b</sup>The probability of an individual experiencing at least 1 PSI. Calculated using age- and sex-adjusted marginal probabilities (all other estimates are unadjusted).

reducing the LOS and cost of postoperative care, without increasing the risk of complications.<sup>7</sup> This may also be true for SPK recipients, as we found that routine ICU admissions did not result in any significant difference in postoperative outcomes. Although our findings suggest that routine ICU care may not always be warranted, this must not undermine the acuity and complex needs of multi-organ transplant recipients.<sup>8</sup> It is important to consider the reason for routine ICU care. Many facilities do not have a functional step-down unit and rely on ICU resources to ensure patient safety in early postoperative management.

There was a high probability of having a PSI in our cohort (44%-60%), which was much higher than other critically ill patients admitted to ICU in Alberta within a similar timeframe (25%).<sup>9</sup> However, the probability of a PSI in our cohort was similar to that reported in kidney-alone transplant recipients (39%), which suggests that this is likely attributed to transplant recipients being at high risk for adverse events.<sup>10</sup> As such, the high probability of PSIs during admission for SPK transplantation may reflect the higher acuity of multi-organ transplantation rather than a higher prevalence of modifiable adverse events. Regardless of the location of postoperative care, units must be adequately equipped to identify and respond to adverse events to support high-acuity patients.

Our study has limitations worth noting. This study was conducted using administrative data from inpatient encounters. Thus, we were unable to account for unmeasured confounding variables or report outcomes after discharge, such as graft loss. Although selection of variables was limited, we still had access to clinically relevant outcome data and other important baseline characteristics. We also had a relatively small sample size and it is possible that we were not sufficiently powered to detect statistically significant differences. Finally, patients in the ICU are monitored more intensely

than they would be on the transplant ward due to differing protocols and available resources. Unfortunately, we did not have access to granular data to explicate differences in care delivery above care setting. Although these factors, among others, would limit the generalizability of our findings, we have provided preliminary data that require further exploration and could have implications for future practice.

## Conclusion

Following SPK transplantation, we found no difference in inpatient postoperative outcomes in recipients who received routine postoperative ICU care compared with ward care. Our study provides preliminary data and suggests that further research using larger data sets or interventional study designs is needed to explore the implications of postoperative care settings on patient outcomes and health care resource utilization.

## Ethics Approval and Consent to Participate

The study was approved by the Conjoint Health Research Ethics Board at the University of Calgary (Calgary, Alberta, Canada; CHREB ID#REB13-0760).

## Consent for Publication

All authors consent to publication.

## Availability of Data and Materials

Data used in this study are available within the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD).

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## Author Contributions

D.E.F. and N.N.L. conceived of the study and participated in the study design. D.E.F. performed the statistical analyses and drafted the initial version of the manuscript. All authors contributed intellectual content during manuscript preparation and revisions. Authorship was granted based on the ICMJE criteria.

## Declaration of Conflicting Interests

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## ORCID iDs

Danielle E. Fox  <https://orcid.org/0000-0001-5343-4951>

Paul E. Ronksley  <https://orcid.org/0000-0002-3958-7561>

Tyrone G. Harrison  <https://orcid.org/0000-0003-1068-8673>

Ngan N. Lam  <https://orcid.org/0000-0002-0129-7091>

## Supplemental Material

Supplemental material for this article is available online.

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