


# Evaluation of a Hockey Deceased Organ Donation Awareness Campaign: A Population-Based Cohort Study

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## Abstract

**Background:** The Kidney Foundation of Canada developed a pilot campaign to educate persons attending junior hockey league games in London, Ontario, Canada, on deceased organ donation.

**Objective:** To evaluate the impact of a hockey campaign on the number of new organ and tissue donor registrants.

**Design:** Population-based retrospective cohort study.

**Setting:** Residents of London, Ontario.

**Patients:** We included 255 476 individuals eligible to register for organ donation with a London, Ontario postal code.

**Measurements:** We compared the number of new deceased organ donor registrants in London, Ontario, during the campaign period (March 12 to April 16, 2015) with 3 different time periods (December 30, 2014 to February 3, 2015; February 4 to March 11, 2015; April 17 to May 22, 2015). We also compared registration rates in London with 2 Ontario cities (Kitchener-Waterloo and Hamilton) matching in a 1:1 ratio on age, sex, and income quintile.

**Methods:** To compare registrations across time periods, we used binomial regression with an identity link function and generalized estimating equations with an independence correlation structure. We used modified Poisson regression to compare registration rates between cities.

**Results:** During the campaign period, there were slightly more registrations (1218 registered of 252 832 unregistered individuals [0.48%]) compared with an earlier time period (risk difference: 0.09%; 95% confidence interval [CI]: 0.05%-0.12%). However, there was no significant difference compared with 2 time periods immediately before and after the campaign. London had slightly more registrations during the campaign period compared with the matched city of Hamilton (1180 registered of 236 582 unregistered individuals [0.50%] vs 490 registered of 236 582 unregistered individuals [0.21%]; risk ratio: 2.41; 95% CI: 2.17-2.68). The registration rate in London did not significantly differ from Kitchener-Waterloo.

**Limitations:** Unable to conclude whether the minor increase in deceased organ donor registration was the result of the campaign or other factors (e.g., simultaneous organ registration events, seasonality).

**Conclusions:** Overall, a minor increase in deceased organ donor registration was observed during the hockey organ donation awareness campaign; however, the specific impact of the campaign on organ donor registration could not be determined.

## Abrégé

**Contexte:** La Fondation canadienne du rein a développé une campagne pilote pour sensibiliser les gens qui assistent à des matchs de hockey junior à London en Ontario (Canada) sur le don d'organes post-mortem.

**Objectif de l'étude:** Évaluer l'impact qu'une campagne de sensibilisation auprès des gens assistant à des parties de hockey pouvait avoir sur le nombre de nouvelles inscriptions à la liste des donneurs d'organes et de tissus.

**Type d'étude:** Il s'agit d'une étude rétrospective de cohorte menée au sein de la population.

**Cadre de l'étude:** L'étude a été réalisée auprès de résidents de London en Ontario.

**Participants:** Nous avons inclus un total de 255 476 individus ayant un code postal inscrit à London en Ontario et qui étaient admissibles à faire un don d'organe.

**Mesures:** Nous avons répertorié le nombre de nouvelles inscriptions à la liste de donneurs d'organes à London en Ontario au cours de la période de la campagne, soit du 12 mars au 16 avril 2015. Nous avons comparé ce résultat aux nombres de nouvelles inscriptions obtenus lors de trois autres périodes, soit du 30 décembre 2014 au 3 février 2015; du 4 février au 11



mars 2015 et du 17 avril au 22 mai 2015. De plus, nous avons comparé le taux de nouvelles inscriptions de London à celui de deux autres villes de l'Ontario, soit Kitchener-Waterloo et Hamilton. La comparaison a été établie selon un ratio de 1:1 où les participants étaient appariés sur la base de leur âge, de leur sexe et de leur revenu.

**Méthodologie:** Pour comparer le nombre de nouvelles inscriptions entre les périodes choisies, nous avons utilisé un modèle de régression binomiale comportant une fonction de lien d'identité, de même que des équations d'estimation généralisées avec structure de corrélation de l'indépendance. Une version modifiée du modèle de régression de Poisson a été utilisée pour comparer les taux d'inscription entre les villes.

**Résultats:** Au cours de la campagne de sensibilisation, nous avons observé une faible hausse des inscriptions (1 218 nouvelles inscriptions [0,48%]) par rapport à une période antérieure (différence de risque: 0,09%; IC 95%: 0,05% - 0,12%). Cependant, aucune différence significative n'a été observée par rapport aux périodes immédiatement avant et après la campagne de sensibilisation. Un nombre légèrement plus élevé d'inscriptions a eu lieu dans la ville de London pour la période étudiée par rapport à la ville de Hamilton (1 180 inscrits et 236 582 non-inscrits [0,50%] contre 490 inscrits et 236 582 non-inscrits [0,21%]; risque relatif = 2,41; IC 95% = 2,17-2,68). Aucune différence significative n'a été observée entre le taux d'inscription à London et celui de Kitchener-Waterloo.

**Limites de l'étude:** Il a été impossible de déterminer si la campagne de sensibilisation a contribué à la légère augmentation du nombre d'inscriptions à la liste de donneurs d'organes post-mortem ou si celle-ci résulte d'autres facteurs (p. ex. événements spontanés d'inscriptions à la liste des donneurs, caractère saisonnier).

**Conclusions:** Dans l'ensemble, une légère augmentation du nombre d'inscriptions à la liste des donneurs d'organes post-mortem a été observée au cours de la campagne de sensibilisation menée pendant les parties de hockey. Toutefois, il a été impossible d'établir si la campagne de sensibilisation a eu un effet réel sur le nombre d'inscriptions.

## Keywords

organ donation campaign, deceased organ donor registration, sports campaign

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## What was known before

The demand for transplantable organs outpaces the supply. One way to potentially increase the number of solid organ transplants is to increase the number of individuals registered for deceased organ donation. However, the most effective way to increase organ donor registration rates is unknown. Sport may be an effective venue to increase organ donor registration rates.

## What this adds

These results suggest that during the hockey organ donation campaign, a minor increase in organ donor registration rates was observed; however, the specific impact of

the campaign on these rates could not be determined. Modifications to the campaign will need to be made before the national roll-out. Findings from this study help contribute to the development of best practices in deceased organ and tissue donor registration.

## Introduction

The demand for transplantable organs outpaces the supply with more than 250 Canadians dying each year while waiting for an organ transplant.<sup>1</sup> One way to increase the number of solid organ transplants is to increase the number of individuals registered for deceased organ donation; in the advent of a loved one's death, families may be more likely to consent to deceased organ donation if they know their family member

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was registered to be a donor.<sup>2,3</sup> Filling the deceased organ donor registry is central to a strategy to increase deceased organ donation in the province of Ontario, Canada (more than 7 million persons in Ontario are eligible to register). As of January 2016, almost 30% of Ontarians are registered for deceased organ and tissue donation.<sup>4</sup>

The Kidney Foundation of Canada is a national volunteer organization which exists to reduce the burden of kidney disease.<sup>5</sup> One of the Kidney Foundation of Canada's goals is to increase organ donation rates by 50% by the year 2020.<sup>6,7</sup> Sport may be used to raise public awareness about deceased organ donation. For example, many countries host transplant games for transplant recipients to raise awareness about organ donation,<sup>8-10</sup> and the National Health Service has a Sign for Life campaign encouraging football and rugby fans to register to be an organ donor.<sup>11,12</sup>

The Kidney Foundation developed a campaign called "Hockey, Organ Donation and You—An Amazing Hat Trick to Save Canadian Lives." The campaign was inspired by Sport Club Recife's (Brazilian soccer club) Immortal Fan organ donation campaign, which increased organ donation by more than 50% in the first year and resulted in more than 50 000 individuals registering for deceased organ donation.<sup>13,14</sup> Briefly, the Sport Club Recife campaign featured an influential advertisement on organ donation at each soccer game and on television. Moreover, the campaign provided fans who registered to be a deceased organ donor with a Sport Club Recife organ donor sport card.<sup>13,14</sup>

A pilot of the Canadian hockey organ donation campaign was held at 8 London Knights games (London, Ontario) between March and April 2015. The Kidney Foundation plans to implement this campaign to all Canadian Hockey League programs and potentially to Canada's National Hockey League teams. To our knowledge, campaigns using sport to raise awareness about organ and tissue donor registration have not been empirically evaluated. Therefore, in partnership with the Kidney Foundation of Canada, we evaluated the effects of this pilot hockey organ donation campaign on the number of new organ and tissue donor registrants in London, Canada, to inform the future national roll-out.

## Materials and Methods

### Design and Setting

We conducted a population-based cohort study using Ontario's large health care databases held at the Institute for Clinical Evaluative Sciences (ICES). These data sets were linked using unique encoded identifiers and analyzed at the ICES Western facility. We conducted this study according to a prespecified protocol that was approved by the research ethics board at Sunnybrook Health Sciences Centre (Toronto, Canada). The full data set creation plan is available from the authors upon request.

### Data Sources

We used postal codes provided in the Ontario Registered Persons Database (RPDB) to identify individuals living in the cities of London, Kitchener-Waterloo, and Hamilton. RPDB was also used to determine information on deceased organ donor registration status.

### Cohorts

London is located in Southwestern Ontario and is Canada's 11th largest city with a population more than 350 000. To compare registration rates across time periods, we included all individuals eligible to register for organ and tissue donation (individuals aged  $\geq 16$  years) with a London, Ontario postal code as of July 1, 2014, excluding individuals already registered for organ donation prior to or on December 30, 2014. To compare registration rates between Ontario cities, we included all individuals eligible to register with a London, Kitchener-Waterloo, or Hamilton postal code, excluding individuals who were registered for deceased organ and tissue donation prior to March 12, 2015, the date the campaign started. We selected Kitchener-Waterloo and Hamilton as comparator cities to London for several reasons, including similar organ registration rates (between 35% and 38% registered),<sup>15</sup> large cities in Ontario, close proximity to each other, similar hockey culture, and similar age and sex demographics. Kitchener-Waterloo was also selected because London played Kitchener in 4 out of the 8 games during the campaign. Therefore, this comparison would allow us to crudely examine whether the campaign had an effect on organ donor registration rates in the city of the opposing team. We matched persons from London in a 1:1 ratio on age ( $\pm 2$  years), sex, and neighborhood income quintile to persons from Kitchener-Waterloo and Hamilton.

### Hockey Deceased Organ Donation Awareness Campaign

The hockey organ donation campaign was held at Budweiser Gardens in London, Ontario, for 8 London Knights (major junior ice hockey team) playoff games (March 12, March 13, March 20, March 27, March 29, April 3, April 12, and April 14, 2015). The goal of the campaign was to raise awareness about organ and tissue donation and increase the number of individuals registered for deceased organ donation. Components of the hockey organ donation campaign are described in Table 1 and included an endorsement from Don Cherry, a popular hockey personality, and on-site registration for organ donation. Approximately 9000 people attend each London Knights game, which are also locally televised.

### Deceased Organ and Tissue Donor Registration

Our outcome was registration for deceased organ and tissue donation. In 2008, Ontario launched an affirmative-only

**Table 1.** Description of the Components of the Hockey Organ Donation Campaign.

- Don Cherry (retired professional hockey player and National Hockey League coach, Canadian ice hockey commentator) dropped the puck at the first game of the campaign (World Kidney Day)
- Don Cherry promotional video on deceased organ donation was played during the first and second intermission
- Opening ceremony welcoming had a key organ donation representative
- More than 18 000 pamphlets with forms to become an organ donor were distributed by hockey team staff
- More than 9000 cards that provided information on deceased organ donation and included a form to become an organ donor were placed on seats in the arena on the opening playoff game
- Radio tags with players' voices promoting organ donation
- Rink boards designated to promote organ donation at Budweiser Gardens (London Knights' home arena) and at 19 different ice pads throughout London
- Organ donation awareness booth and organ donation volunteers answered questions and registered people online on-site (<https://beadonor.ca/londonknights>)
- Official team news release
- Partnership with London Multi-organ Transplant Centre
- Fans who already registered to be a deceased organ and tissue donor were eligible to enter a raffle to win an autographed Don Cherry jersey
- Significant local media attention given to organ donation and the campaign

registry (yes responses only recorded) for deceased organ and tissue donation.<sup>16</sup> Registration can be completed online or mailed for individuals aged  $\geq 16$  years. In addition, the province mandates that opportunities to register are provided with driver's license renewals, health-card transactions, and at Service Ontario's centers during photo ID application renewals.

### Statistical Analysis

To determine whether during the campaign (March 12, 2015 to April 16, 2015) there was an increase in the number of persons who registered their wish to become a deceased organ donor in the advent of their death, we compared the number of new registrants in 2 time periods before the campaign (December 30, 2014, to February 3, 2015, and February 4 to March 11, 2015) and one time period after (April 17 to May 22, 2015). Although the campaign ended on April 14, 2015, we allowed individuals to register up to 2 days after the campaign, recognizing persons may not register immediately after the game. Each time period was 35 days. We calculated the absolute number and proportion of new organ and tissue donor registrants during the campaign and each of the comparator time periods. We used binomial regression with an identity link function and generalized estimating equations with an independence correlation structure to

calculate the risk difference for new registrants in each time period compared with the campaign period (noncampaign periods served as the reference group); the generalized estimating equation method accounts for clustering of individuals by study time intervals, as individuals living in London throughout the study period would be included in multiple time periods. To help understand whether any potential observed increase in organ registrations was the result of the campaign itself versus other factors (eg, seasonality), we examined new organ registrations during several time periods in the year prior to the campaign (excluding individuals who registered prior to December 30, 2013).

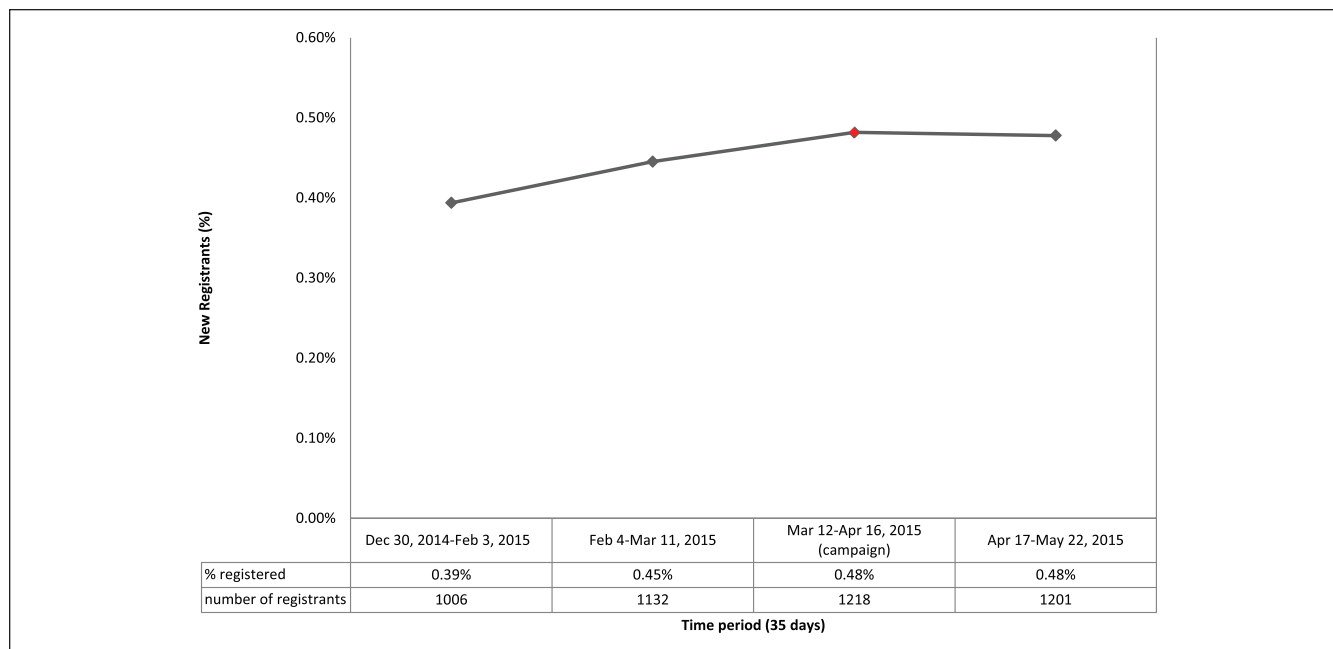
When registration rates in London were compared with Kitchener-Waterloo and Hamilton, we used standardized differences to assess baseline characteristics between groups. Standardized differences can be described as differences between group means compared with the pooled standard deviation with a difference greater than 10% considered meaningful.<sup>17</sup> We used modified Poisson regression to compare registration rates between London and Kitchener-Waterloo, and London and Hamilton. Modified Poisson regression provides an estimate of the risk ratio (based on the incidence rate ratio) and is superior to logistic regression for which the associated odds ratio may overestimate the risk ratio.<sup>18</sup> A 2-tailed *P* value less than .05 was considered statistically significant for all analyses. We used Statistical Analysis Software version 9.4 ([www.sas.com](http://www.sas.com)) to conduct the analyses.

## Results

### Deceased Organ and Tissue Donor Registration in London Before, During, and After the Campaign

We included 255 476 persons from London, Ontario, who were eligible to register for deceased organ and tissue donation (Additional File 1). The absolute number and proportion of new registrants during the campaign period and in each comparator time period are presented in Figure 1. During the campaign period, there were a total of 1218 (0.48%) persons who registered. This was a slightly higher proportion of new registrants during the campaign period compared with the earlier 2 periods (December 30, 2014 to February 3, 2015: 0.39%; and February 4 to March 11, 2015: 0.45%). In absolute terms, there were slightly more registrations during the campaign period compared with the December 30, 2014, to February 3, 2015 time period (risk difference: 0.09%; 95% confidence interval [CI]: 0.05% to 0.12%; *P* < .001). However, there was no significant difference in the number of new registrants during the campaign compared with the 2 time periods immediately before and after the campaign. When trends in organ registration were examined in the year prior to the campaign, we found there were a significantly higher number of registrations from March 12 to April 16,





**Figure 1.** Proportion of new organ and tissue donor registrants in London, Ontario, before, during, and after the hockey organ donation campaign.

Note. The denominator decreased during each time period to account for new registrations and death. From December 30, 2014, to May 22, 2015, there were a total of 4557 new registrations and 1019 deaths. The risk differences when comparing the campaign period with the other 3 time periods were December 30, 2014 to February 3, 2015 (risk difference: 0.09%; 95% CI: 0.05%-0.12%;  $P < .01$ ), February 4 to March 11, 2015 (risk difference: 0.04%; 95% CI: -0.001% to 0.07%;  $P = .06$ ), and April 17 to May 22, 2015 (risk difference: 0.01%; 95% CI: -0.03% to 0.04%;  $P = .84$ ). The noncampaign periods served as the reference group. Red diamond indicates the campaign period. CI = confidence interval.

**Table 2.** Donor Registration in London Compared With Kitchener-Waterloo During the Hockey Organ Donation Campaign.<sup>a</sup>

City <sup>b</sup>	No. of new registrations (%)	Risk difference (95% CI)	Risk ratio (95% CI)	P value
Kitchener-Waterloo (n = 221 482)	1074 (0.48%)	(Reference)	1.00 (reference)	
London (n = 221 482)	1151 (0.52%)	0.03% (-0.01% to 0.08%)	1.07 (0.99-1.16)	.10

Note. CI = confidence interval.

<sup>a</sup>Matched on age ( $\pm 2$  years), sex, and income quintile.

<sup>b</sup>Only includes individuals aged  $\geq 16$  years who were not registered for organ donation at the time of the campaign.

2014, compared with the time period immediately before (risk difference: 0.04%; 95% CI: 0.01%-0.07%;  $P = .01$ ; Additional File 2).

### Comparison of Deceased Organ and Tissue Donor Registration in London With Kitchener-Waterloo and Hamilton

After matching persons in London to the comparator cities, we included 221 482 unregistered persons from both London and Kitchener (Additional File 3; total, n = 442 964) and 236 582 unregistered persons from both London and Hamilton (total, n = 473 164; Additional File 4). Additional File 5 demonstrates baseline characteristics were similar between London and Kitchener, and London and Hamilton. When comparing London with Kitchener-Waterloo, during

the campaign period there was no significant difference in the number of new registrations (1151 [0.52%] vs 1074 [0.48%]; risk ratio: 1.07; 95% CI: 0.99-1.16;  $P = .10$ ; Table 2). However, London had a significantly higher number of new organ and tissue donor registrants compared with Hamilton (1180 [0.50%] vs 490 [0.21%]). In relative terms, this resulted in more than a 2-fold increase in the likelihood of registration in London compared with Hamilton during the campaign period (risk ratio: 2.41; 95% CI: 2.17-2.68;  $P < .01$ ; Table 3).

### Discussion

During the hockey campaign in London, Ontario, the number of new organ and tissue donor registrants slightly increased compared with the earliest time period; however,

**Table 3.** Donor Registration in London Compared With Hamilton During the Hockey Organ Donation Campaign.<sup>a</sup>

City <sup>b</sup>	No. of new registrations (%)	Risk difference (95% CI)	Risk ratio (95% CI)	P value
Hamilton (n = 236 582)	490 (0.21%)	(Reference)	1.00 (reference)	
London (n = 236 582)	1 180 (0.50%)	0.29% (0.26%-0.33%)	2.41 (2.17-2.68)	<.01

Note. CI = confidence interval.

<sup>a</sup>Matched on age ( $\pm 2$  years), sex, and income quintile.

<sup>b</sup>Only includes individuals aged  $\geq 16$  years who were not registered for organ donation at the time of the campaign.

no significant difference was found when compared with the 2 time periods immediately before and after the campaign. During the campaign, there was a minor increase in the number of persons from London with new registrations compared with matched individuals from Hamilton, but not Kitchener-Waterloo. These findings suggest, in its current form, the hockey organ donation campaign may have had a minor association with attracting new persons to register for deceased organ donation; however, the specific impact of the campaign on organ donor registration could not be determined.

A possible explanation for the difference in registration between London and Hamilton but not between London and Kitchener-Waterloo during the hockey organ donation awareness campaign is that 4 of the games during the campaign were against Kitchener-Waterloo, where persons from Kitchener-Waterloo may have attended the games or watched the games on television. It is important to note that although London had a slightly higher number of new registrations compared with Hamilton, we do not know whether London consistently had a higher number of new registrations across different time periods due to factors other than the campaign itself.

To better understand the impact of this campaign on increasing interest in deceased organ donor registration, we were provided with further information. The London Knights estimated that a total of 26 188 unique persons attended all games held during the campaign; this number includes children <16 years who are ineligible to register. We know that 365 visits to Service Ontario's online organ and tissue donor registration site came through the campaign webpage (<https://beadonor.ca/londonknights>)<sup>19</sup>; it is important to note this number captures visits not registrations. Therefore, assuming 62% of the persons (London's current organ registration status is 38%) who attended the games were unregistered (n = 16 236), this would have resulted in 2.2% of these persons visiting the campaign webpage. However, this number is likely an underestimate as any individuals who directly accessed Service Ontario's online donor registration site or accessed the online registration site through the [beadonor.ca](https://beadonor.ca) home page or another campaign page are not captured.

Available literature on the most effective way to increase organ donor registration rates is limited. The literature is largely inconclusive about which strategies can successfully increase registration, and few Canadian studies have assessed

different strategies.<sup>20-22</sup> However, there is evidence to suggest that providing individuals with the ability to immediately register, as done in the hockey organ donation awareness campaign, is an effective method to increase organ donor registration.<sup>23</sup> Moreover, we can learn from successful organ donor registration campaigns, such as the Facebook campaign, which increased the number of registrants by more than 20-fold in the first day.<sup>24</sup> Sport may also be a useful platform to substantially increase organ donor registrations. Anecdotally, Sport Club Recife's Immortal Fans campaign may have had a positive impact on registration with a 54% increase in organ donation in 1 year.<sup>13,14</sup>

Several differences between the Kidney Foundation of Canada's hockey organ donation awareness campaign and the Sport Club Recife campaign may have resulted in the apparent disparity in success between the 2 campaigns. First, the Sport Club Recife campaign played an influential advertisement on organ donation at each soccer game and on television for over 1 year, while the hockey campaign only took place at 8 hockey games. Moreover, this influential advertisement was developed by the world-renowned marketing company, Ogilvy & Mather, and featured fans that were on the transplant waitlist.<sup>13</sup> The advertisement also featured a powerful message that donation would produce immortal Sport Club Recife fans. Second, the number of individuals attending each soccer game was almost 4 times larger than the audience at the hockey games, with 35 000 fans attending each soccer game.<sup>13</sup> Finally, Sport Club Recife organ donor sport cards were given to fans who registered to be an organ donor. Knowledge of the differences between the 2 campaigns can be used to help inform the national roll-out of the hockey organ donation awareness campaign.

The Kidney Foundation of Canada plans to implement a campaign similar to the one assessed in this study across Canada to all Canadian Hockey League teams. However, given the minor association with increased registration found in the pilot phase, they plan to make several modifications. For example, a competition may be held between fans of the home and opposing teams to determine which team can achieve the highest number of new registrants in a given amount of time. Furthermore, to expand the campaign outside of the hockey arena, the Kidney Foundation is examining the possibility of having a national coffee chain promote organ and tissue donor registration on their coffee cups at the same time as the hockey campaign.

There are several limitations to our study. First, we could not account for other organ registration awareness events occurring simultaneously in London, Kitchener-Waterloo, and Hamilton. For example, April is “be a donor” month in Ontario and several simultaneous campaigns and media stories about organ and tissue donation were occurring throughout the province. As a result, we were unable to determine whether the minor increase in deceased organ donor registration was the result of the hockey campaign or other factors. Second, based on information provided by the London Knights we knew that 26 188 unique individuals attended the games. However, we did not know the identities of these individuals; therefore, we could not determine the proportion of individuals attending the London Knights games who registered to be an organ donor during the campaign period. Instead, we had to rely on the assumption that individuals with a London postal code would primarily be attending these games. Third, we could not determine whether the campaign had any impact on organ registration for family members living outside of London. Fourth, we were not able to assess whether the hockey organ donation campaign increased awareness or understanding of deceased organ and tissue donation; increasing awareness may be an important step to get individuals to contemplate becoming a donor.<sup>25</sup> Fifth, we were not able to evaluate the number of persons who registered as a result of the campaign, including information on the number of individuals who filled out the forms to become a registered organ donor. However, as previously highlighted, we know 365 visits to Service Ontario’s online organ and tissue donor registration site were generated through the campaign webpage which may have resulted in registrations. Last, we were not able to ascertain factors associated with registration that may have differed by cities (eg, ethnicity).

There is value in empirically evaluating campaigns aimed at increasing deceased organ and tissue donor registration to determine best practices. Currently, in Ontario, there are more than 100 drives aimed at increasing registration, yet to our knowledge, none have been evaluated. Moreover, in the United States, the number of organ donation campaigns has continued to rise; however, the organ donation rates have remained relatively steady.<sup>26</sup>

In summary, a minor increase in deceased organ donor registration was observed during the hockey organ donation awareness campaign; however, the specific impact of the campaign on organ donor registration could not be determined. We encourage the evaluation and publishing of the results of other organ donation campaigns to help identify best practices in increasing organ and tissue donor registration.

### **Ethics Approval and Consent to Participate**

We conducted all analyses according to a pre-specified protocol that was approved by the institutional review board at Sunnybrook

Health Sciences Centre (Toronto, Ontario, Canada). ICES is a designated prescribed entity under Section 45 of the Personal Health Information Protection Act (PHIPA). Participant informed consent was not required for this study.

### **Consent for Publication**

Not applicable.

### **Availability of Data and Materials**

The data set from this study is held securely in coded form at the Institute for Clinical Evaluative Sciences (ICES). Although data sharing agreements prohibit ICES from making the data set publicly available, access can be granted to those who meet prespecified criteria for confidential access, available at [www.ices.on.ca/DAS](http://www.ices.on.ca/DAS).

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### **Author Contributions**

KLN, SM, CC, and AXG conceived of the study. KLN and AXG participated in its design and coordination. EM provided analytic and statistical support. KLN drafted the manuscript. All authors read and approved the final manuscript.

### **Declaration of Conflicting Interests**

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: S. Joseph Kim and Gregory A. Knoll have received investigator-initiated research grants from Canadian Institutes of Health Research and Astellas Canada. Amit X. Garg received an investigator-initiated grant from Astellas and Roche for a Canadian Institutes of Health Research study in living kidney donors. All other authors have no conflicts of interest to declare.

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