

## Deceased Organ Donor Potential in Canada – A Review and Estimate from Past Studies and Sources

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### ABSTRACT

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#### **Purpose**

To help understand the degree to which Canadian organ donation performance can be improved, a better understanding of deceased donor potential is required. This study reviews and compares a variety of potential organ donor estimates from past studies and sources from the last ten years. These studies used both clinical and administrative analysis methods. They also varied considerably in size/scope—from a few hospitals, to studies of all hospital deaths in a province or the whole country. Given this variation, it is difficult to derive a precise statistical estimate of donor potential from these sources. However, by looking across the range of estimates they provide, a reasonable estimate of Canadian deceased organ donor potential can be derived.

#### **Methods**

The sources reviewed provide potential donor estimates using a variety of methods. Clinical review of hospital medical charts/records of deaths is the most common type of method. Administrative review of death records is another method used in some studies. In most studies, the Holt method or some variation/combination of death codes and medical record analysis was used. When combined with age and other exclusion criteria, they provided an estimate of the numbers of potential deceased donors by neurologically determined death (NDD) and by donation after cardiac death (DCD). Such estimates capture the deceased donor potential from patients admitted to hospitals. A few studies captured estimates of the additional potential from the emergency departments or other locations outside of the hospital.

#### **Results**

The donor potential from the studies was translated into a deceased donor per million population (DPMP) measure where possible, to allow comparison of donor estimates from various studies. From the base estimate of potential deceased donors from in-hospital deaths, potential deceased donors from hospital emergency rooms (ERs) were added. The net result of these elements resulted in a Canadian estimate of deceased donor potential in the range of 48.5 DPMP, or 1600 donors annually. Note that a final reduction to this estimate is required to exclude donors with high risk behaviours and those with profound organ failure, but estimates for these factors could not be found in the studies reviewed.

#### **Conclusions**

With a current approximate 14 DPMP rate in Canada, there is definitely potential for a much higher rate of donation. The studies reviewed for this paper suggested improving donor identification, consent rates and hospital processes to help achieve some of this potential.

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## Introduction

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The number of organ donors in Canada continues to be insufficient to meet the demands for potential transplant recipients. In 2008, Canada had a total deceased donation rate of 14.8 donors per million of population. This donation rate is less than half that of the upper tier of high performing countries. To help understand the degree to which Canadian organ donation performance can be improved, a better understanding of donor potential is required.

Many past reports and studies in Canada and abroad have attempted to estimate potential numbers of donors. This study has a single objective, which is to combine the learning from these sources into a composite estimate of deceased organ donor potential for Canada.

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## Methods

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The studies referenced for this report provided retrospective estimates of organ donor potential. There were clinical medical chart review studies, administrative reviews of deaths both in-hospital and outside of hospitals. There were also studies made on donor consent, and two studies included from outside of Canada (one from Europe, and one from the U.S.). The list and description of studies, with their derived estimate of donor potential, is found in Table 1.

Most Canadian studies estimated the number of in-hospital deaths which met the criteria for neurological death, and hence for deceased organ donation potential. This was often determined using ICD-9 diagnostic codes for patients who died in hospital. Additional exclusion criteria were used for patients who were diseased or elderly (over age 70, for most studies). Note that by definition, patients who die in the ER are not formally admitted to hospital, so are not captured by medical record review. Therefore potential donors from the ER were identified as those who had documented evidence of brain death, or potential progression to brain death based on established criteria.

The studies estimated potential donors in various ways: as annual numbers of donors; as a percentage of in-hospital or total deaths; or as a donor rate per million of population (DPMP). In this study, results were converted into a DPMP measure where such an extrapolation was possible. Although there is debate about the validity of the DPMP measure, it remains the international standard for comparison of donor potential, so was chosen here.

Starting with the base of potential deceased donors from in-hospital deaths, a few other factors were considered.

The use of DCD donation is a means to realize donation potential for those potential deceased donors who did not progress to brain death. DCD donation performance for Canada, for Ontario (as best in class for Canada), and for a few selected high performing international jurisdictions was provided.

In addition to in-hospital deaths, some studies provided an estimate of deceased donor potential from ER deaths in their analysis. This potential was added to the in-hospital donor potential.

The donor potential estimate from this study is the net result of these inputs.

Note that the total donation potential estimate should ideally also exclude potential donor patients due to additional factors not identified through either the medical record or deaths database review methods. This includes:

- Patients with a history of drug use or high-risk sexual behaviours.
- Patients who experience profound organ failure, due to traumatic injury to organs, poor function, or infection.

Unfortunately, these exclusions could not be quantified from previous studies.

**Table 1. Past studies on donor potential**

Study	Type	Scope	Potential donor estimate	Extrapolation of estimate	DPMP	
<b>Canada</b>						
1	<i>Estimating Potential Deceased Organ Donors for Canada and its Provinces, 1992-1998, CIHI, 2001</i>	Administrative review	Analysis of death codes in hospital database records (Holt methodology)	2834 estimated National potential donors in 1997, based on Holt diagnoses and ventilation. Does not remove exclusionary diagnoses, so is a high estimate.		92
2	<i>Estimating Potential Tissue Donors in Canada from 1995-2000: An Exploratory Analysis Based on Acute Care Hospital Admissions Data, CIHI, 2004</i>	Administrative review	Review of CIHI hospital morbidity database for all of Canada	No organ donor estimate, but note that ER deaths added 8% to total hospitals deaths.		
3	<i>Refining Estimates of Potential Deceased Organ Donors from Patient Hospitalization Discharge Records: Findings of a Pilot Project, CIHI, 2005</i>	Administrative review	Review of death coding from the Discharge Abstract Database (DAD), for Canadian hospitals in all provinces except Quebec, 2000.	Based on hospitals contributing to the DAD from 1998-2000, an average of 808 potential donors were identified (neurological deaths, removed cases with exclusionary diagnoses).	For total Canada, this would equate to $808 * 30.7M / 23.2M = 1069$ potential donors.	35
4	<i>Estimating Tissue and Organ Donation Potential Outside the Acute Care Setting, Hornby CCDT, 2006</i>	Administrative review	3% sample of non-hospital deaths in BC, ON, NL.	Uncontrolled DCD potential of 3.7% of non-hospital deaths.		
5	<i>Potential organ donors referred to Ontario neuro-surgical centres – Tenn-Lyn, et al, 2006</i>	Clinical chart review.	9% sample (3.4K deaths) of total Ontario hospital deaths, 1998	4.1% of acute care hospital deaths were potential donors (8% of these deaths were in the ER). These hospitals receive a higher proportion of referrals of patients with acute intracranial emergencies, so their donor rate is likely higher than other hospitals.	This was a selected sample of brain injury, and cannot be extrapolated to the total population.	
6	<i>Brain death diagnoses and evaluation of the number of potential organ donors in Quebec hospitals – Cloutier, et al 2006</i>	Clinical chart review	93% sample (24.7K deaths) of total Quebec hospital deaths, 2000	348 cases (1.4% of acute care hospital deaths) met inclusion criteria, 268 cases proceeded to brain death.	This would imply $268 / 0.93 = 288$ potential donors in all of Quebec.	39

Study		Type	Scope	Potential donor estimate	Extrapolation of estimate	DPMP
7	<i>Number of deaths by neurological criteria, and organ and tissue donation rates at three critical care centres in Canada – Beed, et al 2006</i>	Clinical chart review (within one day of death)	638 deaths from 7 months in 2002-2003	3.9% of acute care hospital deaths (including ER deaths) were potential organ donors.	Due to the study size, this result cannot be extrapolated to the total population.	
8	<i>Benchmarking performance in organ donation programs: dependence on demographics and mortality rates – Barniesh, et al 2006</i>	Administrative review	Study of population distribution and death data for Calgary Health Region versus Spain for the year 2000.	Indicated that Spain DPMP rates are not much higher than that of Calgary region (19.2 vs.17.4) when death data is factored in.		
9	<i>Transplant Manitoba chart reviews - Nickerson 2008/2009</i>	Clinical chart and Administrative review	Chart review of all deaths from Winnipeg ICU patient deaths database, and ER database, 2008	64 potential donors, includes donors from ER.		53 with ER
10	<i>Nova Scotia Organ and Tissue Donation Program 2008 Provincial Chart Audit - 2009</i>	Clinical chart review	4,118 deaths reviewed (all of NS)	47 potential organ donors (50 DPMP) 26/75= 35% were not suitable.		50 with ER
11	<i>Hope North from collaborative 2009</i>	Estimate	Potential for Alberta North, estimated half of total province	60 potential in Hope North (33 DPMP, a low estimate which only factors in missed consent).		33+
12	<i>Missed Opportunities - Non-Referral of Potential Organ and Tissue Donors in the Regina Qu'Appelle Health Region - Sask Transplant 2010</i>	Clinical chart review	Close to 50% of the deaths in the Regina region for fiscal year 2008-2009 were reviewed. These represent the majority of Regina area donors.	Regina area potential was around 20 donors (low estimate, based on auditing charts only from the main area hospitals.	For total Saskatchewan, this would equate to 40 potential donors.	40+
<b>International</b>						
13	<i>Estimating the number of potential organ donors in the United States – Sheehy, et al 2003</i>	Clinical chart review	50% sample of US hospital deaths in ICUs, for 1997-1999.	Potential DPMP = 48.2; Study referral rate was 80%, Request rate 84% (so only 16% of potential donors are not being identified), Consent rate 54%.		48
14	<i>A plea for uniform European definitions for organ donor potential and family refusal rates – Jansen, et al 2009</i>	Literature review	Review of 14 different European studies which estimated organ donation refusal rates.	Refusal rates vary from 10% in Belgium and Finland to around 50% in the US, Sweden and the Netherlands.		

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## Results

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The most reliable donor potential estimates came from clinical chart reviews, which assessed medical chart data. Of the clinical reviews, the following studies best fulfilled the validity threshold for allowing extrapolation to a national donor potential estimate (i.e., reviewed a large number of patients, considered exclusion criteria):

#6 Quebec 2002 / Cloutier (39 DPMP)

#9 Manitoba 2008/ Nickerson (53 DPMP with ER)

#10 Nova Scotia 2008 / Beed (50 DPMP with ER)

#12 Saskatchewan 2010 (40 DPMP)

There were several provincial clinical review estimates with smaller sample sizes, from critical care or neurological centers. The Ontario review (#5) and the critical care estimate (#7) estimated that close to 4% of acute care hospital deaths were potential donors. Since these centers studied likely had a higher proportion of critically ill patients, these results should be considered as very high estimates of the total system potential.

Two national administrative reviews were conducted by CORR/CIHI. The 2001 CIHI project (#1) analyzed several year of hospital death data from the Vital Statistics Death Registry. It provided a high estimate of 92 DPMP, based on Holt methodology diagnoses. Note that this study did not remove exclusionary diagnoses as was done in the 2005 CIHI pilot project study (#3). This second study showed a lower potential of 35 DPMP, using a Holt analysis of deaths from the Discharge Access Database (DAD). It also removed more cases with specific exclusionary diagnoses, which was not done in the 2001 CIHI study.

By considering all the donor potential studies, and particularly by more heavily weighting the above mentioned clinical study results, an in-hospital deceased donor potential of 45 DPMP seems very well supported.

This potential captures those donors which could be either NDD or DCD donors. For patients that do not progress to brain death, greater use of DCD allows

for more potential donors to become actual donors. The current level of DCD donation in a number of locations is shown in Table 2 below. The DCD levels in high performing countries (and in Ontario within Canada) would suggest that Canada can likely achieve a DCD donor level of 20% of total deceased donors. At this level, achieving the total deceased donor potential identified in this study is increased.

**Table 2 - DCD Donors<sup>1</sup>**

	Year	DPMP	DCD as a % of Total Deceased Donors
Netherlands	2008	5.0	41%
UK	2008	5.3	34%
US	2007	2.6	10%
Ontario	FY 2009	2.8	17%
Canada	2009	1.3	9%

Added to the in-hospital deceased donor potential, some studies estimated an added NDD and DCD donor potential of 8% from emergency room patients.

Lastly, it is recognized that the donor potential estimate needs to exclude patients due to high risk behaviours and profound organ failure. These are not known to be large factors in preventing donation, but since they could not be precisely quantified, the amount that they reduce the donor potential was not calculated in this study.

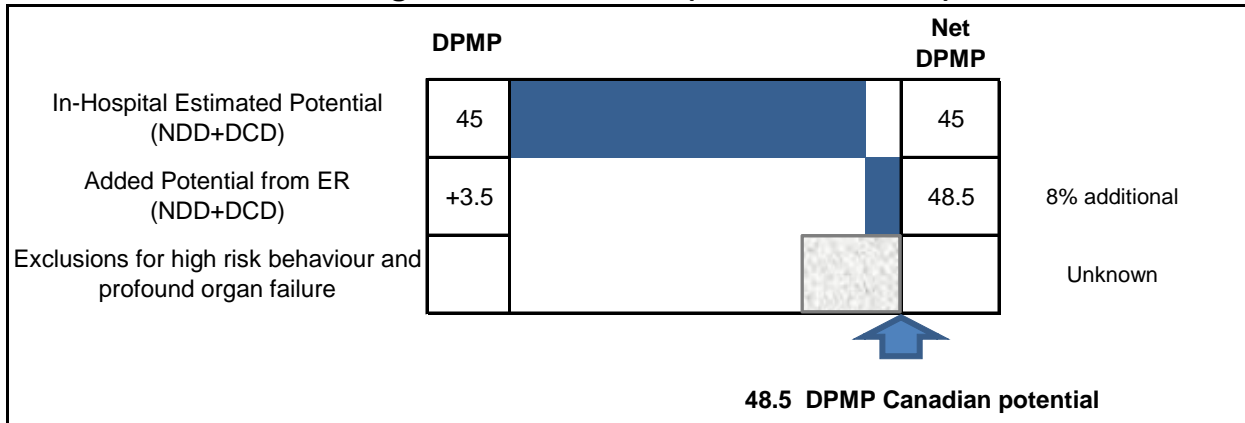
<sup>1</sup> Sources:

Netherlands, UK and US, IRODaT website 2010

Ontario, Trillium Gift of Life

Canada, CORR e-statistics 2009

**Chart 1. Total Deceased Organ Donor Potential (Estimated, DPMP)**



**Summary**

From the results above, a net estimate of organ donor potential (DPMP) can be derived. Chart 1 illustrates the net donor potential calculation.

The estimated in-hospital potential from deceased donors (NDD and DCD) was conservatively estimated at 45 DPMP. Added to that, an additional 8% increase in potential NDD and DCD donors could be possible from ER deaths. A greater use of DCD in Canada could help to meet the total deceased donor potential. Lastly, the exclusions for high risk behavior and profound organ failure cannot be quantified, but would somewhat reduce the final donor potential estimate. Therefore the study result of organ donor potential of 48.5 DPMP should be viewed as slightly high.

Note that a 2010 CIHI administrative review of deceased in-hospital donor potential is currently underway. It will use the Holt methodology to analyze hospital deaths, in a similar manner to the previous CIHI studies, using the DAD database. The results of this study will provide another comparison to the donor potential estimate provided here.

**Limitations**

This report is based on estimates of organ donor potential using various methods. However, patients being assessed as potential donors “real-time” (i.e., while the patient is in-hospital prior to declared brain death) is the best way to get a true measure of donor potential. Unfortunately, this potential is not currently assessed or documented in most Canadian hospitals.

The reports and studies reviewed for this estimate relied on the completeness and accuracy of medical chart or death database contents. Lack of completeness of this data is a possible weakness in the estimate of donor potential, for both the clinical and administrative review methods. Also, the inability to estimate the exclusions for high risk behavior and profound organ failure has been noted.

The result of this study is a current estimate of deceased organ donor potential. This may change in the future with changing demographics and an aging population.