

Solid organ donation from the emergency department – A systematic review

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CLINICIAN'S CAPSULE

What is known about the topic?

There is an organ donor shortage. End-of-life care discussions occur in the emergency department (ED), therefore there may be opportunities for donation.

What did this study ask?

What percentage of successful and missed adult organ donors come from the ED?

What did this study find?

This systematic review found that the ED is a significant source of both successful and missed organ donors.

Why does this study matter to clinicians?

ED healthcare providers should know their local organ donation referral protocol to ensure that donors are not missed.

in the ED are missed due to a failure to refer for consideration of organ donation. Clinical heterogeneity precluded pooling of the data to conduct a meta-analysis.

Conclusions: The ED is a source of actual and missed donors. Potential donors are often missed due to incorrect assumptions regarding eligibility criteria and failure of the healthcare team to refer for consideration of donation. ED healthcare professionals should be aware of organ donation referral protocols at their institution to ensure that no organ donors are missed.

RÉSUMÉ

Objectif: Il existe un écart important entre le nombre de malades dans l'attente d'une transplantation d'organe et celui de donneurs d'organes. L'étude avait donc pour but de déterminer le pourcentage de donneurs effectifs qui proviennent du service des urgences (SU), le risque de non-repérage des donneurs potentiels et les facteurs associés aux dons effectifs ou manqués d'organes.

Méthode: Une revue systématique consistant en une recherche électronique dans les bases de données EMBASE, MEDLINE et CINAHL a été menée selon les lignes directrices PRISMA, le 7 juillet 2017. Ont été retenus des articles de première main faisant état du repérage ou non des donneurs potentiels d'organes chez les adultes. Deux auteurs ont examiné, chacun de leur côté, les articles, et les divergences de points de vue ont été résolues par voie de consensus. La qualité des études a été évaluée à l'aide de la liste de vérification STROBE.

Résultats: La revue systématique a permis de dégager 1058 articles, dont 25 ont été retenus. Les patients au SU représentaient de 4 à 50% des donneurs effectifs en ce qui concerne les cas de mort cérébrale, et de 3,6 à 8,9% des donneurs effectifs en ce qui concerne les cas de mort cardiocirculatoire. D'après l'examen des causes de décès au SU, le taux de non-repérage des donneurs potentiels pouvait atteindre 84% dans les cas de mort cérébrale et 46,2% dans les cas de mort cardiocirculatoire, la situation s'expliquant par le manque de consultations des ressources en dons éventuels d'organes. Enfin, il n'a pas été possible de procéder à une méta-analyse en raison de l'hétérogénéité des données cliniques qui faisait obstacle à leur mise en commun.

ABSTRACT

Objectives: A significant gap exists between people awaiting an organ transplant and organ donors. The purpose of this study was to determine what percent of successful donors come from the emergency department (ED), whether there are any missed donors, and to identify factors associated with successful and missed donation.

Methods: This systematic review used electronic searches of EMBASE, MEDLINE, and CINAHL according to PRISMA guidelines on July 7, 2017. We included primary literature in adults describing successful and missed organ donation. Two authors independently screened articles, and discrepancies were resolved through consensus. Quality was assessed using the STROBE checklist.

Results: This systematic review identified 1,058 articles, and 25 articles were included. For neurologic determination of death, ED patients comprised 4%–50% of successful donors and 3.6%–8.9% of successful donors for donation after circulatory determination of death. ED death reviews revealed up to 84% of missed neurologic determination of death, and 46.2% of missed circulatory determination of death donors who died

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Conclusion: Le SU est une source à la fois effective et non identifiée de donneurs d'organes. Souvent, les donneurs potentiels ne sont pas repérés en raison d'une perception erronée des critères d'admissibilité et du manque de consultations, par l'équipe de soins, des ressources en dons éventuels d'organes. Les professionnels de la santé au SU devraient donc

être bien informés des protocoles de consultation des ressources en la matière dans leur établissement afin d'éviter le non-repérage des donneurs potentiels.

Keywords: Brain death, circulatory death, organ donation, systematic review

INTRODUCTION

There is a significant gap between the number of people waiting for an organ and organ donors. In 2018, in Ontario, there were 1,639 people awaiting organ donation, 456 deceased donors, and 947 organs transplanted from deceased donors.¹ In BC, in 2018, there were 669 people on the transplant wait list, and 27 people died while on the wait list.² Although progress has been made in organ donation in Canada, a significant gap between organ donors and people awaiting organ transplantation still exists; therefore, further efforts are required to ensure that all potential organ donors are identified.

Many end-of-life care discussions occur in the ED.³ Witjes et al. (2017) found that, in 51% of the time, the decision to start end-of-life care was made in the ED.³ One study suggested that 60.5% of family interviews for potential brain dead donors occurred in the ED.⁴ Another study showed that of all successful organ donors, 6/14 (27.3%) had the organ donor discussion initiated in the ED.⁵ Furthermore, two studies have shown that patients referred from the ED are more likely to become successful donors than those referred from elsewhere in the hospital.^{6,7} These studies highlight the role the ED has in ensuring that potential donors are not missed.

Previous systematic reviews have investigated organ donation from the intensive care unit (ICU) exclusively, or pooled organ donation from the ED and ICU together.⁸⁻¹⁰ There may be ED-specific factors that could impact organ donation. The purpose of this study is to determine what percent of successful donors come from the ED, whether there are any missed or potential donors, and what factors impact organ donation in the ED.

METHODS

Data sources and search strategy

We conducted this systematic review according to preferred reporting items for systematic reviews and

meta-analyses (PRISMA) guidelines.^{11,12} A medical librarian performed electronic searches of EMBASE, MEDLINE, and CINAHL on July 7, 2017. Duplicates were electronically removed during the search. Additional duplicates were removed manually during screening.

Our search strategy used Medical Subject Headings (MeSH) terms and free words in the title and abstract by combining terms in two categories. One category included terms related to organ donation such as “tissue and organ procurement,” “donor* or donat*,” “non-heart-beating,” and “brain death.” The other category was related to the types of injuries or terms related to emergency medicine. Terms included “wounds and injuries,” “trauma,” “brain hemorrhage,” “gunshot wound,” “ED or emergency room or emergency service or emergency medicine or emergency care or emergency hospital.” The full search strategy can be found in Appendix I.

Studies were included if they met the following criteria (Figure 1). Primary literature on adult (age \geq 18 years) humans was included if they investigated organ donation and reported either number of actual donors, missed donors, or potential donors. Papers were excluded if they were case reports, not organ donation, outcomes not reported (technique for organ removal, organ donor criteria, factors affecting organ viability, determination of death, recipient-specific data, survey of attitudes, curriculum to increase donation, process of consent), not solid organ donation (living donor, forensic donation), tissue donor (skin, bone marrow, cornea, blood, stem cell, science, sperm), and ethical considerations. For the title and abstract screen, all papers reporting either number of actual, missed, or potential organ donors were included, regardless of the location in the hospital. The full paper was then screened for ED-specific data. If it was unclear whether data reported was ED-specific, authors were contacted to confirm whether there were ED-specific data. If there were no ED-specific data, the paper was excluded according to “ED data not reported.” The full text papers were also

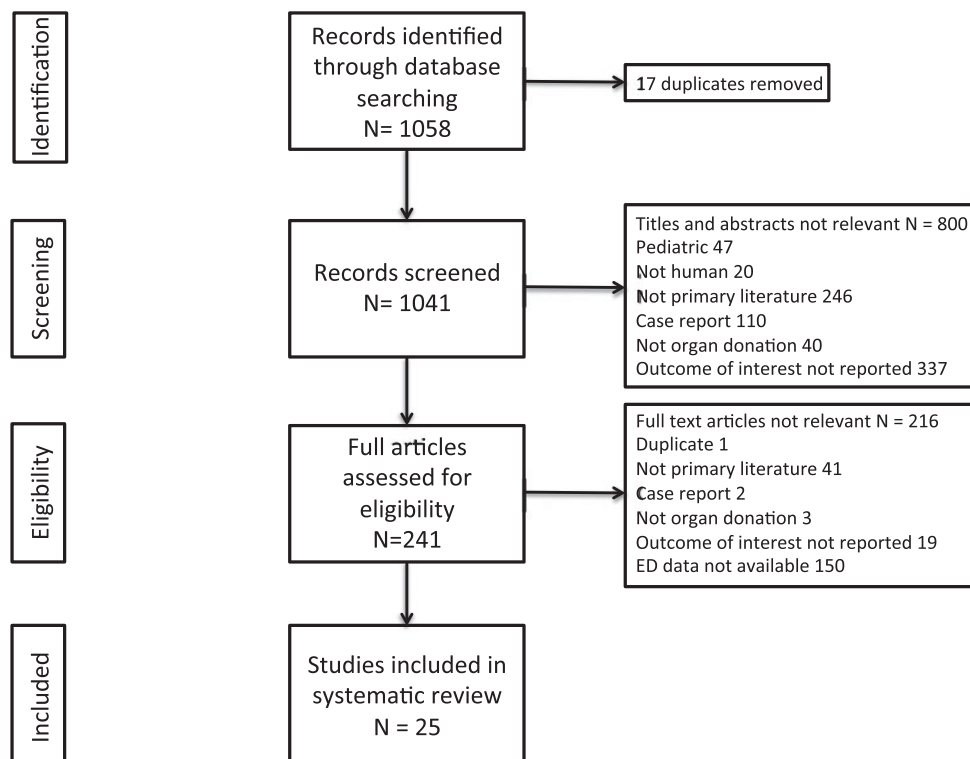


Figure 1. PRISMA flow diagram.

screened for data such that a percentage could be calculated. If papers only reported number of organ donors in the ED without reporting total number of actual or potential donors, the paper was excluded as “outcomes not reported.” The reference list of all included papers was reviewed for additional papers.

Two reviewers (JM, BE) independently screened papers for inclusion according to the criteria outlined previously, using Microsoft Excel[®]. Discrepancies were resolved by consensus.

Data abstraction and quality assessment

Data were abstracted from papers into an Excel database. If data were missing, authors were contacted. Data were abstracted for study design, population, and outcomes. Outcomes included percentage of successful organ donors coming from the ED and percentage of missed or potential donors in the ED (Tables 1–5). Papers were separated by neurologic determination of death and donation after circulatory determination of death. Donors were separated into these two populations, because screening criteria are different. In neurologic determination of death, the patient is declared as brain

dead and in donation after circulatory determination of death the heart and blood circulation stop.¹³ In controlled donation after circulatory determination of death, circulatory death occurs in an expected setting, often after withdrawal of life support, whereas in uncontrolled donation after circulatory determination of death, death occurs in the out-of-hospital setting or after an unsuccessful resuscitation.¹³

Studies were assessed for quality using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist,¹⁴ and missing elements are highlighted in Tables 1–4.

Data synthesis and analysis

There was significant clinical heterogeneity between included papers regarding organ donor population. Heterogeneity existed regarding study design (prospective, retrospective, and convenience sample) and patient population (hospital-wide v. ED, trauma v. all-comers). Similarly, the majority of the studies did not specify organ donor exclusion and inclusion criteria. This precluded pooling of the studies to perform a meta-analysis.

Table 1. Summary of papers for successful neurologic determination of death donors

Paper	Design	Population	Outcomes	STROBE checklist
Witjes et al. (2017)	Prospective observational study of 7 hospitals January 2013 – April 2014	All adult patients dying of devastating brain injury in hospital	7/54 successful donors (13%) came from ED*	Complete
Miller et al. (2014)	Retrospective cohort analysis of 81 hospitals from July 1, 2007 – June 30, 2012	All patients referred to organ procurement organization for consideration of brain death (trauma and non-trauma)	243 organ donors referred from the ED, 7,194 from the ICU Patients referred for evaluation from the ED more likely to become donors than patients referred from the Intensive Care Unit (19.3% v. 5.2%, $p = 0.01$) Total organs per donor higher in ED patients 3.79 v. 3.16, $p = 0.24$ Total donors 47 (ED) + 373 (ICU) = 420 47 / 420 (11%) came from ED	Complete
Summers et al. (2014)	Prospective audit of all deaths in the UK from April 2010 – December 2011 grouped into 9 different zones	All patients who died in a critical care setting Successful kidney donors (NDD and DCD)	Factors considered within the multifactorial model in a forward step-wise fashion were: age, cause of death, ethnicity, and type of critical care in which the death took place. 1528 (5.6%) of patients who died and became kidney donors 3050/27,482 (11%) of deaths were in the ED 67/1528 (4%) successful donors died in ED 43/984 (4%) NDD donors 24/544 (4%) DCD donors	Complete
Michael et al. (2009)	Retrospective single center cohort study January 1, 2005 – September 30, 2008	All solid organ donor referrals for brain death Logistic regression of ED v. inpatient organ donors	6,886 donor referrals Bivariate analysis: successful organ donation associated with younger age, mechanism of injury (CNS injury), referral from ED, Caucasian race Multiple logistic regression showed referral from ED significantly associated with referral OR = 1.52, 95% CI = 1.18 to 1.97), age (OR = 0.96, 95% CI = 0.96 to 0.97), and mechanism of injury ($p < 0.001$) Patients from ED more likely to have consent granted compared to inpatient settings (66.5% v. 57.3% OR = 1.37, 95% CI = 0.93 to 2.02, $p = 0.12$, ED donors 111, inpatient 355) ED donors 111/466 (24%)	Complete
Ergin et al. (2008)	Prospective single site early 2006, exact dates not reported	Death audit of all dying patients	19 patients potential donors in hospital 6 from ED (4 became real donors), 5 pediatric ED, 6 neurosurgical ICU, 2 external centers 9 donors yielding 16 kidneys, 3 hearts, 5 cadaveric valves, 9 livers, 18 corneas ED donors 4 / 9 (44%)	Exact dates of study not specified
Tenn-Lyn et al. (2006)	Retrospective cohort study using convenience sample of 8 Ontario neurosurgical	Patients sent for neurosurgical assessment	141 reviewed 14 (9.9%) successful organ donors, 2 (14%) died in ED, 12 (8.5%) died following admission Of 86 patients who died, 22 (25.6%) had organ donation discussed 6 (27.3%) had discussion initiated in ED	Convenience sample increases risk of selection bias (Continued)

Table 1. Continued.

Paper	Design	Population	Outcomes	STROBE checklist
Henderson et al. (1998)	Retrospective before and after study at single level I trauma center from 1994–1996	Prior to 1995, no program Program instituted 1995 emergency physicians and nurses educated on procurement referral process and on-call transplant nurse hired	1994: 10 potential donors in ED, 1 referred, no actual donors 1995 prior to program: Referral rate 30% with no organs procured 1995 after program: referral rate 100% with 5 ED donors in 1995 and 14 organs procured. ED patients 5/11 total hospital wide donors (45%) 1996 after program: Referral rate 100% with 9 donors in 1996 and 32 procured organs. ED patients 9/17 total hospital wide donors (53%)	Complete

DCD = Donation after circulatory determination of death; ED = emergency department; NDD = donation after brain death.
*Emergency department data were obtained through correspondence with author.

Descriptive data from individual studies are shown in Tables 1–5.

For the purpose of this systematic review, the definition of ED donor varies depending on the study design. In studies of successful organ donation, an ED donor is a donor that was referred to an organ procurement organization from the ED or had brain death declared in the ED. For the death reviews of missed and potential donors, an ED donor is a patient who died in the ED.

RESULTS

Search results

Our search results yielded 1,058 studies (see Figure 1). An additional 17 duplicates were removed, yielding 1,041 individual titles and abstracts to screen. Articles totalling 800 were excluded based on title and abstract, yielding 241 full articles to assess for eligibility. Full-text articles totalling 216 were excluded, yielding 25 articles that were included in the systematic review.

Neurologic determination of death

There were seven papers that reported successful organ donation from ED patients after neurologic determination of death.^{3,5–7,15–17} In these studies, patients were referred for consideration of organ donation while they were in the ED. All seven studies mentioned the role of the ED in referring donors to an organ procurement organization or involvement of an organ donation coordinator to facilitate donation. Taken together, these seven studies suggest that the 4%–50% of successful organ donors come from the ED. A summary of successful neurologic determination of death papers can be found in Table 1.

There were five death reviews that investigated actual missed organ donors who died in the ED that were missed as a result of a failure to refer for consideration of organ donation.^{3,18–21} Two of these studies determined that of all actual missed donors in the hospital, 13%–80.9% died in the ED.^{3,18} One study found that 84% of donors dying in the ED were missed.¹⁹ Two studies found that 0%–2% of brain dead patients dying in the ED are missed. In all cases, these donors were missed due to a failure to refer. A summary of these papers can be found in Table 2.

Table 2. Summary of papers for missed and potential neurologic determination of death donors

Paper	Design	Population	Outcomes	STROBE checklist
Witjes et al. (2017)*	Prospective observational study of 7 hospitals January 2013 – April 2014	All adult patients dying of devastating brain injury in hospital	72 unrecognized potential donors in hospital 9/72 (13%) died in ED In 51% of cases decision to start end of life care made in ED	Complete
Dell Agnolo et al. (2012)	Retrospective single center study Jan 2008 – Dec 2010	Death review of all brain deaths at a University Hospital	34/42 (80.9%) of missed possible donors were in Emergency Department	Complete
Broomberg et al. (2005)	Prospective study at a single teaching hospital March 2003 – June 2003	Death audit of all brain deaths in trauma unit, ED, ICU	13/76 in emergency unit with head injury, 6 patients arrested, 6 patients put on ventilator but not referred, 1 brain dead and referred Missed rate in ED 0%	Complete
Riker et al. (1991)	Retrospective death review at Level I trauma center over 14 months	Potential brain dead patients dying in the ED or referred from the ED to the OR, or Radiology	155 charts reviewed 99 potential cornea donors 61 potential heart valve donors 3 potential kidney donors 130/155 (84%) reviewed made no mention of organ donation	Complete
Garside et al. (2012)	Retrospective single center cohort study March 2008 – August 2010	Before and after study of the effect of a collaborative care pathway of brain death patients in the Emergency Department Death review	Referrals significantly increased from 3/151 eligible patients (2%) to 26/160 patients (16%), $p < 0.001$ Number of successful organ donors increased from 0–2 Missed rate 84%	Complete
Kim et al. (2000)	Retrospective review May 1997 – October 1997	Death review of all potential brain death donors for renal transplantation	718 deaths reviewed 324 (45%) died in the ED 35 (8.9%) acceptable potential donors in ICU and 3 (0.9%) potential donors in the ED ED donors 3 / 38 (8%)	Complete
Andres et al. (1999)	Retrospective single center review November 1997 – March 1998	Death review of potential donors. Elderly non-traumatic ICH patients with no mechanical ventilator support who could have been potential donors had they been ventilated	Group A: spontaneous ICH patient who died during 5 days of review due to neurologic impairment Group B: those who were alive or died from non-neurologic causes during same period 135 patients reviewed: 15 (11%) in Group A and 120 (89%) in Group B 13/15 Group A patients (86%) were in the ED	Complete
Le Conte et al. (2012)	Prospective post-hoc cross sectional survey of 174 hospitals during 2, 2-month periods in 2004 and 2005	Potential organ donors dying in ED with cardiac function	174/2420 patients (7.2%) of all patients dying in the ED could have been potential organ donors	Complete
Aubrey et al. (2008)	Retrospective study at 10 accident and emergency departments in UK October 2004 - December 2005	Death audit of potential heart beating and controlled non-heart beating donors on a ventilator	770/1204 deaths audited 20 potential solid organ donors (16 retrospective, 4 prospective) 14 potential heart beating (2%) and 2 potential non-heart beating donors died in the ED	Convenience sample increases risk of selection bias

DCD = Donation after circulatory determination of death; ED = emergency department; NDD = donation after brain death.
*Emergency department data were obtained through correspondence with author.

Table 3. Summary of papers for successful donation after circulatory determination of death donors

Paper	Design	Inclusion/exclusion	Outcomes	STROBE checklist
Alarhyem et al. (2017)	Retrospective single center chart review level I trauma center Jan 2001 – Dec 2014	Trauma patients presenting with no signs of life	340 patients, 7 survived Of 333 remaining 12 (3.6%) donated major organs. 24 organs donated (16 kidneys, 2 hearts, 4 livers, 2 pairs lungs) Average 2 organs per donor	Complete
Love et al. (2016)	Retrospective single center chart review at a level I trauma center January 1, 2010 – December 31, 2012	Adult patients requiring resuscitation for TCPA, eligibility assessed after arrival to ED	5/237 patients with TCPA successful donors (5%) 11 patients had ROSC and underwent evaluation for organ donation, organs procured from 5 patients 1 heart, 5 livers, 8 kidneys, 2 pancreata Donation rate 3.2 organs per donor	Complete
Raouf et al. (2011)	Retrospective single center chart review at level I Trauma center April 2007 – March 2010	All patients who sustained TCPA	252 patients 39 (15.5%) survived 19/213 (8.9%) patients who died became organ donors 15 kidneys, 6 livers, 4 hearts, 1 pancreas, 1.37 organs per donor 64.7% of patients who did not become donors had cardiac arrest after referral but before organ donor network arrival Donation requested for only 136/213 patients (63.8%)	Complete
Summers et al. (2014)	Prospective audit of all deaths in the UK from April 2010 – December 2011 grouped into 9 different zones	All patients who died in a critical care setting to Successful kidney donors	3050/27,482 (11%) of deaths in ED 43/984 (4%) DBD donors 24/544 (4%) were DCD donors Total: 67/1528 (4.4%)	Complete
Gerstenkorn et al. (2003)	Single center review March 1995 – June 2001	Review of all DCD kidney donors from the accident and emergency department or ICU	41 DCD kidneys 8 from ED, 2 successful (4.9%)	Did not specify whether study was prospective or retrospective
DeVita et al. (2016)	Prospective study at 2 hospitals Feb 2009 – June 2010	Patients with pre-existing donor designation who received CPR, failed to respond, pronounced dead, underwent in-ED cannulation for organ donation	18 patients potential candidates, 6 responses triggered, 2 underwent in-ED cannulation, 4 organs recovered (3 kidney and 1 liver) Time from trigger to perfusion 14–22.3 minutes No organs transplanted due to prolonged warm time	Complete

DCD = Donation after circulatory determination of death; ED = emergency department; ICU = intensive care unit; NDD = neurologic determination of death; TCPA = traumatic cardiopulmonary arrest.

Table 4. Summary of papers for missed and potential donation after circulatory determination of death donors

Paper	Design	Inclusion/exclusion	Outcomes	STROBE checklist
Halpern et al. (2013)	Population-based cohort study among randomly selected sample of 50 acute care hospitals in the highest volume donor areas in United States from July 1, 2008 – June 30, 2009	All potentially eligible donors dying within 90 minutes of withdrawal of life-sustaining therapy	130 potential controlled (52 optimal, 78 suboptimal) DCD donors 3 (2.3%) died in ED	Randomly selected sample could increase selection bias
Campbell et al. (1999)	Retrospective single center chart review January 1, 1995 – December 31, 1995	Death review of potential kidney donors who did not meet criteria for brain death and experienced cardiopulmonary arrest after withdrawal of ventilator support	209 patients died in ED and ICU 17 (8%) potential controlled non-heart beating donors identified, 6 (3%) uncontrolled DCD 3/17 (18%) controlled DCD donors seen only in the ED	Complete
Daemen et al. (1997)	Retrospective single center death review in 1994	Potential non-heart beating kidney donors who died just before or after admission to ED screened, medical suitability scores assigned to give low, moderate, or high potential group	200 in-hospital deaths 25 deaths in Emergency Department 8 potential brain dead heart beating donors 56 non-heart beating donors (7 low, 22 moderate, 27 high potential) 20/56 (36%) died in ED	Complete
Lacroix et al. (2004)	Retrospective death review January 1999 – May 2001	All potential non-heart beating donors who died in the ICU and ED broken down into NHB category (1–4)	83 potential NHB donors 62 (75%) died in the ED 23/23 (100%) Category 1 donors 37/37 (100%) Category 2 donors 2/22 (9%) Category 3 donors 0/1 (0%) Category 4 donors	Complete
Blackstock et al. (2010)	Retrospective single center chart review 2004–2008	All patients who underwent tracheal intubation in ED who were not admitted to ICU, then underwent extubation in the ED and died within 2 hours	1166 patients died in ED 6 (0.5%) potential DCD	Complete
Aubrey et al. (2008)	Retrospective study at 10 accident and emergency departments in UK October 2004 - December 2005	Death audit of potential heart beating and controlled non-heart beating donors on a ventilator	770/1204 deaths audited 20 potential solid organ donors (16 retrospective, 4 prospective) 14 potential heart beating (2%) and 2 (0.3%) potential non-heart beating donors died in the ED	Possible selection bias since only 770/1204 charts reviewed
Raouf et al. (2011)	Retrospective single center chart review at level I Trauma center April 2007 – March 2010	All patients who sustained TCPA	64.7% of patients who did not become donors had cardiac arrest after referral but before organ donor network arrival Donation requested for only 136/213 patients (63.8%)	Complete

DCD = Donation after circulatory determination of death; ED = emergency department; ICU = intensive care unit; NDD = neurologic determination of death; ROSC = return of spontaneous circulation; TCPA = traumatic cardiopulmonary arrest.

Table 5. Summary of all papers

	Neurologic determination of death	Donation after circulatory determination of death
Percent of successful organ donors who died in the ED	4% – 50% 7 studies	TCPA: 3.6% – 8.9% 3 studies All patients: 4% – 4.9% 2 studies
Percent of actual missed donors dying in the ED	13% – 80.9% 2 studies	
Percent of all patients dying in the ED who were actual missed donors	0% – 2% 2 studies	TCPA: 46.2% 1 study
Percent of actual missed donors in the ED	84% 1 study	
Percent of hospital wide potential donors dying in the ED	8% – 86% 2 studies	2.3% – 36% controlled 3 studies 67% – 75% uncontrolled 2 studies
Patients dying in the ED who could have been potential donors	2% – 7.2% 2 studies	0.3% – 0.5% 2 studies

ED = emergency department;
TCPA = traumatic cardiopulmonary arrest.

There were four death reviews that screened for potential organ donors using pre-specified organ donor criteria; however, the criteria varied between studies or was not specified in the paper.^{22–25} Two studies found that 8%–86% of hospital-wide potential donors die in the ED.^{22,23} Two studies found that 2%–7.2% of patients who die in the ED could be potential donors.^{24,25} A summary of these papers can be found in [Table 2](#).

One study investigated all spontaneous intracerebral hemorrhage patients to determine how many potential donors were not approached due to not being ventilated.²³ They found that 12/15 (86%) of these patients died in the ED.²³ The authors of this study highlighted the ethical considerations in ventilating a person exclusively for organ donation.

Donation after circulatory determination of death

There were six studies that described successful donation after circulatory determination of death.²⁶ All six studies involved an organ procurement organization or coordinator in the donation process. Three studies investigated patients with traumatic cardiopulmonary arrest who achieved return of spontaneous circulation and went on to become organ donors. Alarhyem et al. found that 12/333 (3.6%) donated 24 major organs.²⁶ Love et al. (2016) found that 5/237 (2%) patients donated 16

major organs.²⁷ Raouf et al. (2011) found that 19/213 (8.9%) donated 26 major organs.²⁸ Taken together, 3.6%–8.9% of traumatic cardiopulmonary arrest patients dying in the ED become successful organ donors. Two studies reviewed successful kidney donation specifically. Summers et al. (2014) found that 67/1528 (4%) of successful donors (neurologic determination of death and donation after circulatory determination of death) died in the ED and 24/544 (4%) of the donation after circulatory determination of death donors came from the ED.¹⁵ Another study found that 8/41 kidneys came from patients dying in the ED, with 2/41 (4.9%) successfully transplanted.²⁹ These studies suggest that 4%–4.9% of successful donations after circulatory determination of death kidney donors come from the ED. One study investigated the use of in-ED cannulation for uncontrolled donation after circulatory determination of death. There were 18 potential candidates, and four organs were recovered (three kidneys and one liver). There were no organs transplanted due to prolonged warm time, but, as technology advances, this could improve in the future.³⁰ A summary of successful donation after circulatory determination of death donors can be found in [Table 3](#).

There was one death review in traumatic cardiopulmonary arrest that investigated actual missed organ donors who died in the ED and were missed donors as a result of a

failure to refer for consideration of organ donation.²⁸ This study reported that 46.2% of traumatic cardiopulmonary arrest patients dying in the ED were not referred.

There were six death reviews that screened for potential donation after circulatory determination of death donors, using pre-specified criteria; however, the criteria varied between studies.^{11,25,31–34} Three death reviews investigated potential controlled donation after circulatory determination of death donors hospital-wide and found that 2.3%–3.6% died in the ED.^{11,31,32} Similarly, two death reviews investigated potential uncontrolled donation after circulatory determination of death donors hospital-wide and found that 67%–75% died in the ED.^{31,33} Two death reviews investigated all patients dying in the ED and found that 0.3%–0.5% of them could be potential donors.^{25,34} A summary of missed and potential donation after circulatory determination of death donors can be found in [Table 4](#).

Factors associated with successful and missed organ donation

Several studies investigated factors associated with successful organ donation ([Tables 1–4](#)). One study found that successful organ donation was associated with a referral from the ED instead of inpatient.⁷ There was also an insignificant trend towards ED referrals being more likely to have consent granted compared with inpatient settings.⁷ When compared with patients referred from the ICU, patients referred from the ED were more likely to become actual organ donors, and the total organs donated had a trend towards being higher.⁶ Two studies investigated education programs, including an on-call transplant coordinator or nurse and found they increased organ donation.^{17,19} Three studies included in this review investigated specific reasons why potential organ donors are missed. One study found the main reasons that organ donation was not discussed were that the treating physician forgot (23/72), the incorrect assumption that the patient was too old (11/72), or the incorrect assumption that the patient was not suitable as an organ donor (7/72).³ Similarly, another study found that out of 19 charts with patients documented as “medically unsuitable” for organ donation, only 3 were actually medically unsuitable.²¹ Perceived barriers cited by healthcare staff included non-recognition as an organ donor, lack of confidence in offering organ donation, no contact for transplant coordinator, shortage of ICU beds, coroner involvement, and limited resources.²⁵

DISCUSSION

Interpretation

This systematic review investigated what percent of actual, missed, and potential organ donors come from the ED ([Table 5](#)). We demonstrated that the ED is a source of successful organ donors; patients referred from the ED are more likely to become successful donors, and they donate more organs than patients referred from elsewhere in the hospital ([Tables 1 and 2](#)). We also found that a significant proportion of patients die in the ED without exploring the possibility of organ donation and are often missed as donors due to a failure to refer for consideration of organ donation ([Tables 3 and 4](#)). Several themes emerged regarding why potential donors are missed. The most common were inaccurate assumptions regarding inclusion criteria and forgetting to refer the patient. All seven papers describing successful neurologic determination of death and all six papers describing successful donation after circulatory determination of death highlighted the importance of involving an organ procurement organization or coordinator in the donation process. The role of the ED healthcare team is predominantly in referral for consideration of organ donation to the organ donation organization or coordinator.

Comparison to previous systematic reviews

Several systematic reviews have been conducted on organ donation previously; however, they describe techniques of organ extraction, discuss techniques to increase likelihood of successful donation, or pool all acute areas of the hospital.^{9,10,35} The strength of this systematic review is that it is the first that we are aware of to investigate organ donation in ED patients specifically.

Limitations

There are several limitations to this systematic review. The studies had heterogeneous populations, used different inclusion criteria for organ donors, or did not mention their criteria, precluding a meta-analysis. There is a very large range in percentages of successful and missed donors in the studies, and it is difficult to draw meaningful conclusions on why these large ranges exist based on the data in the studies. Many of these factors impacting rates of donation may be out of the realm of the ED. Studies investigating missed or potential donors do not reflect on how many

of each of those donors would be lost in the consent process, procurement process, or transplantation process, so the numbers of potential donors would be lower than reported. In addition, most of the studies included in this review were retrospective and are limited by the biases associated with conducting a retrospective study.

Clinical implications

Inaccurate assumptions regarding inclusion criteria and medical suitability can be addressed by involving an organ donation coordinator, organ donation nurse, or organ procurement organization involved early in the dying process.²⁶ The role of the ED in many of the successful organ donation studies was in timely referral to the organization or coordinator. Involving a separate organization also removes some of the conflict of interest and ethical dilemma placed on the ED to simultaneously provide patient care and discuss organ donation.⁶ Recent Canadian guidelines have been developed regarding the process of consent and approaching families.³⁶ The role of the physician is to ensure that the organ procurement organization has been contacted. These guidelines also recommend the healthcare team involved in patient care not approach the family regarding organ donation until an organ donation organization has been contacted. They suggest that any family meetings involve the donor coordinator, primary bedside nurse, and most responsible treating physician. It is clear that a multi-disciplinary approach is essential when discussing organ donation.

Resource utilization was another ethical dilemma identified in this systematic review. Although it seems intuitive that ICU admission for organ donation is costly, Melville et al. (2017) found that patients transferred to the ICU for consideration of organ donation did not use disproportionate resources when compared with patients transferred for palliative care.³⁷ This perceived boundary should not prevent referral of dying patients to an organ procurement organization.

Research implications

Several knowledge gaps exist in organ donation from the ED. Future research should determine the optimal education curriculum to overcome misconceptions regarding organ donation. Also, the optimal timing of organ donation discussions during resuscitations should be elucidated. The feasibility and impact of uncontrolled donation after circulatory determination of death and

donation in conjunction with Extracorporeal membrane oxygenation (ECMO) and Resuscitative endovascular balloon occlusion of the aorta (REBOA) are other areas of future research.

CONCLUSION

In conclusion, the ED is a source of actual and missed donors. Potential donors are often missed due to incorrect assumptions regarding eligibility criteria and failure of the healthcare team to refer patients for consideration of donation. Early incorporation of an organ procurement organization increases successful donation. ED healthcare professionals should be aware of the organ donation referral process at their institution to ensure that no organ donors are missed.

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SUPPLEMENTARY MATERIAL

The supplementary material for this article can be found at <https://doi.org/10.1017/cem.2019.365>

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