

Impact of Donation Physicians on Deceased Organ Donation: A Systematic Review

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Abstract

Background: An emerging strategy to increase deceased organ donation is to use dedicated donation physicians to champion organ donation. We sought to conduct a systematic review of the effectiveness of donation physicians in improving organ donation outcomes.

Methods: A systematic review was conducted following Cochrane principles. MEDLINE, Embase, and CINAHL databases were searched from inception to March 26, 2020. Quantitative studies examining the effects of donation physicians on all deceased organ donation outcomes were considered for inclusion. Review articles, editorials and opinion articles, and case studies were excluded. Study selection was completed independently by two team members; all discrepancies were resolved by consensus. Two team members independently extracted data from studies.

Results: A total of 1,017 studies were screened, and 12 met inclusion criteria. Included studies were published between 1994 and 2019. Half used an interrupted time series design ($n = 6$; 50%), three (25%) were cohort studies, and three (25%) used a before-and-after study design. Outcomes (reported in greater than 50% of included articles) included consent/refusal rate ($n = 8$; 67%), number of potential donors ($n = 7$; 58%), and number of actual donors ($n = 7$; 58%). Across studies and design types, there was an increase in potential organ donors ranging from 8 to 143% ($Mdn = 33\%$), an increase in actual organ donors from 15 to 113% ($Mdn = 27\%$), an increase in donor consent rate from -3 to 258% ($Mdn = 12\%$) and an increase in deceased donor transplants from 13 to 24% ($Mdn = 19\%$) following the introduction of donation physicians.

Conclusions: Donation physicians have the potential to significantly improve deceased organ donation. Further implementation and evaluation of donation physician programs is warranted. However, implementation should be undertaken with a clear plan for a methodologically rigorous evaluation of outcomes.

Background

Despite improvements in organ donation procedures and practices in many countries across the world, a global shortage of organs remains. In the United States, for example, despite a nearly 5% annual increase in transplantation rates, the gap between organ supply and demand has widened due to an increase in patients awaiting transplants (1). Internationally, specialists called “donation physicians,” “donor physicians” or “transplant physicians” are increasingly recognized as playing a key role in improving organ donation rates (2). Besides acting as local champions for organ donation within intensive care units and the broader hospital, donation physicians have responsibility and accountability for organ deceased donation (3) and work alongside other healthcare professionals and administration to facilitate organ donation (2).

While donation physician programs exist, given the continued need to optimize organ donation internationally, it is essential that interventions being used to increase organ donation be evaluated for effectiveness so that resources can be allocated appropriately (4). To this end, the purpose of this review was to examine the effectiveness of donation physicians on deceased organ donation outcomes, including the number of potential donors, the number of actual donors, and consent rates, across different interventions and study designs.

Methods

Search Strategy

The search strategy was developed and carried out with a health sciences librarian who has expertise in systematic reviews. A total of three online databases were searched: EMBASE, MEDLINE, and CINAHL. There was no limit on the date of publication and the search accounted for studies published from the inception of each database up to March 26, 2020. Key terms used in the search included “donor physician,” “donation physician,” and “transplant physician.” The complete search strategy is provided (see Additional file 1). Reference lists of included studies and excluded review papers were assessed for eligible studies.

Inclusion and Exclusion Criteria

All quantitative studies that examined the effects of donation physicians on deceased donation outcomes were included. The specific outcomes were not decided upon *a priori* to maximize inclusion of any articles that quantitatively evaluated one or more possible outcomes following implementation of donation physicians (e.g., the number of potential donors, actual donors, consent rate, etc.). Review articles, editorials, opinion articles, and case studies were excluded. Articles focused on living donation and non-physician donor coordinators were also excluded.

Study Identification

Screening was undertaken using Distiller Systematic Review Software (5), a web-based software that facilitates collaboration among reviewers during the study selection and data extraction processes. Screening occurred in two phases. In both phases, all records were assessed using two screening questions: 1) Does the study report on the role of the donation physician?; and 2) Does the study report on the effect of a donation physicians on an organ donation outcome such as referral, consent, and/or donation rates? In level 1 screening, two team members (LDA, WS) independently assessed the titles and abstracts of all records identified in the search strategy. All potentially relevant articles, as well as those where there was insufficient information to decide eligibility, progressed to level 2 screening. In level 2 screening, full-text articles were assessed for eligibility based on the inclusion criteria by two team members (LDA, WS). All discrepancies in study selection were resolved through consensus between team members with consultation of a third senior team member (JES) when necessary. Reasons for exclusion were documented for all full-text articles.

Data Extraction

A structured data extraction form was developed and piloted on a sample of five studies. Once the form was finalized, data from each article was extracted independently by two of three possible team members (LDA, WS, NG). Data extracted included: 1) study identification—authors, publication year, country/province/territory, language, publication status, funding, study design, data collection dates; 2) participant characteristics—sample description including sample size and gender, age, education, healthcare professionals’ role, healthcare professionals’ experience; healthcare setting and, 3) outcomes—any information pertaining to organ donation outcomes. Any discrepancies in data extraction were resolved through a consensus process between the data extractors. A third senior team member (JES) was consulted when necessary.

Quality of Included Studies

Two team members assessed methodological quality of the studies independently (LDA, WS, DCY). Discrepancies in methodological quality assessments between reviewers were resolved through consensus. Two validated assessment tools were used to conduct the methodological quality assessments. The Checklist for Quasi-Experimental Studies (non-randomized experimental studies) from the Joanna Briggs Institute was used for interrupted time series studies (6). This checklist contains nine items and assesses studies in the areas of sampling, measurement, outcomes, and statistical analysis. The Quality Assessment and Validity Tool for Pre/Post-test Studies tool was used for cohort and before-and-after study designs (7–11). The Pre/Post-test Studies tool assesses studies in six core areas: sampling, design, control of confounders, data collection and outcome measurement, statistical analysis, and drop out. A quality score for each article was obtained by dividing the sum of the scores by the total amount possible. All included studies were classified using the same rating scale: weak (≤ 0.50), low-moderate (0.51 to 0.65), high-moderate (0.66 to 0.79), or strong (≥ 0.80). This rating system is based on a previously developed system (12) and has been used in previous systematic reviews (7–11).

Data Synthesis

The data were categorized according to the organ donation outcome addressed in the study. Data synthesis differed by study design. For interrupted time series studies, the relative year-to-year percent changes were calculated (e.g., $[(2001-2000)/2000]$ and $[(2002-2001)/2001]$) and presented as dot plots. The average relative percent change was calculated and presented as bar graphs. For cohort and before-and-after study designs, the relative percent change between the cohorts or before-and-after data points were synthesized and presented as bar graphs.

Results

Eligible Studies

A total of 1,621 records were identified in the search. After the removal of duplicates ($n = 487$), 1134 articles remained and underwent screening based on title and abstract. This first level of screening led to the exclusion of 1,014 articles. A total of 120 articles were assessed for eligibility through full-text screening and 12 studies met the inclusion criteria for the review. A list of studies that were excluded upon full-text review, including the reason(s) for their exclusion, are provided in Additional file 2.

Study Characteristics

Characteristics of the included studies are provided in Table 1. All studies were published between 1994 and 2019. Nearly half of the studies were conducted in Spain ($n = 5$; 42%). Other countries represented were Netherlands ($n = 2$; 17%), Poland ($n = 2$; 17%), Brazil ($n = 1$; 8%), Greece ($n = 1$; 8%), Uruguay ($n = 1$; 8%). None of the included studies were conducted in North America.

Half of the studies ($n = 6$; 50%) used an interrupted time series design, while 3 (25%) studies used cohort designs, and 3 (25%) used a before-and-after study design. The period of data collection in the studies ranged from 1 year (13, 14) to 11 years (15). Several different organ donation outcomes were reported in included studies: consent or refusal rate ($n = 8$; 67%) (13–20), number of potential organ donors ($n = 7$; 58%) (15, 17–20, 21, 22), number of actual organ donors ($n = 7$; 58%) (17–20, 21–24), number of deceased donor transplantations ($n = 4$; 33%) (19, 20, 21, 23), conversation rate (i.e., how many potential donors become actual donors) ($n = 4$; 33%) (18–20, 22), number of organs removed ($n = 3$; 33%) (20, 23, 24), and number of multiple organs removed ($n = 2$; 17%) (19, 24) (Table 1).

Table 1.

Information for included studies.

First Author, Year (Ref)	Data Collection (Total Years)	Deceased Donation Outcomes Reported (Units)					
		Potential Donors	Actual Donors	Consent Rate	Organ Procurement	Organ Transplants	Conversion Rate
Cohort Studies							
<i>Netherlands</i>							
(Vorstius Kruijff, 2016) (14)	01/2014 – 12/2014 (1)			%			
(Witjes, 2019) (16)	01/2013 – 06/2016 (4)			%			
<i>Spain</i>							
(Domínguez- Gil, 2017) (21)	11/01/2014 – 04/30/2015 (1)			%			
Interrupted Time Series Studies							
<i>Brazil</i>							
(Sarlo, 2015) (23)	2011 – 2014 (4)	N	N				%
<i>Greece</i>							
(Karatzas, 2007) (22)	2001 – 2005 (5)	N	N			N	
<i>Spain</i>							
(Matesanz, 1994a) ^a (25)	1989 – 1992 (4)		pmp		%		
(Matesanz, 1994b) ^a (24)	1989 – 1992 (4)		pmp		pmp/% ^d	pmp	
(Miranda, 2001) ^a (15)	1990 – 2000 (11)	pmp		% ^b			
<i>Uruguay</i>							
(Mizraji, 2007) (17)	2000 – 2005 (6)	N/pmp	N/pmp	% ^b			
Before-and-After Studies							
<i>Poland</i>							

(Czerwiński, 2014) (19)	~ 2011 – 2014 (3.5)	N	N	% ^b	% ^d	N/per donor	% of PD ^c
(Sikora, 2014) (18)	? – 06/2012 (>1.5)	N	N	% ^b			% of PD ^c
<i>Spain</i>							
(Santiago, 2005) (20)	Not specified (> 6)	%	pmp	% ^b	per donor	per donor	% of AD
<p><i>Note.</i> AD = actual donors; PD = potential donors; a = for some, but not all, variables; b = calculated from refusal rates; c = calculated from potential and actual donors; d = multiple organs remove</p>							

Methodological Quality of Included Studies

All studies were rated as “weak” in methodological quality. Reasons for reduced quality scores were largely around sampling and statistical analyses. The quality ratings for each included study is presented in the supplementary file (see Additional file 3 for studies with an interrupted time series study design; see Additional file 4 for cohort and before-and-after study design).

Organ Donation Outcomes

Potential Organ Donors.

Of the studies reporting on potential organ donors ($n = 7$), four reported data as absolute values (18, 19, 21, 22), two as donors per million (15, 17), and one as percent change (20). All seven studies found a relative increase, between 8% (15) and 143% (20), in potential organ donors following implementation of donation physicians (median increase, 33%). Among the interrupted time-series studies (Figure 1A-B), the average relative year-to-year increase in potential organ donors across all studies ranged from 8% (15) to 67% (21). Among the before-and-after studies (Figure 1C), the relative percent change in potential organ donors ranged from 27% (19) to 143% (20).

Actual Organ Donors.

Of the studies reporting on actual organ donors ($n = 7$), three reported data as part per million (17, 20, 23) and four as the absolute value (18, 19, 21, 22). All seven studies found an increase between 15% (24) and 113% (18) in actual organ donors following implementation of donation physicians (median increase, 27%). Among interrupted time series studies (Figure 2A-B), the average relative year-to-year increase in actual organ donors ranged from 15% (24) to 73% (22). Among the before-and-after studies (Figure 2C), the relative percent change in actual donors ranged from 24% (19) to 113% (18).

Donor Consent Rate.

Of the studies reporting donor consent or refusal rates (n = 8), the average relative change in donor consent rates ranged from -3 to 258% (median increase, 12%). Among interrupted time series studies (Figure 3A-B), the average relative increase in the year-to-year percent change in donor consent rates ranged from 1% (15) to 17% (17). In before-and-after studies (Figure 3C), the average relative increase in donor consent rate ranged from -1% (19) to 11% (18). In cohort studies (Figure 3D), the relative percent change in donor consent rate varied from 5% (16) to 259% (14).

Organ Procurement.

Of the three studies (20, 23, 24) reporting on single organs procured, two reported data as absolute numbers (23, 24) and one as per donor (20). The change in single organs procured (Additional file 5) ranged from 16% (20) to 81% (23, 24). Both studies (19, 24) reporting on the procurement of multiple organs provided data as a percent change (Additional file 6). For the interrupted time series study, the average relative year-to-year increase was 38% (24) and for the before-and-after study, the average relative change in multiple organs procured was 4% (19).

Transplants.

Four studies (19, 20, 21, 23) reported on the number of transplants from deceased donors (Additional file 7). Of these, two reported data as absolute numbers (19, 21), two as per donor (19, 20), and one as part per million (23). Among all studies, there was an increase in deceased donor transplants from 13 to 24% (median increase, 19%). Among interrupted time series studies, the average relative year-to-year increase in deceased donor transplants ranged from 13% (23) to 24% (21). Among before-and-after studies, the average relative year-to-year increase in deceased donor transplants ranged from 13% (20) to 20% (19).

Organ Donor Conversion Rate.

Of the four studies (18–20, 22) reporting on organ donor conversion rates (Additional file 8), three reported data as percent of potential donors (18, 19, 22) and one as percent of actual brain deaths (20). Among interrupted time series data, the average relative year-to-year increase in the organ donor conversion rate was 30% (22). Among before-and-after studies, the relative percent change in organ donor conversion rates ranged from 6% (18) to 23% (20) among studies reporting a positive change and a -3% percent change in one study reporting a decrease (19).

Discussion

Summary of Findings

Of the studies that reported actual and potential numbers of deceased organ donors in this review, all found an increase in these outcomes following implementation of a donation physician program. Organ donor consent rate and actual deceased donor transplantations also experienced positive increases in most studies. Overall,

implementation of donation physicians was associated with a positive effect on deceased organ donation and transplantation.

Limitations of Included Studies

While we saw a trend for a positive effect on donation outcomes with donation physicians, the included studies had several limitations. First, as most studies included in this review found a positive result, it is possible that the presence of publication bias may have distorted the results of the current study. It is therefore possible that the true effects of donor physicians are not as favorable as the current findings suggest. As well, there were several methodological weaknesses in the studies. Notably, all included studies were rated as weak, the lowest grading in methodological quality, illustrating a need for well-designed studies in this area. For before-and-after or cohort studies, it was not clear if the interventions (e.g., training sessions for physicians) would need to be regularly implemented, and if so, how regularly they would need to be implemented to ensure the positive effects are maintained. Thus, future longitudinal studies would be an asset in this area of study. The amount and type of training physicians received also varied between studies. When defined, training appeared to range from online modules to in-person training courses; however, in many studies, training of physicians was not explicitly defined. This may have affected the study outcomes. Studies also varied in statistical rigor, and few studies performed inferential statistical tests. As most studies did not report statistical significance, we could not consider effect sizes or precision of estimates in evaluating the findings. As well, none of the interrupted time series studies reported baseline data, making it difficult to evaluate the extent to which the intervention improved organ donation outcomes over and above secular trends. As with all uncontrolled studies, it is possible that other interventions were implemented during the period that resulted in the improved outcomes.

Limitations of the Present Review

The present review has some limitations. First, as we did not search grey literature databases, this review may not include all relevant work. Second, we did not contact study authors to clarify data that could have made pooling easier. Third, the wide diversity in how the data were reported complicated our ability to compare results across studies. For instance, some studies reported results as absolute values, others as percent change, and others as parts per million or per donor, leading to difficulties in data synthesis. To address this in interrupted time series data, we calculated the average relative percent change year-over-year for each variable. This allowed us to better compare intervention outcomes across studies, irrespective of how the data were reported. Finally, studies conducted in Spain are overrepresented in this review, with five out of the 12 utilising Spanish data. While Europe is well represented, with 9 out of 12 studies from European countries, and South America also has representation, with 3 out of 12 studies, none of the included studies were from North America or Asia. Thus, it is not clear to what extent the findings would be applicable globally.

Conclusions

In summary, this review found important improvements in deceased organ donation outcomes following the introduction of organ donation physicians. Although the quality of the included data was weak, the positive trend found in this review suggests that further implementation and evaluation of donation physician programs is

warranted. However, implementation should only be undertaken with a clear plan for a methodologically rigorous evaluation of outcomes, including economic indicators.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

All authors contributed to the conceptualization of the project. Screening, data extraction, and quality assessment was completed by LDA, WJS, and DCY. Tables and figures were approved by all authors. LDA and JES were major contributors to the writing of the manuscript. All authors read and approved the final manuscript.

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Not applicable

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Figures

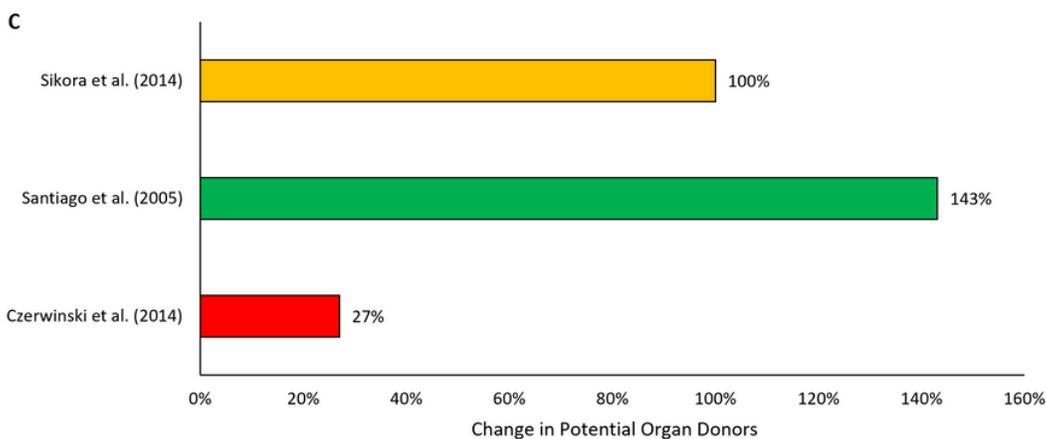
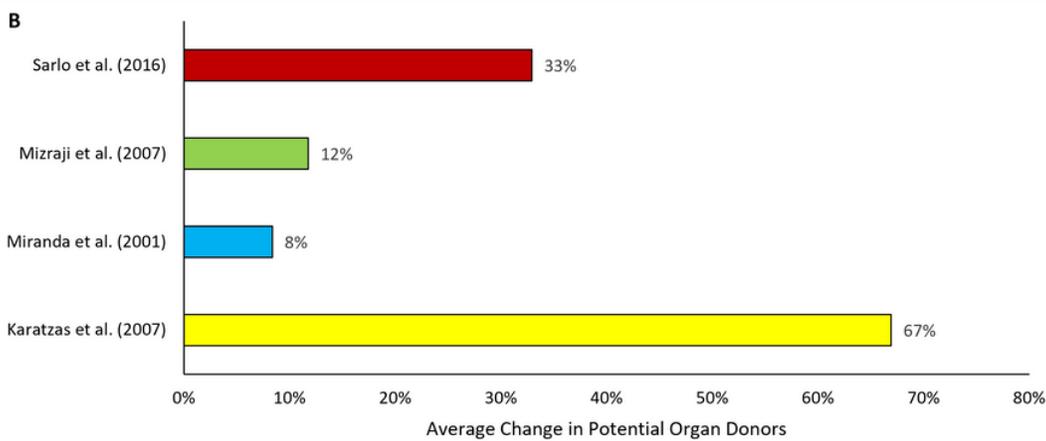
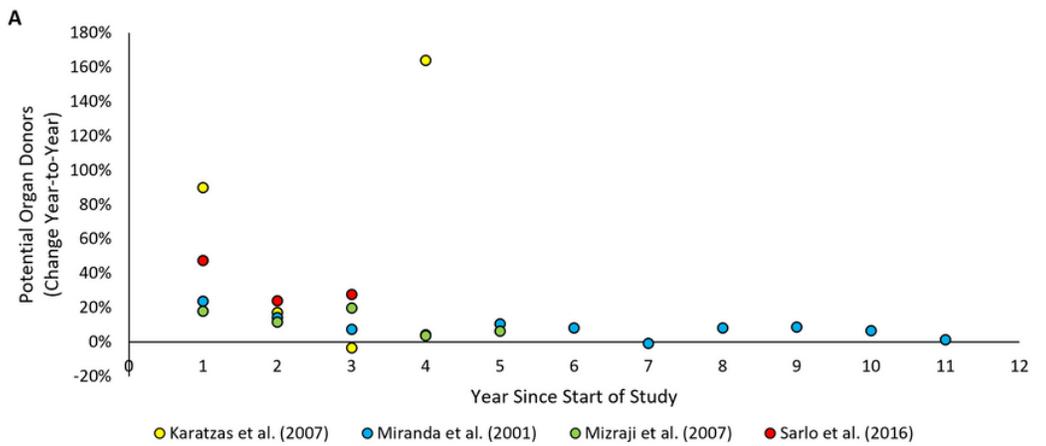


Figure 1

Relative percent change in potential organ donors for interrupted time series (A-B) and before-and-after (C) studies. Figure 1A reflects the average relative year-to-year increase in potential organ donors over the course of the study. Figure 1B reflects average relative change year-over-year of the time series data presented in Figure 1A. Figure 1C reflects the percent change in potential organ donors following the intervention.

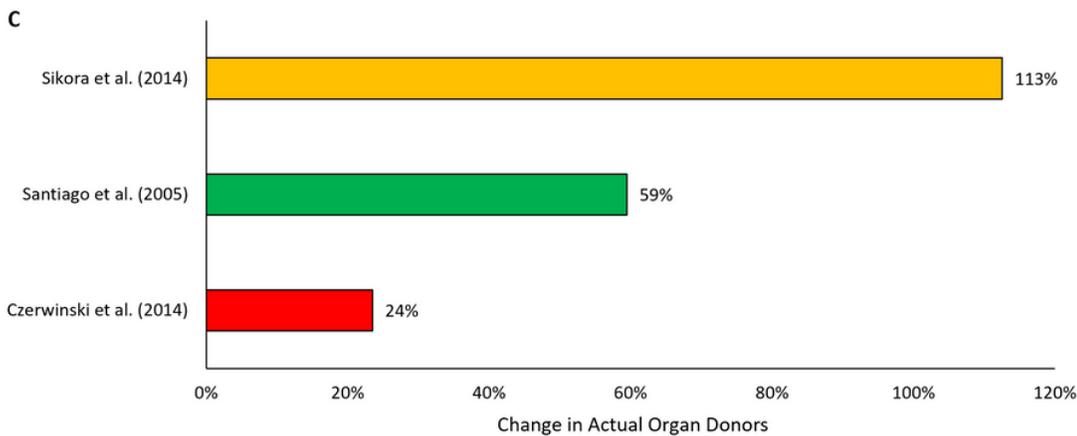
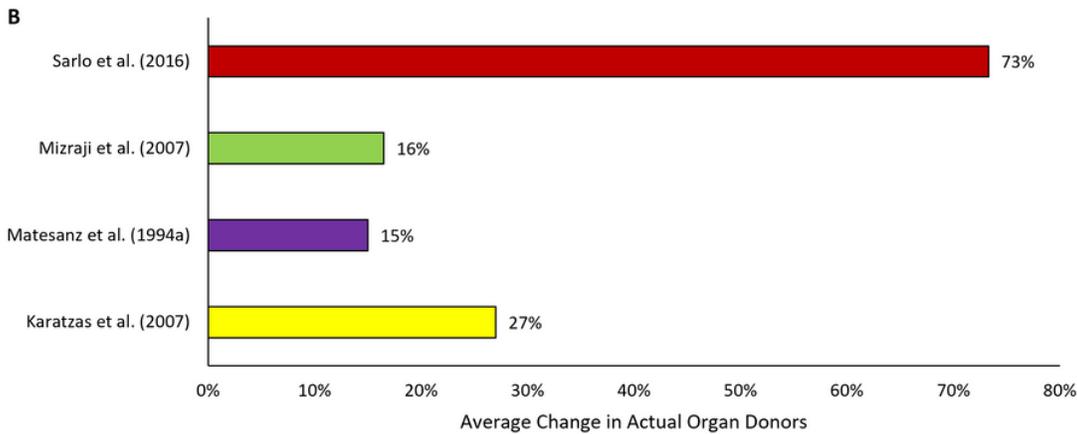
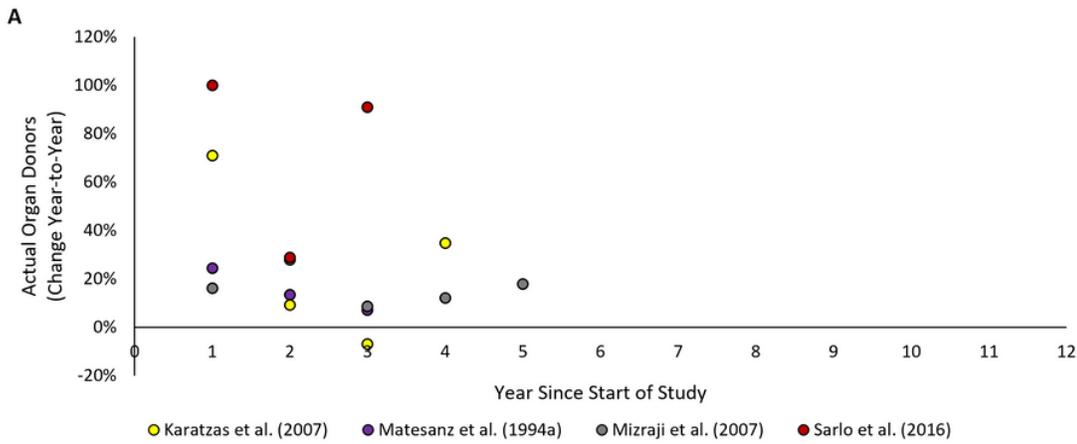


Figure 2

Relative percent change in actual organ donors for interrupted time series (A-B) and before-and-after (C) studies. Figure 2A reflects the relative average year-to-year increase in actual organ donors over the course of the study. Figure 2B reflects average relative change year-over-year of the time series data presented in Figure 2A. Figure 2C reflects the percent change in actual organ donors following the intervention.

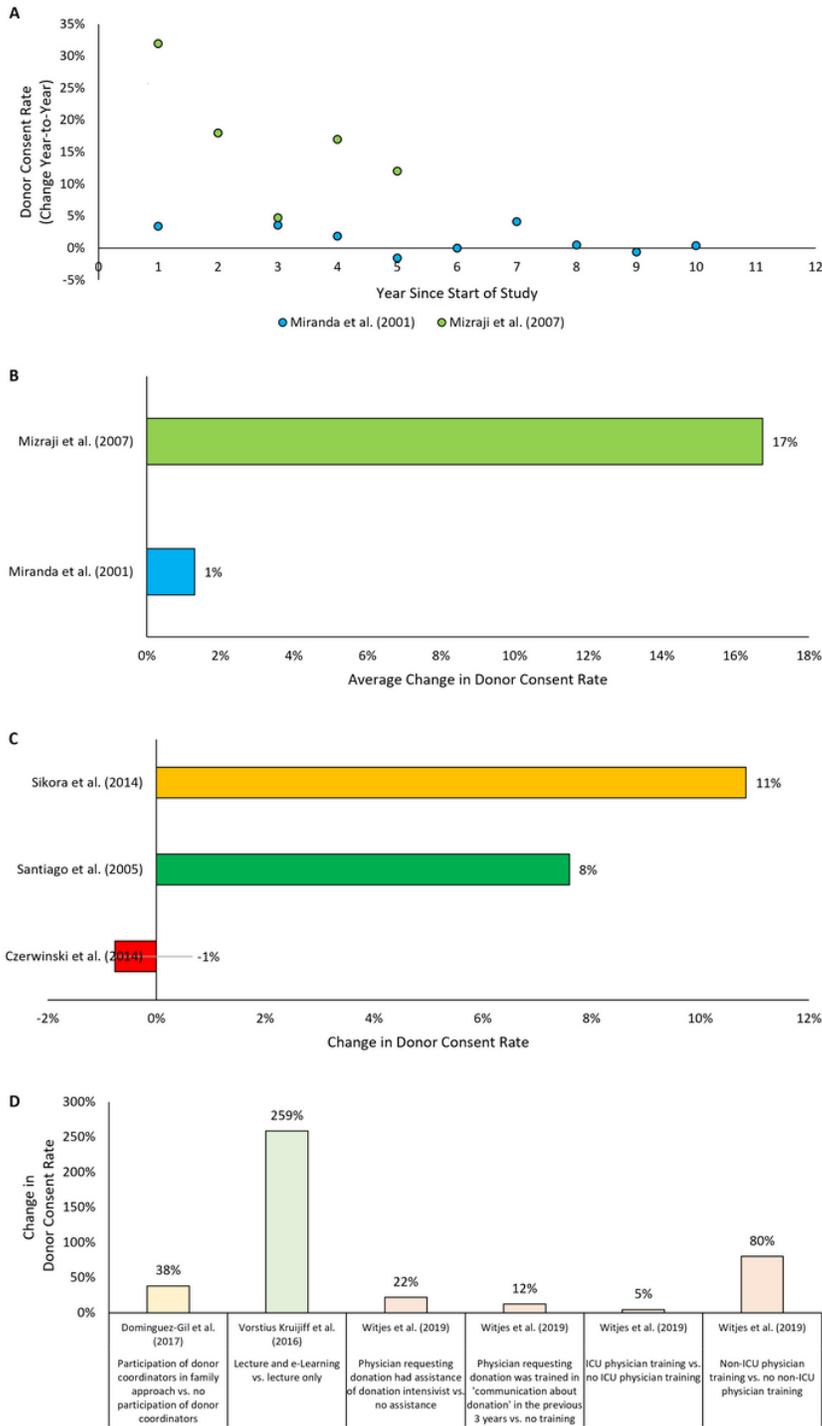


Figure 3

Percent change in donor consent rates for interrupted time series (A-B), before-and-after (C), and cohort (D) studies. Figure 3A reflects the average relative year-to-year increase in donor consent rates over the course of the study. Figure 3B reflects average relative change year-over-year of the time series data presented in Figure 3A. Figure 3C reflects the percent change in donor consent rates following the intervention. Figure 3D reflects the percent difference in donor consent rates between two cohorts.

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