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ORIGINAL RESEARCH ARTICLE

## Explaining Failure Through Success: A Critical Analysis of Reduction in Road and Stroke Deaths as an Explanation for Australia's Low Deceased Organ Donation Rates

(Short Title: Public Safety and Low Organ Donor Rates)

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### ABSTRACT:

During the past 20 years Australian federal and state governments have funded many initiatives to bolster organ donation. Despite large investments of time, effort and money, Australia's deceased donation rate is amongst the world's lowest and has only slightly increased from 11.9 donors per million people (pmp) in 1990 to 13.8 donors pmp in 2010. An often-cited explanation for this situation is that Australia's success in increasing levels of public health and safety has reduced the number of potential deceased organ donors. We refer to this as the "Failure Because of Success" hypothesis. Although commonly accepted, this hypothesis is largely untested. Analysis of health data on road trauma and stroke deaths from Australia and other OECD countries reveals that improvements in public health and safety do not provide an adequate explanation for Australia's low organ donor rates.

Keywords: Organ donation, Public safety, Brain death, Traffic fatalities, Stroke

## FIGURE 1<sup>1</sup>: Deceased Organ Donation Rates for 2009

### INTRODUCTION:

Organ transplantation is a well-established treatment for many chronic diseases, with the potential to save lives and significantly improve the quality of life of severely ill people. Unfortunately, the demand for organs exceeds supply and despite Australia's excellent record in organ transplantation outcomes, **(1,2)** and Australian federal and state governments' continued investment of substantial resources to improve donation rates, **(3)** Australia's deceased organ donation rate continues to languish in the bottom third of OECD donor rankings (Figure 1). While much discussion has centred on recent improvements to Australia's organ donation rates, Australia's 2010 deceased donor rate of 13.8 donors pmp is less than one half of (world leading) Spain's 2010 rate of 32 donors pmp **(4)** (in 1989 both Australia and Spain had virtually identical deceased donor rates). Australia's low donation rate is frequently explained by reference to success in increasing levels of public health and safety, which have directly reduced the number of potential organ donors. **(5–8)**

With the exception of a relatively small but increasing number of patients who donate organs after cardiac death, virtually all solid organs for transplant in Australia are retrieved from brain dead donors. **(9)** In Australia, the types of donor death are tracked and categorised into six broad categories (each with its own subcategories) which largely parallel the types of donor deaths tracked in many other OECD countries. These are: Strokes (Cerebral Vascular Accidents (CVA)), Road Trauma (RT), Non-Road Trauma, Cerebral Tumour, Hypo/Hyper Anoxia and Other (Unspecified). **(9–17)** Of these, the majority of deceased donors are the victims of CVA and RT. (The percentage of these deaths is broadly similar across most OECD countries (Figures 2a, 2b & 2c).)

Figure 2a - Percentage of Donor Death Caused by Road Trauma Fatalities by Country **(9–17)**

Figure 2b - Percentage of Donor Death Caused by CVA Fatalities by Country **(9–17)**

Figure 2c - Percentage of Donor Death Caused by Road Trauma & CVA Fatalities (combined) by Country **(9–17)**

Over the past several decades, Australian road trauma (RT) fatalities have steadily fallen from 13.66 deaths per 100,000 population in 1990 to 6.8 in 2009 **(18)** (Figure 3). Rates of death from CVA in Australia have similarly declined from 61.2 per 100,000 population in 1990 to 35.2 in 2006 **(19)** (Figure 4). The fact that these significant reductions in death rates from RT and CVA have occurred parallel to a long period of stasis in Australian deceased organ donation rates has supported lay and professional claims that Australia's failure to improve organ donation rates is due to success in saving people's lives through improvements in public health and safety, thereby depleting our pool of potential organ donors. **(5–8)** We refer to this notion as the "Failure Because of Success" hypothesis.

The validity of this assumption has generally been accepted as self-evident and true despite the fact that the quantum of the impact of road trauma and CVA deaths on overall organ donation rates has not been fully examined. In this paper we examine this argument by comparing the RT death, CVA death and deceased donation rates for seven leading donor countries with those from Australia.

### METHOD:

Using published reports **(9–11,13,14)** and data from the International Registry of Donation and Transplants (IRODAT) complemented with unpublished data from several other sources **(12,15–17)**, we analysed the annual deceased organ donation rates for 54 countries from 1990 through to 2009. We then extracted data for the seven leading donor countries, which were Spain, Portugal, France, USA, Belgium, Italy and Austria. For the purposes of this study, we define the term "leading donor countries" as those countries whose deceased donor rates exceeded 20 donors pmp for at least five of the ten years between 2000 and 2009. These countries' deceased donation rates were then compared to that of Australia for the same time

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<sup>1</sup> All tables and figures are located at the end of this article.

period. (Puerto Rico, which showed the greatest improvement in deceased donation rates of all the countries during the time period analysed is not included because we were unable to find reliable data on CVA and RT fatality rates for the period under study).

Road Trauma (RT) fatality rates from the International Road Traffic and Accident Database (IRTAD) for the leading donor countries and for Australia were then compared for the same time period (1990 through 2009). A Road Trauma fatality was defined as death where road trauma was the primary cause of the death, occurring within 30 days of a traffic accident.

Stroke (CVA) death data from the Organisation of Economic Co-operation and Development (OECD) Health Statistics Database for the leading donor countries and Australia was also compared for the same time period. CVA deaths were defined as a death whose cause was listed as ICD I60 through I69.

#### FINDINGS:

##### FIGURE 3: Road Trauma Fatality rates by country from 1990 to 2009

#### Road Trauma Mortality

Figure 3 shows that all eight countries had significant reductions in road trauma fatality rates from 1990 to 2009. During the past 20 years, the trend for RT fatality rates for the majority of the countries studied have essentially merged. Spain, at 5.9 fatalities per 100,000 population is the lowest, with both Australia and France next at 6.8, followed closely by Italy, Austria and Portugal at 7.1, 7.6 and 7.9, respectively (Table 1). Australian RT fatality rates improved significantly during the past 20 years, and although it started from a lower (safer) base, its improvement lags significantly behind that of many other leading donor countries. Australia ranks sixth in terms of rate percentage reduction in RT mortality (50% reduction). The USA shows the smallest net reduction of RT fatality rates, dropping from 17.88 per 100,000 population in 1990 to 12.25 in 2008 (31% reduction). Spain and Portugal show the greatest improvement with each having reduced its RT fatality rate by more than 70%. Spain, Portugal and France's performance in increasing road safety is particularly noteworthy given the dramatic increases in deceased donation rates that occurred in these countries during the same time period (see Figure 5).

##### FIGURE 4: CVA Fatality rates by country from 1990 to 2008

#### CVA Mortality

All eight countries examined have achieved steep reductions in CVA fatality rates during the time period studied (see Figure 4). While the incomplete data sets in the OECD database records make analysis of CVA fatality rates beyond the 2006 time period difficult, certain trends are evident. Portugal shows a surprisingly high CVA death rate--several times that of other countries (i.e. in 1990, Portugal's CVA mortality rate was 204.7 per 100,000 population while that of Spain was 86.2, Australia's was 68.2 and the USA was 47.4) (Table 2). Of the eight countries included in the analysis, as of 2004 (the latest year most countries reported), at 40.2 CVA deaths, per 100,000 population, Australia ranks in the middle in CVA fatality rates with 40.2 CVA deaths per 100,000 population per year, while France, the USA and Austria show the lowest CVA fatality rates with 30.6, 35.7 and 40.1 respectively. Therefore, as is the case with RT fatalities, reductions in CVA fatalities do not appear to have compromised the leading donor countries' ability to maintain, and in most cases, dramatically improve their organ donor rates.

##### FIGURE 5: Deceased organ donation rates by country from 1990 to 2009 (9–17,20)

#### Deceased Organ Donation Rates

All countries, with the exception of Australia and Austria, demonstrated significant increases in their deceased organ donation rates during the study period (see Figure 5). Italy showed the highest percentage rate improvement at more than 238% from 1993 to 2009. Spain, Portugal, France and the USA also showed dramatic increases to their deceased donation rates (Spain, from 17.8 in 1990 to 34.0 in 2009; Portugal from 15.0 in 1993 to 31.0 in 2009; France from 17.1 in 1993 to 24.2 in 2009 and USA from 17.9 in 1992 to

24.0 in 2009) (Table 3). Overwhelmingly, these countries demonstrated steady, progressive improvement in rates of deceased organ donation throughout the study period.

With the exception of the 13.2% decrease observed in Austrian donations during the study period, the sustained and significant increases in donation rates in all other leading donor countries are independent of the steady and notable improvements (reductions) observed in their road trauma and stroke fatality levels.

#### DISCUSSION:

Whether measured in relative or absolute terms, Australia's performance in increasing levels of public health and safety and achieving significant reductions in road trauma and CVA deaths is neither unique nor exemplary when compared to the improvements seen in many of the leading donor countries analysed in this study. Importantly, most of the world's highest performing donor countries have succeeded in improving public safety and reducing mortality from cerebrovascular disease while concurrently increasing their deceased organ donor rates. With one exception (Austria), their achievements demonstrate that success in improving public health and reducing both road trauma and CVA deaths does not necessarily compromise success in substantially raising deceased organ donation rates. Success in improving public safety through reducing road trauma and CVA deaths does not, therefore, appear to adequately explain failure to achieve improvements in organ donation rates. (It is theoretically possible, of course, that management of CVA and Road Trauma in Australia differs from other leading donor countries and that neurological outcomes, including a diagnosis of brain death, in such circumstances, are also different. There is however, no data to suggest that this is true, and even if it were, the impact on donation rates would be minimal at best.)

This raises a series of troubling questions. The first is, how could a "failure because of success" hypothesis such as we have described have gained such political, medical and lay traction and been so widely adopted as factually correct without being subjected to rigorous examination? The second is whether there is, or has been, a "cost" to our donor rates through uncritical acceptance both of this hypothesis and the idea that Australia is somehow "different" to other western democracies in terms of improvements made to public health and safety.

While Australia's achievements in improving levels of public health and safety are laudable, and, as some evidence in both Spain and the UK demonstrates, might have shrunk the potential donor pool by reducing the over-all number of Australians who would potentially become brain dead (**4,21,22**), very recent evidence from Spain shows that this shrinkage in the potential donor pool can be more than compensated for through implementation of hospital-wide donor best practice recommendations and through the development of a systemic approaches to organ donation that include, but are not limited to the identification and management of donors in hospitals (**23**). The fact that many leading donor countries have been successful at improving deceased donation rates while at the same time achieving impressive improvements in public health and safety, suggests that improvements in public health and safety are not a sufficient explanation for Australia's low organ donor rates. Indeed, the success of these countries in achieving *both* improvement in public health and safety and high deceased organ donation rates suggests that they have been able to "do more with less."

We believe that continued acceptance of this failure because of success hypothesis prevents Australia from acknowledging that success in increasing public health and safety is not incompatible with success in achieving high organ donation rates. We hope that by demonstrating that simultaneous improvements to both public safety and organ donation is not only possible, but common amongst the world's leading donor countries, we can shift Australia's attention onto evidence-based explanations for why Australia continues to have such a low supply of organs for transplantation and away from this convenient mythology.

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#### Statements and Competing Interests Declarations:

- 1) All authors have completed and signed the Unified Competing Interest form at (available on request from Aric Bendorf, the corresponding author) and declare that (1) All Authors (Aric Bendorf, Ian H Kerridge, Patrick Kelly, Bruce Pussell & Xavier Guasch) have support from the University of Sydney, the Blood and Marrow Transplant Unit of Westmead Hospital, the Prince of Wales Clinical School, the Department of Nephrology of the Prince of Wales Hospital, the TPM – DTI Foundation of the Universitat de Barcelona and the Intensive Care Unit of the Hospital de la Plana, for the submitted work; (2) All authors (Aric Bendorf, Ian H Kerridge, Patrick Kelly, Bruce Pussell & Xavier Guasch) have no relationships with any companies or organisations that might have an interest in the submitted work in the previous 3 years; (3) All of our spouses, partners, or children have no financial relationships that may be relevant to this submitted work; and (4) All authors (Aric Bendorf, Ian H Kerridge, Patrick Kelly, Bruce Pussell & Xavier Guasch) have no non-financial interests that may be relevant to the submitted work.
- 2) Aric Bendorf is the principal researcher and is the guarantor of this study. His details, along with details for all of the other researchers is listed on the title page of our manuscript.
- 3) As only officially released statistics were used for this study and none of this information is considered private nor in any way contains any type of information that could lead to identification of specific person or individual, no ethics approval was required for this study. Our study utilises only analysis of publicly available statistics.
- 4) This study required no funding and all of the researchers are independent from funders of any type.
- 5) All authors had full access to all of the data (including all statistical reports and tables) in the study and take responsibility for the integrity of the data and accuracy of the data analysis.
- 6) As there were no individual participants and all data used for this study is publicly accessible, the sharing of

the data used in this study poses no potential harms to any person nor to any organisation.

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## Tables & Figures

**TABLE 1: ROAD TRAUMA FATALITIES BY COUNTRY 1990–2009 (18)**  
(Deaths per 100,000 Population)

	Australia	Spain	Portugal	France	USA	Belgium	Austria	Italy
1990	13·66	23·2	28·25	19·82	17·88	19·86	20·26	12·4
1991	12·23	22·73	30·16	18·54	16·44	18·75	20·0	14·0
1992	11·28	20·06	28·86	17·3	15·39	16·68	17·89	14·15
1993	11·05	16·33	25·21	16·63	15·58	16·49	16·23	12·6
1994	10·8	14·35	23·32	15·6	15·64	16·75	16·86	12·43
1995	11·16	14·67	25·23	15·32	15·9	14·3	15·22	12·28
1996	10·76	13·97	25·38	14·66	15·86	13·37	12·9	11·67
1997	9·54	14·26	23·38	14·44	15·69	13·4	13·87	11·7
1998	9·38	15·12	22·44	15·19	15·36	14·72	12·07	11·89
1999	9·32	14·52	21·02	14·39	15·3	13·68	13·5	11·6
2000	9·49	14·54	18·13	13·64	15·25	14·36	12·18	12·2
2001	8·95	13·75	16·18	13·82	14·79	14·48	11·93	12·27
2002	8·73	12·87	16·09	12·9	14·93	13·12	11·83	12·25
2003	8·15	12·8	14·76	10·16	14·75	11·71	11·47	11·45
2004	7·86	11·02	12·29	9·34	14·63	11·18	10·74	10·58
2005	7·98	10·22	11·8	8·78	14·72	10·43	9·33	9·95
2006	7·74	9·33	9·58	7·7	14·3	10·17	8·8	9·65
2007	7·63	8·64	9·6	7·5	13·7	10·0	8·3	8·68
2008	6·75	6·85	8·3	6·91	12·25	8·9	8·15	7·94
2009	6·8	5·9	7·9	6·8	11·1	8·9**	7·6	7·1
% Reduction from 1990 to 2009 Level	50·22	74·57	72·04	65·69	37·92	55·19	62·49	42·83

\*\*At time of publication, Belgium had not reported its 2009 RT fatality rate to the IRTAD. This number represents its 2008 rate.



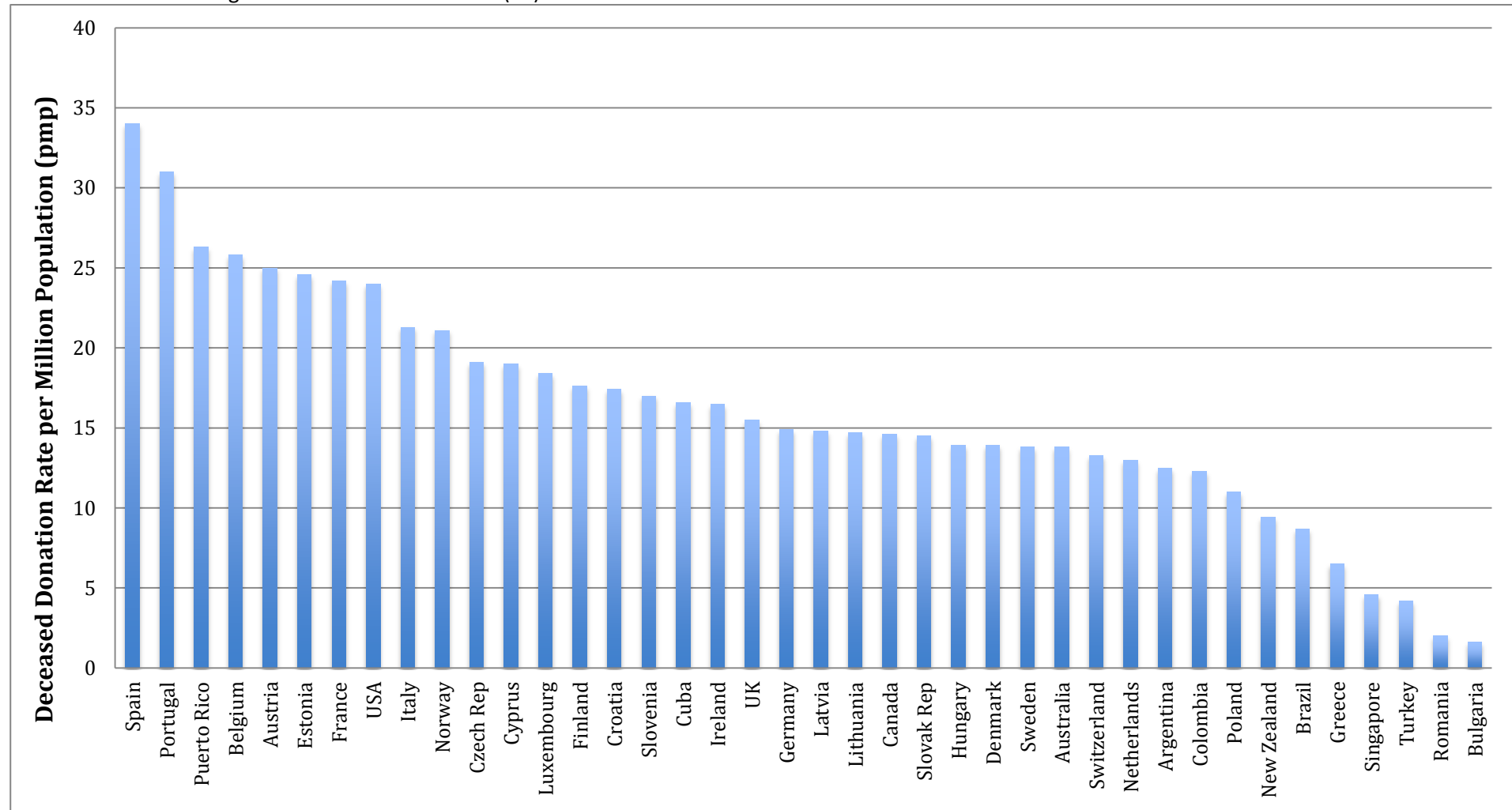
TABLE 2: CVA FATALITIES BY COUNTRY 1990–2008 (19)  
 (ICD Codes I60-I69, Deaths per 100,000 Population, Age standardised)

	Australia	Spain	Portugal	France	USA	Belgium	Austria	Italy
1990	68·20	86·20	204·70	52·90	47·40	68·80	95·30	88·60
1991	64·70	85·60	202·50	52·00	45·70	66·20	94·20	87·60
1992	63·00	78·60	188·50	48·70	44·70	64·60	88·00	84·70
1993	61·10	75·20	190·80	47·30	45·40	65·90	82·80	83·50
1994	63·10	71·90	172·30	43·70	45·30	61·50	80·30	80·60
1995	59·20	68·10	170·50	43·10	45·70	58·60	77·40	73·40
1996	57·60	64·40	166·80	42·40	45·20	58·50	80·10	68·60
1997	52·50	60·90	151·00	40·90	44·30	57·40	77·00	68·10
1998	51·60	59·70	146·00	40·50	42·80	51·4	73·20	68·20
1999	49·30	58·70	140·80	39·40	44·00	49·8	69·90	63·90
2000	47·40	53·00	132·50	37·00	43·20		65·70	61·30
2001	44·90	51·60	124·90	35·90	41·10		59·50	57·10
2002	43·90	49·20	116·80	34·60	39·90		58·20	55·40
2003	41·70	49·10	111·20	34·50	38·00		52·60	56·70
2004	40·2	44·00		30·60	35·70	43·9	40·10	
2005		43·30		29·90	33·40		38·30	
2006	35·2			27·8			37·3	45·8
2007				26·0			34·8	44·2
2008							33·5	
2009								
% Reduction from 1990 to last year reported	48·39	49·77	45·68	50·85	29·54	36·19	64·85	50·11

TABLE 3: DECEASED DONOR RATES BETWEEN 1990-2009 (9-17,20)  
(Deceased Donation per 1,000,000 Population)

	Australia	Spain	Portugal	France	USA	Belgium	Austria	Italy
1990	11.9	17.8					28.8	
1991	12.1	20.2					26.5	
1992	12.3	21.7			17.9		22.1	
1993	12.3	22.6	15.0	17.1	19.2	21.7	25.8	6.3
1994	10.2	25.0	18.4	15.3	20.2	22.8	21.3	7.9
1995	10.2	27.0	20.0	15.0	21.0	19.0	22.9	9.8
1996	10.6	26.8	21.2	15.1	21.2	20.9	24.7	10.9
1997	10.2	29.1	20.6	14.9	21.2	22.5	19.5	11.6
1998	10.4	31.5	16.6	16.8	22.4	19.4	20.7	12.3
1999	8.6	33.6	19.0	16.2	22.5	23.8	24.8	13.6
2000	10.2	33.9	19.4	16.9	23.0	25.6	23.2	15.2
2001	9.5	32.4	20.2	17.8	20.7	21.5	23.6	17.0
2002	10.4	33.6	21.7	20.3	20.8	21.6	22.1	18.1
2003	9.0	33.7	19.0	18.6	21.3	23.3	22.0	18.5
2004	10.8	34.6	22.1	21.0	23.1	21.1	22.0	21.1
2005	10.0	35.0	19.0	22.2	23.8	22.8	24.5	21.0
2006	9.8	33.8	20.1	23.2	25.0	26.4	24.3	21.7
2007	9.4	34.3	23.9	25.3	26.6	28.0	21.9	20.9
2008	12.1	34.2	26.7	25.3	26.0	24.8	20.1	21.0
2009	11.3	34.0	31.0	24.2	24.0	25.8	25.0	21.3
% Increase from first reported donation rate	-5.0	91.0	108.7	41.5	34.0	18.9	-13.1	238.1

FIGURE 1: Deceased Organ Donation Rates for 2009 (20)



Note: At the time of publication, Cyprus, Luxembourg and the Slovak Republic did not yet report 2009 rates to the IRODaT. 2008 rates were used.

Figure 2a - Percentage of Donor Death Caused by Road Trauma Fatalities (9-17)

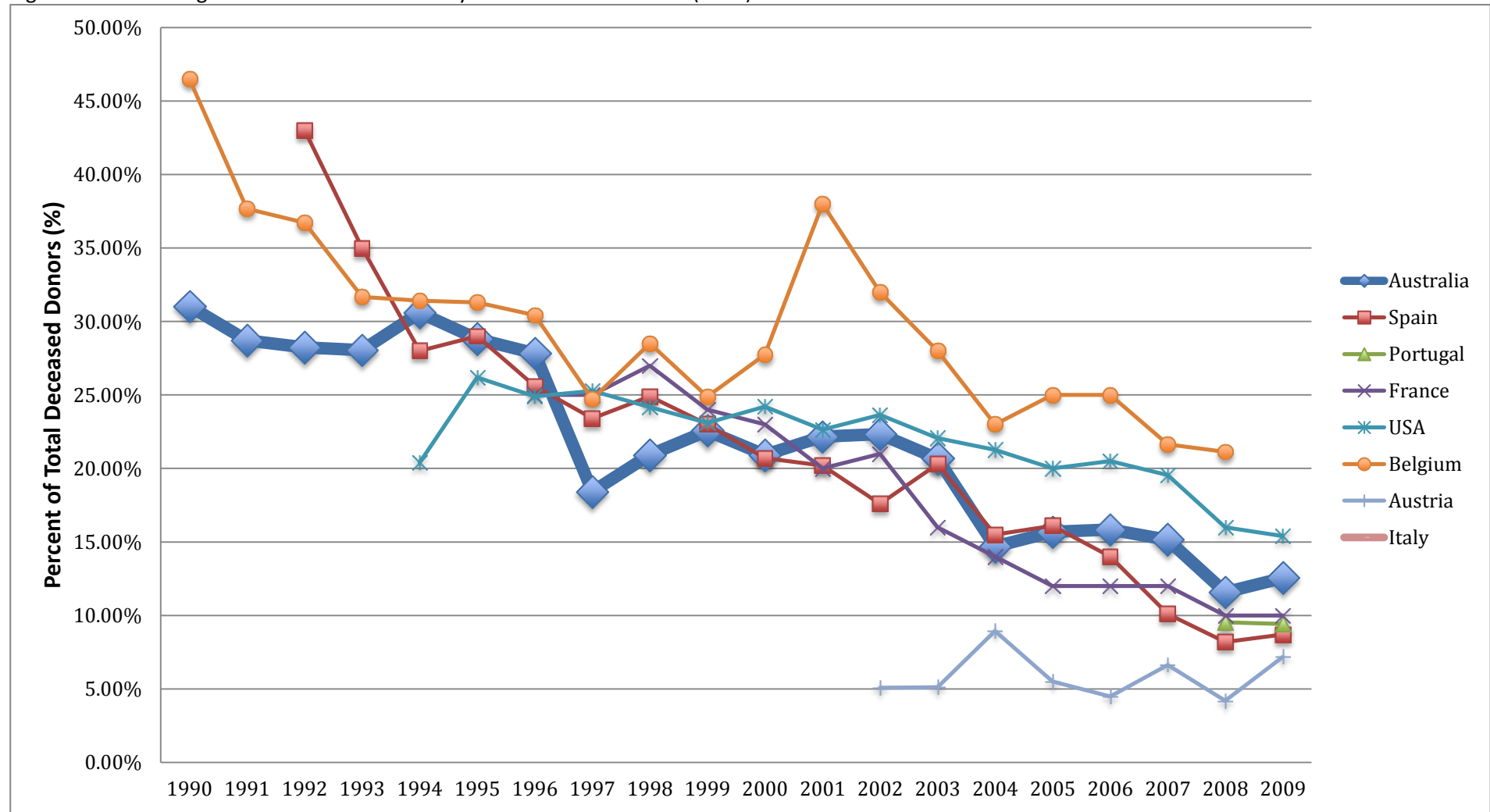


Figure 2b - Percentage of Donor Death Caused by CVA Fatalities (9-17)

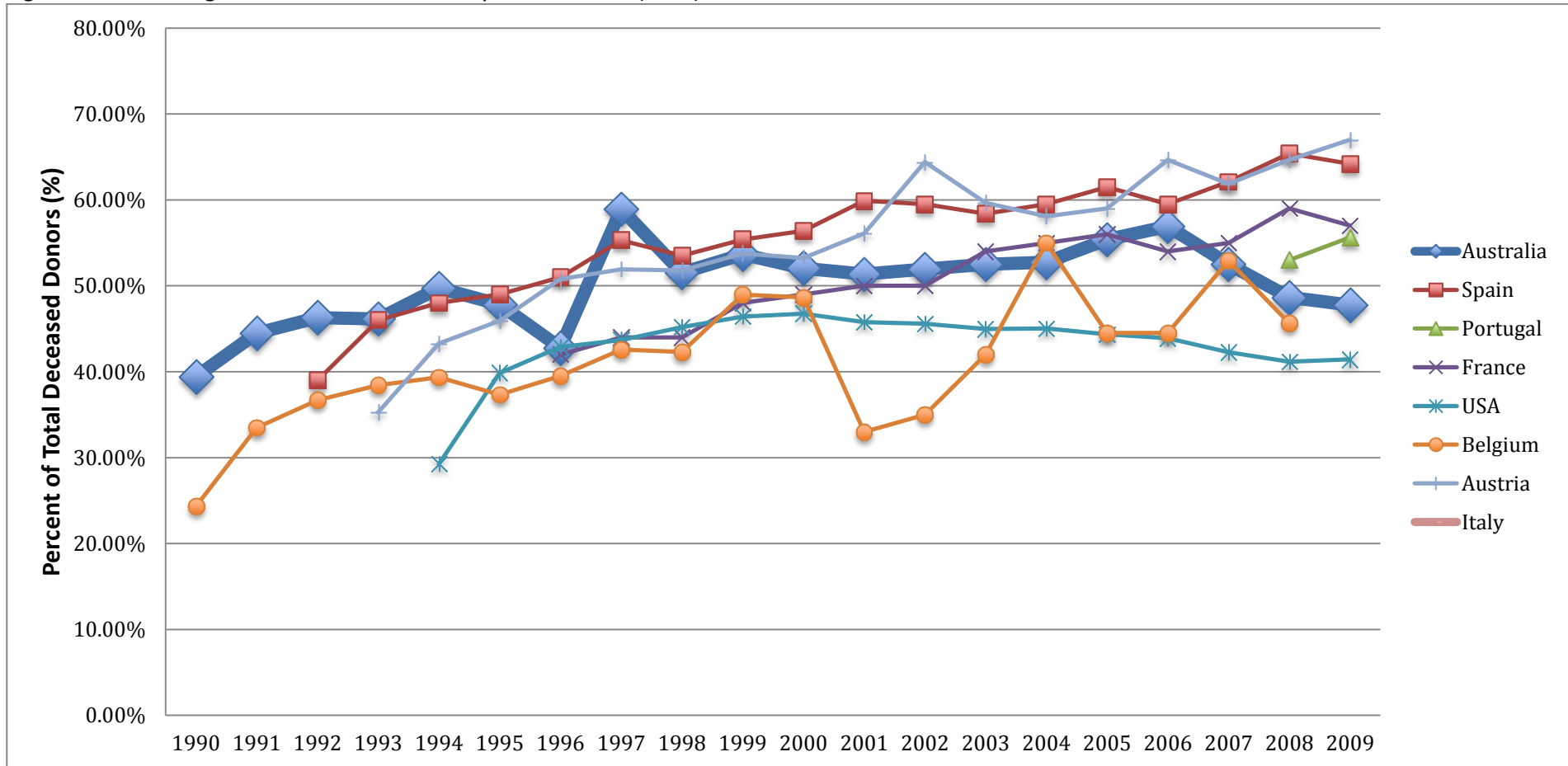


Figure 2c - Percentage of Donor Death Caused by Road Trauma & CVA Fatalities (combined) (9-17)

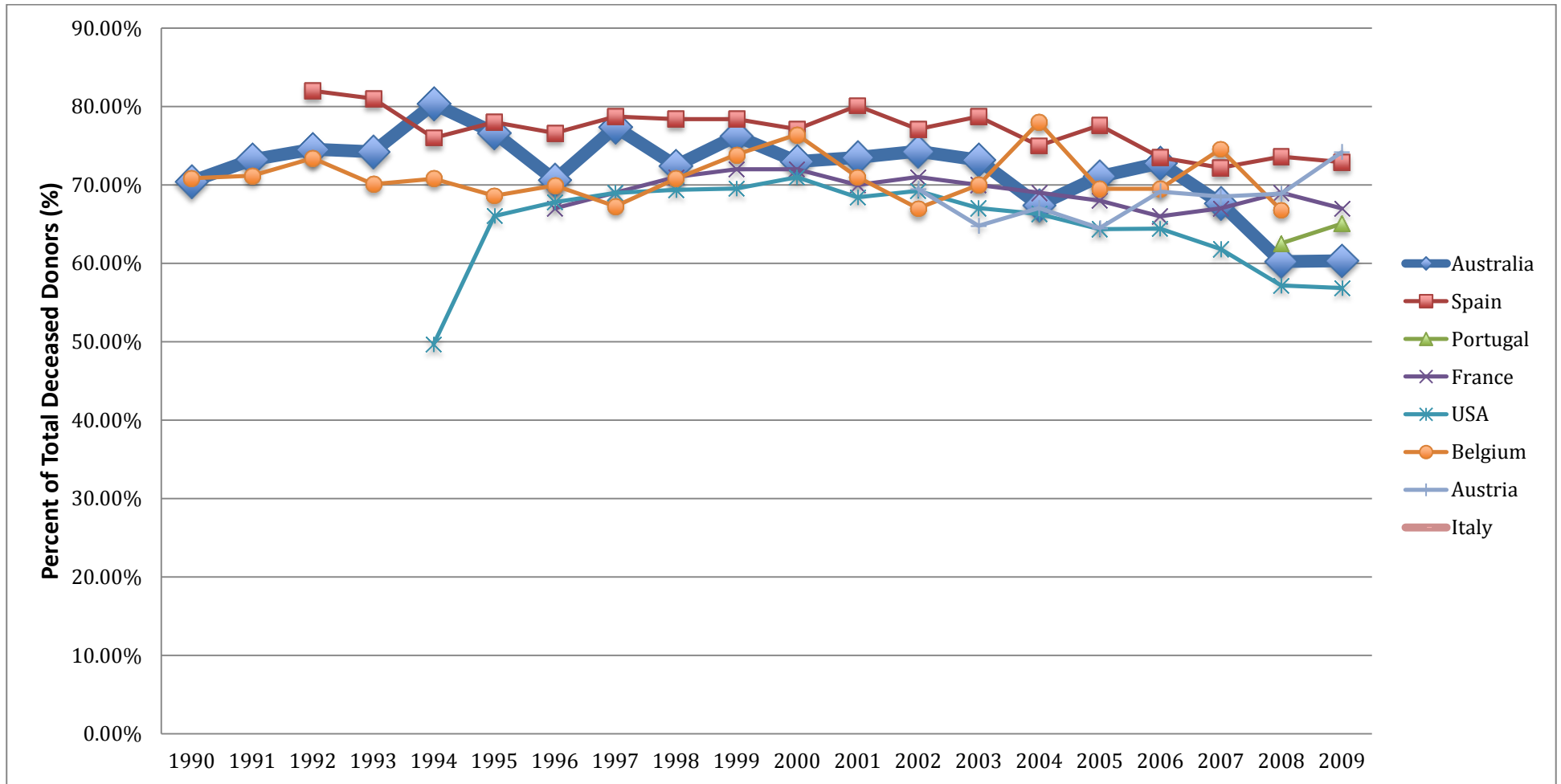


FIGURE 3: Road Trauma Fatality rates by country from 1990 to 2009 (18)  
 (RT Fatality defined as death within 30 days, with RT the primary cause)

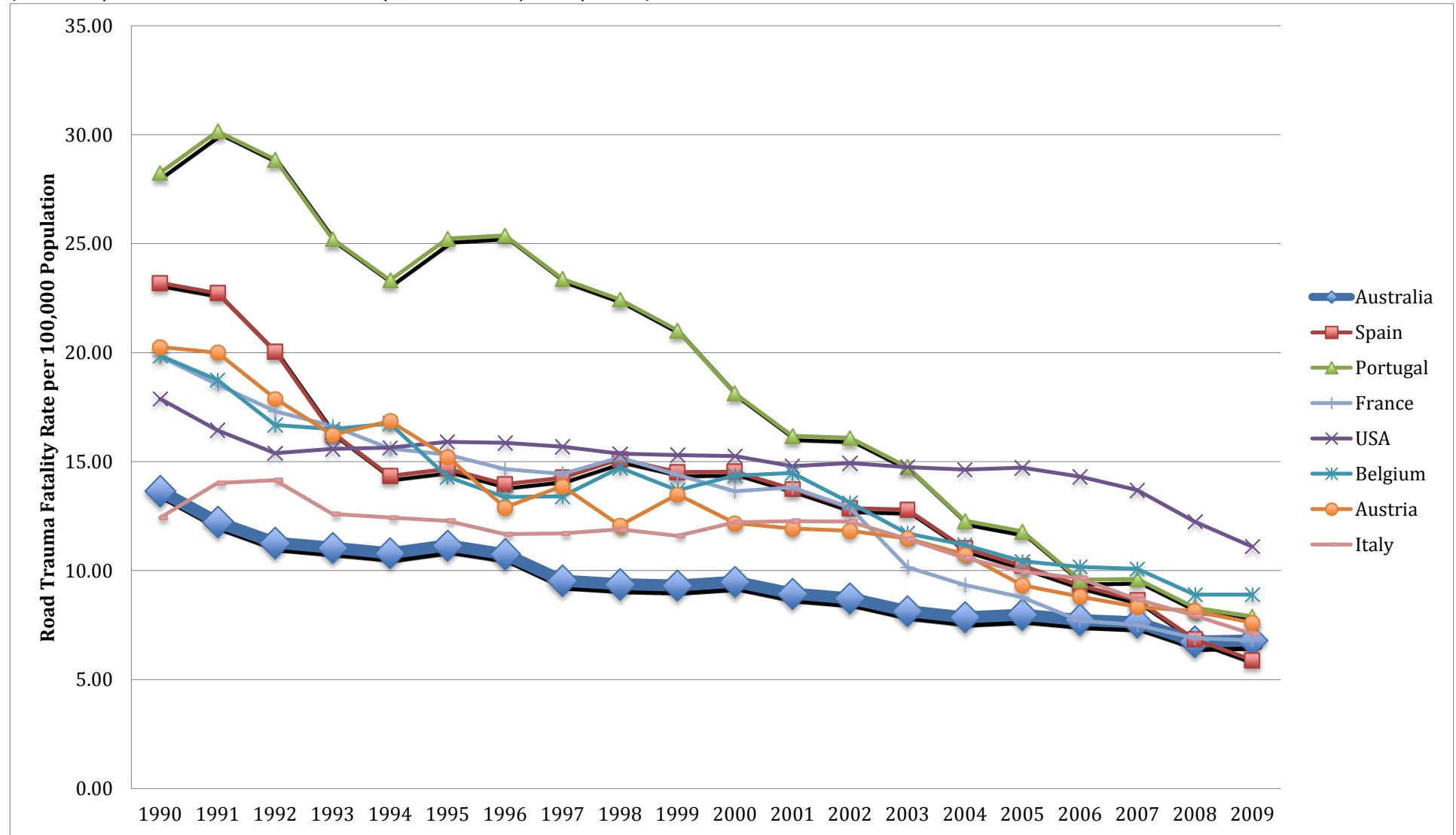


FIGURE 4: CVA Fatality rates (ICD I60 – I69) from 1990 to 2008 (19)

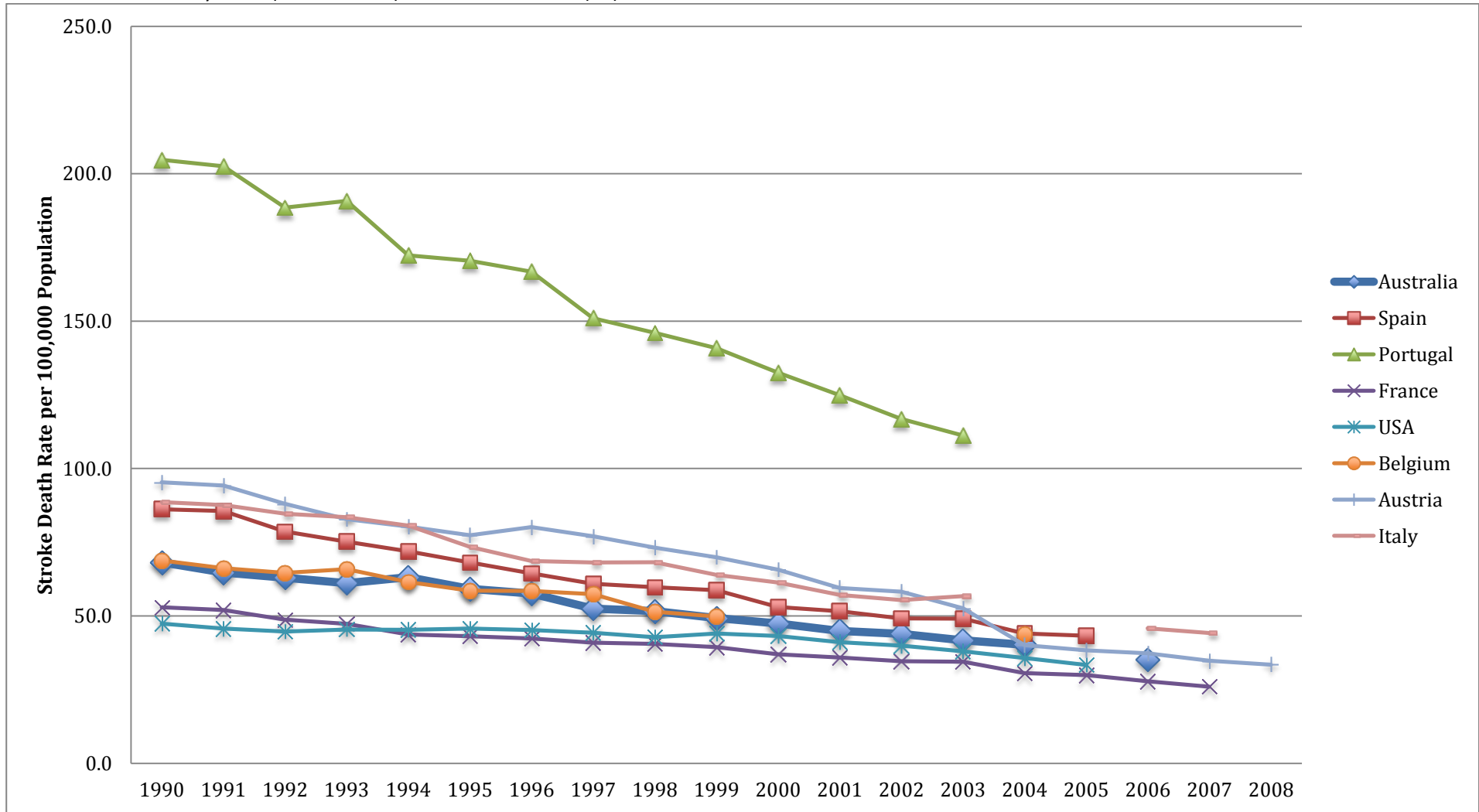




FIGURE 5: Deceased organ donation rates from 1990 to 2009 (20)

