

# Suicide prevention through means restriction: Assessing the risk of substitution

## A critical review and synthesis

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### Abstract

The effectiveness of restricting access to certain means of committing suicide has been demonstrated, at least as regards toxic domestic gas, firearms, drugs and bridges. At the individual level, studies tend to indicate that many persons have a preference for a given means, which would limit the possibility of substitution or displacement towards another method. Similarly, the fact that suicidal crisis are very often short-lived (and, what is more, influenced by ambivalence or impulsiveness) suggests that an individual with restricted access to a given means would not put off his plans to later or turn to alternative methods. This has been more difficult to demonstrate scientifically in population studies. Nevertheless, it appears that, should such a shift occur towards other means, it would be put into effect only in part and over a longer term.

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**Keywords:** Suicide; Means; Restriction; Substitution; Displacement

### 1. Introduction

The field of suicide prevention was marked early on by such characters as the Reverend Chad Varah in the United Kingdom and Dr. Edwin Shneidman in the United States. However, these often cited men, as well as all the volunteers from Samaritans and Suicide Prevention Centres after them and all the professionals of the mental health field, contributed to give an essentially clinical or individual character to interventions in this domain. As early as in 1968, Bagley (1968) turned his focus to measuring the effect of hotline services on suicide rates even though, contemporaneously, other factors such as the detoxification (reduction of the carbon monoxide content) of domestic gas could be at play (Kreitman, 1976). Clinicians have thus tended to overlook broad sections of suicide prevention, namely those centered on environmental

approaches even if it could be the most promising strategy for the future (Johansson et al., 2005). Among these, means restriction has been drawing more and more attention, as evidenced by the fact that nine of the presentations at the 2003 congress of the *International Association for Suicide Prevention* referred to this measure, compared with none at the 1988 congress. The effectiveness of restricting access to certain means has been demonstrated (Leenaars et al., 2000), at least as regards toxic domestic gas (Kreitman, 1976), firearms (Bridges and Kunselman, 2004; Conwell et al., 2002; Hemenway and Miller, 2002), drugs (Hawton et al., 2001; Wilkinson et al., 2002) and bridges (Beautrais, 2001; Berman et al., 1994). However, there remains the question of substitution or displacement, that is, the possibility that suicidal individuals, once deprived of their preferred means of committing suicide, shift their consideration towards alternative methods. The purpose of this article is to examine the issue of means substitution from the point of view of individuals and populations.

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## 2. Methods

Printed documentation, in English or French, was searched in the following electronic databases: MedLine and PsychInfo. Two specialized documentation centers, both located in Canada, were also consulted: the Centre for Research and Intervention on Suicide and Euthanasia (Montreal) and the Suicide Information and Education Center (Calgary). The keywords “displacement” or “substitution” not being very productive, the following search strategy was also used: suicide AND (epidemiology OR rate OR rates OR trends OR “statistics & numerical data” OR incidence) AND (“cause of death” OR “prevention & control” OR mortality OR method OR methods).

## 3. At the individual level

In this regard, two types of studies can be distinguished, namely those that have focused on a preference for a particular method of committing suicide and those that have examined the fact that suicide crises tend to be short-lived.

### 3.1. Preference for a particular means of committing suicide

Suicide is not a homogeneous category of behaviour. For instance, regarding suicide from domestic gas intoxication, a method once widely used in England, suicidal persons probably considered this a highly lethal, painless, clean and easy to use method that required little “courage” and planning. Probably, no other means of suicide shares these characteristics (Clarke and Lester, 1989). Individuals who jump off bridges, for their part, often suffer from severe mental illness (see many studies in the summary list of Table 1). In such cases, auditory hallucinations, for example, can influence the decision to commit suicide in a specific manner. It should be pointed out that among the suicides by all other means put together, the percentage of psychotic individuals is usually no way as high as in this group (Cantor et al., 1989). However, at least one study by Nowers and Gunnell (1996) found that those jumping from the Clifton Suspension Bridge in England were no more likely to have psychiatric histories and have been psychiatric inpatients than matched controls using other suicide methods.

In response to a questionnaire, female college students indicated their preference for methods deemed quick and painless and entailing no risk of disfigurement. However, both women and men would use a firearm as they were more concerned with getting it over with quickly than with the danger of disfigurement (Lester, 1988). This type of study tends to show that, notwithstanding gender differences in this regard, individuals have a preference for a specific means and that they would not easily resolve to change method. More specifically, in a study that sought to understand why more people committed suicide by jumping off the *Golden Gate Bridge*

than from the nearby *San Francisco-Oakland Bay Bridge* (Seiden and Spence, 1983), the factors mentioned included, in particular, the more or less morbid and contagious publicity that surrounded cases at the *Golden Gate*. The symbolism (“suicide shrine”) and romanticism associated with the site would also explain why many suicidal persons chose it, even though the other bridge was sometimes definitely closer to their homes.

A certain copycat and contagion effect has been observed in particular when the media put out information in more or less adequate fashion regarding suicides already perpetrated in a given place. It is believed that this type of coverage pushes certain individuals, especially the most vulnerable, to adopt a given method of suicide rather than another. This contagion phenomenon has been particularly well documented over the years, beginning with the example of Werther, the character created by 18th century German writer Goethe, up until more recent cases, such as those in the Vienna subway and at Mount Mihara in Japan (Clarke and Lester, 1989; Ellis, 1996; Gunnell and Nowers, 1997).

Certain personal and cultural factors are also at play. Depending on the individuals concerned, certain forms of death seem more inculcating or exculpating for the bereaved or more terrifying, more painful or more shameful. Persons who are more ambivalent or who could eventually manipulate the people around them might also prefer a less lethal method (Clarke and Lester, 1989). To understand how people choose a particular method, these authors suggest 20 “choice structuring properties of methods of suicide”: availability; familiarity with the method; technical skills needed (hanging, gasing); planning necessary (buy a gun, save up pills); likely pain (cutting wrists); so-called “courage” needed (high building, train); consequence of failure (disability, publicity); disfigurement after death (hanging versus overdose); danger/inconvenience to others (car crash, subway leap); messiness, bloodiness (wrist cutting); discovery of body (by loved ones or strangers); contamination of nest (i.e., avoid home); scope for concealing or publicizing death—shame, insurance (car crash, drowning, subway leap); certainty of death (perceived/actual); time taken to die while conscious (poisons, wrist cutting); scope for second thoughts (swim back to shore, switch off gas); chances of intervention; symbolism (cleansing by fire); masculine/feminine (guns); dramatic impact.

Also, the methods used vary greatly across the countries and even within the countries; consequently, a means restriction approach that might work in under one set of cultural and environmental conditions might not work under another (Cantor, 2000; Cheng and Lee, 2000; Marzuk et al., 1992). Table 2 shows some comparisons between USA, Canada, Australia and England but also gender differences. One can see that data are not always reported the same way from one country to the other despite the now growing use in the death certificates of the *International Classification of Diseases, Ninth Revision*. Nevertheless, that table shows that suicide by firearm is very common in USA for both the sexes but much less in the other countries where hanging is most common,

**Table 1**  
**Summary of included studies on risk of substitution**

Focus	Authors	Location	Population/sample <sup>a</sup>	Key findings	
<b>Individual level</b>					
Preferences (vs. mental illness)	Prasad and Lloyd (1983)	Scotland	18 survivors jumping from height	All have a mental illness	
	Kontaxakis et al. (1988)	Greece	46 survivors jumping from height and 214 from drug overdose	More major psychopathologies in the first group	
	Cantor et al. (1989)	Australia	40 survivors and 47 suicides from bridge	Most suffer from severe mental illness	
	Pommereau et al. (1989)	France	110 survivors jumping from height and 908 from drug overdose	More psychiatric history in first group	
	Nowers and Gunnell (1996)	England	127 suicides from bridge and 127 other suicides	Same number of individuals with mental illness	
	De Moore and Robertson (1999)	Australia	31 survivors jumping from height and 51 from using firearms	More psychiatric history in first group	
	Coman et al. (2000)	Australia	7 survivors and 55 suicides from bridge	Most suffer from severe mental illness	
	Beautrais (2001)	Australia	15 suicides from bridges	Most suffer from severe mental illness	
	Lindqvist et al. (2004)	Sweden	50 suicides from bridge	Most had psychiatric problems	
	Preferences (other)	Rosen (1975)	USA	7 survivors from 2 bridges	Preference for one out of two available bridges
Seiden and Spence (1983)		USA	555 suicides from one bridge and 112 from the nearby other	Publicity, symbolism, romanticism influence the choice of the bridge	
Lester (1988)		USA	429 college students	Men and women choose different methods	
Cantor and Hill (1990)		Australia	73 suicides from 2 bridges	2 different profiles of suicides	
Kaplan and Geling (1999)		USA	Total population	Regional cultural factors influence choice	
Cheng and Lee (2000)		Asia and the Far East	Total populations	Methods vary across and within countries and across genders	
Hawton et al. (2004a,b)		UK	428 survivors from self-cutting and 11 065 from self-poisoning	More men and previous deliberate self-harm in self-cutters	
see Table 2		USA, Canada, Australia, England	Total populations	Methods vary across countries and across genders	
Short-lived crises		Seiden (1978)	USA	515 survivors bridges and 184 survivors from other types of attempts	Long term follow-up shows 90% do not die later on from violent death
		Glatt (1987)	USA	30 survivors from bridge	Ambivalence about death
	Hawton et al. (2001)	UK	Total population	Impulsive or ambivalent people do not accumulate lethal drugs	
	Lindqvist et al. (2004)	Sweden	50 suicides from bridges	Peak of alcohol-related suicides during weekends	
	Suominen et al. (2004) Sakinofsky (2000) (review) Owens et al. (2002) (review)	Finland Many Many	100 survivors from self-poisoning Survivors from suicide attempts Survivors from suicide attempts	87% will not commit suicide after 37 years 89% will not commit suicide on the long term 93% will not commit suicide on the long term	
<b>Population level</b>					
Toxic gas	Kreitman (1976)	UK	Total population	Almost no substitution	
	Burvill (1980)	Australia	Total population	Substitution for men only	
	Lester and Abe (1989)	Japan	Total population	Almost no substitution	
	Lester (1990)	USA	Total population	Almost no substitution	
Firearms	Carrington and Moyer (1994)	Canada	Total population	No substitution	
	Lester (1995)	USA	Total population	No substitution	
	Leenaars and Lester (1996)	Canada	Total population	Substitution for men only	
	Kaplan and Geling (1998)	USA	Total population	Substitution for men only	
	Conner and Zhong (2003)	USA	Total population	No substitution	
	De Leo et al. (2003)	Australia	Male population	No substitution	
	Bridges (2004)	Canada	Total population	Substitution	
	Caron (2004)	Canada	Total population	Substitution	
	Clark and Lester (1989) (review)	All	Total populations	Mixed results	
	Lambert and Silva (1998) (review)	All	Total populations	No substitution	
Drugs	Oliver and Hetzel (1972)	Australia	Total population	Almost no substitution	
	Whitlock (1975)	Australia	Total population	Almost no substitution	
	Yamasawa et al. (1980)	Japan	Total population	Almost no substitution	
	Wilkinson et al. (2002)	England	Total population	Substitution	
	Hawton et al. (2004a,b)	UK	Total population	Some substitution	
	Nordentoft et al. (2004)	Denmark	Total population	No substitution	
Bridges	Berman et al. (1994)	USA	Total population	No substitution	
	Beautrais (2001)	Australia	Suicides from height	No substitution	

<sup>a</sup> The survivors samples include attempted suicides and failed suicides.

Table 2  
Percentage of utilization of different methods of suicide in four countries

Method	Males				Females			
	USA (2000) <sup>a</sup>	Canada (1998) <sup>b</sup>	Australia (1998) <sup>c</sup>	England (2003) <sup>d</sup>	USA (2000) <sup>a</sup>	Canada (1998) <sup>b</sup>	Australia (1998) <sup>c</sup>	England (2003) <sup>d</sup>
Firearms	61.2	26.2	10.1	N/R <sup>e</sup>	37.2	6.6	3.2	N/R <sup>e</sup>
Hanging, strangulation, suffocation	20	40	47.1	46.1	16.7	33.9	32.3	25.6
Solid and liquid poisoning	7.1	9.6	8.3	18.5	30.6	32.4	29.6	43.9
Gas poisoning (motor vehicle exhaust and other)	4.8	12.4	21	8.4	5.5	9	14.4	3.1
Jumping from height	1.8	3.9	N/R <sup>f</sup>	3.2	3.1	5.8	N/R <sup>f</sup>	4.6
Cutting and piercing	N/R <sup>g</sup>	1.6	1.8	N/R <sup>g</sup>	N/R <sup>g</sup>	1.4	1.9	N/R <sup>g</sup>
All other methods	5.1	6.2	11.8	23.8	7	7	18.6	22.8

<sup>a</sup> McIntosh (2003).

<sup>b</sup> Langlois and Morrison (2002) (Population aged 10 or older).

<sup>c</sup> Steenkamp and Harrison (2000).

<sup>d</sup> National Institute for Mental Health in England (2005).

<sup>e</sup> Not reported for England. Included in "all other methods".

<sup>f</sup> Not reported for Australia. Included in "all other methods".

<sup>g</sup> Not reported for USA and England. Included in "all other methods".

at least for men. As for applying means restriction to this last method, this represents a real challenge except in hospitalized or incarcerated populations. Dahlberg et al. (2004) also report that, in their American sample, 76.3% of all suicides occurred in the home, which is also a challenge for suicide prevention, except if intervention takes place before the suicidal crisis, in controlling the purchase or ownership of means of suicide like firearms.

Regarding more particularly the symbolism associated with suicide from bridges, there is no doubt that the spectacular aspect of the deed is a major factor. Survivors have indicated that not only had they planned to commit suicide by jumping off a bridge but also off a very specific bridge. They generally referred to an association that they had made between death and the particular "beauty/grace" of the given bridge (Rosen, 1975, 1976). Moreover, all this symbolism seems to rest at least in part on a popular myth to the effect that committing suicide by jumping off a bridge is easy to do and hassle free and that the person in question gently disappears under the surface (Seiden, 1978). Be this as it may, studies as a whole indicate that many individuals prefer a particular means of suicide, if not a particular place for it (De Moore and Robertson, 1999). In Australia, researchers found major differences between the persons who committed suicide at two Australian bridges (Cantor and Hill, 1990). It ensues from this that these individuals would not readily go through with their intentions using other means or in other places.

### 3.2. Short-lived crises

It is recognized that suicidal crisis are usually of short duration and that, if their fatal outcome is prevented, they will not be repeated or help will be made available in the meantime. At worst, suicidal individuals deprived of their preferred means of committing suicide will fall back on another, possibly less lethal, method. In this regard, elements

of transitory impulsiveness have been found to be significant in suicidal behaviour, especially among young people and even more specifically in suicides committed by jumping from high places (Pommereau et al., 1989). At the same time, it is important to acknowledge that ambivalence is typical of the suicidal process (Centers for Disease Control and Prevention, 1992), which is precisely what has been observed in suicidal persons who contact crisis lines using telephones installed on bridges (Glatt, 1987). The study by Hawton et al. (2001), showing that restricting pack sizes of drugs lower suicide rates, could also be explained by the fact that impulsive or ambivalent suicidal people do not accumulate their pills and that they change their mind in the mean time.

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### 4. Populat

If indivi... have a preference for a specific means of suicide and if they essentially experience short-lived crises, restricting access to a specific method should not bring about an increase in the use of other means. By the same token, overall suicide rates should decrease, all other

things remaining the same. This is what population studies should confirm. However, it is evident that the direct effects of restricting access to means of suicide are hard to observe, as is an eventual shift towards other means, when the method targeted is already seldom used in the population (see Table 2). At the statistical level, proving a phenomenon whatsoever is rendered much more difficult. This is true for suicides, completed or not, committed from bridges and for an eventual displacement towards other methods (Gunnell and Nowers, 1997). This is why it would be interesting also to look at what has been reported about means that are much more commonly used and relatively easier to restrict like firearms. Consequently, we will examine the issue of displacement when access is restricted to the following four means of suicide: domestic toxic gas, firearms, drugs and bridges.

#### 4.1. Domestic toxic gas

It has been demonstrated that the detoxification of domestic gas in Great Britain brought about a considerable reduction in both the number of suicides by this method and the overall suicide rate (down by one-third) (Clarke and Lester, 1989). Kreitman (1976) was among the first to make the connection between the decline in overall suicide rates and the detoxification of domestic gas in the United Kingdom. As domestic gas poisoning had always been the preferred means of suicide in this country (49.8% in 1958), a reduction in the gas's lethality is believed to have had a direct effect on the overall suicide rates, without giving rise to displacement towards other means. The same effect has been observed in Japan (Lester and Abe, 1989) and the United States (Lester, 1990). The gradual detoxification of domestic gas did not bring about a genuine displacement towards other methods of suicide. Thousands of lives have thus been saved by simply reducing the toxicity level of domestic gas. If any displacement occurred in these studies, it was very weak and towards intoxication by motor vehicle exhaust fumes which had become much more easily available in the meantime (Clarke and Lester, 1989). In Australia, Burvill (1980) found this type of displacement towards car exhaust fumes but only for men.

#### 4.2. Firearms

Results have been mixed regarding restricted access to firearms, at least as far as the very specific situation in the United States (Clarke and Lester, 1989) but a recent review is more optimistic (Lambert and Silva, 1998). A large Canadian study reached such conclusions in favour of firearms control (Carrington and Moyer, 1994). In this case, researchers investigated the effect of Bill C-51 which imposed certain restrictions on firearms possession as of 1978. Their interrupted time series statistical analyses revealed positive associations between restrictions on firearms and reduction of suicide rates and found no evidence of displacement regarding the means used in Canada. Other researchers, instead, have noted a certain displacement in Canada, although only with respect to

men (Leenaars and Lester, 1996). However, the methodology of this study has been contested rather convincingly by the first team (Carrington and Moyer, 1994; Carrington, 1999). In fact, Leenaars (2001, p. 260) himself concluded that "people did not switch to other methods of suicide". Two more recent Canadian studies (Bridges, 2004; Caron, 2004) analyzed the effect of another Canadian law (Bill C-17) enforced in 1992 on the safe storage of firearms. In a specific region of northern Quebec, Caron compared suicide methods 6 years prior to the enactment of the law and 5 years after. Suicide by firearms decreased for both sexes but not among men over 45 who may be the owners of the key giving access to the firearms. In his study, hanging increased among youths and suicide by poisoning doubled in the female population. Caron concludes that his findings support the substitution hypothesis despite the unexplained high rise in hanging method. Bridges (2004) reaches similar conclusion for the total Canadian population. De Leo et al. (2003) were particularly interested in such an apparent displacement from firearms towards hanging in Australia. Rates of suicide by hanging were found to have begun increasing prior to the decline in firearm suicide in Australia. They concluded that individual suicide method choice may be related to independent changes in the social acceptability of each method as well as to an increasing prevalence of suicide in younger males who are more likely to use the hanging method. It seems that such a method is no more associated to shame in new generations.

#### 4.3. Drugs and other toxic substances

Numerous studies have shown that no displacement effect occurs when access to lethal drugs is restricted (Clarke and Lester, 1989). Oliver and Hetzel (1972) showed that, following control on sales of sedatives in Australia, suicides related to such a means decreased with no substitution of other methods. Whitlock (1975) did the same in the specific region of Brisbane. In this regard, a study conducted in Japan demonstrated that since 1956, the availability of certain drugs by prescription only had diminished the rate of suicide by this method without displacement towards other intoxicants such as chemical farming products or cyanide (Yamasawa et al., 1980). More recently, Hawton et al. (2004a,b) showed that a legislation restricting pack sizes of drugs like paracetamol and salicylates had substantial beneficial effects on the mortality and morbidity in UK; in the mean time, ibuprofen overdoses increased, but with little or no effect on deaths. Nevertheless, looking only at hospital admissions for the same period, Wilkinson et al. (2002) found also a decrease in admissions following paracetamol overdoses but an increase in other types of admissions.

#### 4.4. Bridges

The installation of an anti-suicide fence on the *Duke Ellington Bridge* in Washington, DC, where an average 3.67 suicides a year were committed, resulted in only one such

death in the following 5 years. Meanwhile, the average number of suicides remained essentially the same at a less popular bridge nearby with no such fence (1.69 before and 2 after). Over the same period of time, the overall number of suicides in Washington, DC, declined from 76.4 to 71.6, thereby indicating that no displacement had occurred towards other methods (Lester, 1993; Berman et al., 1994). This last paper being a “case consultation” between three specialists, one should otherwise note that the second author, O’Carroll, is less convinced, pointing to the fact that this was not a real controlled study. Actually, most studies reported on means restriction are ecological ones. He argues that only interrupted time series analyses, if really specific data could be made available, would give us the right answer about displacement in this case. These analyses would then take into account the overall and specific trends in suicide rates and show if real changes appear when a specific intervention is implemented.

In an Australian study examining the effects of the removal of an anti-suicide fence from an overpass often used by suicidal psychiatric patients in large part suffering from schizophrenia, the number of suicides was shown to have increased from 3 in 1992–1995 to 15 in 1997–2000, while the total number of suicides in the region from jumping off high places remained stable. At first glance, this seemed to indicate that displacement occurred towards the overpass that was once again accessible, all the more so that, over this period, fewer suicides were committed by jumping off other sites. However, a more in-depth analysis revealed that the profiles of the persons who died from suicide were very different from one site to another. Indeed, 78% of the persons who jumped from the overpass in question suffered from schizophrenia compared with just 21% of those who jumped off other high places. This would indicate, then, that there was actually no displacement, but rather an increase in suicides (by persons with schizophrenia) off the overpass and at the same time, a decrease in suicides from jumping off other high places (for other reasons) (Beautrais, 2001). As seen above, this was again the case of a very specific site holding a particular interest for certain persons. Note also that bridge barriers, like some control on firearms, may have another injury preventive effect on homicides (Berman et al., 1994) but also on traumatization of surrounding people.

On a similar topic, Reisch and Michel (2004) reported that, after the installation of a protective net at a well known terrace in Berne (Switzerland), no suicides occurred at this site. Furthermore, the number of people jumping from all high places (including from bridges) in this city was reduced compared to the years before the installation, although no safety means were installed at the other sites.

## 5. Conclusion

Generally speaking, then, the risk of substitution or displacement towards other methods seems small (Clarke and Lester, 1989; Gunnell and Nowers, 1997; Prévost et al.,

1996). At the individual level, studies tend to demonstrate that many suicidal persons have a preference for a specific method. Similarly, the fact that suicidal crises are very often short-lived (and, what is more, influenced by ambivalence or impulsiveness) suggests that a given individual who has limited access to a given means will not put off his intentions to later or shift to another method. However, where population studies are concerned, scientific proof to this effect is sometimes harder to establish and most studies are ecological. This notwithstanding, means restriction can in the meantime save lives and buy time for interventions of a more clinical nature.

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