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How does legalization of physician assisted suicide affect rates of suicide?

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How does legalization of physician assisted suicide affect rates of suicide?

Abstract

Objectives. Several US states have legalized or decriminalised physician assisted suicide (PAS) whilst others are currently considering permitting PAS. Although it has been suggested that legalization could plausibly lead to a reduction in total suicides and to a delay in those suicides which do occur, to date no research has tested whether these effects can be identified in practice. The aim of this paper was to fill this gap by examining the association between the legalization of PAS and state-level suicide rates in the USA between 1990 and 2013.

Methods. We used regression analysis to test the change in rates of non-assisted suicides and total suicides (i.e. including assisted suicides) before and after legalization of PAS.

Results. Controlling for various socio-economic factors, unobservable state- and year effects, and state-specific linear trends, legalizing PAS was associated with a 6.3% (95% confidence interval [CI] = 2.70%, 9.9%) increase in total suicides (i.e. including assisted suicides). This effect was larger in the over 65s (14.5%, CI = 6.4%, 22.7%). Introduction of PAS was not associated with a reduction in non-assisted suicide rates, nor with an increase in the mean age of non-assisted suicide.

Conclusion. Legalizing PAS has been associated with an increased rate of total suicides relative to other states and no decrease in non-assisted suicides. This suggests either that PAS does not inhibit (nor acts as an alternative to) non-assisted suicide, or that it acts in this way in some individuals but is associated with an increased inclination to suicide in other individuals.

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***Key words*: physician assisted suicide, suicide, Oregon, Washington**

Introduction

A significant stream of literature has focused on how socio-economic factors and policy changes may impact suicide rates at a population level. It is well established that adverse economic conditions can lead to significant increases in suicide rates.[1, 2] Individual-level attitudes (for example towards religion) are also known to affect suicides.[3, 4, 5, 6] Other authors have found that stricter alcohol regulations can be associated with fewer suicides,[7] whilst recent research suggests that the legalization of marijuana for medical purposes may have led to a reduction in male suicides.[8] Reporting of celebrity suicide also seems to have population level effects on suicide rates.[9, 10] A policy area which has received surprisingly little attention is the effect of changes to the legal code addressing suicide itself.

In recent years, several American states have moved either to legalize or to decriminalize some forms of assistance with suicide. In 1998, Oregon became the first state to legalize physician assisted suicide (PAS) for terminally ill patients.[11] Washington State passed a similar law in 2008,[12] and Vermont in 2013.[13] In addition, in 2010, a court decision in Montana declared that "physician aid in dying" was not contrary to legal precedent or public policy.[14] In 2013, there were 73 deaths under the assisted dying law in Oregon[11] and 133 in Washington State.[12]

The likely effect of legalizing physician assisted suicide (PAS) on suicide rates is not easy to predict a priori. In the first place, it is necessary to distinguish between those deaths that conform with PAS law versus suicides outside this legal framework (which we term 'non-assisted suicides', though in practice these would include some assisted suicides outside the parameters of the law). The rationale of PAS laws is to enable people who would otherwise have died from an underlying illness such as terminal cancer to end their lives at an earlier stage with the assistance of a physician. However, in the absence of PAS, there will already be some people who are seriously ill who die by suicide.[15,16] A study from Switzerland found that, in the 20% of non-assisted suicides which involved physical illness, "the range of physical illnesses reported with suicide is similar to that reported with assisted suicide".[17] Similarly, in Oregon around 25% of non-assisted suicides were found to have had physical health problem, while in the cohort of men over 65, 66% had a physical illness (including 26% cancer, 25% chronic pain, 16% heart disease).[18] The legalization of PAS could provide an alternative to non-assisted suicide for some chronically or terminally ill people. If so, then the direct effect of legalizing PAS would be for the total number of intentional self-inflicted deaths (including assisted suicides) to increase but for deaths by non-assisted suicide to decrease.

There may also be significant indirect consequences of legalizing PAS. Richard Posner has conjectured that legalizing PAS may have the effect of *reducing* the total number of suicides and postponing those that do occur.[19] The knowledge that PAS is available for people who have physical incapacity could enable such patients to delay their decision to attempt suicide. Furthermore, some may be contemplating suicide because of an overly pessimistic belief about the progress of their disease and/or about their ability to cope with their declining condition. If people delayed their

attempt at suicide they might then come to see that they had been mistaken. As a result, "if physician-assisted suicide in cases of physical incapacity is permitted, the number of suicides … will be reduced … Moreover, in the fraction of cases in which suicide does occur … it will occur later than if physician-assisted suicide were prevented."[19] An implication of Posner's conjecture about delays to suicide is that there would be an increase in the average age of suicide.

Posner's conjectures have come to renewed prominence in the context of debates over the legalization of assisted dying both sides of the Atlantic. In 2014 "evidence of premature death" due to the lack of access to PAS was presented before the Supreme Court of Canada. In February 2015 the court concluded that "the prohibition deprives some individuals of life.".[20] In the United Kingdom, in the House of Lords in July 2014 it was argued that "many people… are dying earlier" because of the prohibition of PAS and the some "might have chosen to live" had PAS been legal.[21] On the same basis, the Swiss organisation EXIT claims that the "option of physician-assisted suicide is actually an effective form of suicide prevention".[22]

Systematic empirical analysis of Posner hypothesis is limited. Although Posner examined state data on suicides to illustrate his hypothesis, his data predated Oregon's legalization of PAS. To date there have been no formal tests of the impact of state-level regulation of PAS on suicide rates. Furthermore, no research has examined the association between PAS and age of suicides. In the paper we aim to help fill these gaps in knowledge by exploiting the 'natural experiments' which have occurred through various states legalizing or decriminalizing PAS at different times.

Materials and Methods

Data on the number and age-adjusted rate of (non-assisted) suicides in each state from 1990 to 2013 were taken from the Center for Disease Control (CDC) Compressed Mortality Statistics[23] and also from state-level Departments of Health. To calculate total suicides (i.e. all intentional self-inflicted deaths), we added deaths occurring under the auspices of the PAS regulations of Washington[12] and Oregon.[11] There were no PAS deaths recorded in Vermont in 2013.[24] Montana does not record the numbers of physician-assisted deaths. The results below are robust to excluding Montana and Vermont. Suicide rates are calculated using age-adjusted populations reported by the CDC.

Among men over 65 who die by suicide, a significant proportion had suffered from serious illnesses of a kind which could make them eligible for PAS.[18] For this reason, we collected data on non-assisted suicide rates for different age groups for the 28 states which provide such information. We used these data to calculate the rates of total suicide and non-assisted suicide in those under and over the age of 65. Finally, we used the mid-point of age groups to estimate the mean age of suicide each year in those states for which data is available.

We also collected data on a number of other socio-economic and demographic variables which have been found to affect suicide rates. State unemployment rates were taken from the Bureau of Labor Statistics. Data on per capita disposable income (adjusted for inflation) for each state were

taken from the Bureau of Economic Analysis. The percentages of the population that are black and Hispanic were calculated from the CDC state bridged-race population estimates. Annual data on the percentage of adherents to recognized religions were taken from the US Religious Census. As these data are collected at irregular intervals (1990, 2000 and 2010), we used linear interpolation to estimate values for intervening years. We used existing sources to collect indicators for states in which medical marijuana was legal in that year, for whether marijuana possession was decriminalized and whether a 0.08 blood alcohol content law was in effect.[25, 26]

We constructed graphs of rates of total deaths by suicide and deaths by non-assisted suicide for Oregon and Washington and rates of suicide for Montana. In each case, we compared these with the rates in all other US states.

We then used grouped logistic regression to estimate the association between PAS and suicide rates. We estimated the association for total suicide and for non-assisted suicide and also (for the 25 states with available data) separately for suicides by those aged under and over 65. The coefficient on PAS can be interpreted as the estimated percentage change in suicide rates associated with the legalization of PAS-states. Finally we used ordinary least square (OLS) regressions to estimate the association between the legalization of PAS and the estimated age of non-assisted suicide. For the logistic regressions, we used Huber-White standard errors which control for heteroskedasticity. For the OLS regressions, we clustered standard errors by state. We highlighted estimates that are significantly different to zero at the 10%, 5% and 1% level.

In each regression, we included an indicator (dummy) variable for each state and for each year. These control for unobservable state and year fixed effects, respectively and mean that the coefficient on PAS legalization can be interpreted as the average percentage change in suicide rates before and after legalization of PAS relative to the change over the same time period in states that did not legalize PAS. We estimated further specifications of our models in which we included independent variables measuring factors which have previously been found to be associated with suicides: the proportion of the population that is black, the proportion that is Hispanic, the proportion of the population that adheres to a recognized religion, the unemployment rate, the annual per capita disposable income, whether marijuana was legal for medical reasons, whether marijuana was decriminalized for recreational purposes and whether a 0.08 blood alcohol content law was in place. We also estimated a specification which includes state-specific linear trends. These help control for state-specific effects which change gradually over time and which are not captured by other variables, though they decrease the residual variability in the dependent variable and in the covariates. As a result, they may reduce the power of the tests to pick up effects as significant.

Results

States that legalized PAS were characterized by higher rates of non-assisted suicide, lower rates of religious adherence and a lower proportion of the population who were black or Hispanic. In relation

to unemployment, per capital income and mean age of suicide, PAS states were very similar to non-PAS states (see Table A1 in the Appendix).

Table 1 reports average numbers and rates per 100,000 residents of non-assisted suicide, PAS (where available) and total suicides per year in each of the four legalizing states both before and after legalization. The Table also reports the equivalent figures for non-PAS states. Figure 1 compares presents trends of the total suicide rates in Oregon and Washington with those in all other US states, before and after legalization of PAS. Figure 2 provides the same comparison for non-assisted suicide rates, this time including Montana.

Table 2 reports results of grouped logistic regressions of the associations between PAS and total suicide rates. Controlling for state and year fixed effects, PAS is associated with an 8.9% increase in total suicide rates (i.e. including assisted suicides), an effect which is strongly statistically significant (95% CI = 6.6%, 11.2%). Once we control for a range of demographic and socio-economic factors, PAS is estimated to increase rates by 11.79% (95% CI = 9.3%, 14.1%). When we include state-specific time trends, the estimated increase is 6.3% (95% CI = 2.7%, 9.9%).

Table 2 also reports the estimated association between PAS and non-assisted suicides. Controlling for state and year fixed effects, PAS is estimated to be associated with a 1.6% increase in non-assisted suicide rates but this is not statistically significant (95% CI = -0.8%, 3.9%). The estimated effect is larger and statistically significant once other covariates are included (4.4%, 95% CI = 1.9%, 6.8%). However, when we include state-specific linear trends, the estimated increase is 1.1% and not statistically significant (95% CI = -2.5%, 4.8%).

In Table 3, we report the estimated associations between PAS and suicide for under and over 65s. We find a significant positive association with total suicides for both age groups but the effect for under-65s is generally smaller. In no case do the estimates suggest a significantly negative association between legalization of PAS and non-assisted suicide. Indeed, for the under-65 group, the association is found to be positive, and significantly so when we do not include state-specific trends.

The estimated association between the mean age of non-assisted suicide and legalization of PAS is negative but generally insignificant (see Table 4). The exception is the case in which we include covariates but not state time trends. Here the estimated effect of legalizing PAS is a reduction of -0.9% and statistically significant (95% CI = -1.8%, 0.0%).

Taken together, our results provide strong evidence that legalization of PAS is associated with increases in the rate of suicide, if assisted suicides are included. We find no evidence that PAS is associated with reductions in the non-assisted suicide rate or with increases in the mean age of death for non-assisted suicide.

Discussion

By examining the change in suicide rates before and after legalization relative to the change in states which did not legalize PAS, we are able to control for unobservable state-specific effects which might

otherwise lead one to observe spurious correlations. By examining changes occurring at different times, we can also control for time-specific unobservable factors.

The formal regression analysis found clear evidence that PAS has been associated with an increase in the overall rate of death by suicide (i.e. including assisted suicides). These estimates were robust to the inclusion of state-specific time trends. The results pertaining to non-assisted suicide rates were equivocal. Some estimates suggested that PAS was also associated with a significant increase in the rate of non-assisted suicide. However, when we included state-specific trends, the estimated association, though positive, was smaller and was no longer statistically significant.

The association between PAS and total deaths by suicide is stronger for the over 65 group. There is no evidence that PAS is associated with significant reductions in non-assisted suicide for either older or younger people. Further, the estimates of the determinants of the mean age at suicide do not suggest that PAS leads, on average, to delays in non-assisted suicide.

It should be noted that the rise in overall rates of death by suicide and the absence of a fall in rates of non-assisted suicide are both net effects and do not necessarily mean that legalizing PAS has no suicide-inhibiting effects of the kind outlined by Posner and others.[19, 20, 21] Rather, the results suggest that, if such inhibitory mechanisms exist, they are counteracted by equal or larger opposite effects. Drawing on resources from social learning theory, Stack and Kposowa show how "persons socialized in nations with relatively high rates of suicide are more likely to be exposed to suicidal role models, which provide positive definitions of suicide".[3] Such mechanisms increase the level of individual approval of suicide and hence reinforce the high rate of suicide within the culture. This is analogous to the effect of media reporting that 'normalizes' suicide.[9, 10, 27] It may be that legalizing PAS also provides positive role models that help normalize suicide more generally.[28]

Conclusion

The evidence from suicide rates in states that have legalized PAS is not consistent with Posner's conjecture that such legal changes would lead to delays in, and net reductions in, suicide. Rather, the introduction of PAS seemingly induces more self-inflicted deaths than it inhibits. Furthermore, while a significant proportion of non-assisted suicides involve chronic or terminal illness, especially in the over 65s, the available evidence does not support the conjecture that legalising assisted suicide would lead to a reduction in non-assisted suicides. This suggests either that PAS does not inhibit (nor acts as an alternative to) non-assisted suicide, or that it acts in this way in some individuals but is associated with an increased inclination to suicide in other individuals.

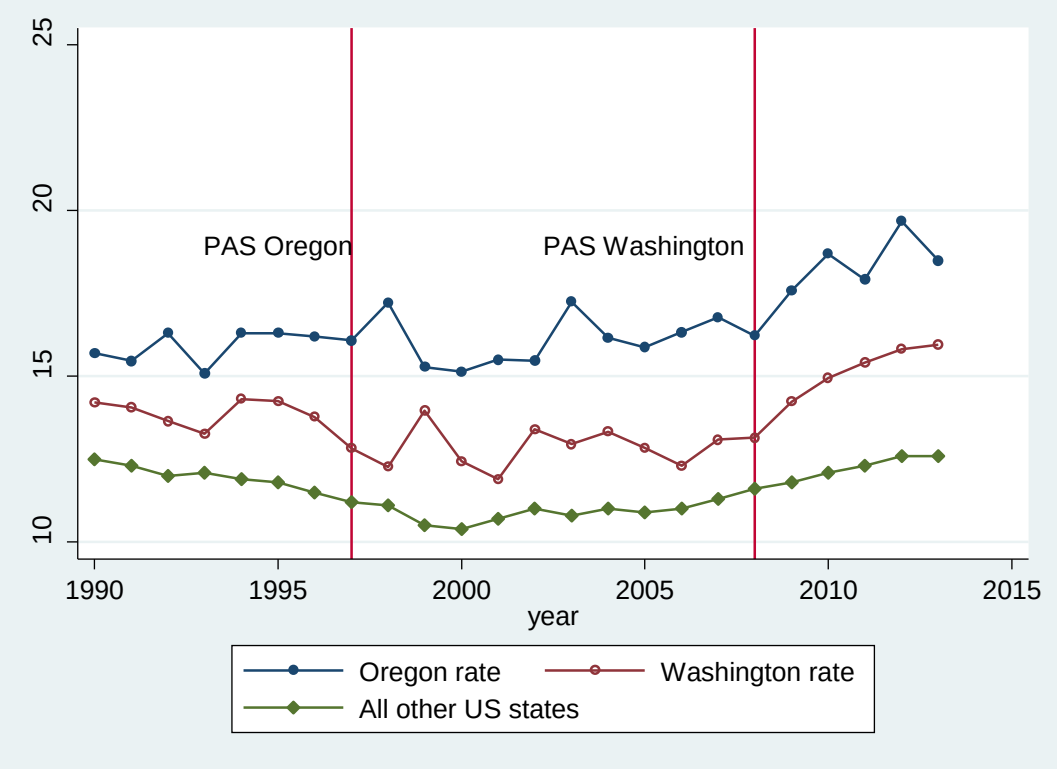
There are a number of limitations to the analysis in this study which suggest our results should be treated with some caution. In the first place suicide, whether non-assisted or assisted, raises ethical and existential issues for the individuals concerned and political questions of public policy that are not addressed in this paper. The aim of this paper is to help inform those decisions but is not

intended to imply that the complex issue of assistance in suicide can be resolved purely by statistical analysis. Neither has this paper considered whether the prevention strategies that are effective with non-assisted suicide may also inhibit assisted suicide, though this may sometimes be the case. For example research has shown that "the protective effect of a religious affiliation… is evident both for assisted and non-assisted suicides".[29, 30]

Although many suicides are among people who would not have been eligible for PAS, and this may limit our ability to identify any direct effect of PAS on non-assisted suicide, our findings that there was a significant increase in total suicides, and more so in the over 65s, and that there was no significant decrease in non-assisted suicides, even amongst over 65s, provides some reassurance as to the robustness of our results. Next, there are still relatively few states that have legalized PAS and it is hard to know how well the effects can be generalized. It should also be noted that all states that have legalized or decriminalized PAS are in the North of the United States, indeed three of the four share a border with Canada. There are as yet no analogous data for states in the South of the United States. Further, for some PAS states, we have very few post-legalization observations. It will be important to further monitor the longer term impact of PAS as more data points become available. Further evidence may also resolve the question of whether there is a significant association between legalizing PAS and increases in non-assisted suicide. The evidence examined here was equivocal on that point.

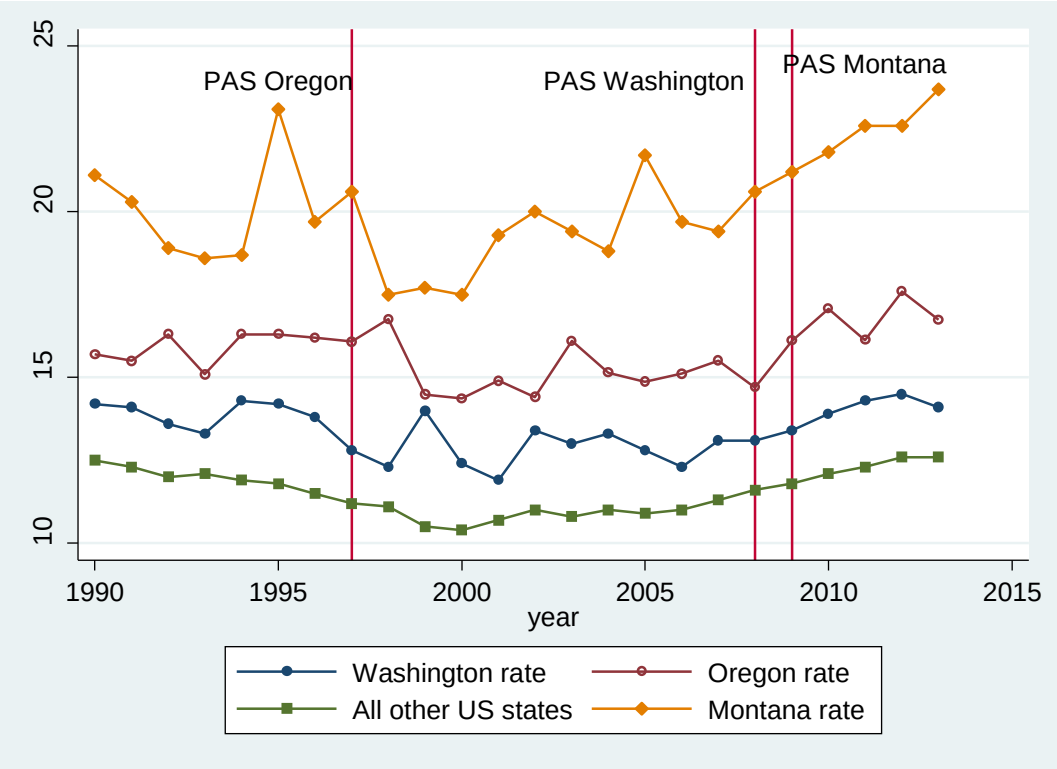
Finally, our use of state and time effects and state-specific trends allow us to control for many unobservable differences between states. However, it is possible that there remain other unobservable factors affecting observed suicide rates and which are correlated with the legalization of PAS and which might affect our conclusions. For this reason, we believe it is important that the quantitative approach in this paper is supplemented with qualitative research looking at the circumstances and motivation of those who die by suicide within jurisdictions that have legalized physician assisted suicide, and also research looking at how attitudes to suicide vary in jurisdictions with different legislative frameworks in place. Such research might help to identify mechanisms that lie behind the bare statistics considered in this study.

Figure 1: Total suicide rates per 100,000 residents, PAS and non-PAS states, 1990-2013



Notes: Vermont is excluded as PAS was legalized in 2013 and no assisted suicides were recorded in that year. Montana is excluded as PAS was decriminalized rather than legalized and, as such, no data are collected on PAS. The vertical lines indicate the timing of the legalization of PAS in the two states.

Figure 2: Non-assisted suicide rates per 100,000 residents, PAS and non-PAS states, 1990-2013



Notes: Vermont is excluded as PAS was legalized in 2013 and no PAS suicides were recorded in that year. The vertical lines indicate the timing of the legalization/decriminalization of PAS in each state.

Table 1: Suicides per year and rates per 100,000 in PAS and non-PAS States, 1990-2013

		Non-Assisted Suicides		Assisted Suicides		Total Suicides		Suicides in Non-PAS States	
		N	Rate	N	Rate	N	Rate	N	Rate
Oregon	Pre-PAS	495.5	15.9	0	0	495.5	15.9	29,435	11.8
	Post-PAS	590.6	15.6	47.1	1.2	637.8	16.9	32,545	11.3
Washington	Pre-PAS	767.7	13.3	0	0	767.7	13.3	29,984	11.3
	Post-PAS	992.8	14.0	88.0	1.2	1,080	15.3	37,301	12.2
Montana	Pre-PAS	177.9	19.7	0	0	177.9	19.7	30,237	11.3
	Post-PAS	233.8	22.7	-	-	*233.8*	*22.7*	37,866	12.3
Vermont	Pre-PAS	83.9	13.5	0	0	83.87	13.5	31,180	11.4
	Post-PAS	112.0	16.8	0	0	112.0	16.8	39,069	12.5

Notes: N is the mean number of suicides per year. Rate is calculated per 100,000 age-adjusted population. In Montana, PAS was decriminalised in 2010 but no data are collected on the number of assisted deaths. The post-PAS periods are as follows: Oregon 1998-2013; Washington 2009-2013; Montana 2010-2013; Vermont 2013.

Table 2: Estimates of the relationship between total suicide/ non-assisted suicide rates and PAS, 1990-2013

	Total	Non-Assisted Suicides
State & year effects	0.089*** (0.066, 0.112)	0.016 (-0.008, 0.039)
State & year effects + covariates	0.117*** (0.093, 0.141)	0.044*** (0.019, 0.068)
State & year effects + covariates & state time trends	0.063*** (0.027, 0.099)	0.011 (-0.025, 0.048)

Notes: results are from logistic regressions grouped by annual, state-level populations, N = 1224. 95% confidence intervals are reported in brackets using Huber-White standard errors. Regression coefficients are reported which can be multiplied by 100 to yield percentage effects. Logistic regression is used due to the dichotomous nature of the dependent variable (=1 if a resident committed suicide; = 0 if not). Grouped regression reflects the fact that the data are grouped together at the state-year level. Results using ordinary least squares (OLS) regression with suicide rates as the dependent variable give very similar results and are presented in the Appendix. Covariates are measured at state level and include the unemployment rate, annual per capital real income, percentage of the population that are Hispanic, percentage of the population that are black, percentage of the population that report being adherents to a recognized religion, whether possession of marijuana was decriminalized, whether marijuana was legalized for medical purposes and whether a 0.08 blood alcohol law was in place.

*** P < .01, ** P < 0.05, * P < 0.1

Table 3: Estimates of the relationship between total suicide/non-assisted suicide rates and PAS, 1990-2013: aged under-65 and 65+

	Deaths by suicide under-65		Deaths by suicide aged 65+	
	Total	**Non-Assisted**	**Total**	**Non-Assisted**
State & year effects	0.049*** (0.023, 0.070)	0.025* (-0.002, 0.052)	0.197*** (0.144, 0.248)	-0.005 (-0.058, 0.049)
State & year effects + covariates	0.079*** (0.052, 0.107)	0.054*** (0.026, 0.082)	0.217*** (0.163, 0.271)	0.014 (-0.042, 0.071)
State & year effects + covariates & state time trends	0.044** (0.003, 0.086)	0.016 (-0.027, 0.058)	0.145*** (0.064, 0.227)	-0.045 (-0.132, 0.041)

Notes: results are from logit regressions grouped by annual, state-level populations, N = 975 for under-65 and 675 for 65+. 95% confidence intervals are reported in brackets. Regression coefficients are reported which can be multiplied by 100 to yield percentage effects using Huber-White standard errors. Logistic regression is used due to the dichotomous nature of the dependent variable (=1 if a resident committed suicide; = 0 if not). Covariates are measured at state level and include the unemployment rate, annual per capital real income, percentage of the population that are Hispanic, percentage of the population that are black, percentage of the population that report being adherents to a recognized religion, whether possession of marijuana was decriminalized, whether marijuana was legalized for medical purposes and whether a 0.08 blood alcohol law was in place. The difference between the coefficients for under-65 and 65+ are statistically significant at conventional levels for total suicides but not for non-assisted suicides.
*** P < .01, ** P < 0.05, * P < 0.1

Table 4: Estimates of the relationship between natural log of mean age of Non-Assisted suicide and PAS, 1990-2013

	Non-Assisted Suicide
State & year effects	-0.004 (-0.012, 0.005)
State & year effects + covariates	-0.009** (-0.018, -0.000)
State & year effects + covariates & state time trends	-0.010 (-0.023, 0.004)

Notes: results are from OLS regressions weighted by state-level populations, N = 674. 95% confidence intervals are reported in brackets using standard errors clustered at the state level. Regression coefficients are reported which can be multiplied by 100 to yield percentage effects. Covariates are measured at state level and include the unemployment rate, annual per capital real income, percentage of the population that are Hispanic, percentage of the population that are black, percentage of the population that report being adherents to a recognized religion, whether possession of marijuana was decriminalized, whether marijuana was legalized for medical purposes and whether a 0.08 blood alcohol law was in place.
*** P < 0.01, ** P < 0.05, * P < 0.1

Data Appendix

Table A1: Data definitions and Sources

Variable	Description	Source
Non-physician-assisted suicide (Non-PAS) rate	Number of suicides recorded amongst residents of each state in a calendar year per 100,000 population. Population is age-adjusted as reported by the CDC.	CDC Compressed Mortality Statistics series; State health departments
Total suicide rate	Non-PAS rate plus the rate of deaths under the auspices of assisted dying acts which occurred in the same calendar year. Note that age groups for deaths under the Oregon Dying With Dignity Act are not provided prior to 2003. The age breakdown for these years is estimated using the reported post-2003 breakdown.	State health departments
Mean age of suicide	The mean age in each state is calculated using the mid-points of the age groupings for state-level suicide deaths reported by the CDC.	CDC Compressed Mortality Statistics series;
PAS	The proportion of months in each calendar year for which physician assisted suicide was legalized or (for Montana) decriminalized.	State health departments
% religious adherence	Percentage of the population in each state reporting that they are adherents to a recognised religion. Linear interpolation to estimate values for intervening years	Associations of Statisticians of American Religious Bodies, 'U.S. Religious Census', 2010, 2000 and 1990, www.rcms2010.org/
% Black	Percentage of the population in each state that are black.	CDC state bridged-race population estimates
% Hispanic	Percentage of the population in each state that are Hispanic.	CDC state bridged-race population estimates
Real disposable income per capita	Annual per capita real GDP by state in chained 2009 dollars.	Bureau of Economic Analysis
Unemployment rate	Annual State level unemployment rates.	Bureau of Labor Statistics
BAC 08 law	The proportion of months in a year in which a state has a law setting the Blood Alcohol Concentration limit for driving at 0.08 grams of alcohol per 100.	Freeman (2007)
Medical marijuana	The proportion of months in a year in which a state has a law in effect permitting the use of marijuana for medical purposes.	Anderson et al (2015) and Marijuana Policy Project (2013), 'State-By-State Medical Marijuana Laws', www.marijuanapolicy.org
Decriminalized marijuana	The proportion of months in a year in which a state has permitted alternatives to incarceration for Marijuana possession.	Marijuana Poly Project (2014), 'State laws with alternatives to incarceration for

		marijuana possession', www.marijuanapolicy.org

Table A1: Characteristics of PAS and non-PAS States in 1997 (pre-PAS)

	All States		**PAS States**		**Control States**	
	Mean	SD	Mean	SD	Mean	SD
Non-PAS suicide rate	12.65	3.9	15.4	3.91	12.3	3.65
Mean age of non-PAS suicide	47.6	1.27	48.0	1.74	47.6	1.24
% religious adherence	60.6	20.4	40.1	6.12	62.3	20.3
% Black	11.3	12.1	1.61	1.544	12.1	12.3
% Hispanic	6.89	8.42	3.91	3.087	7.14	1.27
Real disposable income per capita	28,034	3,758	27,055	3,162	28,117	3,822
Unemployment rate	4.72	1.19	4.95	0.695	4.70	1.22

Notes: figures are state means and standard deviations for the year 1997, the year immediately prior to the first state (Oregon) legalizing PAS. N = 51 for All States, 4 for PAS States and 47 for control states. N for mean age of suicide = 28 for All States, 3 for PAS States and 25 for control states.

Table A2: Covariate coefficients from Table 1 (total suicide rates)

Dependent variable: total suicide rates	**State & year effects +covariates**	**State & year effects + cov**
PAS	0.117*** (0.012)	0.063*** (0.018)
% religious adherence	-4.53 e-3*** (4.64 e-4)	-4.19 e-3*** (5.17 e-4)
% Black	-6.14 e-4 (2.39 e-3)	-0.020** (9.87 e-3)
% Hispanic	-0.025*** (9.99 e-4)	-0.019*** (5.43 e-3_
Real disposable income per capita	-2.53 e-6* (1.32 e-6)	1.89 e-6 (2.14 e-6)
Unemployment rate	6.63 e-3*** (1.69 e-3)	0.012*** (2.00 e-3)
BAC 08 law	1.53 e-4 (4.80 e-3)	-7.64 e-3 (5.60 e-3)
Medical marijuana	-0.027*** (5.80 e-3)	-0.025** (8.09 e-3)
Decriminalized marijuana	0.029*** (8.88 e-3)	0.041*** (9.49 e-3)
State effects	Yes	Yes
Year effects	Yes	Yes
State-specific trends	No	Yes
Log pseudolikelihood	-7991472.6	-7991799.2

Notes: this table reports the coefficients and (in brackets) Huber-White standard errors for all the covariates for the specifications reported in Table 1, column 1 (Total suicides), row 2 (State & year effects + covariates) and row 3 (State & year effects + covariates & state time trends).
*** P < .001, ** P < 0.05, * P < 0.1

Table A3: Weighted OLS estimates of the relationship between total suicides/non-PAS rates and PAS, 1990-2013

	Total suicides	**Non-PAS**
State & year effects	0.090*** (0.064, 0.117)	0.014 (-0.014, 0.042)
State & year effects + covariates	0.123*** (0.083, 0.162)	0.047** (0.007, 0.087)
State & year effects + covariates & state time trends	0.071*** (0.022, 0.119)	0.015 (-0.009, 0.039)

Notes: results are from OLS regressions weighted by state populations, N = 1224. The dependent variable is the natural logarithm of (total) suicides. 95% confidence intervals are reported in brackets using standard errors clustered at the state level. Note that results are robust to alternative approaches to standard errors including allowing for contemporaneous correlation or first order autocorrelation. Covariates are measured at state level and include the unemployment rate, annual per capital real income, percentage of the population that are Hispanic, percentage of the population that are black, percentage of the population that report being adherents to a recognized religion, whether possession of marijuana was decriminalized, whether marijuana was legalized for medical purposes and whether a 0.08 blood alcohol law was in place.
*** P < .001, ** P < 0.05, * P < 0.1

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