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Quasi experimental study of same-sex marriage laws & sexually transmitted infections

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ABSTRACT

Objectives: On June 26, 2015, the Supreme Court legalized same-sex marriages in the United States. This change has had some positive implications for the health of Lesbian, gay, bisexual, and transgender (LGBT) individuals and public health in general. Sexually transmitted infections (STIs) are common among LGBT individuals and legalization of same sex marriage effected the rate of emergency department (ED) visits for STIs. We examined the effect of same-sex marriage legalization on emergency department visits related to STIs among LGBT individuals.

Study design: Quasi-experimental difference-in-difference negative binomial design is used with state and time fixed-effects. We used data for 16 states from State Emergency Department Database and State Inpatient Database from January 2007–December 2015. People over 18 years of age visited the ED for STIs were included.

Results: At 5% significance level, number of STIs cases decreased by 6.1% (95% CI, 0.906–0.973; P = 0.001) after same-sex marriage legalization. When adjusting for sex, these cases decreased by 7.6% (95% CI, 0.885–0.966; P < 0.001) for females, and 4.7% (95% CI, 0.914–0.995; P = 0.027) for males. By age cohorts, 18–24 aged had 8.5% (95% CI, 0.875–0.957; P < 0.001) decrease, while older age cohorts was statistically insignificant.

Conclusions: Our results show that there is an association between legalization and decreased STIs cases in ED visits. Policy makers need to focus on encouraging a positive attitude towards LGBT community, as it leads to better quality of health for sexual minority groups and leads to positive externalities for general community.

1. Introduction

In 1996, Congress passed the *Defense-of-Marriage Act* and defined marriage as “a legal union between one man and one woman.” [1]. Public opinion has changed since then, and people have become more supportive of same-sex couples and the legalization of same-sex marriage [1]. On November 18, 2003, the Massachusetts Supreme Court ruled that the State could not deny the protections, benefits, and obligations conferred by civil marriage to two individuals of the same sex who wish to marry [2]. In 2004, Massachusetts was the first state to fully legalize same-sex marriage; as of October 2014, 32 states have also legalized same-sex marriage [3]. After a long legal battle, on June 26, 2015, the Supreme Court of the United States, in a 5-4 decision, ruled state-level bans on same-sex marriages unconstitutional, therefore legalizing same-sex marriages in the United States [4].

This change has had some positive implications for the health of LGBT individuals and public health in general. For instance, access to health insurance has allowed LGBT people better access to and benefits from health services [5]. Data from Massachusetts and California indicate that same-sex marriage laws led to fewer mental health care visits and expenditures for gay men, and that it reduced psychological distress among lesbian, gay, and bisexual adults in legally recognized same-sex relationships [6]. Prior to legalization of same-sex marriage, a report from Healthy People 2020 showed that gay men are at higher risk of contracting HIV and other sexually transmitted infections (STIs), while lesbian women are less likely to access preventive services for cancer [7].

STIs such as syphilis, gonorrhea, and chlamydia are common among gay and bisexual men and women [8]. A report by the CDC shows that in 2014, gay, bisexual, and other men who have sex with men accounted for 83% of primary and secondary syphilis cases, where the sex partner was known, in the United States [9]. Even though the cases of STIs are higher among LGBT individuals the policy changes can effect the number of detected STI cases. For example, Dee (2008) found that the

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incidence of STIs decreased after the legalization of same-sex marriage in European countries due to the promotion of sexual fidelity [10].

People with STIs may suffer other complications such as pelvic inflammatory diseases, heart diseases, pelvic pain, arthritis, etc. These complications can result in ED visits. Pearson et al. (2017) found that having STIs will increase an individual's likelihood of visiting emergency departments more often [11]. To the best of our knowledge, no published studies focus on the frequency of Emergency Department (ED) visits with a STIs diagnosis among LGBT patients. The aim of this study is to analyze the number of STIs-related ED visits before and after the legalization of same-sex marriage. To address this gap in knowledge and to drive future research, we conducted a quasi-experimental difference-in-difference negative binomial model design with a state and time fixed-effects model.

2. Methods

We included sixteen states in this study; the states with same-sex marriage laws were designated as treatment states, and those that did not allow same-sex marriages were designated as control states. Of these, 12 had legalized same-sex marriages before the Supreme Court ruling in June 2015. Eleven of the 16 states legalized same-sex marriages during the study period. One state (Massachusetts) had legalized the practice before the study period (treatment state without variation), and four states did not legalize it during the study period (control states). Therefore, the study has pre-and post-treatment data from 11 states, information that helped us determine the variation in STIs-related ED visits associated with same-sex marriage legalization.

We used a quasi-experimental design to compare the treatment states (Kentucky, Arizona, Massachusetts, North Carolina, Nebraska, New Jersey, New Mexico, New York, Rhode Island, Vermont, Washington, Wisconsin) to the control states (California, Arkansas, Maryland, Utah), before and after the legal status of same-sex marriage changed.

The State Emergency Department Databases (SEDD) and State Inpatient Databases (SID) databases were used to collect data on ED visits for STIs. These databases are part of the family of databases and software tools developed for the Healthcare Cost and Utilization Project (HCUP). The SEDD captures emergency visits at hospital-owned emergency departments that do not result in hospitalization [12]. Information about patients initially seen in the ED and then admitted to the hospital is included in the SID. The SID also includes inpatient discharge records from community hospitals in that state. The SID and SEDD files encompass all patients regardless of payer, providing a unique view of emergency department or inpatient care, respectively, in a defined market or state over time [13].

A difference-in-difference model design with negative binomial distribution was used. The model controlled for state and time fixed effects. The policy change variable was same-sex marriage legalization, which takes the value '1' if the state has legalized and '0' otherwise.

$$H_0 : \beta_{Same-sex\ Marriage\ Legalized} = 0\ , H_1 : \beta_{Same-sex\ Marriage\ Legzalied} \neq 0$$

The study hypothesized that the legalization of same-sex marriages will result in fewer ED visits with a STIs diagnosis. Legalization increases the acceptance of the LGBT community by the general public, and will improve access to quality healthcare. The institution of marriage will also be a factor in keeping two individuals together, reducing the likelihood of multiple partners and result in a lower rate of STIs.

The SEDD and SID data are given in count form; hence, we used a count data model. Our dependent variable was the count of STIs cases based on ICD-9 & ICD-10 codes for a particular month, year, and state. Using the state-year-month level of observation allowed us to fully capture the effect of legalization and provided us with a higher number of observations than the state-year level of observations. The negative binomial was used because STIs-related ED visits were not normally distributed, and the conditional mean value differed from conditional variance for state-year-month. Since it was a count data model, we also included an exposure variable to define the number of times the occurrence of interest could have happened:

$$Y_{jimt} = f(L_{imt}, S_i, M_m, T_t)$$

where Y_{imt} represents the total number of cases related to STIs for category *j* in state *i* at month *m* and time *t*. L_{imt} represents whether same-sex marriage is legalized or not, taking the value 1 if legalized and 0 otherwise. S_i controls for state-fixed effects, hence it only changes with state (i). M_m is a vector of month dummy variable, controlling for month effects. T_t is a vector of year dummies and controls for year effects.

Our inclusion criteria were patients ≥18 years of age and visiting the ED (inpatient or outpatient) with primary ICD-9 codes for syphilis and other venereal diseases (090–099), high-risk cervical human papillomavirus (795.05), high-risk vaginal HPV (795.15), low-risk vaginal HPV (795.19), high-risk anal HPV (796.75), and low-risk anal HPV (796.79). Hospitals were required to use the ICD-10 code starting October 2015; therefore, our data includes the time period beyond September 2015. Equivalent ICD-10 codes were generated: 090–099 (A50-A64), 795.05 (R87.810), 795.15 (R87.811), 795.19 (R87.628), 796.75(R85.81), and 796.79 (R85.82). Considering the legal age of consent being 18 with no restriction, only the patents 18 or older were considered from the dataset (Table 1).

Our dataset had 16 states, and 12 of those had legalized same-sex marriage before the Supreme Court decision was introduced in June 2015. In addition, we used different timelines for the datasets available from each state. The number of cases with relevant ICD codes per state-year-month from 2007 to 2015 (depending on years available for each state) was used as the dependent variable. The key independent variable was the policy change of same-sex marriage legalization. The exposure variable was the total number of ED visits per state-year-month.

The analysis was conducted using two different versions of the same model. In the first model, we looked at the effect of same-sex marriage legalization on the percentage change in STIs cases immediately after legalization. In the second model, we added another independent legalization dummy, which accounted for the impact of legalization with a 12-month lag; this helped us to see the effect on STIs cases one year after legalization, it assigned the value 1 to the dummy variable one year after the same-sex marriage was legalized (to separate the short-term and long-term effects of legalization).

We also accounted for different subgroups of the population. First, we analyzed the whole subset. The data then was separated by sex to look at the impact separately on males and females. We also looked at the impact of legalization on different age cohorts. The population was divided into four age cohorts: 18–24, 25–40, 41–64, and 65+. By grouping people in different age categories, we could see which group was affected most strongly and which were not affected at all. Finally, we adjusted the subgroups by controlling for both sex and age cohort to see the impact on males and females in different age groups.

To confirm our model design and check the robustness of our study, we also conducted a falsification analysis on tuberculosis and hypertension. Changes in other kinds of ED visits should not be affected by the changes in same-sex marriage laws; hence, this analysis should provide us with insignificant results to confirm the robustness of our model. The analyses were conducted in Stata version 12 (Stata Corp LP, College Station, TX). This study was IRB exempt since the data is publicly available to use (all methods were carried out in accordance with relevant guidelines and regulations.)

3. Results

In general, the rate of STIs cases per total ED visits increased among all the states in our dataset with observations available after legalization, except Vermont where the STIs rate decreased by 7.6% (from 2.13 to 1.99 per 10,000 total ED visits). The State of Washington had the

Table 1
STI cases by state and the same sex marriage law date.

State	Years	No. of observations before legalization	No. of observations after legalization	No. of observations one year after legalization	Date effective	STI cases per 10,000 ED visits before legalization	STI cases per 10,000 ED visits after legalization
Arkansas	2012–14	36	0	0	06/26/2015	7.979	N/A
Arizona	2007–15	94	14	2	10/17/2014	4.624	6.313
California	2007–11	60	0	0	06/28/2013	4.475	N/A
Kentucky	2008–15	90	6	0	06/26/2015	4.875	6.520
Massachusetts	2007–13	0	84	84	05/17/2004	N/A	4.609
Maryland	2008–11	48	0	0	January 01, 2013	11.092	N/A
Nebraska	2007–15	102	6	0	06/26/2015	5.885	8.084
New Jersey	2007–14	82	14	2	10/21/2013	12.043	14.101
New Mexico	2008–14	72	12	0	12/19/2013	12.503	12.763
New York	2007–14	45	41	29	07/24/2011	10.485	10.833
North Carolina	2007–15	93	15	3	October 10, 2014	8.984	9.086
Rhode Island	2007–14	79	17	5	January 08, 2013	5.037	5.379
Utah	2007–13	84	0	0	June 10, 2014	2.052	N/A
Vermont	2007–14	32	64	52	January 09, 2009	2.127	1.990
Washington	2007–14	71	25	13	February 12, 2012	7.855	11.390
Wisconsin	2007–15	93	15	3	June 10, 2014	5.176	5.665

highest increase in the proportion of STIs at 45% (from 7.86 in 2007 to 11.39 in 2015).

Using the first model, we found that overall STIs cases decreased significantly after legalization of same-sex marriage. Same-sex marriage legalization was associated with a decrease in STIs visits by 6.1% (IRR 0.939; 95% CI, 0.906–0.973; P = 0.001); this was the case when we did not adjust for age or sex. After adjusting for sex, visits decreased by 4.7% for males (IRR 0.953; 95% CI, 0.914–0.995; P = 0.027), and 7.6% for females (IRR 0.924; 95% CI, 0.885–0.966; P < 0.001). In terms of age cohorts; visits for patients in the 18–24 age cohort decreased by 8.5% (IRR 0.915; 95% CI, 0.875–0.957; P < 0.001), and there was no statistically significant change for other age cohorts at a 5% significance level. After controlling for both age and sex; males aged 18–24 had a decrease of 7% (IRR 0.93; 95% CI, 0.878–0.985; P = 0.013), and females aged 18–24 had a decrease of 9.9% in STIs visits (IRR 0.901; 95% CI, 0.853–0.952; P < 0.001). Other subsets, when controlling for age and sex, did not have statistically significant changes.

The second model includes an additional dummy variable that represents a value of 1 a year after the legalization. Using the second model (after adding the long-term effect) there is no statistically significant change in STIs at the 5% level in the short term, but a year after legalization, visits decreased by 7.4% (IRR 0.926; 95% CI, 0.887–0.967; P < 0.001) (Table 2).

One year after legalization, the number of STIs-related ED visits decreased by 9.1% for males (IRR 0.909; 95% CI, 0.864–0.956; P < 0.001), and 5.1% for females (IRR 0.924; 95% CI, 0.901–0.999; P = 0.045). There was no immediate effect of legalization on the number of visits for males, but the number of visits for females decreased by 5.6% (IRR 0.944; 95% CI, 0.900–0.990; P = 0.019). In terms of age cohorts in the short-term, STIs-related ED visits for the 18–24 age cohort decreased by 5.6% (IRR 0.944; 95% CI, 0.899–0.992; P = 0.022), and there was no statistically significant change for other age cohorts at the 5% significance level. One year after legalization, visits decreased by 7.2% for the 18–24 age group (IRR 0.928; 95% CI, 0.879–0.979; P = 0.007), and decreased by 9.3% for the 25–40 age group (IRR 0.907; 95% CI, 0.859–0.957; P < 0.001). There was no effect on the number of visits in the long term for the other two age groups.

After controlling for both age and sex in the short term, only females aged 18–24 had a decrease of 7.6% (IRR 0.924; 95% CI, 0.870–0.981; P = 0.010). A year after legalization, males in the 18–24 age group had a decrease of 9.4% (IRR 0.906; 95% CI, 0.845–0.970; P = 0.005), males aged 25–40 had a decrease of 10.1% (IRR 0.899; 95% CI, 0.842–0.960; P = 0.001), and the age group of 41–64 had a decrease of 9.4% (IRR 0.906; 95% CI, 0.828–0.992; P = 0.034). Other subsets did not significantly change when controlling for age and sex (Table 3).

The falsification analysis was used to confirm the robustness of the model. Hypertension and tuberculosis cases were used as dependent variables instead of STIs cases. We determined if there was a significant effect on any of these cases. As shown in Table 3, hypertension and tuberculosis were not affected by legalization [14].

4. Discussion

The purpose of the study was to understand the impact of the legalization of same-sex marriage on ED visits for the diagnosis of STIs across 16 states. All selected states had an increase in STIs-related ED visits except for Vermont, which had a decrease in STIs-related ED visits after legalization. Based on the descriptive analysis, we found that STIs visits increased after legalization, but past research has shown that STIs-related ED visits were already trending upward. Therefore, we used the difference-in-difference model to look at the effect of legalization while controlling for state and time fixed effects. According to a study by Francis et al., same-sex bans have a modest positive association with syphilis rates [15]. Our results were similar and indicate that there is a positive association between legalization and decreased STIs cases related ED visits. Our analysis indicated that different subsets of the population responded in different ways to the legalization of same-sex marriage, having no effect, short-term effect (the impact of policy does not last long), or a long-term effect (the impact of policy last for a long period of time).

We found a decrease in STIs-related ED visits immediately after the legalization of same-sex marriage. Any modifications in law and policies require time to see the impact of such changes; therefore, a one-year lag was used for the policy variable to see the impact of same-sex marriage law on the rate of STIs-related ED visits. The analysis showed that the long-term effect of the legalization of same-sex marriage was a decrease in the rate of STIs-related ED visits.

Males had fewer ER visits one year after legalization, and females had fewer ER visits in both the short term (immediately after legalization) and the long term. Females have a decrease in both short-term and long-term; this could indicate that females responded quicker than males. It also aligns with the data published by Pew research, which

Table 2
Difference-in-difference negative binomial regression with state and time fixed effects, 2007–2015.

Short-term effect			Short-term and long-term effect			
Category	IRR (95% CI)	P-value	IRR (95% CI)	p-value	IRR with one-year lag (95% CI)	p-value
All	0.939 (0.906, 0.973)	0.001	0.968 (0.931, 1.007)	0.111	0.926 (0.887, 0.967)	0.000
Male	0.953 (0.914, 0.995)	0.027	0.990 (0.946, 1.037)	0.683	0.909 (0.864, 0.956)	0.000
Female	0.924 (0.885, 0.966)	0.000	0.944 (0.900, 0.990)	0.019	0.949 (0.901, 0.999)	0.045
18–24	0.915 (0.875, 0.957)	0.000	0.944 (0.899, 0.992)	0.022	0.928 (0.879, 0.979)	0.007
25–40	0.958 (0.914, 1.003)	0.068	0.996 (0.947, 1.047)	0.869	0.907 (0.859, 0.957)	0.000
41–64	0.967 (0.905, 1.032)	0.309	0.982 (0.914, 1.053)	0.608	0.959 (0.889, 1.035)	0.287
65+	0.912 (0.782, 1.065)	0.245	0.922 (0.783, 1.087)	0.335	0.966 (0.808, 1.155)	0.705
Male 18-24	0.930 (0.878, 0.985)	0.013	0.968 (0.909, 1.030)	0.308	0.906 (0.845, 0.970)	0.005
Male 25-40	0.965 (0.913, 1.021)	0.218	1.007 (0.948, 1.070)	0.819	0.899 (0.842, 0.960)	0.001
Male 41-64	0.978 (0.904, 1.057)	0.570	1.014 (0.932, 1.103)	0.749	0.906 (0.828, 0.992)	0.034
Male 65+	0.831 (0.675, 1.022)	0.079	0.847 (0.680, 1.056)	0.140	0.940 (0.742, 1.192)	0.611
Female 18-24	0.901 (0.853, 0.952)	0.000	0.924 (0.870, 0.981)	0.010	0.940 (0.880, 1.003)	0.060
Female 25-40	0.952 (0.894, 1.013)	0.123	0.982 (0.918, 1.051)	0.605	0.920 (0.856, 0.989)	0.024
Female 41-64	0.942 (0.837, 1.061)	0.325	0.908 (0.797, 1.034)	0.144	1.105 (0.963, 1.267)	0.156
Female 65+	1.026 (0.813, 1.294)	0.828	1.025 (0.801, 1.311)	0.844	1.003 (0.765, 1.317)	0.981

Table 3
Falsification analysis using hypertension and tuberculosis.

Short-term effect			Short-term and long-term effect			
Diagnosis	IRR (95% CI)	P-value	IRR (95% CI)	p-value	IRR with one-year lag (95% CI)	p-value
Hypertension	0.989 (0.971, 1.007)	0.232	0.996 (0.975, 1.016)	0.670	0.984 (0.962, 1.006)	0.152
Tuberculosis	0.958 (0.795, 1.156)	0.657	0.934 (0.762, 1.146)	0.513	1.074 (0.863, 1.337)	0.521

shows that females are usually more likely to do same-sex marriages.

Our analysis also showed that people in the age category of 18–24 were more likely to have ER visits, aligning with the findings of Twenge et al. (2017) that people are more sexually active in their 20s [16]. Moreover, people in the 18–24 age group were affected by the policy change in both the short and long term. The 24–40 age group had a decrease in STIs-related ED visits in the long term, but the number of STIs-related ED visits for this group did not change in short term (immediately after legalization), which could be explained by their age category and being less sexually active. STIs-related ED visits did not change for people older than 40 years old, possibly due to less sexual activity and lower STIs rates among that age group.

When we looked at the effects in terms of age and sex, STIs-related ED visits by males aged 18–24, 25–40, and 41–64 were all affected a year after legalization, although there was no effect for any of these groups in the short-term.

5. Limitation

We did not control for any possible confounders because we assumed that the policy change would be the only factor affecting the number of STIs-related ED visits within our defined time period between treatment and control states, and state-fixed effects would adjust for the rest of the changes. Nevertheless, more research is needed in this area to account for any possible confounders. It is worthy to note that this study does not prove any causal relationship between legalization and reduced in number of STIs related ED visits.

6. Conclusion

The legalization of same-sex marriage is associated with fewer ED visits and reduced rate of STIs among LGBT people. Creating a more positive attitude toward the acceptance of LGBT rights will result in better health outcomes. Implementation of such policies and regulations (e.g., same-sex marriage laws) will create a positive and supportive environment for sexual minorities, and they will also result in reduced healthcare costs and better healthcare access for LGBT people.

Ethics approval and consent to participate

This study used publicly available data. All the participants were deidentified.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are available at https://www.hcup-us.ahrq.gov/db/state/siddbdocumentation.jsp and https://www.hcup-us.ahrq.gov/db/state/sedddbdocumentation.jsp.

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Authors' contributions

Dr. Aftab: Data analysis, write up, Dr. Imanpour: Literature review, write up.

Disclaimer

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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