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Changes in Inpatient Healthcare Utilization after Legalization of Recreational Cannabis

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Changes in Inpatient Healthcare Utilization after Legalization of Recreational Cannabis

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ABSTRACT

OBJECTIVE: To assess the effect of cannabis legalization on health effects and healthcare utilization.

DESIGN: We used the 2010-2014 Healthcare Cost and Utilization Project (HCUP) inpatient databases to compare changes in rates of healthcare utilization and diagnoses in Colorado (CO) versus 2 control states, New York (NY) and Oklahoma (OK).

SETTING: Population-based, inpatient.

PARTICIPANTS: HCUP state-wide data comprising over 28 million individuals and over 16 million hospitalizations across 3 states.

MAIN OUTCOME MEASURES: We used International Classification of Diseases-9th Edition (ICD-9) codes to assess changes in healthcare utilization specific to various medical diagnoses potentially treated by or exacerbated by cannabis use. Diagnoses were classified based on weight of evidence from the National Academy of Science (NAS).

RESULTS: In CO compared to NY and OK, respectively, cannabis abuse increased (risk ratio [RR], 1.30; 95% confidence interval [CI], 1.26 to 1.34 and RR 1.27; 95% CI 1.27 to 1.28) post-legalization. In CO, there was a minimal reduction in total admissions (RR 0.98; 95% CI 0.98 to 0.99 and RR 0.97; 95% CI 0.92 to 1.02) and length of stay (-3.98% per year; 95% CI -4.13 to -3.82% and -2.48%, 95% CI -2.57 to -2.38%), and a small yearly increase in costs (1.83%; 95% CI 1.82 to 1.84% and 4.9%; 95% CI 4.68 to 5.13%) compared to NY and OK, respectively. Post-legalization changes most consistent with NAS-based evidence included less Tourette syndrome and post-traumatic stress disorder, but more alcohol abuse (each meeting a Bonferroni-corrected $P < 0.0014$ compared to each control state).

CONCLUSIONS: Cannabis legalization is associated with neutral effects on healthcare utilization, and variable health effects relative to previously established evidence. Such

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population-level effects may help guide future decisions regarding cannabis use, prescription, and policy.

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Strengths and limitations of this study

- The study focuses on the impact of recreational cannabis legalization on health care utilization instead of its legal or societal effects
- This study utilizes HCUP data comprising over 28 million individuals and over 16 million hospitalizations
- Stringent standards were employed to address possible false positives due to multiple hypotheses testing
- Follow up data after the 2012 Amendment 64 only includes two subsequent years
- Physician coding with ICD-9 codes does not capture potentially important mediators related to cannabis use

INTRODUCTION

Over 147 million people, or 2.5 percent of the world's population, use cannabis (marijuana),¹ and more than 20 million Americans have reported the use of cannabis in the past 30 days.¹ Because cannabis use is a federal crime, clinical studies have been challenging to pursue, resulting in substantial knowledge gaps regarding actual health consequences. Twenty-eight states and the District of Columbia now allow cannabis for the treatment of medical conditions.² Of these, 9 have recently legalized cannabis for recreational use. Given such pervasive policy changes, understanding potential shifts in healthcare utilization is vital.

A rigorous summary of the evidence regarding the health effects of cannabis was recently reported by the National Academy of Science (NAS).³ While this is a valuable starting place that makes use of the available data, we do not yet know whether that evidence, based largely on small studies, will translate into real-world ramifications after legalization of recreational cannabis.

On December 10, 2012, Colorado enacted *Colorado Amendment 64*, legalizing recreational cannabis. This change provides a unique opportunity to observe changes in healthcare utilization and diagnoses that occur when access to cannabis becomes liberalized.

METHODS

We used Agency for Healthcare Research and Quality (AHRQ)-funded Healthcare Cost and Utilization Project (HCUP) databases to measure inpatient healthcare utilization and diagnoses in Colorado (CO) between 2010 and 2014. Comparisons were made

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3 with 2 control states in order to address possible secular trends. New York (NY), the
4 most populous state with inpatient HCUP data available up to 2014 was selected, and,
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6 to counter this coastal and largely urban state, we also selected Oklahoma (OK), a
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8 predominately rural state directly adjacent to CO with HCUP hospitalization data up to
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10 2014. Annual demographic data, including age, sex, and race, was obtained from the
11
12 United States Census Bureau. Only month and year were available in all HCUP
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14 databases; as legalization took effect on December 10, 2012, hospitalizations following
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16 December 2012 were considered “after” enactment of the law. Patients with missing
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18 information on age, sex, race, and year of encounter were excluded.
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24 Age, sex, race, income level, and insurance payer were recorded at each
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26 healthcare encounter. Hispanic ethnicity was not coded in the OK State Department of
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28 Health data source. In order to use comparable categorizations across the 3 states, we
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30 separated race into white, black, Native American, and other. Income level was
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32 categorized by quartiles using the median household income for each patient’s ZIP
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34 code. Income level was not available for OK.
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38 We first performed a validation analysis to assess changes in cannabis abuse
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40 diagnoses in CO after versus before recreational cannabis legalization and compared
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42 those rates to changes in NY and OK over the same time period. To determine changes
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44 in overall healthcare utilization, we assessed changes in total number of
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46 hospitalizations, length of inpatient stay, and healthcare costs. We estimated the cost of
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48 each hospitalization by multiplying the charges by a cost-to-charge ratio for the
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50 admitting hospital for the given year. For NY and CO, we used the all-payer cost-to-
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52 charge ratios provided by HCUP. When the all-payer cost-to-charge ratio was missing,
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3 we applied the average cost-to-charge ratio particular to state and year. As HCUP does
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5 not provide cost-to-charge ratios for OK, we assumed a constant state-wide cost-to-
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7 charge ratio (0.3119 as derived from the Institute for Health and Socio-Economic Policy
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9 calculations of federal cost reports) to estimate healthcare costs in OK;⁴ we then
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11 conducted a sensitivity analysis setting the cost-to-charge ratio for OK to equal to the
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13 average for NY and CO for the corresponding year. See online supplementary
14
15 eMethods and eTable 1 for additional details.
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19 We used International Classification of Diseases-9th Edition (ICD-9) codes (see
20
21 online supplementary eTable 2) to assess changes in healthcare utilization specific to
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23 various medical diagnoses potentially treated by or exacerbated by cannabis use as
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25 identified by the NAS summary. Only diagnoses with substantial, moderate, or limited
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27 evidence per the NAS were included.
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31 Certification to use de-identified HCUP data was obtained from the University of
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33 California, San Francisco Committee on Human Research.
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38 **Statistical Analysis**

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40 Demographic and lifestyle characteristics are presented as mean \pm standard deviation
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42 (SD) or n (% of total admissions) and were compared between states using linear,
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44 logistic, and multinomial models as appropriate. Rates of admissions for NAS diagnoses
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46 (with the population size as the denominator) were compared between states using
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48 negative binomial models.
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51 To assess the effects of recreational cannabis legalization, we used negative
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53 binomial models for the number of admissions, both overall and for particular
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3 diagnoses, with the log of the subgroup population sizes as an offset and the use of
4 robust standard errors. Analogous linear models were utilized for length of stay and
5
6 robust standard errors. Analogous linear models were utilized for length of stay and
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8 cost, which were both log-transformed in order to meet normality assumptions. All
9
10 models were adjusted for age, race, and sex. In order to relax the linearity assumption,
11
12 each 5-year age range was included as a separate category. To flexibly model secular
13
14 patterns, year was included as a categorical rather than continuous variable (with a
15
16 category for each year between 2010 and 2014). The crucial predictors in our model
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18 included an indicator for CO (versus the comparison state) and interactions of this
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20 indicator with 2 continuous linear spline basis functions, year-2012, and max (0, year-
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22 2012). The main effect for CO estimated the between-state risk ratio (RR) in 2012, the
23
24 first interaction estimated the slope of the between-state RR in 2010-12, and the second
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26 estimated the change in slope after 2012. The first interaction was used to project the
27
28 counterfactual 2013-2014 rates in CO that would be expected in the absence of
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30 legalization, while the second was used to capture the legalization effect. Like a
31
32 standard interrupted time series (ITS) model, our model assumed that the between-
33
34 state RR changed linearly at different rates before and after the intervention, but used
35
36 the categorical indicator for year to relax the standard ITS assumption of piecewise
37
38 linear trends in the underlying state-specific rates, substantially improving model fit.

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41 A 2-tailed $P < 0.05$ was considered statistically significant for the validation
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43 analyses (cannabis use), and analyses related to overall healthcare utilization. In order
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45 to minimize false positive results and to account for secular trends that might differ
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47 across different populations, we assessed for validation in comparisons versus NY and
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49 then OK separately.
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3 In order to address possible false positives due to multiple hypotheses testing in
4 assessing all of the diagnoses described in the NAS document, we employed stringent
5 standards: to be considered “positive,” the comparisons between CO and *each* of the
6 other 2 states needed to be in the direction expected from the NAS report, each
7 exhibiting statistical significance using a Bonferroni-corrected two-tailed alpha of 0.0014
8 ($P=0.05$ divided by 35, the number of comparisons derived from NAS-based
9 diagnoses). A “positive” designation also required absence of a statistically significant
10 difference between NY versus OK using a two-tailed alpha of 0.05. All analyses were
11 performed using Stata 15 (StataCorp, College Station, TX).
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26 **Patient and Public Involvement**

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28 The patients and public were not involved in the study.
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33 **RESULTS**

34 **Baseline Characteristics**

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36 The total number of admissions between 2010 and 2014 are shown for each state in
37 **table 1**. Patients in CO were generally younger, more commonly female, and less
38 ethnically diverse. Wealth in CO was less equally distributed, with a higher proportion of
39 individuals with lower income in CO compared to NY. Finally, admission rates were
40 lower in CO than the control states for most NAS diagnoses, with exceptions for pre-
41 diabetes and post-traumatic stress disorder.
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54 **Study Validation**

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3 Over 2010-2014, the change in rates of cannabis abuse admissions after versus before
4 recreational cannabis legalization in 2012 was greater in CO than in NY and OK (risk
5 ratio [RR], 1.3; 95% confidence interval [CI], 1.2 to 1.3 and RR 1.27; 95% CI 1.27 to
6 1.28; both $P < 0.00005$, respectively) (**figure 1A-B**). No significant changes comparing
7 the two control states, NY and OK, were observed over the same time period (RR 0.96;
8 95% CI 0.88 to 1.03; $P = 0.26$).

19 **Inpatient Healthcare Utilization after Cannabis Legalization**

21 *Number of admissions*

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23 In unadjusted analyses, CO, NY, and OK had a similar number of total admissions
24 before and after cannabis legalization (**figure 2A**). After taking population demographics
25 into account, there was a reduction of number of admissions following *Colorado*
26 *Amendment 64* in CO when compared to NY (RR 0.98; 95% CI 0.98 to 0.99;
27 $P < 0.00005$). The point estimate was similar when comparing CO to OK, but did not
28 reach statistical significance (RR 0.97; 95% CI 0.92 to 1.02; $P = 0.27$).

39 *Length of stay*

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41 The median length of stay was also similar after cannabis legalization across the 3
42 states in unadjusted analyses (**figure 2B**). After adjusting for population demographics,
43 length of inpatient stay was shorter in CO following the law change when compared with
44 each of the 2 control states (3.98% annual reduction; 95% CI -4.13% to -3.82% in CO
45 versus NY, and 2.48% annual reduction, 95% CI -2.57% to -2.38% versus OK; both $P =$
46 0.002).

Healthcare Costs

In unadjusted analyses, the 3 states exhibited similar total costs across the study time period (**figure 2C** and online supplementary eTable 2). In multivariate analyses accounting for population demographics, healthcare costs increased by 1.83% (95% CI 1.82 to 1.84%; $P=0.0003$) in CO compared to NY and by 4.9% (95% CI 4.68 to 5.13%; $P=0.0023$) versus OK after cannabis legalization. No meaningful differences were observed in the sensitivity analysis assuming the cost-to-charge ratio for OK was equal to the average of the other states.

Changes in Specific Diagnoses Highlighted by the National Academy of Sciences

Among the diagnoses with evidence of influence by cannabis per the NAS (**figure 3**), we distinguished between: 1) a group with no statistically significant post-legalization differences between control states (NY versus OK $P>0.05$), suggesting that secular trends unlikely explained differences between CO and control states; and 2) a group with significant differences in diagnoses post-legalization between control states (NY versus OK $P<0.05$).

In the NY versus OK $P>0.05$ group (**figure 3**), changes in rates of diagnoses after cannabis legalization did not consistently reflect NAS-based evidence. Among the diagnoses most consistent with NAS-based evidence, there was a reduction in Tourette syndrome and post-traumatic stress disorder, and an increase in alcohol abuse after cannabis legalization (each meeting the Bonferroni-corrected alpha, $P<0.0014$). Motor vehicle accidents also increased, although the P value compared to OK was 0.073.

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3 Among outcomes where the direction of the effect was discordant with NAS-based
4 evidence, most diagnoses (predominantly cardiometabolic and psychiatric) rested on
5 limited (rather than moderate or substantial) NAS-based evidence. In the NY versus OK
6 $P < 0.05$ group (**figure 3**), changes in diagnoses that were concordant with NAS findings
7 and met the Bonferroni alpha included a reduction in chronic pain and an increase in
8 hallucinations. Changes of risk over time with counterfactual are shown for each NAS
9 diagnosis in online supplementary eFigures 1-31.
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21 **DISCUSSION**

22 **Principal findings**

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26 Legalization of recreational cannabis was associated with more cannabis abuse, and
27 minimal effects on overall healthcare utilization. Changes in specific medical diagnoses
28 post-legalization did not consistently reflect previously published evidence on the health
29 effects of cannabis.
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35 The increased frequency of cannabis abuse diagnoses in CO helps to validate
36 the concept that legalization would result in greater use.
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40 Effects of cannabis legalization on healthcare utilization appeared to be overall
41 neutral. There was no evidence that either the number of overall hospitalizations or
42 length of stay increased. However, yearly total costs in CO increased to a small degree
43 compared to NY and OK following cannabis legalization, potentially because changing
44 admissions for specific medical diagnoses may have driven costs differently.
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51 Changes in the frequency of diagnoses did not consistently reflect NAS-based
52 evidence. Among the changes in diagnoses consistent with NAS-based evidence that
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3 met the stringent criteria described in the Methods section, there was a reduction in
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5 Tourette syndrome and in post-traumatic stress disorder, and an increase in alcohol
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7 abuse after cannabis legalization. Motor Vehicle accidents also became more common
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9 (meeting Bonferroni-corrected P value versus NY, but did not reach statistical
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11 significance compared to OK). Although both cited by the NAS as based on limited
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13 evidence, cannabis has been shown to be effective in suppressing tics and associated
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15 behavioral problems in Tourette syndrome⁹ and in reducing symptoms attributed to
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17 post-traumatic stress disorder.¹⁰ Consistent with our findings, a substantial bidirectional
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19 comorbidity between cannabis use and alcohol use has been previously demonstrated,
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21 resulting in a moderate level of evidence designation for this relationship per the NAS.¹¹
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23 Finally, the NAS document described strong evidence supporting a relationship
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25 between cannabis use and motor vehicle accidents, consistent with our data and
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27 findings from a meta-analysis using either self-report or laboratory evidence of cannabis
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29 use.¹²
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38 **Strengths and Weaknesses**

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40 Although several studies have investigated the health effects of cannabis,⁵ they have
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42 relied on small sample sizes or have generated conflicting data.⁶⁻⁸ In contrast, our
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44 findings are derived from HCUP state-wide data comprising over 28 million individuals
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46 and over 16 million hospitalizations across CO, site of the 2012 *Amendment 64*, and 2
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48 controls states without cannabis legalization over the same time period.
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51 Several limitations should be acknowledged. The HCUP database relies on
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53 physician coding; however, such coding for several medical diagnoses listed in **table 1**
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3 have been shown to be highly specific with variable sensitivity^{4, 13, 14} and HCUP has
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5 proven to be a powerful tool in large population studies.¹⁵⁻¹⁹ Some potentially important
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7 mediators are not captured by ICD-9 codes, such as quantity of cannabis used or
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9 formulation (oral versus other), although these may be more relevant to identifying
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11 mechanisms and their absence would likely not lead to false positive results. As with
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13 any observational study, we cannot exclude residual confounding as an explanation of
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15 our findings. However, we adjusted for conventionally recognized confounders as
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17 appropriate and as available, and, as this was largely a study of the same populations
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19 pre- and post-legalization, many of the limitations inherent to conventional individual-
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21 level analyses are likely less relevant. The HCUP database does not capture
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23 information regarding outpatient activity and therefore these findings are restricted to
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25 hospital-based medicine. Our use of Bonferroni correction in assessing changes related
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27 to NAS diagnoses may have been too conservative, leading to a sacrifice of false
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29 negatives in order to avoid false positives. Finally, our study was limited to two-year
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31 follow-up after cannabis legalization, and we therefore cannot comment on long-term
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33 effects that may result.
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42 **Conclusions**

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44 In conclusion, cannabis legalization is associated with an expected increase in cannabis
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46 abuse. Overall effects on inpatient healthcare utilization appear to be neutral, with
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48 subtle changes in various components of that utilization likely occurring due to changes
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50 in the types of admissions observed. Measurable effects of cannabis legalization on
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52 various inpatient diagnoses are not all consistent with previous evidence based on small
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3 studies and experience outside the world of legalized recreational cannabis. These data
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5 provide the first description of population-level effects that may help guide future
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7 decisions regarding cannabis policy, individuals considering using cannabis, and
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9 physicians caring for those who may choose to consume it.
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3 **Contributors** FND and GMM had full access to all of the data in the study and take
4 responsibility for the integrity of the data and the accuracy of the data analysis. FND
5 and GMM were responsible for the study concept and design. All authors contributed to
6 data acquisition, analysis, and interpretation. EV, GN, and GMM completed the
7 statistical analysis. FND and GMM drafted the manuscript and were responsible for the
8 critical revision of the manuscript for important intellectual content. GMM obtained
9 funding for the study. All authors contributed to the administrative, technical, and
10 material support for the study and approved the final version of the manuscript.

11
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15 study; data analysis or interpretation; preparation of the manuscript; or the decision to
16 submit the manuscript for publication.

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18 **Competing interests** None declared.

19
20 **Patient consent** Not required.

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22 **Ethics approval** Ethical approval to use de-identified HCUP data was obtained from
23 the University of California, San Francisco Committee on Human Research.

24
25 **Data sharing** No additional data are available.

26
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FIGURE LEGENDS

Figure 1. Multivariate adjusted rates of admissions for cannabis abuse over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, compared with New York (A) and Oklahoma (B), control states without cannabis legalization. Red lines show the predicted rates of admissions for cannabis abuse had the cannabis legalization policy not been instituted. The comparison between Colorado and the control states with regards to change of risk ratio (RR) slope within the 2010-2012 period (pre-legalization) and 2012-2014 period (post-legalization), as well of the overall RR slope change, are also represented for the Colorado versus New York (A) and Colorado versus Oklahoma (B) comparisons. Red lines show the predicted rates of admissions for cannabis abuse had the cannabis legalization policy not been instituted. Each model was adjusted for age, gender, and race (see Methods section for further details). CI = confidence interval; vs = versus.

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Figure 3. Health outcomes with at least limited evidence of a statistical association with cannabis use based on the National Academy of Science (NAS) summary statement. Two main groups of medical diagnoses are identified based on a non-significant ($P>0.05$) (A) versus significant ($P<0.05$) (B) comparison between New York (NY) and

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Table 1. Baseline clinical characteristics of the 3 study states.

	Colorado	New York	Oklahoma	<i>P</i> value
Total population	5,197,237	19,594,599	3,819,383	
Total admissions	2,088,909	11,726,283	2,334,988	
Total admissions/1,000 population	402±0.27	598±0.17	611±0.40	0.0001
Demographics				
Age – yr	45 ± 28	49 ± 28	48 ± 28	0.0001
Male – no. (%)	870,573 (42)	5,087,181 (41)	954,848 (43)	0.0001
Race – no. (%)				0.0001
White	1,548,099 (74)	6,406,582 (55)	1,879,727 (81)	
Black	102,444 (5)	2,083,366 (18)	202,420 (9)	
Native American	13,143 (1)	36,216 (0.3)	131,714 (6)	
Other	425,223 (20)	3,200,119 (27)	121,127 (5)	
Lifestyle				
Median Household Income, dollars (quartiles for patient ZIP code) – no. (%)				0.0001
Quartile 1	617,537 (30)	3,087,192 (28)	No data	
Quartile 2	558,760 (27)	2,623,087 (24)		
Quartile 3	470,051 (23)	2,673,153 (24)		
Tobacco use – no. (%)	251,566 (12)	1,717,940 (10)	235,685 (14)	0.0001
Alcohol abuse – no. (%)	112,715 (5)	652,608 (6)	71,931 (3)	0.0001
NAS Diagnoses				
Non-seminoma type testicular germ cell cancer – no. (%)	405 (0.02)	2,487 (0.02)	480 (0.02)	0.0001
Acute myocardial infarction – no. (%)	39,513 (1.9)	271,285 (2.3)	60,413 (2.6)	0.0001
Brain hemorrhage – no. (%)	10,963 (0.5)	58,278 (0.5)	10,245 (0.4)	0.0001
Ischemic stroke – no. (%)	27,986 (1.3)	194,478 (1.7)	45,602 (2)	0.0001

Metabolic syndrome & diabetes – no. (%)	294,821 (14)	2,301,835 (20)	465,353 (20)	0.0001
Prediabetes – no. (%)	42,544 (2)	73,407 (0.6)	24,246 (1)	0.0001
Bronchitis – no. (%)	65,265 (3)	429,230 (4)	131,343 (6)	0.0001
Motor vehicle accidents – no. (%)	14,941 (0.7)	59,686 (0.5)	13,692 (0.6)	0.0001
Overdose injury – no. (%)	10,933 (0.5)	40,226 (0.3)	12,147 (0.5)	0.0001
Substance abuse – no. (%)	158,244 (7.6)	974,856 (8.3)	109,305 (4.7)	0.0001
Anxiety disorders – no. (%)	131,426 (6.4)	595,478 (5.2)	139,627 (6.1)	0.0001
Anxiety disorders (except social anxiety) – no. (%)	51,913 (2.5)	283,280 (2.4)	65,279 (2.8)	0.0016
Bipolar disorders – no. (%)	52,348 (2.5)	287,735 (2.5)	61,411 (2.6)	0.0001
Depressive disorders – no. (%)	213,851 (10)	827,932 (7)	190,083 (8)	0.0001
Schizophrenia or other psychoses – no. (%)	53,652 (2.6)	352,533 (3)	68,385 (2.9)	0.0001
Positive symptoms of schizophrenia (i.e. hallucinations) – no. (%)	2,653 (0.1)	9,482 (0.1)	3,531 (0.2)	0.0001
Post-traumatic stress disorder – no. (%)	28,582 (1.4)	75,608 (0.6)	17,101 (0.7)	0.0001
Social anxiety disorder – no. (%)	295 (0.01)	1,090 (0.01)	135 (0.01)	0.0295
Suicide – no. (%)	4,957 (0.2)	15,646 (0.1)	4,407 (0.2)	0.0001
Low offspring birthweight – no. (%)	2,842 (0.1)	7,462 (0.1)	1,742 (0.1)	0.0002
Maternal pregnancy complications – no. (%)	39,343 (1.9)	144,353 (1.2)	40,938 (1.8)	0.0001
Unemployment/low income – no. (%)	3,134 (0.2)	76,789 (0.7)	730 (0.03)	0.0001
Nausea or vomiting – no. (%)	63,806 (3)	162,11(1.4)	58,706 (2.5)	0.0001
Chronic pain – no. (%)	140,209 (6)	234,160 (2)	123,563 (5)	0.0001
Spasticity – no. (%)	5,759 (0.3)	12,517 (0.1)	5,371 (0.2)	0.0001

Short-term sleep – no. (%)	652 (0.03)	3,364 (0.03)	357 (0.02)	0.0001
Tourette syndrome – no. (%)	428 (0.02)	2,784 (0.02)	336 (0.01)	0.0001
Increased appetite & weight gain – no. (%)	1,022 (0.05)	3,017 (0.03)	651 (0.03)	0.0001

NAS = National Academy of Science. All NAS diagnoses listed had at least limited evidence of a statistical association with cannabis use based on the 2017 NAS summary statement. Substance abuse includes dependence or abuse of alcohol, tobacco, or other illicit drug. All variables pertain to the 2010-2014 period. Plus-minus values are means \pm SD. No. (%) indicates number of admissions with a specific demographic/lifestyle characteristic or NAS diagnosis (% of total admissions). A *P* value less than 0.05 is considered statistically significant.

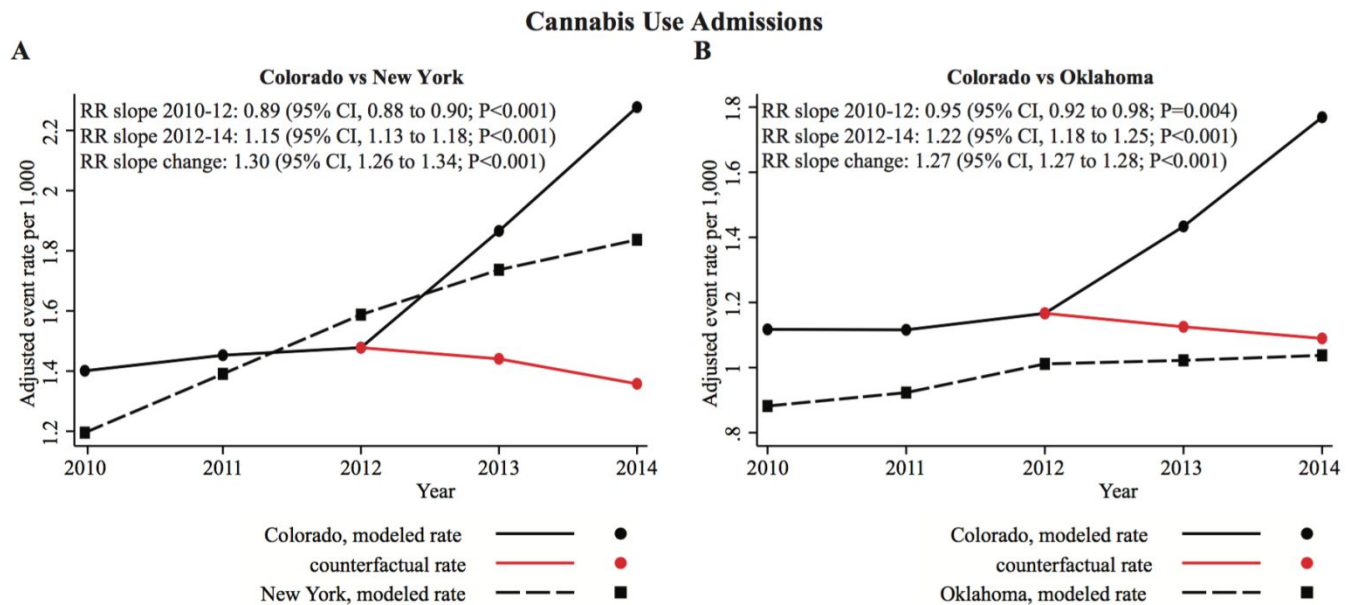
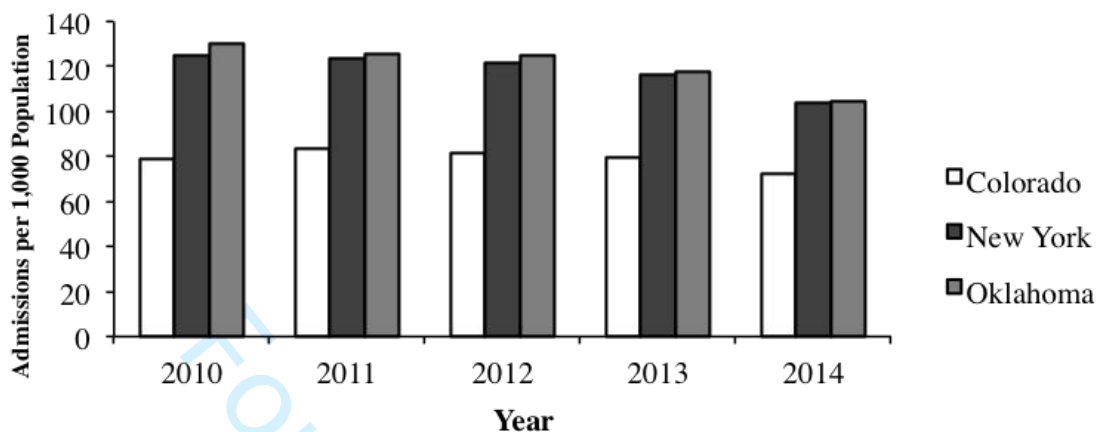


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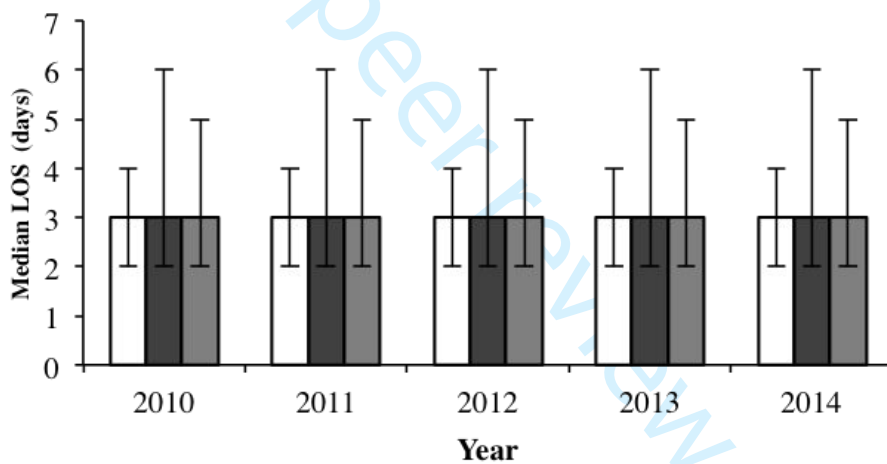
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Admissions per 1,000 Population by Year



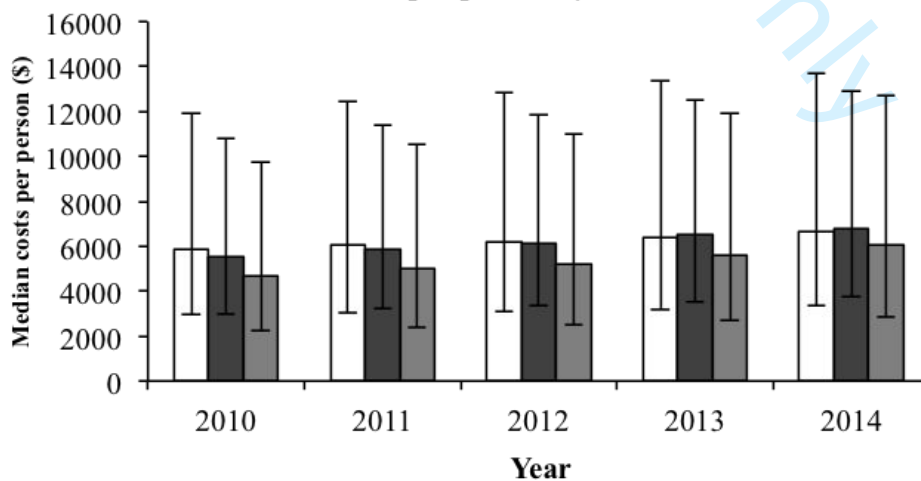
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Median length of stay (LOS) by Year



C

Median costs per person by Year



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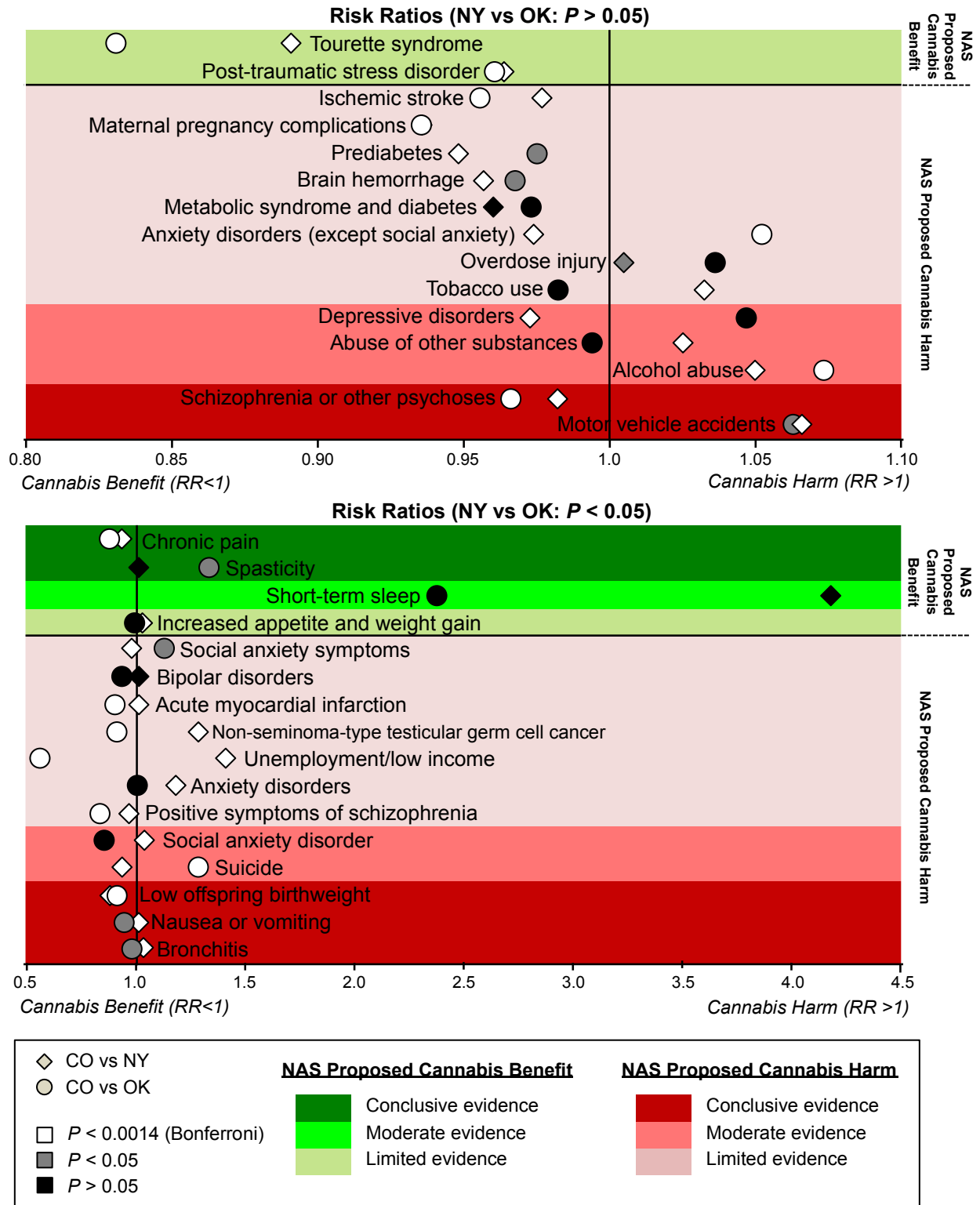


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Supplementary Appendix

Changes in Inpatient Healthcare Utilization after Legalization of Recreational Cannabis

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eFigure 1-31. Plots depicting admission rates for diagnoses classified based on weight of evidence from the National Academy of Science

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Cost Analysis

Cost Estimations

The inpatient cost for each hospitalization in New York and Colorado was estimated by multiplying the total charges (TOTCHG) obtained from HCUP State Inpatient Database with the institution-specific all-payer cost-to-charge ratio (APICC) obtained from the Cost-to-Charge Ratio file. Hospital ID was used as a linkage to merge both files. Total inpatient costs were calculated as the sum of the cost for all hospitalizations in a given state for a particular year. The databases contained 186,226 (8.7%) encounters with non-matched/missing hospital ID for NY and 1,132,696 (9.6%) encounters with non-matched/missing hospital ID for Colorado; for these encounters. In order to estimate the cost of these hospitalizations (for which we had charges but no cost-to-charge ratio) we applied the average cost-to-charge ratio for that state-year. This was estimated by dividing the sum of costs for all hospitalizations for which cost-to-charge ratios were available by the sum of charges for all hospitalizations for which cost-to-charge ratios were available in a given state-year (**Table S2**).

Oklahoma Total Cost Estimate

HCUP does not produce SID and CCR file for Oklahoma. We obtained these data from Oklahoma State Department of Health – this dataset contains information about total charges but not cost-to-charge ratios. We estimated total inpatient costs in Oklahoma in two ways. First, we used a state-wide constant cost-to-charge ratio (0.3119) to estimate the total cost (ratio derived from the Institute for Health and Socio-Economic Policy calculations of federal cost reports). We then conducted a sensitivity analysis in which we used the average of the cost-to-charge ratios of New York and Colorado for any given state-year (**Table S2**).

eTable 1. Yearly costs and charges for the 3 study states

Colorado	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	397,505	428,912	424,640	418,952	418,900	2,088,909
Hospitalizations for which CCR is available, n (%)	396,433 (99.7%)	301,586 (70.3%)	382,021 (90.0%)	412,483 (98.5%)	413,160 (98.6%)	1,905,683 (91.2%)
Total charges for hospitalizations for which CCR is available	\$14,382,791,648	\$11,170,040,412	\$15,821,232,608	\$19,349,895,615	\$20,370,018,114	\$81,093,978,397
Total costs for hospitalizations for which CCR is available	\$4,104,443,164	\$3,033,915,324	\$3,963,892,093	\$4,619,884,886	\$4,700,380,255	\$20,422,515,722
Average CCR*	0.2854	0.2716	0.2505	0.2388	0.2309	
Hospitalizations for which CCR is not available, n (%)	1,072 (0.3%)	127,326 (29.7%)	42,619 (10.0%)	6,469 (1.5%)	5,740 (1.4%)	183,226 (8.8%)
Total charges for hospitalizations for which CCR is not available	\$55,039,614	\$5,704,285,087	\$2,494,379,901	\$241,011,451	\$211,228,665	\$8,705,944,718
Total costs for hospitalizations for which CCR is not available†	\$15,708,306	\$1,549,283,830	\$624,842,165	\$57,553,535	\$48,772,699	\$2,296,160,534
Total inpatient costs	\$4,120,151,470	\$4,583,199,154	\$4,588,734,258	\$4,677,438,421	\$4,749,152,954	\$22,718,676,256

*Average CCR was estimated by dividing the total of costs for all hospitalizations for which cost-to-charge ratios were available by the total charges for hospitalizations for which cost-to-charge ratios were available in a given state-year.

†Total charges for hospitalization for which CCR is not available multiplied by Average CCR in a given state-year.

New York	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	2,417,298	2,414,985	2,389,701	2,290,502	2,213,797	11,726,283
Hospitalizations for which CCR is available, n (%)	2,189,513 (90.6%)	2,157,629 (89.3%)	2,168,880 (90.8%)	2,056,367 (89.8%)	2,021,199 (91.3%)	10,593,588 (90.3%)
Total charges for hospitalizations for which CCR is available	\$66,303,900,691	\$69,885,515,755	\$74,728,795,811	\$77,680,292,105	\$79,252,368,106	\$367,850,872,468
Total costs for hospitalizations for which CCR is available	\$22,376,381,374	\$23,448,311,348	\$24,539,963,919	\$24,331,920,273	\$23,892,478,440	\$118,589,055,354
Average CCR*	0.3375	0.3355	0.3283	0.3132	0.3014	
Hospitalizations for which CCR is not available, n (%)	227,785 (9.4%)	257,356 (10.7%)	220,821 (9.2%)	234,135 (10.2%)	192,598 (8.7%)	1,132,695 (9.7%)
Total charges for hospitalizations for which CCR is not available	\$4,168,104,163	\$4,821,903,339	\$4,088,909,686	\$5,687,320,556	\$5,336,461,039	\$24,102,698,783
Total costs for hospitalizations for which CCR is not available†	\$1,406,735,155	\$1,617,748,571	\$1,342,797,941	\$1,781,268,798	\$1,608,409,357	\$7,756,959,821
Total inpatient costs	\$23,783,116,529	\$25,066,059,919	\$25,882,761,860	\$26,113,189,071	\$25,500,887,797	\$126,346,015,175

*Average CCR was estimated by dividing the total of costs for all hospitalizations for which cost-to-charge ratios were available by the total charges for hospitalizations for which cost-to-charge ratios were available in a given state-year.

†Total charges for hospitalization for which CCR is not available multiplied by Average CCR in a given state-year.

Oklahoma	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	489,724	476,605	476,728	452,724	439,207	2,334,988
Hospitalizations for which CCR is available, n (%)	489724 (100%)	476605 (100%)	476728 (100%)	452724 (100%)	439207 (100%)	2334988 (100%)
Total charges for hospitalizations for which CCR is available	\$13,927,214,520	\$14,645,751,657	\$15,247,598,300	\$15,596,643,583	\$15,003,967,132	\$74,421,175,192
Total costs for hospitalizations for which CCR is available	\$4,343,898,209	\$4,568,009,942	\$4,755,725,910	\$4,864,593,134	\$5,001,131,977	\$23,533,359,171
Average CCR*	0.3119	0.3119	0.3119	0.3119	0.3119	

*Statewide constant CCR (0.3119) used to estimate the total cost across years.

Oklahoma (sensitivity analysis)	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalization, n	489,724	476,605	476,728	452,724	439,207	2,334,988
Hospitalization for which CCR is available, n (%)	489724 (100%)	476605 (100%)	476728 (100%)	452724 (100%)	439207 (100%)	2334988 (100%)
Total charges for hospitalization for which CCR is available	\$13,927,214,520	\$14,645,751,657	\$15,247,598,300	\$15,596,643,583	\$15,003,967,132	\$74,421,175,192
Total costs for hospitalization for which CCR is available	\$4,337,630,962	\$4,445,717,915	\$4,413,417,328	\$4,304,673,629	\$4,267,557,794	\$21,768,997,628
Average CCR*	0.3114	0.3036	0.2895	0.276	0.2662	

*Average of the CCRs of New York and Colorado for any given state-year.

eTable 2. International Classification of Diseases-9th Edition (ICD-9) codes defining each medical diagnosis.

Chronic pain

ICD-9 Code	Short Description	Long Description
338.21	Chronic pain d/t trauma	Chronic pain due to trauma
338.22	Chronic post-thoracotomy pain	Chronic post-thoracotomy pain
338.28	Chronic postoperative pain NEC	Other chronic postoperative pain
338.29	Chronic pain NEC	Other chronic pain
338.4	Chronic pain syndrome	Chronic pain syndrome

Nausea or vomiting

ICD-9 Code	Short Description	Long Description
787.03	Vomiting alone	Vomiting alone
787.02	Nausea alone	Nausea alone
787.01	Nausea with vomiting	Nausea with vomiting

Spasticity

ICD-9 Code	Short Description	Long Description
728.85	Spasm of muscle	Spasm of muscle

Short-term sleep disorders

ICD-9 Code	Short Description	Long Description
307.4	Nonorganic sleep disorder NOS	Nonorganic sleep disorder, unspecified
307.41	Transient insomnia	Transient disorder of initiating or maintaining sleep
307.42	Persistent insomnia	Persistent disorder of initiating or maintaining sleep
307.45	Nonorganic circadian rhythm	Circadian rhythm sleep disorder of nonorganic origin
307.47	Sleep stage dysfunction NEC	Other dysfunctions of sleep stages or arousal from sleep

307.49	Nonorganic sleep dis NEC	Other specific disorders of sleep of nonorganic origin
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Increased appetite and weight gain

ICD-9 Code	Short Description	Long Description
783.1	Abnormal weight gain	Abnormal weight gain
783.6	Polyphagia	Polyphagia

Tourette's syndrome

ICD-9 Code	Short Description	Long Description
307.23	Tourette's disorder	Tourette's disorder

Posttraumatic stress disorder

ICD-9 Code	Short Description	Long Description
309.81	Posttraumatic stress dis	Posttraumatic stress disorder

Non-seminoma-type testicular germ cell cancer

ICD-9 Code	Short Description	Long Description
186.9	Malig neo testis NEC	Malignant neoplasm of other and unspecified testis

Acute myocardial infarction

ICD-9 Code	Short Description	Long Description
410	AMI anterolateral,unspec	Acute myocardial infarction of anterolateral wall, episode of care unspecified
410.01	AMI anterolateral, init	Acute myocardial infarction of anterolateral wall, initial episode of care
410.02	AMI anterolateral,subseq	Acute myocardial infarction of anterolateral wall, subsequent episode of care
410.1	AMI anterior wall,unspec	Acute myocardial infarction of other anterior wall, episode of care unspecified
410.11	AMI anterior wall, init	Acute myocardial infarction of other anterior wall,

		initial episode of care
410.12	AMI anterior wall,subseq	Acute myocardial infarction of other anterior wall, subsequent episode of care
410.2	AMI inferolateral,unspec	Acute myocardial infarction of inferolateral wall, episode of care unspecified
410.21	AMI inferolateral, init	Acute myocardial infarction of inferolateral wall, initial episode of care
410.22	AMI inferolateral,subseq	Acute myocardial infarction of inferolateral wall, subsequent episode of care
410.3	AMI inferopost, unspec	Acute myocardial infarction of inferoposterior wall, episode of care unspecified
410.31	AMI inferopost, initial	Acute myocardial infarction of inferoposterior wall, initial episode of care
410.32	AMI inferopost, subseq	Acute myocardial infarction of inferoposterior wall, subsequent episode of care
410.4	AMI inferior wall,unspec	Acute myocardial infarction of other inferior wall, episode of care unspecified
410.41	AMI inferior wall, init	Acute myocardial infarction of other inferior wall, initial episode of care
410.42	AMI inferior wall,subseq	Acute myocardial infarction of other inferior wall, subsequent episode of care
410.5	AMI lateral NEC, unspec	Acute myocardial infarction of other lateral wall, episode of care unspecified
410.51	AMI lateral NEC, initial	Acute myocardial infarction of other lateral wall, initial episode of care
410.52	AMI lateral NEC, subseq	Acute myocardial infarction of other lateral wall, subsequent episode of care
410.6	True post infarct,unspec	True posterior wall infarction, episode of care unspecified
410.61	True post infarct, init	True posterior wall infarction, initial episode of care
410.62	True post infarct,subseq	True posterior wall infarction, subsequent episode of care
410.7	Subendo infarct, unspec	Subendocardial infarction, episode of care unspecified
410.71	Subendo infarct, initial	Subendocardial infarction, initial episode of care
410.72	Subendo infarct, subseq	Subendocardial infarction, subsequent episode of

		care
410.8	AMI NEC, unspecified	Acute myocardial infarction of other specified sites, episode of care unspecified
410.81	AMI NEC, initial	Acute myocardial infarction of other specified sites, initial episode of care
410.82	AMI NEC, subsequent	Acute myocardial infarction of other specified sites, subsequent episode of care
410.9	AMI NOS, unspecified	Acute myocardial infarction of unspecified site, episode of care unspecified
410.91	AMI NOS, initial	Acute myocardial infarction of unspecified site, initial episode of care
410.92	AMI NOS, subsequent	Acute myocardial infarction of unspecified site, subsequent episode of care

Ischemic stroke

ICD-9 Code	Short Description	Long Description
435.8	Trans cereb ischemia NEC	Other specified transient cerebral ischemias
435.9	Trans cereb ischemia NOS	Unspecified transient cerebral ischemia
433.01	Ocl bsrlr art w infrc	Occlusion and stenosis of basilar artery with cerebral infarction
433.11	Ocl crtd art w infrc	Occlusion and stenosis of carotid artery with cerebral infarction
433.21	Ocl vrtb art w infrc	Occlusion and stenosis of vertebral artery with cerebral infarction
433.31	Ocl mlt bi art w infrc	Occlusion and stenosis of multiple and bilateral precerebral arteries with cerebral infarction
433.81	Ocl spcf art w infrc	Occlusion and stenosis of other specified precerebral artery with cerebral infarction
433.91	Ocl art NOS w infrc	Occlusion and stenosis of unspecified precerebral artery with cerebral infarction
434.91	Crbl art ocl NOS w infrc	Cerebral artery occlusion, unspecified with cerebral infarction

Brain hemorrhage

ICD-9 Code	Short Description	Long Description
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430	Subarachnoid hemorrhage	Subarachnoid hemorrhage
431	Intracerebral hemorrhage	Intracerebral hemorrhage
432	Nontraum extradural hem	Nontraumatic extradural hemorrhage
432.1	Subdural hemorrhage	Subdural hemorrhage
432.9	Intracranial hemorr NOS	Unspecified intracranial hemorrhage

Metabolic syndrome and diabetes

ICD-9 Code	Short Description	Long Description
277.7	Dysmetabolic syndrome x	Dysmetabolic syndrome X
250	DMII wo cmp nt st uncntr	Diabetes mellitus without mention of complication, type II or unspecified type, not stated as uncontrolled
250.02	DMII wo cmp uncntrld	Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled
250.1	DMII keto nt st uncntrld	Diabetes with ketoacidosis, type II or unspecified type, not stated as uncontrolled
250.12	DMII ketoacd uncntrld	Diabetes with ketoacidosis, type II or unspecified type, uncontrolled
250.2	DMII hprsm nt st uncntrl	Diabetes with hyperosmolarity, type II or unspecified type, not stated as uncontrolled
250.22	DMII hprosmldr uncntrld	Diabetes with hyperosmolarity, type II or unspecified type, uncontrolled
250.3	DMII o cm nt st uncntrld	Diabetes with other coma, type II or unspecified type, not stated as uncontrolled
250.32	DMII oth coma uncntrld	Diabetes with other coma, type II or unspecified type, uncontrolled
250.4	DMII renl nt st uncntrld	Diabetes with renal manifestations, type II or unspecified type, not stated as uncontrolled
250.42	DMII renal uncntrld	Diabetes with renal manifestations, type II or unspecified type, uncontrolled
250.5	DMII ophth nt st uncntrl	Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled
250.52	DMII ophth uncntrld	Diabetes with ophthalmic manifestations, type II or unspecified type, uncontrolled

250.6	DMII neuro nt st unctrl	Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled
250.62	DMII neuro unctrl	Diabetes with neurological manifestations, type II or unspecified type, uncontrolled
250.7	DMII circ nt st unctrl	Diabetes with peripheral circulatory disorders, type II or unspecified type, not stated as uncontrolled
250.72	DMII circ unctrl	Diabetes with peripheral circulatory disorders, type II or unspecified type, uncontrolled
250.8	DMII oth nt st unctrl	Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled
250.82	DMII oth unctrl	Diabetes with other specified manifestations, type II or unspecified type, uncontrolled
250.9	DMII unspf nt st unctrl	Diabetes with unspecified complication, type II or unspecified type, not stated as uncontrolled
250.92	DMII unspf unctrl	Diabetes with unspecified complication, type II or unspecified type, uncontrolled

Prediabetes

ICD-9 Code	Short Description	Long Description
790.29	Abnormal glucose NEC	Other abnormal glucose

Bronchitis

ICD-9 Code	Short Description	Long Description
466	Acute bronchitis	Acute bronchitis
490	Bronchitis NOS	Bronchitis, not specified as acute or chronic
491	Simple chr bronchitis	Simple chronic bronchitis
491.1	Mucopurul chr bronchitis	Mucopurulent chronic bronchitis
491.2	Obst chr bronc w/o exac	Obstructive chronic bronchitis without exacerbation
491.21	Obs chr bronc w(ac) exac	Obstructive chronic bronchitis with (acute) exacerbation
491.22	Obs chr bronc w ac bronc	Obstructive chronic bronchitis with acute bronchitis

491.8	Chronic bronchitis NEC	Other chronic bronchitis
491.9	Chronic bronchitis NOS	Unspecified chronic bronchitis

Motor vehicle accidents

ICD-9 Code	Short Description	Long Description
E812.0	Mv collision NOS-driver	Other motor vehicle traffic accident involving collision with motor vehicle injuring driver of motor vehicle other than motorcycle
E812.1	Mv collision NOS-pasngr	Other motor vehicle traffic accident involving collision with motor vehicle injuring passenger in motor vehicle other than motorcycle
E812.2	Mv collis NOS-motorcycl	Other motor vehicle traffic accident involving collision with motor vehicle injuring motorcyclist
E812.3	Mv coll NOS-mcycl psngr	Other motor vehicle traffic accident involving collision with motor vehicle injuring passenger on motorcycle
E812.4	Mv collision NOS-st car	Other motor vehicle traffic accident involving collision with motor vehicle injuring occupant of streetcar
E812.5	Mv coll NOS-anim rid	Other motor vehicle traffic accident involving collision with motor vehicle injuring rider of animal; occupant of animal-drawn vehicle
E812.6	Mv coll NOS-ped cycl	Other motor vehicle traffic accident involving collision with motor vehicle injuring pedal cyclist
E812.7	Mv collision NOS-pedest	Other motor vehicle traffic accident involving collision with motor vehicle injuring pedestrian
E812.8	Mv collis NOS-pers NEC	Other motor vehicle traffic accident involving collision with motor vehicle injuring other specified person
E812.9	Mv collis NOS-pers NOS	Other motor vehicle traffic accident involving collision with motor vehicle injuring unspecified person
E813.0	Mv-oth veh coll-driver	Motor vehicle traffic accident involving collision with other vehicle injuring driver of motor vehicle other than motorcycle
E813.1	Mv-oth veh coll-pasngr	Motor vehicle traffic accident involving collision with other vehicle injuring passenger in motor vehicle other than motorcycle
E813.2	Mv-oth veh coll-motcycl	Motor vehicle traffic accident involving collision

		with other vehicle injuring motorcyclist
E813.3	Mv-oth veh coll-mcyc psg	Motor vehicle traffic accident involving collision with other vehicle injuring passenger on motorcycle
E813.4	Mv-oth veh coll-st car	Motor vehicle traffic accident involving collision with other vehicle injuring occupant of streetcar
E813.5	Mv-oth veh coll-anim rid	Motor vehicle traffic accident involving collision with other vehicle injuring rider of animal; occupant of animal-drawn vehicle
E813.6	Mv-oth veh coll-ped cycl	Motor vehicle traffic accident involving collision with other vehicle injuring pedal cyclist
E813.7	Mv-oth veh coll-pedest	Motor vehicle traffic accident involving collision with other vehicle injuring pedestrian
E813.8	Mv-oth veh coll-pers NEC	Motor vehicle traffic accident involving collision with other vehicle injuring other specified person
E813.9	Mv-oth veh coll-pers NOS	Motor vehicle traffic accident involving collision with other vehicle injuring unspecified person
E814.0	Mv coll w pedest-driver	Motor vehicle traffic accident involving collision with pedestrian injuring driver of motor vehicle other than motorcycle
E814.1	Mv coll w pedest-pasngr	Motor vehicle traffic accident involving collision with pedestrian injuring passenger in motor vehicle other than motorcycle
E814.2	Mv coll w pedest-motcycl	Motor vehicle traffic accident involving collision with pedestrian injuring motorcyclist
E814.3	Mv coll w ped-mcycl psg	Motor vehicle traffic accident involving collision with pedestrian injuring passenger on motorcycle
E814.4	Mv coll w pedest-st car	Motor vehicle traffic accident involving collision with pedestrian injuring occupant of streetcar
E814.5	Mv coll w ped-anim rid	Motor vehicle traffic accident involving collision with pedestrian injuring rider of animal; occupant of animal drawn vehicle
E814.6	Mv coll w ped-ped cycl	Motor vehicle traffic accident involving collision with pedestrian injuring pedal cyclist
E814.7	Mv coll w pedest-pedest	Motor vehicle traffic accident involving collision with pedestrian injuring pedestrian
E814.8	Mv coll w pedes-pers NEC	Motor vehicle traffic accident involving collision with pedestrian injuring other specified person

E814.9	Mv coll w pedes-pers NOS	Motor vehicle traffic accident involving collision with pedestrian injuring unspecified person
E815.0	Mv coll w oth obj-driver	Other motor vehicle traffic accident involving collision on the highway injuring driver of motor vehicle other than motorcycle
E815.1	Mv coll w oth obj-pasngr	Other motor vehicle traffic accident involving collision on the highway injuring passenger in motor vehicle other than motorcycle
E815.2	Mv coll w oth obj-mocycl	Other motor vehicle traffic accident involving collision on the highway injuring motorcyclist
E815.3	Mv coll w obj-mcycl psgr	Other motor vehicle traffic accident involving collision on the highway injuring passenger on motorcycle
E815.4	Mv coll w obj-st car	Other motor vehicle traffic accident involving collision on the highway injuring occupant of streetcar
E815.5	Mv coll w obj-anim rider	Other motor vehicle traffic accident involving collision on the highway injuring rider of animal; occupant of animal-drawn vehicle
E815.6	Mv coll w obj-ped cycl	Other motor vehicle traffic accident involving collision on the highway injuring pedal cyclist
E815.7	Mv coll w obj-pedest	Other motor vehicle traffic accident involving collision on the highway injuring pedestrian
E815.8	Mv coll w obj-pers NEC	Other motor vehicle traffic accident involving collision on the highway injuring other specified person
E815.9	Mv coll w obj-pers NOS	Other motor vehicle traffic accident involving collision on the highway injuring unspecified person
E816.0	Loss control mv acc-driv	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring driver of motor vehicle other than motorcycle
E816.1	Loss control mv acc-psgr	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring passenger in motor vehicle other than motorcycle
E816.2	Loss control mv-mocycl	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring motorcyclist
E816.3	Loss control mv-mcyc psg	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring passenger on motorcycle

E816.4	Loss cont mv acc-st car	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring occupant of streetcar
E816.5	Loss cont mv-anim rider	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring rider of animal; occupant of animal-drawn vehicle
E816.6	Loss control mv-ped cycl	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring pedal cyclist
E816.7	Loss control mv-pedest	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring pedestrian
E816.8	Loss control mv-pers NEC	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring other specified person
E816.9	Loss control mv-pers NOS	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring unspecified person
E819.0	Traffic acc NOS-driver	Motor vehicle traffic accident of unspecified nature injuring driver of motor vehicle other than motorcycle
E819.1	Traffic acc NOS-pasngr	Motor vehicle traffic accident of unspecified nature injuring passenger in motor vehicle other than motorcycle
E819.2	Traffic acc NOS-motcycl	Motor vehicle traffic accident of unspecified nature injuring motorcyclist
E819.3	Traff acc NOS-mcycl psgr	Motor vehicle traffic accident of unspecified nature injuring passenger on motorcycle
E819.4	Traffic acc NOS-st car	Motor vehicle traffic accident of unspecified nature injuring occupant of streetcar
E819.5	Traff acc NOS-anim rider	Motor vehicle traffic accident of unspecified nature injuring rider of animal; occupant of animal-drawn vehicle
E819.6	Traffic acc NOS-ped cycl	Motor vehicle traffic accident of unspecified nature injuring pedal cyclist
E819.7	Traffic acc NOS-pedest	Motor vehicle traffic accident of unspecified nature injuring pedestrian
E819.8	Traffic acc NOS-pers NEC	Motor vehicle traffic accident of unspecified nature injuring other specified person
E819.9	Traffic acc NOS-pers NOS	Motor vehicle traffic accident of unspecified nature injuring unspecified person

Overdose injuries

ICD-9 Code	Short Description	Long Description
E950.0	Poison-analgesics	Suicide and self-inflicted poisoning by analgesics, antipyretics, and antirheumatics
E950.1	Poison-barbiturates	Suicide and self-inflicted poisoning by barbiturates
E950.2	Poison-sedat/hypnotic	Suicide and self-inflicted poisoning by other sedatives and hypnotics
E950.3	Poison-psychotropic agt	Suicide and self-inflicted poisoning by tranquilizers and other psychotropic agents
E950.4	Poison-drug/medicin NEC	Suicide and self-inflicted poisoning by other specified drugs and medicinal substances
E950.5	Poison-drug/medicin NOS	Suicide and self-inflicted poisoning by unspecified drug or medicinal substance

Assault-based gunshot injuries

ICD-9 Code	Short Description	Long Description
E965.0	Assault-handgun	Assault by handgun
E965.1	Assault-shotgun	Assault by shotgun
E965.2	Assault-hunting rifle	Assault by hunting rifle
E965.3	Assault-military weapon	Assault by military firearms
E965.4	Assault-firearm NEC	Assault by other and unspecified firearm

Low offspring birthweight

ICD-9 Code	Short Description	Long Description
764.9	Fet growth retard wtNOS	Fetal growth retardation, unspecified, unspecified [weight]
764.91	Fet growth retard <500g	Fetal growth retardation, unspecified, less than 500 grams
764.92	Fet growth ret 500-749g	Fetal growth retardation, unspecified, 500-749 grams
764.93	Fet growth ret 750-999g	Fetal growth retardation, unspecified, 750-999 grams

764.94	Fet grwth ret 1000-1249g	Fetal growth retardation, unspecified, 1,000-1,249 grams
764.95	Fet grwth ret 1250-1499g	Fetal growth retardation, unspecified, 1,250-1,499 grams
764.96	Fet grwth ret 1500-1749g	Fetal growth retardation, unspecified, 1,500-1,749 grams
764.97	Fet grwth ret 1750-1999g	Fetal growth retardation, unspecified, 1,750-1,999 grams
764.98	Fet grwth ret 2000-2499g	Fetal growth retardation, unspecified, 2,000-2,499 grams
764.99	Fet growth ret 2500+g	Fetal growth retardation, unspecified, 2,500 grams and over

Maternal pregnancy complications

ICD-9 Code	Short Description	Long Description
640.8	Hem early preg NEC-unsp	Other specified hemorrhage in early pregnancy, unspecified as to episode of care or not applicable
640.81	Hem early preg NEC-deliv	Other specified hemorrhage in early pregnancy, delivered, with or without mention of antepartum condition
640.83	Hem early pg NEC-anteper	Other specified hemorrhage in early pregnancy, antepartum condition or complication
640.9	Hemorr early preg-unspec	Unspecified hemorrhage in early pregnancy, unspecified as to episode of care or not applicable
640.91	Hem early preg-delivered	Unspecified hemorrhage in early pregnancy, delivered, with or without mention of antepartum condition
640.93	Hem early preg-anteper	Unspecified hemorrhage in early pregnancy, antepartum condition or complication
641	Placenta previa-unspec	Placenta previa without hemorrhage, unspecified as to episode of care or not applicable
641.01	Placenta previa-deliver	Placenta previa without hemorrhage, delivered, with or without mention of antepartum condition
641.03	Placenta previa-anteper	Placenta previa without hemorrhage, antepartum condition or complication
641.1	Placenta prev hem-unspec	Hemorrhage from placenta previa, unspecified as to episode of care or not applicable

641.11	Placenta prev hem-deliv	Hemorrhage from placenta previa, delivered, with or without mention of antepartum condition
641.13	Placen prev hem-antepart	Hemorrhage from placenta previa, antepartum condition or complication
641.2	Prem separ placen-unspec	Premature separation of placenta, unspecified as to episode of care or not applicable
641.21	Prem separ placen-deliv	Premature separation of placenta, delivered, with or without mention of antepartum condition
641.23	Prem separ plac-antepart	Premature separation of placenta, antepartum condition or complication
642	Essen hyperten preg-unsp	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, unspecified as to episode of care or not applicable
642.01	Essen hyperten-delivered	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, delivered, with or without mention of antepartum condition
642.02	Essen hyperten-del w p/p	Benign essential hypertension, complicating pregnancy, childbirth, and the puerperium, delivered, with mention of postpartum complication
642.03	Essen hyperten-antepart	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, antepartum condition or complication
642.04	Essen hyperten-postpart	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, postpartum condition or complication
642.3	Trans hyperten preg-unsp	Transient hypertension of pregnancy, unspecified as to episode of care or not applicable
642.31	Trans hyperten-delivered	Transient hypertension of pregnancy, delivered, with or without mention of antepartum condition
642.32	Trans hyperten-del w p/p	Transient hypertension of pregnancy, delivered, with mention of postpartum complication
642.33	Trans hyperten-antepart	Transient hypertension of pregnancy, antepartum condition or complication
642.34	Trans hyperten-postpart	Transient hypertension of pregnancy, postpartum condition or complication
642.4	Mild/NOS preeclamp-unsp	Mild or unspecified pre-eclampsia, unspecified as to episode of care or not applicable

642.41	Mild/NOS preeclamp-deliv	Mild or unspecified pre-eclampsia, delivered, with or without mention of antepartum condition
642.42	Mild preeclamp-del w p/p	Mild or unspecified pre-eclampsia, delivered, with mention of postpartum complication
642.43	Mild/NOS preeclamp-antep	Mild or unspecified pre-eclampsia, antepartum condition or complication
642.44	Mild/NOS preeclamp-p/p	Mild or unspecified pre-eclampsia, postpartum condition or complication
642.5	Severe preeclamp-unspec	Severe pre-eclampsia, unspecified as to episode of care or not applicable
642.51	Severe preeclamp-deliver	Severe pre-eclampsia, delivered, with or without mention of antepartum condition
642.52	Sev preeclamp-del w p/p	Severe pre-eclampsia, delivered, with mention of postpartum complication
642.53	Sev preeclamp-antepartum	Severe pre-eclampsia, antepartum condition or complication
642.54	Sev preeclamp-postpartum	Severe pre-eclampsia, postpartum condition or complication
642.6	Eclampsia-unspecified	Eclampsia, unspecified as to episode of care or not applicable
642.61	Eclampsia-delivered	Eclampsia, delivered, with or without mention of antepartum condition
642.62	Eclampsia-deliv w p/p	Eclampsia, delivered, with mention of postpartum complication
642.63	Eclampsia-antepartum	Eclampsia, antepartum condition or complication
642.64	Eclampsia-postpartum	Eclampsia, postpartum condition or complication
642.7	Tox w old hyperten-unsp	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, unspecified as to episode of care or not applicable
642.71	Tox w old hyperten-deliv	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with or without mention of antepartum condition
642.72	Tox w old hyp-del w p/p	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with mention of postpartum complication
642.73	Tox w old hyper-antepart	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, antepartum condition or complication

642.74	Tox w old hyper-postpart	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, postpartum condition or complication
642.9	Hyperten preg NOS-unspec	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, unspecified as to episode of care or not applicable
642.91	Hypertens NOS-delivered	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, delivered, with or without mention of antepartum condition
642.92	Hypertens NOS-del w p/p	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, delivered, with mention of postpartum complication
642.93	Hypertens NOS-antepartum	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, antepartum condition or complication
642.94	Hypertens NOS-postpartum	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, postpartum condition or complication
646.8	Preg compl NEC-unspec	Other specified complications of pregnancy, unspecified as to episode of care or not applicable
646.81	Preg compl NEC-delivered	Other specified complications of pregnancy, delivered, with or without mention of antepartum condition
646.82	Preg compl NEC-del w p/p	Other specified complications of pregnancy, delivered, with mention of postpartum complication
646.83	Preg compl NEC-antepart	Other specified complications of pregnancy, antepartum condition or complication
646.84	Preg compl NEC-postpart	Other specified complications of pregnancy, postpartum condition or complication
646.9	Preg compl NOS-unspec	Unspecified complication of pregnancy, unspecified as to episode of care or not applicable

Unemployment or low income

ICD-9 Code	Short Description	Long Description
V62.0	Unemployment	Unemployment

Schizophrenia or other psychoses

ICD-9 Code	Short Description	Long Description
295	Simpl schizophren-unspec	Simple type schizophrenia, unspecified
295.01	Simpl schizophren-subchr	Simple type schizophrenia, subchronic
295.02	Simple schizophren-chr	Simple type schizophrenia, chronic
295.03	Simp schizo-subchr/exacer	Simple type schizophrenia, subchronic with acute exacerbation
295.04	Simpl schizo-chr/exacerb	Simple type schizophrenia, chronic with acute exacerbation
295.05	Simpl schizophren-remiss	Simple type schizophrenia, in remission
295.1	Hebephrenia-unspec	Disorganized type schizophrenia, unspecified
295.11	Hebephrenia-subchronic	Disorganized type schizophrenia, subchronic
295.12	Hebephrenia-chronic	Disorganized type schizophrenia, chronic
295.13	Hebephren-subchr/exacerb	Disorganized type schizophrenia, subchronic with acute exacerbation
295.14	Hebephrenia-chr/exacerb	Disorganized type schizophrenia, chronic with acute exacerbation
295.15	Hebephrenia-remission	Disorganized type schizophrenia, in remission
295.2	Catatonia-unspec	Catatonic type schizophrenia, unspecified
295.21	Catatonia-subchronic	Catatonic type schizophrenia, subchronic
295.22	Catatonia-chronic	Catatonic type schizophrenia, chronic
295.23	Catatonia-subchr/exacerb	Catatonic type schizophrenia, subchronic with acute exacerbation
295.24	Catatonia-chr/exacerb	Catatonic type schizophrenia, chronic with acute exacerbation
295.25	Catatonia-remission	Catatonic type schizophrenia, in remission
295.3	Paranoid schizo-unspec	Paranoid type schizophrenia, unspecified
295.31	Paranoid schizo-subchr	Paranoid type schizophrenia, subchronic
295.32	Paranoid schizo-chronic	Paranoid type schizophrenia, chronic
295.33	Paran schizo-subchr/exac	Paranoid type schizophrenia, subchronic with acute exacerbation

295.34	Paran schizo-chr/exacerb	Paranoid type schizophrenia, chronic with acute exacerbation
295.35	Paranoid schizo-remiss	Paranoid type schizophrenia, in remission
295.4	Schizophreniform dis NOS	Schizophreniform disorder, unspecified
295.41	Schizophrenic dis-subchr	Schizophreniform disorder, subchronic
295.42	Schizophren dis-chronic	Schizophreniform disorder, chronic
295.43	Schizo dis-subchr/exacer	Schizophreniform disorder, subchronic with acute exacerbation
295.44	Schizophr dis-chr/exacer	Schizophreniform disorder, chronic with acute exacerbation
295.45	Schizophrenic dis-remiss	Schizophreniform disorder, in remission
295.5	Latent schizophr-unsp	Latent schizophrenia, unspecified
295.51	Lat schizophr-subchr	Latent schizophrenia, subchronic
295.52	Latent schizophr-chr	Latent schizophrenia, chronic
295.53	Lat schizo-subchr/exacer	Latent schizophrenia, subchronic with acute exacerbation
295.54	Latent schizo-chr/exacer	Latent schizophrenia, chronic with acute exacerbation
295.55	Lat schizophr-remiss	Latent schizophrenia, in remission
295.6	Schizophr dis resid NOS	Schizophrenic disorders, residual type, unspecified
295.61	Schizoph dis resid-subch	Schizophrenic disorders, residual type, subchronic
295.62	Schizophr dis resid-chr	Schizophrenic disorders, residual type, chronic
295.63	Schizo resid subchr/exac	Schizophrenic disorders, residual type, subchronic with acute exacerbation
295.64	Schizoph resid-chro/exac	Schizophrenic disorders, residual type, chronic with acute exacerbation
295.65	Schizoph dis resid-remis	Schizophrenic disorders, residual type, in remission
296.2	Depress psychosis-unspec	Major depressive affective disorder, single episode, unspecified
296.21	Depress psychosis-mild	Major depressive affective disorder, single episode, mild

296.22	Depressive psychosis-mod	Major depressive affective disorder, single episode, moderate
296.23	Depress psychosis-severe	Major depressive affective disorder, single episode, severe, without mention of psychotic behavior
296.24	Depr psychos-sev w psych	Major depressive affective disorder, single episode, severe, specified as with psychotic behavior
296.25	Depr psychos-part remiss	Major depressive affective disorder, single episode, in partial or unspecified remission
296.26	Depr psychos-full remiss	Major depressive affective disorder, single episode, in full remission
296.3	Recurr depr psychos-unsp	Major depressive affective disorder, recurrent episode, unspecified
296.31	Recurr depr psychos-mild	Major depressive affective disorder, recurrent episode, mild
296.32	Recurr depr psychos-mod	Major depressive affective disorder, recurrent episode, moderate
296.33	Recur depr psych-severe	Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior
296.34	Rec depr psych-psychotic	Major depressive affective disorder, recurrent episode, severe, specified as with psychotic behavior
296.35	Recur depr psyc-part rem	Major depressive affective disorder, recurrent episode, in partial or unspecified remission
296.36	Recur depr psyc-full rem	Major depressive affective disorder, recurrent episode, in full remission
298	React depress psychosis	Depressive type psychosis
298.1	Excitativ type psychosis	Excitative type psychosis
298.4	Psychogen paranoid psych	Psychogenic paranoid psychosis
298.8	React psychosis NEC/NOS	Other and unspecified reactive psychosis
298.9	Psychosis NOS	Unspecified psychosis

Depressive disorders

ICD-9 Code	Short Description	Long Description
296.82	Atypical depressive dis	Atypical depressive disorder

311	Depressive disorder NEC	Depressive disorder, not elsewhere classified
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Suicide

ICD-9 Code	Short Description	Long Description
E950.6	Poison-agricult agent	Suicide and self-inflicted poisoning by agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E950.7	Poison-corrosiv/caustic	Suicide and self-inflicted poisoning by corrosive and caustic substances
E950.8	Poison-arsenic	Suicide and self-inflicted poisoning by arsenic and its compounds
E950.9	Poison-solid/liquid NEC	Suicide and self-inflicted poisoning by other and unspecified solid and liquid substances
E951.0	Poison-piped gas	Suicide and self-inflicted poisoning by gas distributed by pipeline
E951.1	Poison-gas in container	Suicide and self-inflicted poisoning by liquefied petroleum gas distributed in mobile containers
E951.8	Poison-utility gas NEC	Suicide and self-inflicted poisoning by other utility gas
E952.0	Poison-exhaust gas	Suicide and self-inflicted poisoning by motor vehicle exhaust gas
E952.1	Poison-co NEC	Suicide and self-inflicted poisoning by other carbon monoxide
E952.8	Poison-gas/vapor NEC	Suicide and self-inflicted poisoning by other specified gases and vapors
E952.9	Poison-gas/vapor NOS	Suicide and self-inflicted poisoning by unspecified gases and vapors
E953.0	Injury-hanging	Suicide and self-inflicted injury by hanging
E953.1	Injury-suff w plas bag	Suicide and self-inflicted injury by suffocation by plastic bag
E953.8	Injury-strang/suff NEC	Suicide and self-inflicted injury by other specified means
E953.9	Injury-strang/suff NOS	Suicide and self-inflicted injury by unspecified means
E954.	Injury-submersion	Suicide and self-inflicted injury by submersion [drowning]

E955.0	Injury-handgun	Suicide and self-inflicted injury by handgun
E955.1	Injury-shotgun	Suicide and self-inflicted injury by shotgun
E955.2	Injury-hunting rifle	Suicide and self-inflicted injury by hunting rifle
E955.3	Injury-military firearm	Suicide and self-inflicted injury by military firearms
E955.4	Injury-firearm NEC	Suicide and self-inflicted injury by other and unspecified firearm
E955.5	Injury-explosives	Suicide and self-inflicted injury by explosives
E955.6	Self inflict acc-air gun	Suicide and self-inflicted injury by air gun
E955.7	Self inj-paintball gun	Suicide and self-inflicted injury by paintball gun
E955.9	Injury-firearm/expl NOS	Suicide and self-inflicted injury by firearms and explosives, unspecified
E956.	Injury-cut instrument	Suicide and self-inflicted injury by cutting and piercing instrument
E957.0	Injury-jump fm residence	Suicide and self-inflicted injuries by jumping from residential premises
E957.1	Injury-jump fm struc NEC	Suicide and self-inflicted injuries by jumping from other man-made structures
E957.2	Injury-jump fm natur sit	Suicide and self-inflicted injuries by jumping from natural sites
E957.9	Injury-jump NEC	Suicide and self-inflicted injuries by jumping from unspecified site
E958.0	Injury-moving object	Suicide and self-inflicted injury by jumping or lying before moving object
E958.1	Injury-burn, fire	Suicide and self-inflicted injury by burns, fire
E958.2	Injury-scald	Suicide and self-inflicted injury by scald
E958.3	Injury-extreme cold	Suicide and self-inflicted injury by extremes of cold
E958.4	Injury-electrocution	Suicide and self-inflicted injury by electrocution
E958.5	Injury-motor veh crash	Suicide and self-inflicted injury by crashing of motor vehicle
E958.6	Injury-aircraft crash	Suicide and self-inflicted injury by crashing of aircraft
E958.7	Injury-caustic substance	Suicide and self-inflicted injury by caustic substances, except poisoning

E958.8	Injury-NEC	Suicide and self-inflicted injury by other specified means
E958.9	Injury-NOS	Suicide and self-inflicted injury by unspecified means

Social anxiety disorder

ICD-9 Code	Short Description	Long Description
300.23	Social phobia	Social phobia

Anxiety disorders

ICD-9 Code	Short Description	Long Description
293.84	Anxiety disorder oth dis	Anxiety disorder in conditions classified elsewhere
300	Anxiety state NOS	Anxiety state, unspecified

Anxiety disorders (except social anxiety)

ICD-9 Code	Short Description	Long Description
300.01	Panic dis w/o agoraphobia	Panic disorder without agoraphobia
300.02	Generalized anxiety dis	Generalized anxiety disorder
300.09	Anxiety state NEC	Other anxiety states
300.1	Hysteria NOS	Hysteria, unspecified
300.11	Conversion disorder	Conversion disorder
300.12	Dissociative amnesia	Dissociative amnesia
300.13	Dissociative fugue	Dissociative fugue
300.14	Dissociative identity dis	Dissociative identity disorder
300.15	Dissociative react NOS	Dissociative disorder or reaction, unspecified
300.16	Factitious dis w symptom	Factitious disorder with predominantly psychological signs and symptoms
300.19	Factitious ill NEC/NOS	Other and unspecified factitious illness
300.2	Phobia NOS	Phobia, unspecified
300.21	Agoraphobia w panic dis	Agoraphobia with panic disorder

300.22	Agoraphobia w/o panic	Agoraphobia without mention of panic attacks
300.29	Isolated/spec phobia NEC	Other isolated or specific phobias
300.3	Obsessive-compulsive dis	Obsessive-compulsive disorders
300.4	Dysthymic disorder	Dysthymic disorder
300.5	Neurasthenia	Neurasthenia
300.6	Depersonalization disord	Depersonalization disorder
300.7	Hypochondriasis	Hypochondriasis
300.81	Somatization disorder	Somatization disorder
300.82	Undiff somatoform disrd	Undifferentiated somatoform disorder
300.89	Somatoform disorders NEC	Other somatoform disorders
300.9	Nonpsychotic disord NOS	Unspecified nonpsychotic mental disorder

Positive symptoms of schizophrenia (i.e., hallucinations)

ICD-9 Code	Short Description	Long Description
780.1	Hallucinations	
293.81	Psy dis w delus oth dis	Psychotic disorder with delusions in conditions classified elsewhere
333.99	Extrapyramidal dis NEC	Other extrapyramidal diseases and abnormal movement disorders

Bipolar disorders

ICD-9 Code	Short Description	Long Description
296.5	Bipol I cur depres NOS	Bipolar I disorder, most recent episode (or current) depressed, unspecified
296.51	Bipol I cur depress-mild	Bipolar I disorder, most recent episode (or current) depressed, mild
296.52	Bipol I cur depress-mod	Bipolar I disorder, most recent episode (or current) depressed, moderate
296.53	Bipol I curr dep w/o psy	Bipolar I disorder, most recent episode (or current) depressed, severe, without mention of psychotic behavior
296.54	Bipol I currnt dep w psy	Bipolar I disorder, most recent episode (or current) depressed, severe, specified as with

		psychotic behavior
296.55	Bipol I cur dep rem NOS	Bipolar I disorder, most recent episode (or current) depressed, in partial or unspecified remission
296.56	Bipol I currnt dep remis	Bipolar I disorder, most recent episode (or current) depressed, in full remission
296.6	Bipol I currnt mixed NOS	Bipolar I disorder, most recent episode (or current) mixed, unspecified
296.61	Bipol I currnt mix-mild	Bipolar I disorder, most recent episode (or current) mixed, mild
296.62	Bipol I currnt mixed-mod	Bipolar I disorder, most recent episode (or current) mixed, moderate
296.63	Bipol I cur mix w/o psy	Bipolar I disorder, most recent episode (or current) mixed, severe, without mention of psychotic behavior
296.64	Bipol I cur mixed w psy	Bipolar I disorder, most recent episode (or current) mixed, severe, specified as with psychotic behavior
296.65	Bipol I cur mix-part rem	Bipolar I disorder, most recent episode (or current) mixed, in partial or unspecified remission
296.66	Bipol I cur mixed remiss	Bipolar I disorder, most recent episode (or current) mixed, in full remission
296.7	Bipolor I current NOS	Bipolar I disorder, most recent episode (or current) unspecified
296.8	Bipolar disorder NOS	Bipolar disorder, unspecified
296	Bipol I single manic NOS	Bipolar I disorder, single manic episode, unspecified
296.01	Bipol I single manic-mild	Bipolar I disorder, single manic episode, mild
296.02	Bipol I single manic-mod	Bipolar I disorder, single manic episode, moderate
296.03	Bipol I sing-sev w/o psy	Bipolar I disorder, single manic episode, severe, without mention of psychotic behavior
296.04	Bipo I sin man-sev w psy	Bipolar I disorder, single manic episode, severe, specified as with psychotic behavior
296.05	Bipol I sing man rem NOS	Bipolar I disorder, single manic episode, in partial or unspecified remission

296.06	Bipol I single manic rem	Bipolar I disorder, single manic episode, in full remission
296.4	Bipol I currnt manic NOS	Bipolar I disorder, most recent episode (or current) manic, unspecified
296.41	Bipol I currnt manic-mild	Bipolar I disorder, most recent episode (or current) manic, mild
296.42	Bipol I currnt manic-mod	Bipolar I disorder, most recent episode (or current) manic, moderate
296.43	Bipol I manic-sev w/o psy	Bipolar I disorder, most recent episode (or current) manic, severe, without mention of psychotic behavior
296.44	Bipol I manic-sev w psy	Bipolar I disorder, most recent episode (or current) manic, severe, specified as with psychotic behavior
296.45	Bipol I cur man part rem	Bipolar I disorder, most recent episode (or current) manic, in partial or unspecified remission
296.46	Bipol I cur man full rem	Bipolar I disorder, most recent episode (or current) manic, in full remission

Substance dependence or abuse of alcohol, tobacco, and other illicit drugs

ICD-9 Code	Short Description	Long Description
303.9	Alcoh dep NEC/NOS-unspec	Other and unspecified alcohol dependence, unspecified
303.91	Alcoh dep NEC/NOS-contin	Other and unspecified alcohol dependence, continuous
303.92	Alcoh dep NEC/NOS-episod	Other and unspecified alcohol dependence, episodic
303.93	Alcoh dep NEC/NOS-remiss	Other and unspecified alcohol dependence, in remission
304	Opioid dependence-unspec	Opioid type dependence, unspecified
304.01	Opioid dependence-contin	Opioid type dependence, continuous
304.02	Opioid dependence-episod	Opioid type dependence, episodic
304.03	Opioid dependence-remiss	Opioid type dependence, in remission
304.1	Sed,hyp,anxiolyt dep-NOS	Sedative, hypnotic or anxiolytic dependence, unspecified
304.11	Sed,hyp,anxiolyt dep-con	Sedative, hypnotic or anxiolytic dependence, continuous

304.12	Sed,hyp,anxiolyt dep-epi	Sedative, hypnotic or anxiolytic dependence, episodic
304.13	Sed,hyp,anxiolyt dep-rem	Sedative, hypnotic or anxiolytic dependence, in remission
304.2	Cocaine depend-unspec	Cocaine dependence, unspecified
304.21	Cocaine depend-contin	Cocaine dependence, continuous
304.22	Cocaine depend-episodic	Cocaine dependence, episodic
304.23	Cocaine depend-remiss	Cocaine dependence, in remission
304.3	Cannabis depend-unspec	Cannabis dependence, unspecified
304.31	Cannabis depend-contin	Cannabis dependence, continuous
304.32	Cannabis depend-episodic	Cannabis dependence, episodic
304.33	Cannabis depend-remiss	Cannabis dependence, in remission
304.4	Amphetamin depend-unspec	Amphetamine and other psychostimulant dependence, unspecified
304.41	Amphetamin depend-contin	Amphetamine and other psychostimulant dependence, continuous
304.42	Amphetamin depend-episod	Amphetamine and other psychostimulant dependence, episodic
304.43	Amphetamin depend-remiss	Amphetamine and other psychostimulant dependence, in remission
304.5	Hallucinogen dep-unspec	Hallucinogen dependence, unspecified
304.51	Hallucinogen dep-contin	Hallucinogen dependence, continuous
304.52	Hallucinogen dep-episod	Hallucinogen dependence, episodic
304.53	Hallucinogen dep-remiss	Hallucinogen dependence, in remission
304.6	Drug depend NEC-unspec	Other specified drug dependence, unspecified
304.61	Drug depend NEC-contin	Other specified drug dependence, continuous
304.62	Drug depend NEC-episodic	Other specified drug dependence, episodic
304.63	Drug depend NEC-in rem	Other specified drug dependence, in remission
304.7	Opioid/other dep-unspec	Combinations of opioid type drug with any other drug dependence, unspecified
304.71	Opioid/other dep-contin	Combinations of opioid type drug with any other drug dependence, continuous
304.72	Opioid/other dep-episod	Combinations of opioid type drug with any other

		drug dependence, episodic
304.73	Opioid/other dep-remiss	Combinations of opioid type drug with any other drug dependence, in remission
304.8	Comb drug dep NEC-unspec	Combinations of drug dependence excluding opioid type drug, unspecified
304.81	Comb drug dep NEC-contin	Combinations of drug dependence excluding opioid type drug, continuous
304.82	Comb drug dep NEC-episod	Combinations of drug dependence excluding opioid type drug, episodic
304.83	Comb drug dep NEC-remiss	Combinations of drug dependence excluding opioid type drug, in remission
304.9	Drug depend NOS-unspec	Unspecified drug dependence, unspecified
304.91	Drug depend NOS-contin	Unspecified drug dependence, continuous
304.92	Drug depend NOS-episodic	Unspecified drug dependence, episodic
304.93	Drug depend NOS-remiss	Unspecified drug dependence, in remission
305	Alcohol abuse-unspec	Alcohol abuse, unspecified
305.01	Alcohol abuse-continuous	Alcohol abuse, continuous
305.02	Alcohol abuse-episodic	Alcohol abuse, episodic
305.03	Alcohol abuse-in remiss	Alcohol abuse, in remission
305.3	Hallucinog abuse-unspec	Hallucinogen abuse, unspecified
305.31	Hallucinog abuse-contin	Hallucinogen abuse, continuous
305.32	Hallucinog abuse-episod	Hallucinogen abuse, episodic
305.33	Hallucinog abuse-remiss	Hallucinogen abuse, in remission
305.4	Sed,hyp,anxiolytc ab-NOS	Sedative, hypnotic or anxiolytic abuse, unspecified
305.41	Sed,hyp,anxiolytc ab-con	Sedative, hypnotic or anxiolytic abuse, continuous
305.42	Sed,hyp,anxiolytc ab-epi	Sedative, hypnotic or anxiolytic abuse, episodic
305.43	Sed,hyp,anxiolytc ab-rem	Sedative, hypnotic or anxiolytic abuse, in remission
305.5	Opioid abuse-unspec	Opioid abuse, unspecified
305.51	Opioid abuse-continuous	Opioid abuse, continuous
305.52	Opioid abuse-episodic	Opioid abuse, episodic

305.53	Opioid abuse-in remiss	Opioid abuse, in remission
305.6	Cocaine abuse-unspec	Cocaine abuse, unspecified
305.61	Cocaine abuse-continuous	Cocaine abuse, continuous
305.62	Cocaine abuse-episodic	Cocaine abuse, episodic
305.63	Cocaine abuse-in remiss	Cocaine abuse, in remission
305.7	Amphetamine abuse-unspec	Amphetamine or related acting sympathomimetic abuse, unspecified
305.71	Amphetamine abuse-contin	Amphetamine or related acting sympathomimetic abuse, continuous
305.72	Amphetamine abuse-episod	Amphetamine or related acting sympathomimetic abuse, episodic
305.73	Amphetamine abuse-remiss	Amphetamine or related acting sympathomimetic abuse, in remission
305.8	Antidepress abuse-unspec	Antidepressant type abuse, unspecified
305.81	Antidepress abuse-contin	Antidepressant type abuse, continuous
305.82	Antidepress abuse-episod	Antidepressant type abuse, episodic
305.83	Antidepress abuse-remiss	Antidepressant type abuse, in remission

Cannabis abuse

ICD-9 Code	Short Description	Long Description
305.2	Cannabis abuse-unspec	Cannabis abuse, unspecified
305.21	Cannabis abuse-contin	Cannabis abuse, continuous
305.22	Cannabis abuse-episodic	Cannabis abuse, episodic
305.23	Cannabis abuse-in remiss	Cannabis abuse, in remission

Tobacco use

ICD-9 Code	Short Description	Long Description
305.1	Tobacco use disorder	Tobacco use disorder

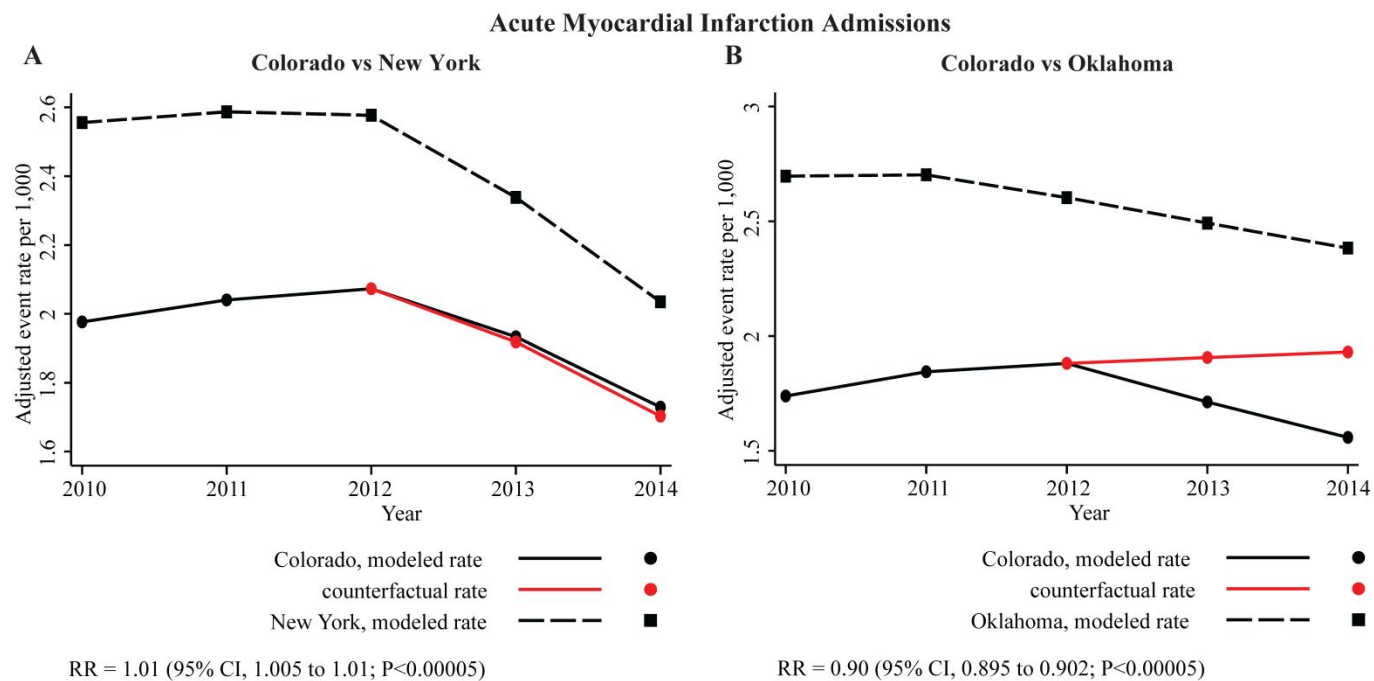
Alcohol abuse

ICD-9 Code	Short Description	Long Description
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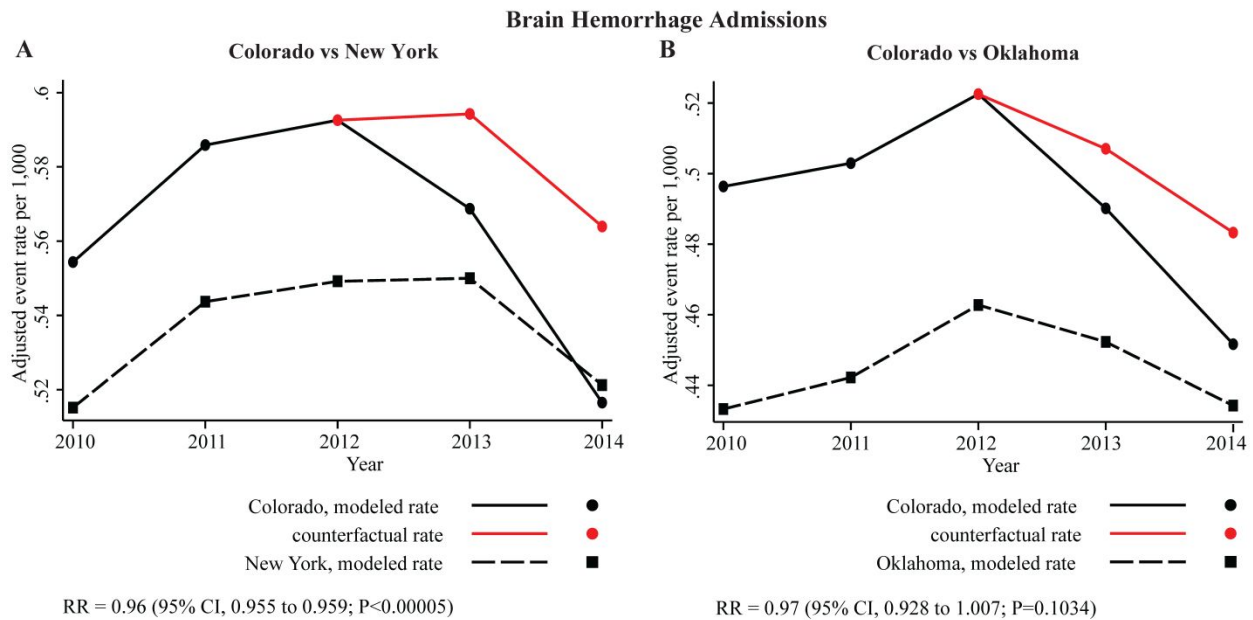
303.9	Alcoh dep NEC/NOS-unspec	Other and unspecified alcohol dependence, unspecified
303.91	Alcoh dep NEC/NOS-contin	Other and unspecified alcohol dependence, continuous
303.92	Alcoh dep NEC/NOS-episod	Other and unspecified alcohol dependence, episodic
303.93	Alcoh dep NEC/NOS-remiss	Other and unspecified alcohol dependence, in remission

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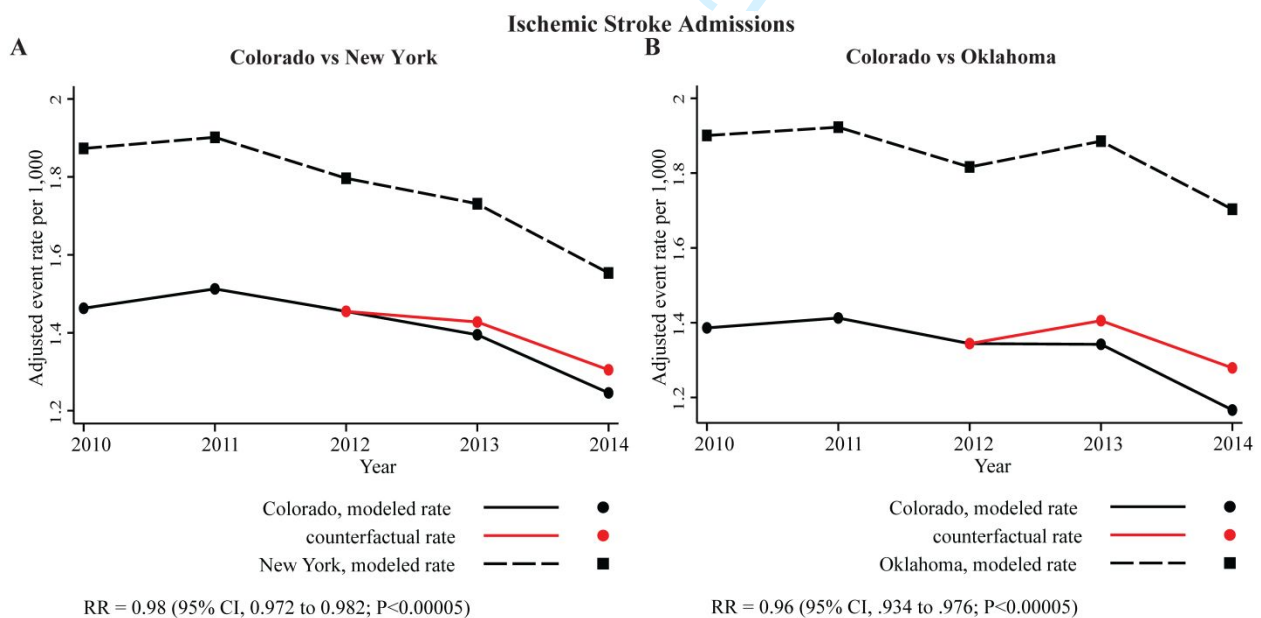
eFigure 1. Multivariate adjusted rates of admissions for myocardial infarction over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, compared with New York (A) and Oklahoma (B), control states without cannabis legalization. Red lines show the predicted rates of admissions for myocardial infarction (and all remaining medical diagnoses plotted in Figures S2-S31) had the cannabis legalization policy not been instituted. RR = risk ratio; CI = confidence interval.



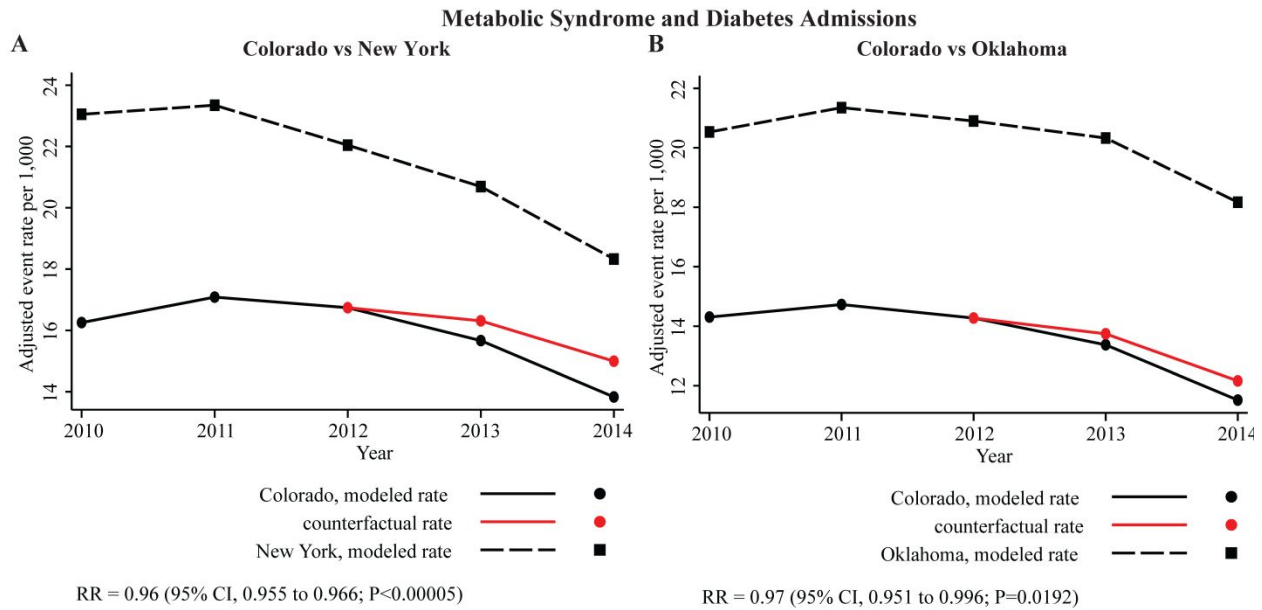
eFigure 2. Multivariate adjusted rates of admissions for brain hemorrhage over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



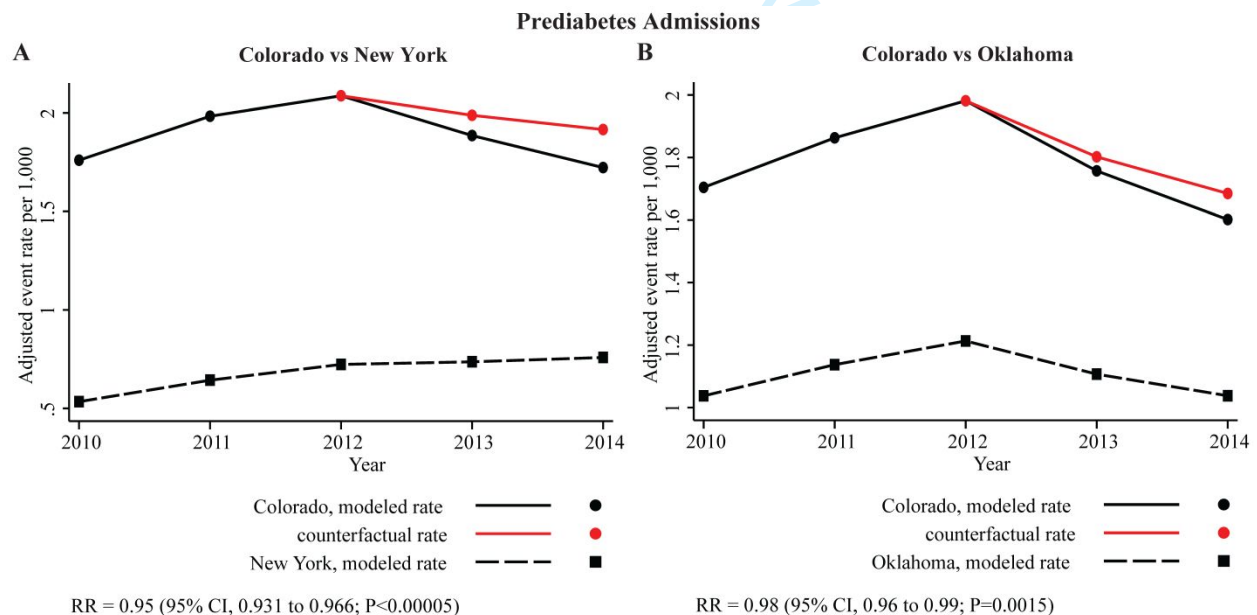
eFigure 3. Multivariate adjusted rates of admissions for ischemic stroke over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



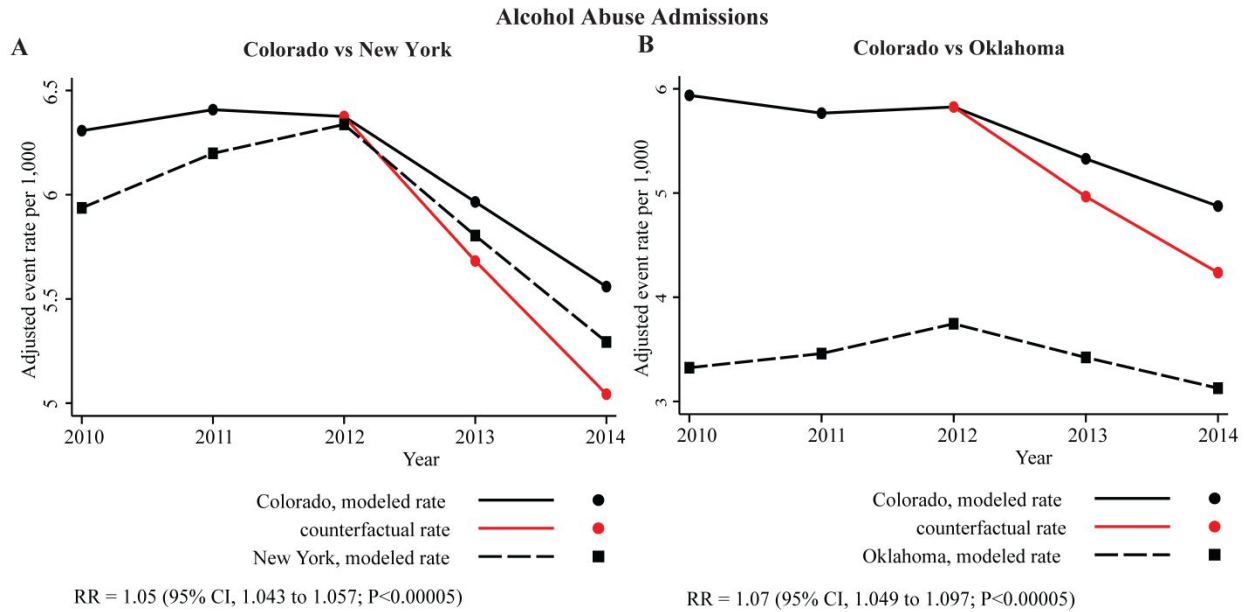
eFigure 4. Multivariate adjusted rates of admissions for metabolic syndrome and diabetes over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



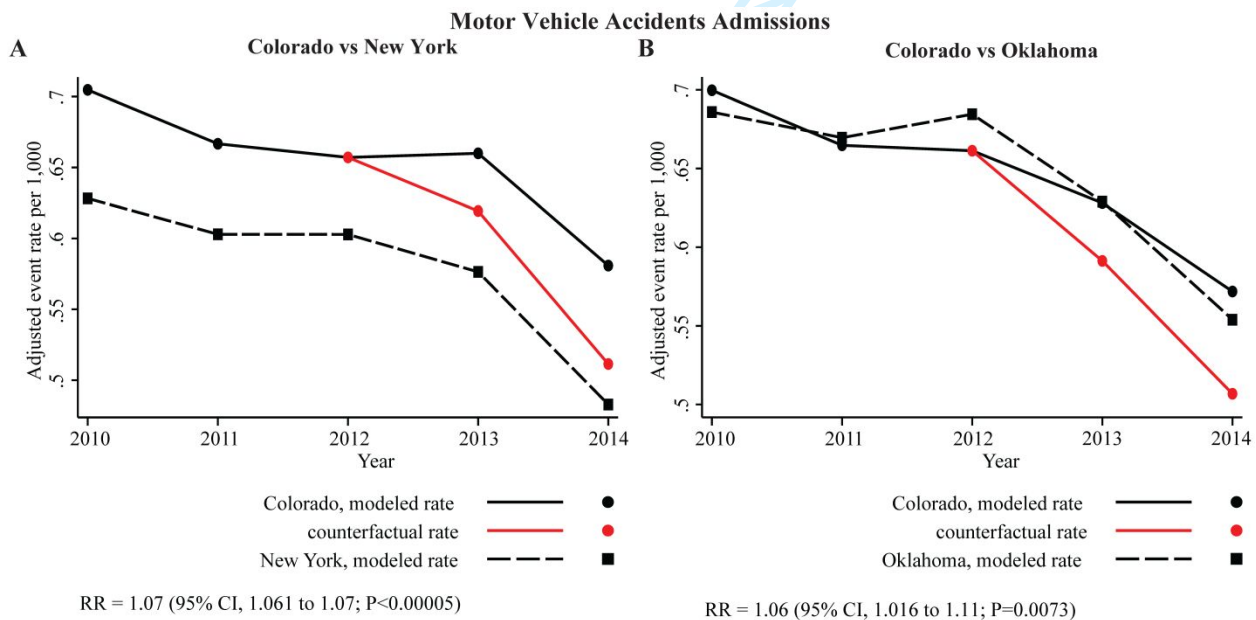
eFigure 5. Multivariate adjusted rates of admissions for prediabetes over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



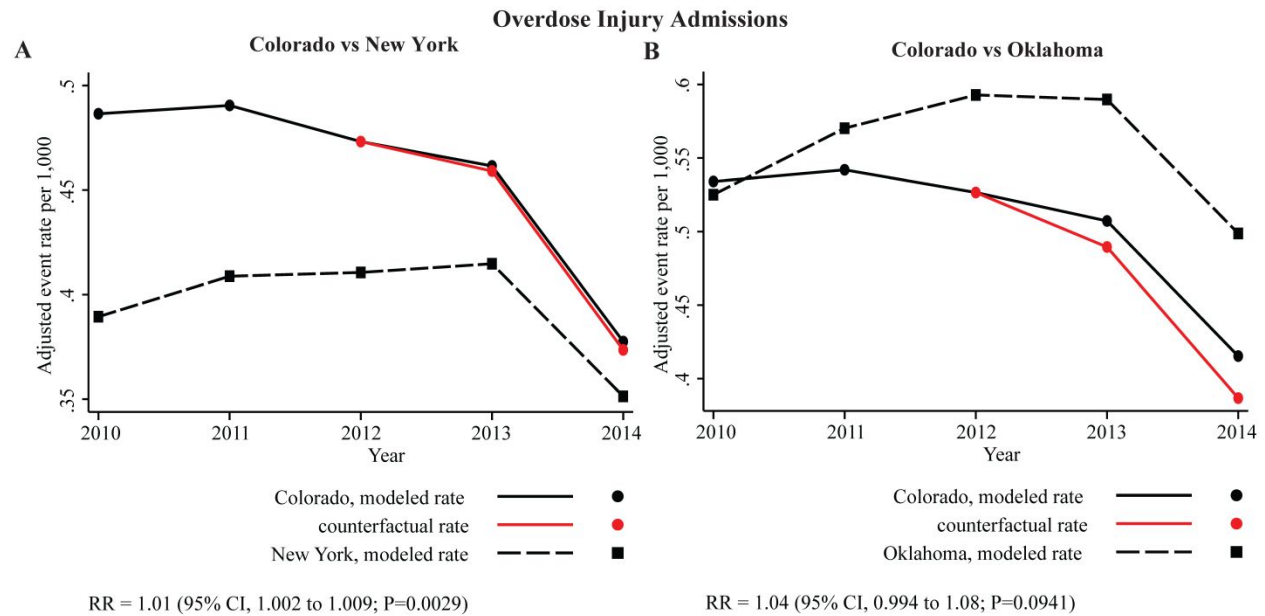
eFigure 6. Multivariate adjusted rates of admissions for alcohol abuse over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



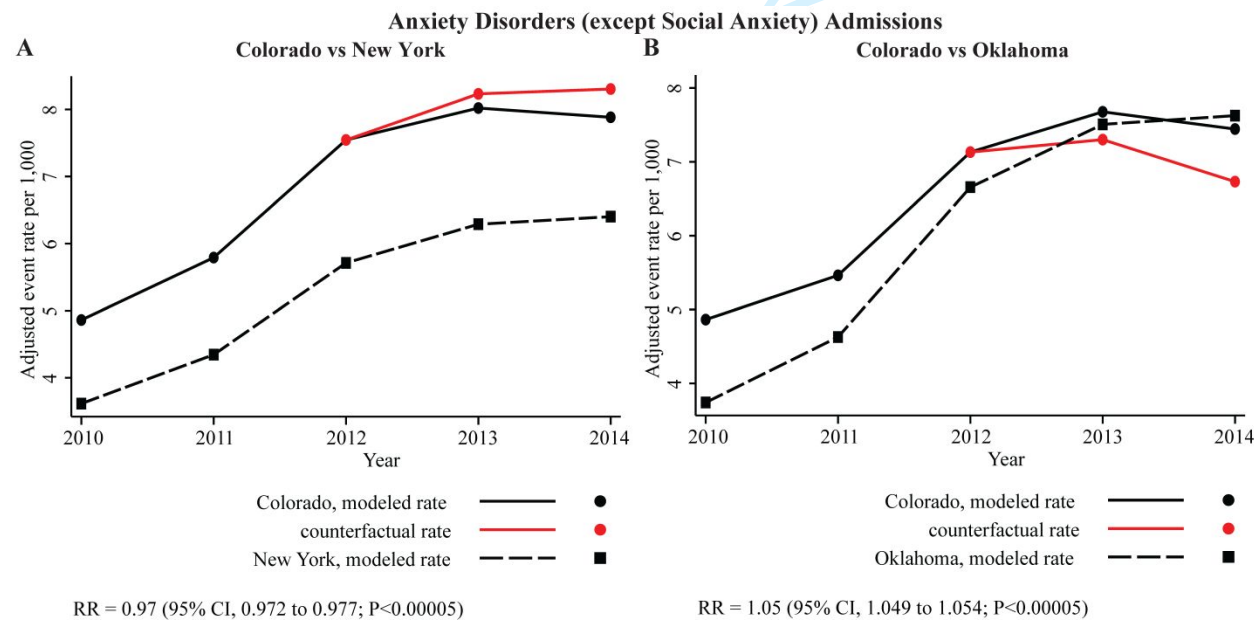
eFigure 7. Multivariate adjusted rates of admissions for motor vehicle accidents over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



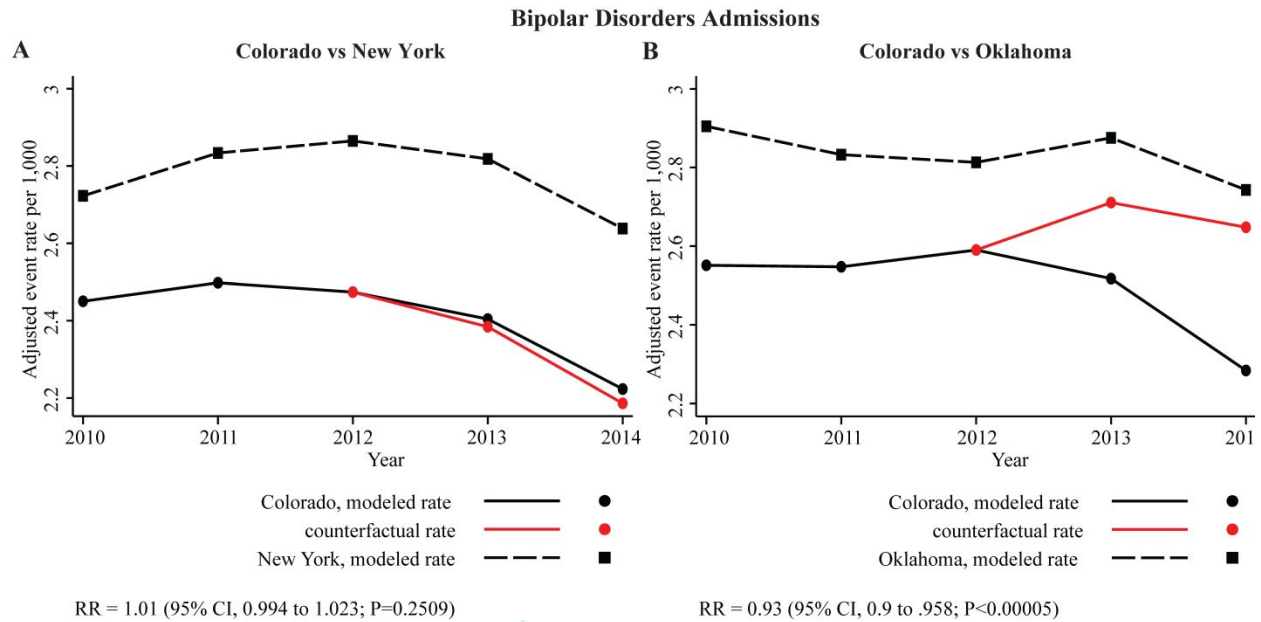
eFigure 8. Multivariate adjusted rates of admissions for overdose injury over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



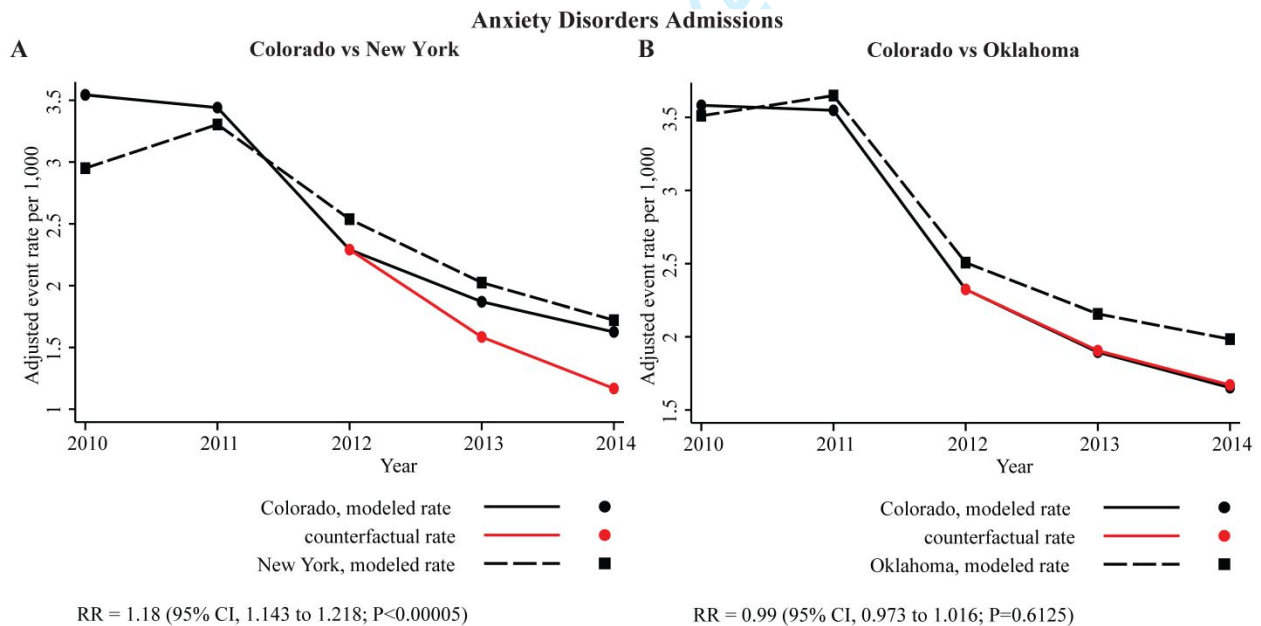
eFigure 9. Multivariate adjusted rates of admissions for anxiety disorders (except social anxiety) over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



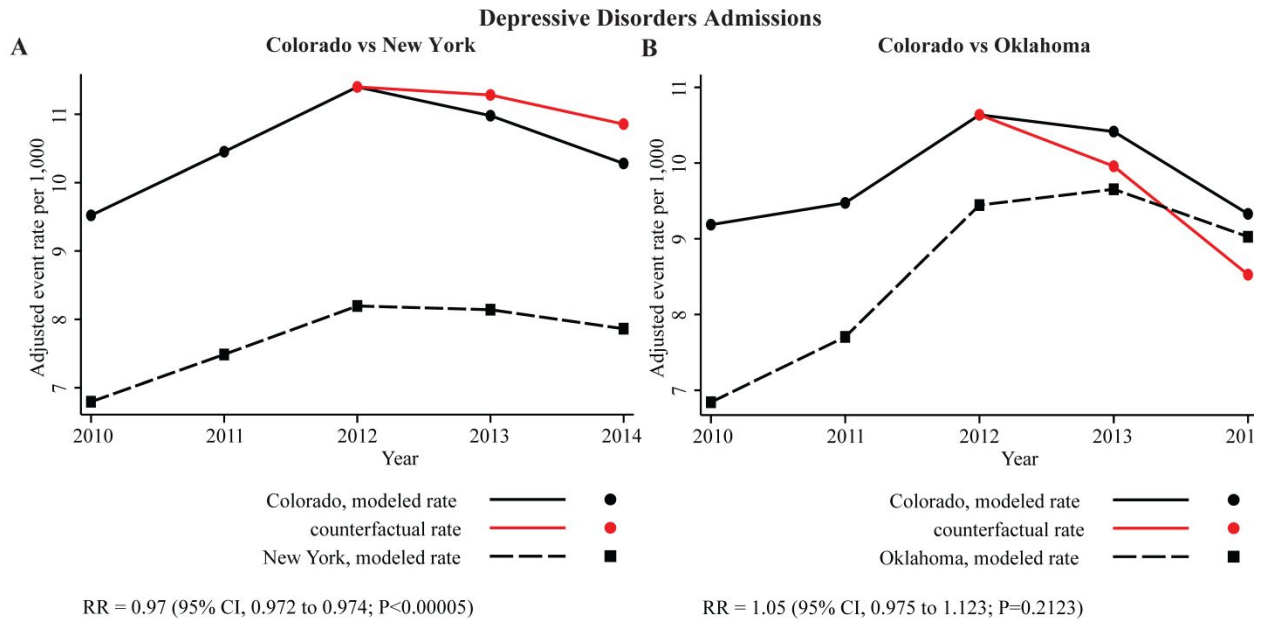
eFigure 10. Multivariate adjusted rates of admissions for bipolar disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



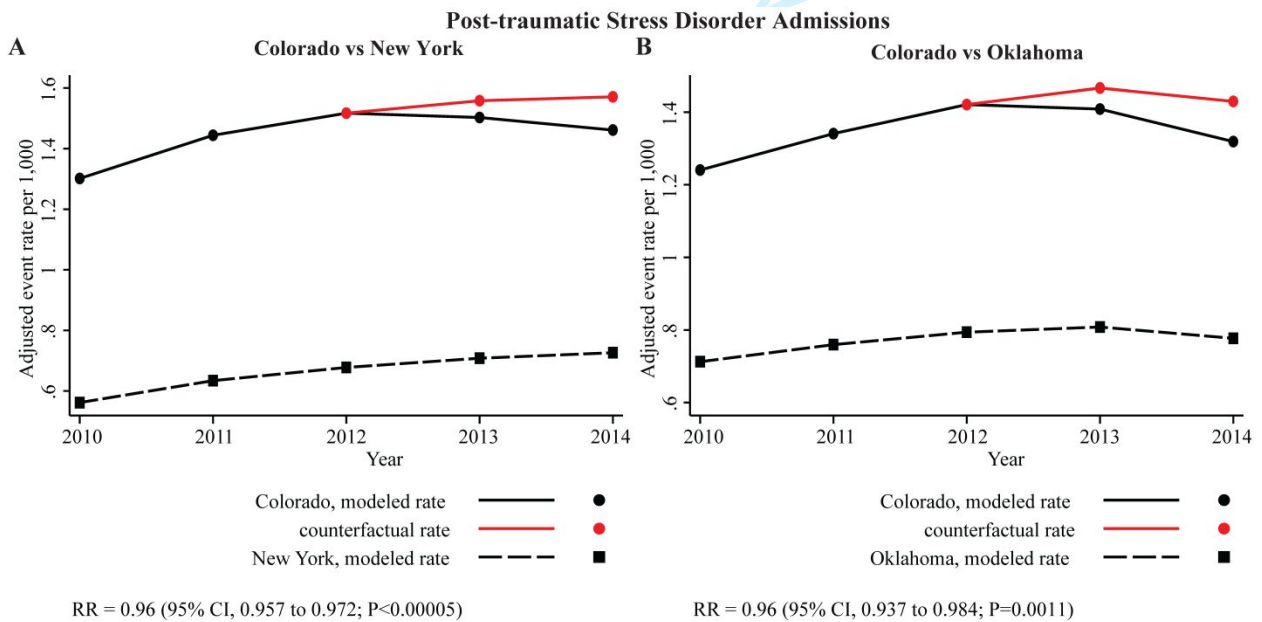
eFigure 11. Multivariate adjusted rates of admissions for anxiety disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



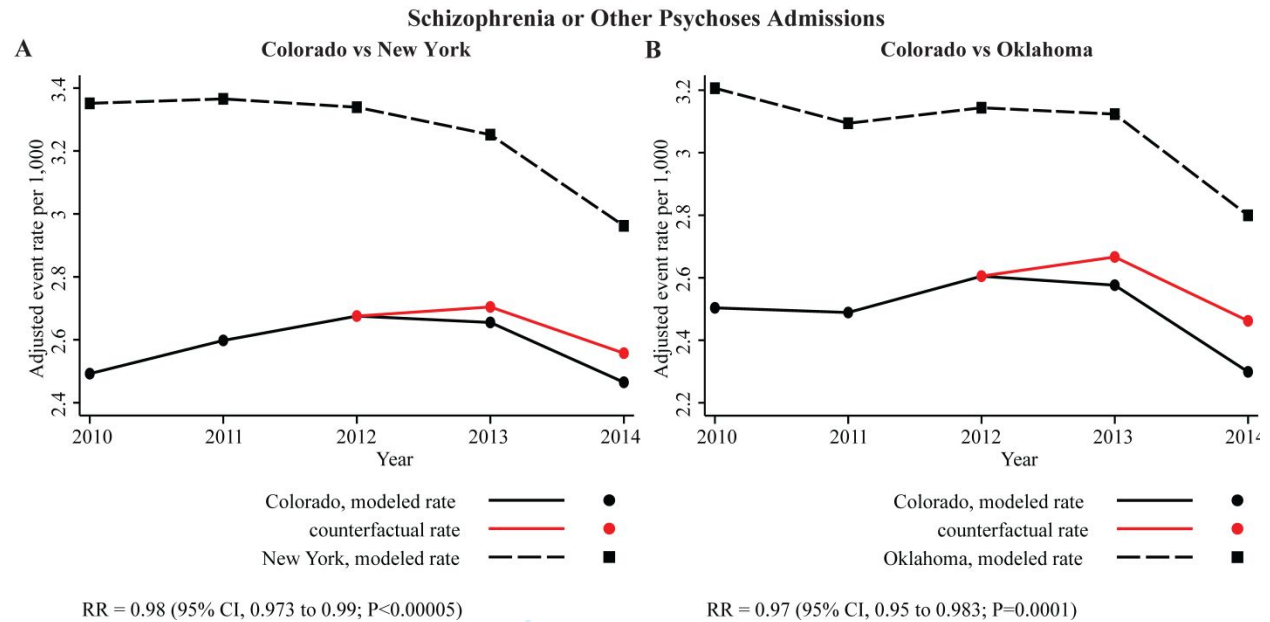
eFigure 12. Multivariate adjusted rates of admissions for depressive disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



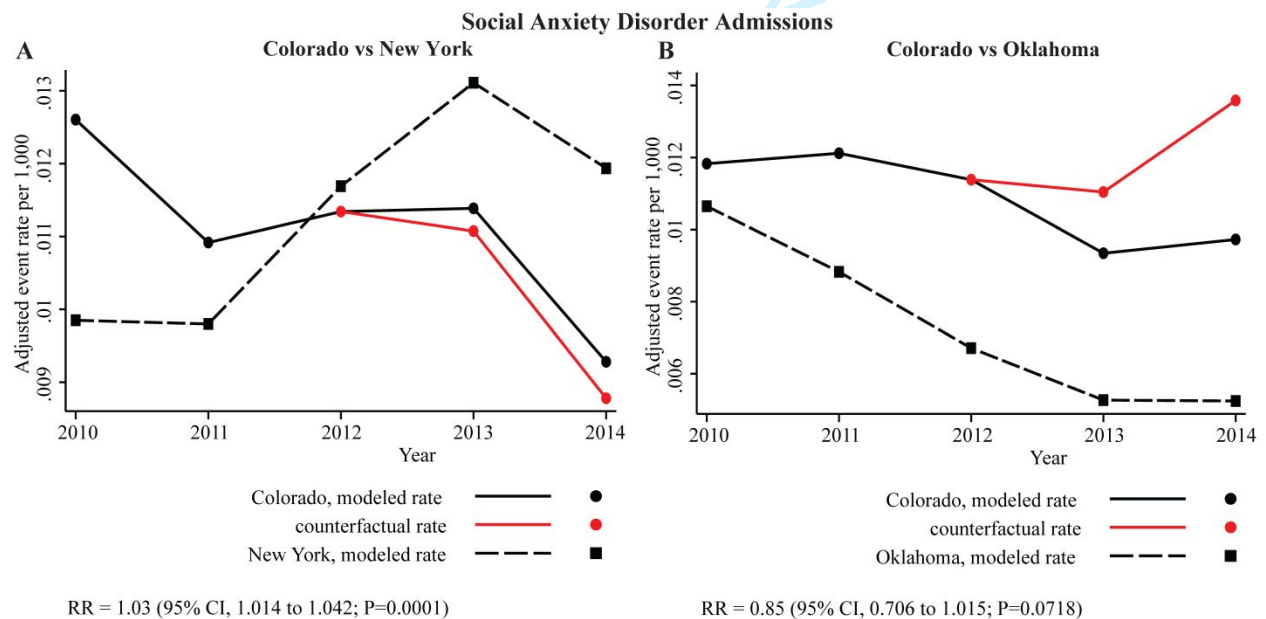
eFigure 13. Multivariate adjusted rates of admissions for post-traumatic stress disorder over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



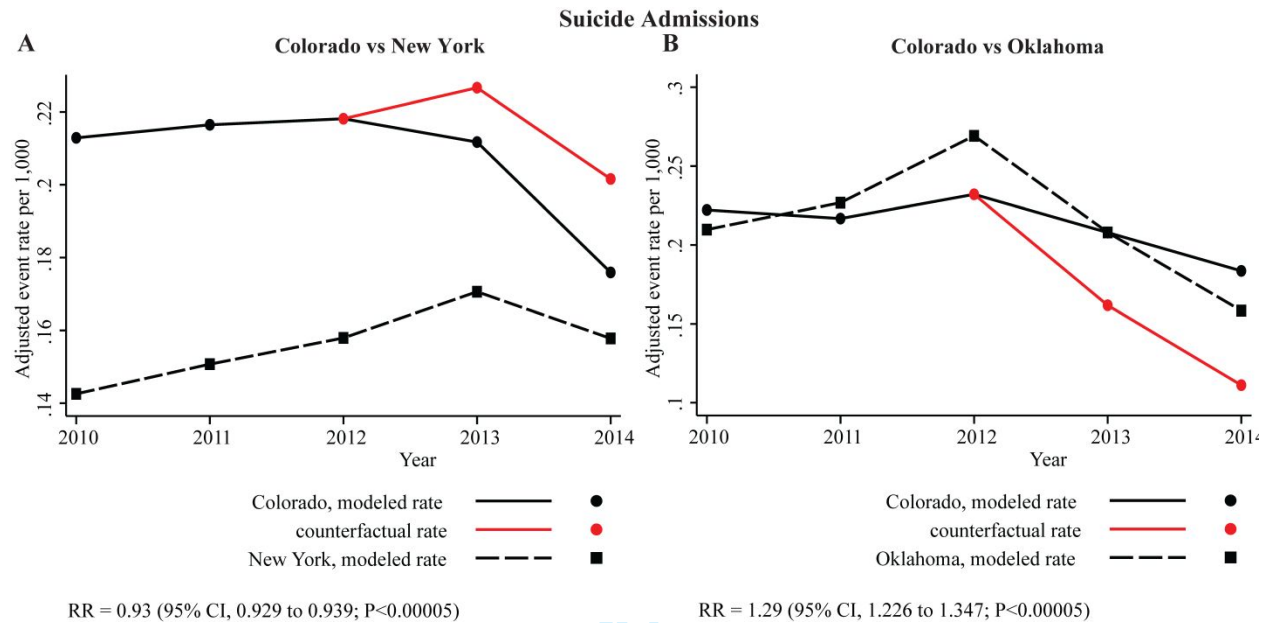
eFigure 14. Multivariate adjusted rates of admissions for schizophrenia or other psychoses over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



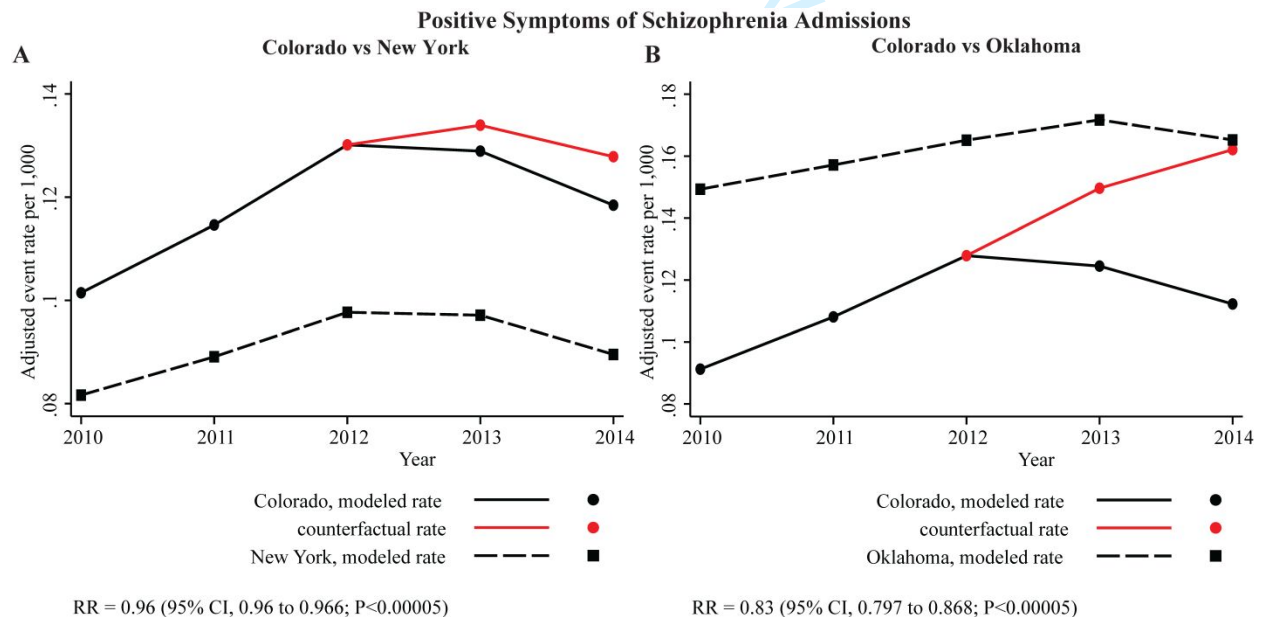
eFigure 15. Multivariate adjusted rates of admissions for social anxiety disorder over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



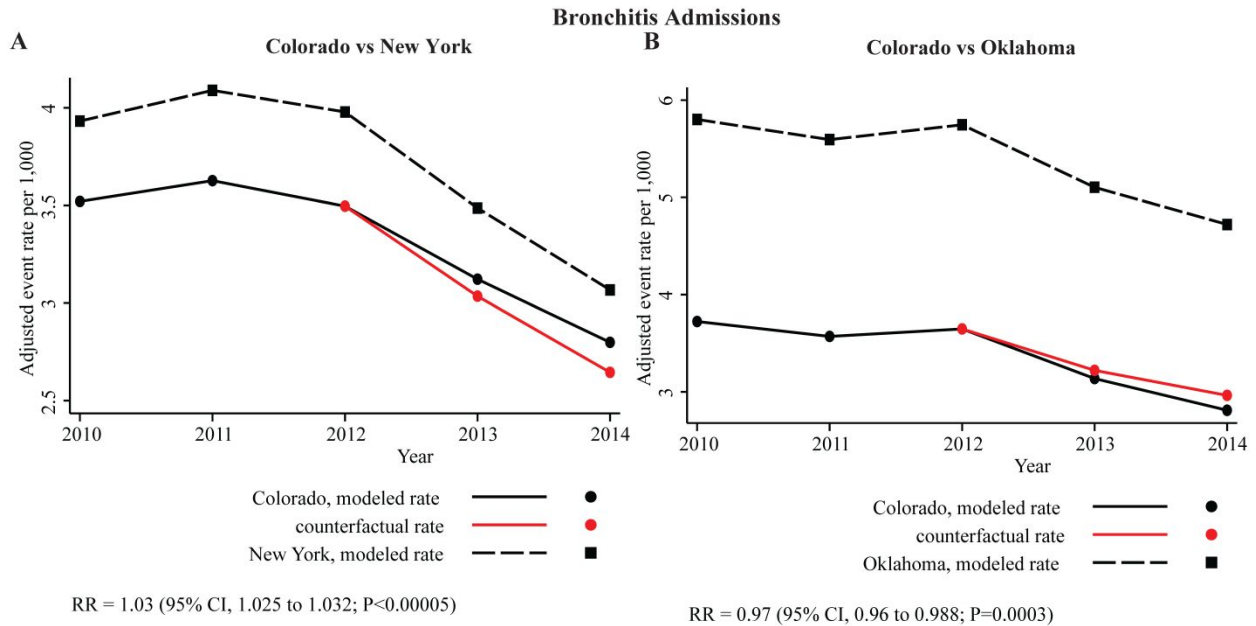
eFigure 16. Multivariate adjusted rates of admissions for suicide over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



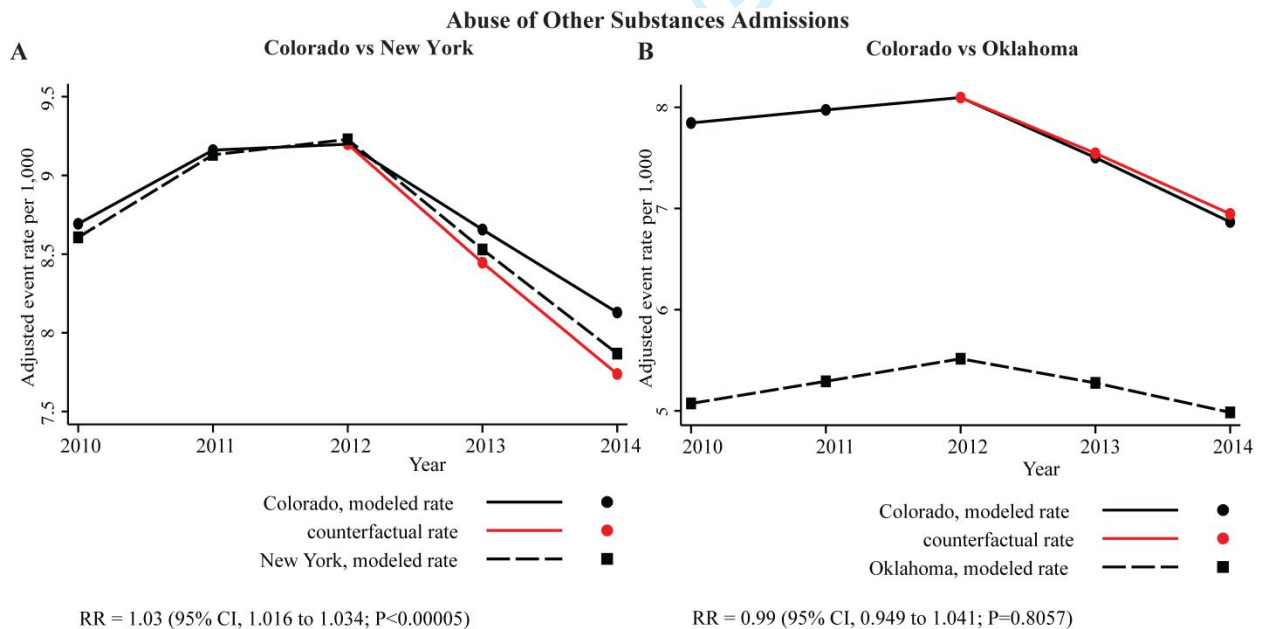
eFigure 17. Multivariate adjusted rates of admissions for positive symptoms of schizophrenia over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



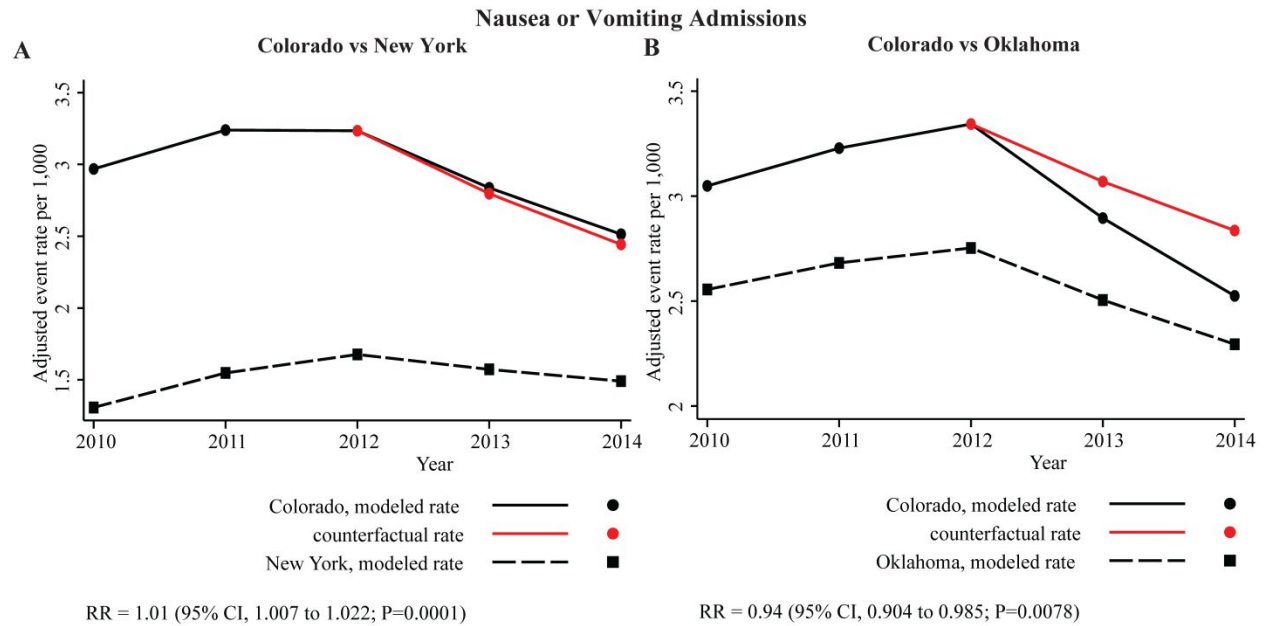
eFigure 18. Multivariate adjusted rates of admissions for bronchitis over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



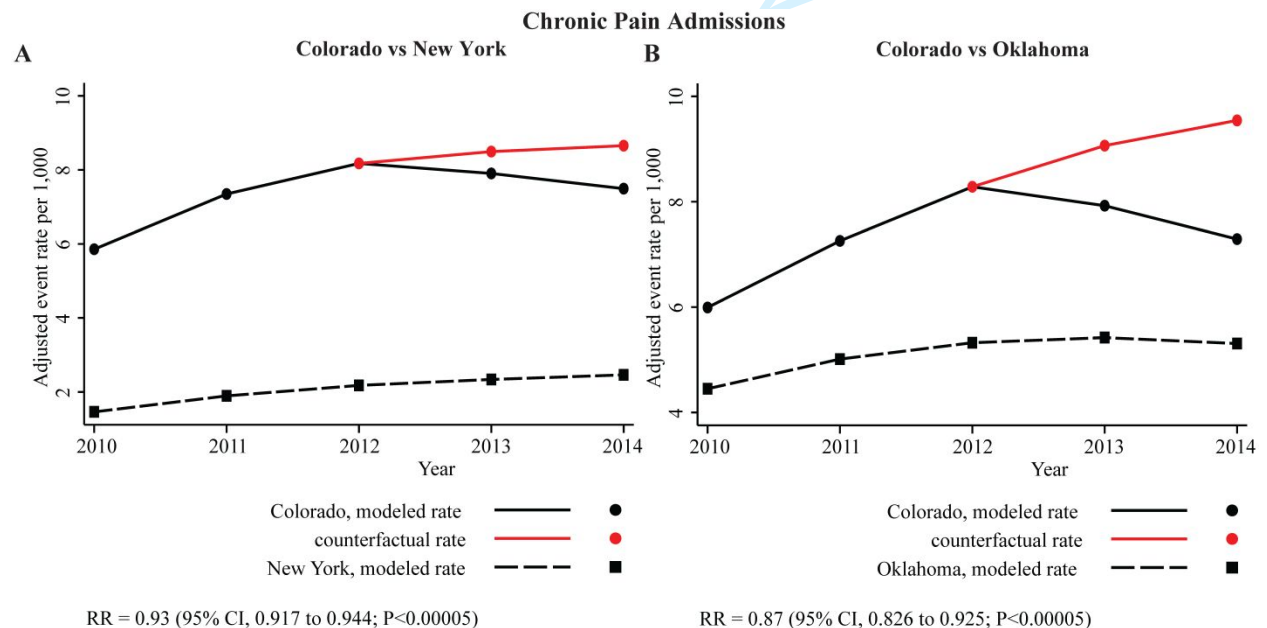
eFigure 19. Multivariate adjusted rates of admissions for abuse of other substances over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



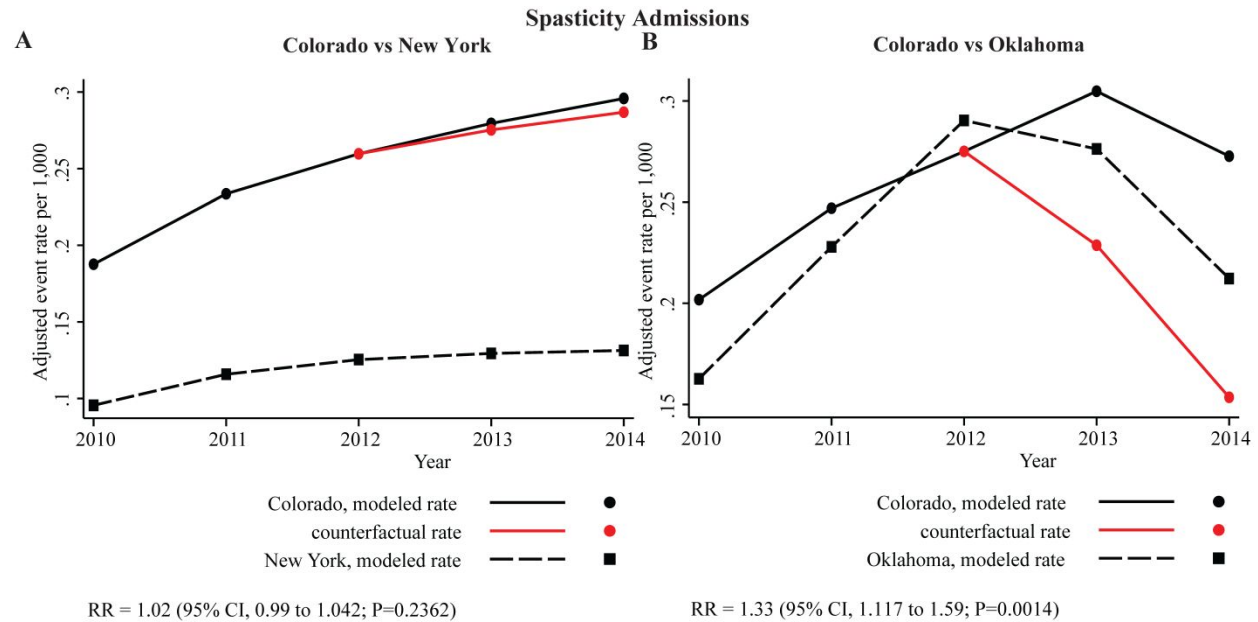
eFigure 20. Multivariate adjusted rates of admissions for nausea or vomiting over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



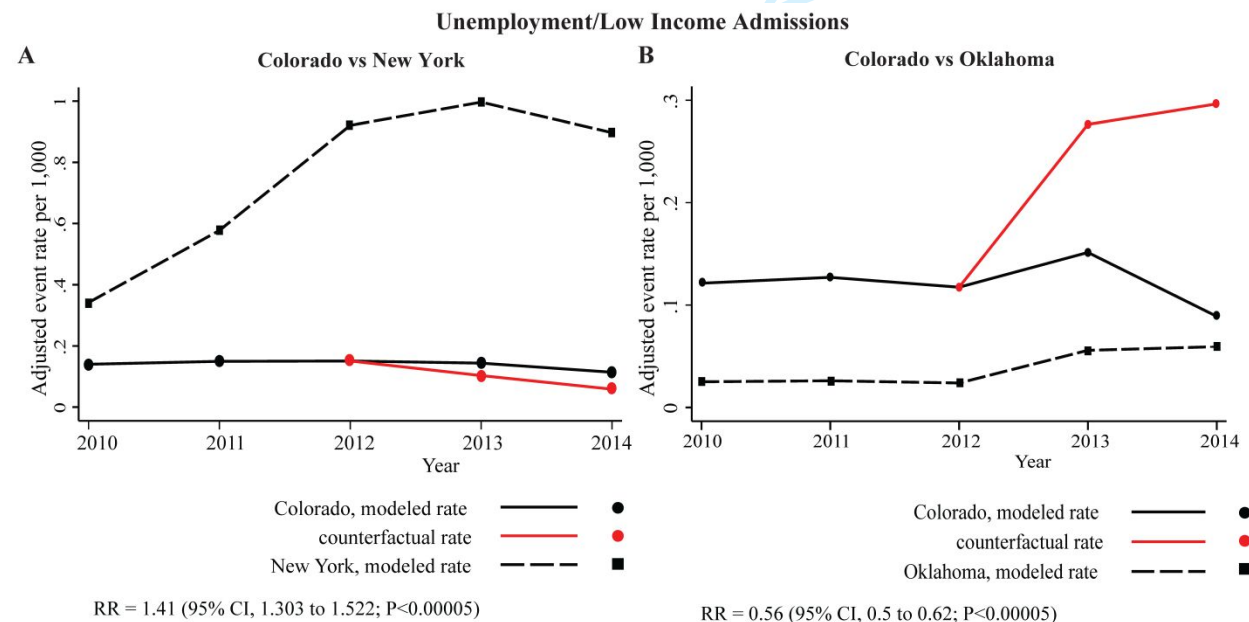
eFigure 21. Multivariate adjusted rates of admissions for chronic pain over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



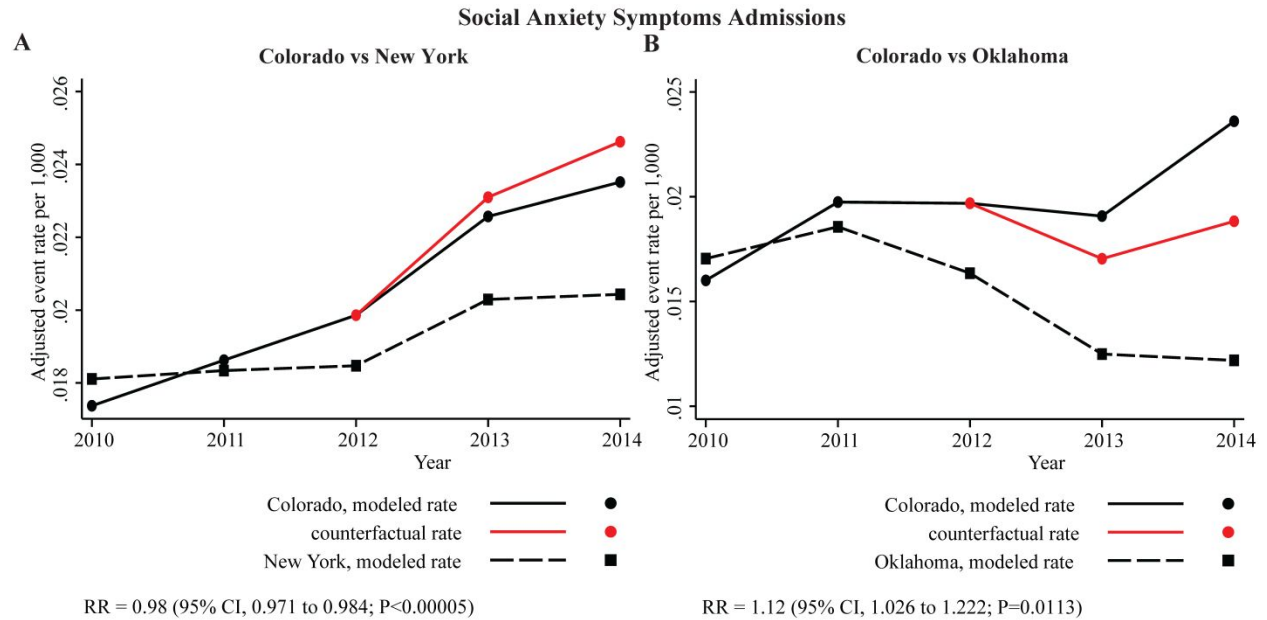
eFigure 22. Multivariate adjusted rates of admissions for spasticity over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



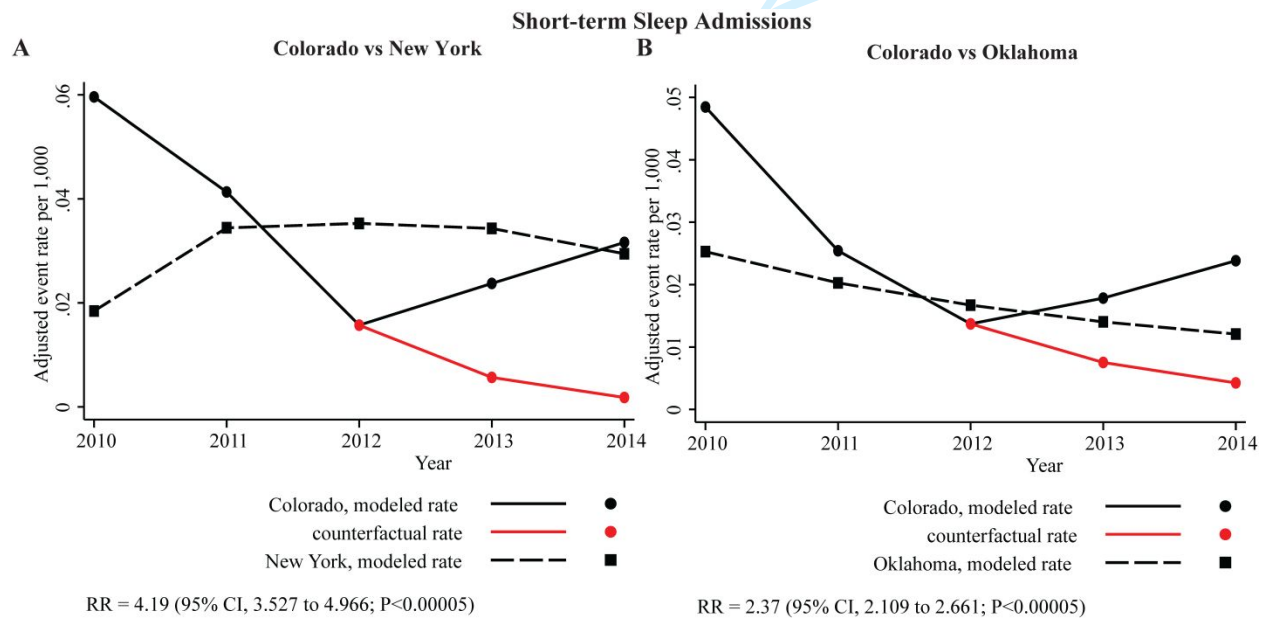
eFigure 23. Multivariate adjusted rates of admissions for unemployment/low income over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



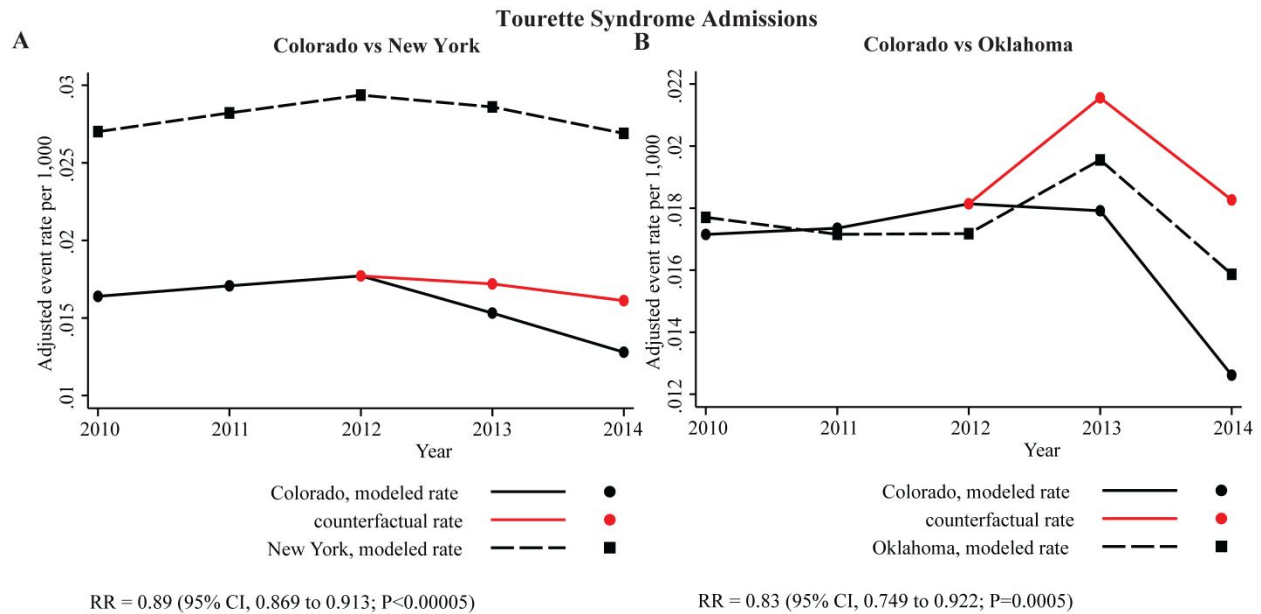
eFigure 24. Multivariate adjusted rates of admissions for social anxiety symptoms over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



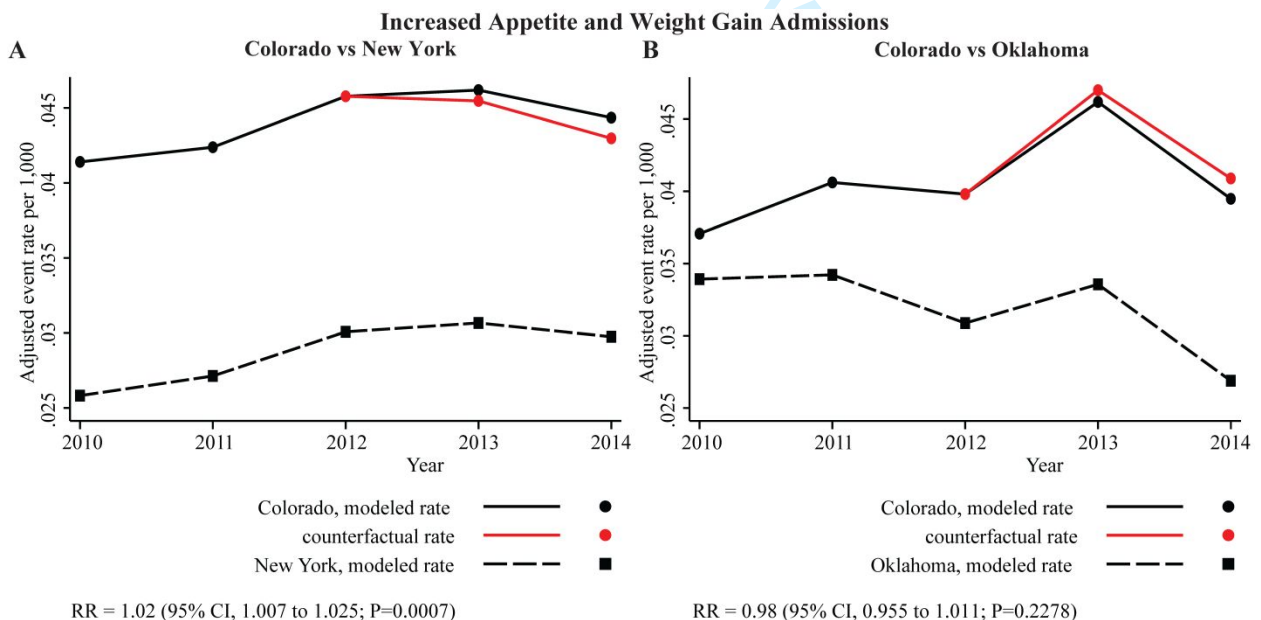
eFigure 25. Multivariate adjusted rates of admissions for short-term sleep disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



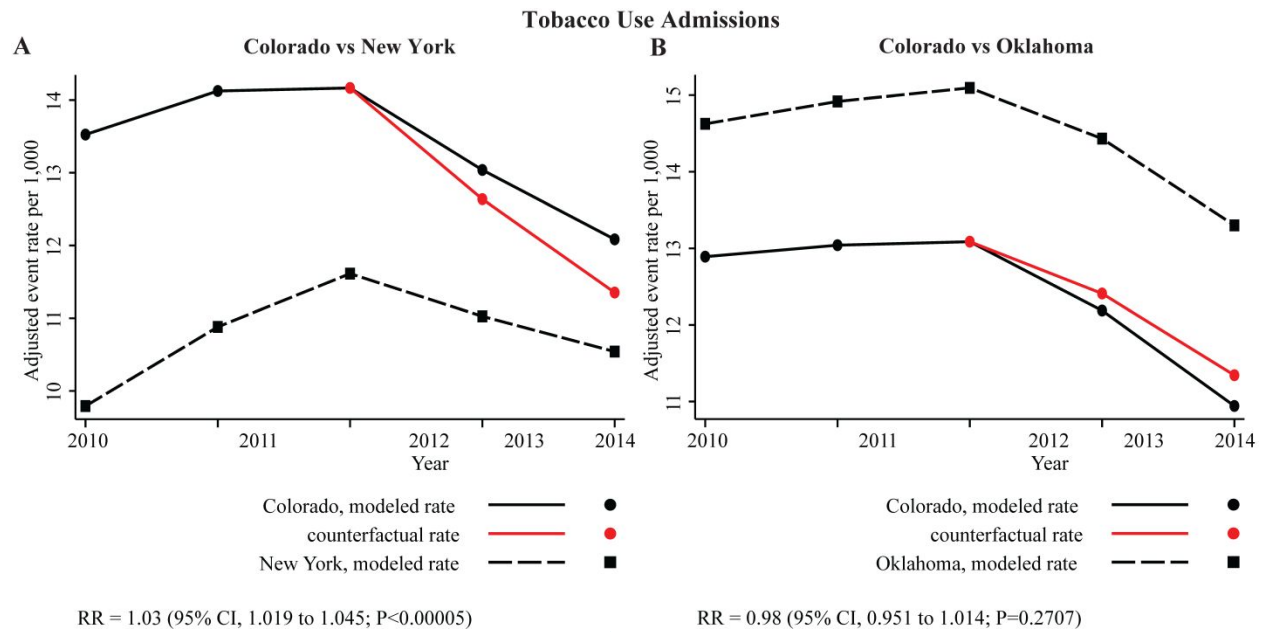
eFigure 26. Multivariate adjusted rates of admissions for Tourette's syndrome over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



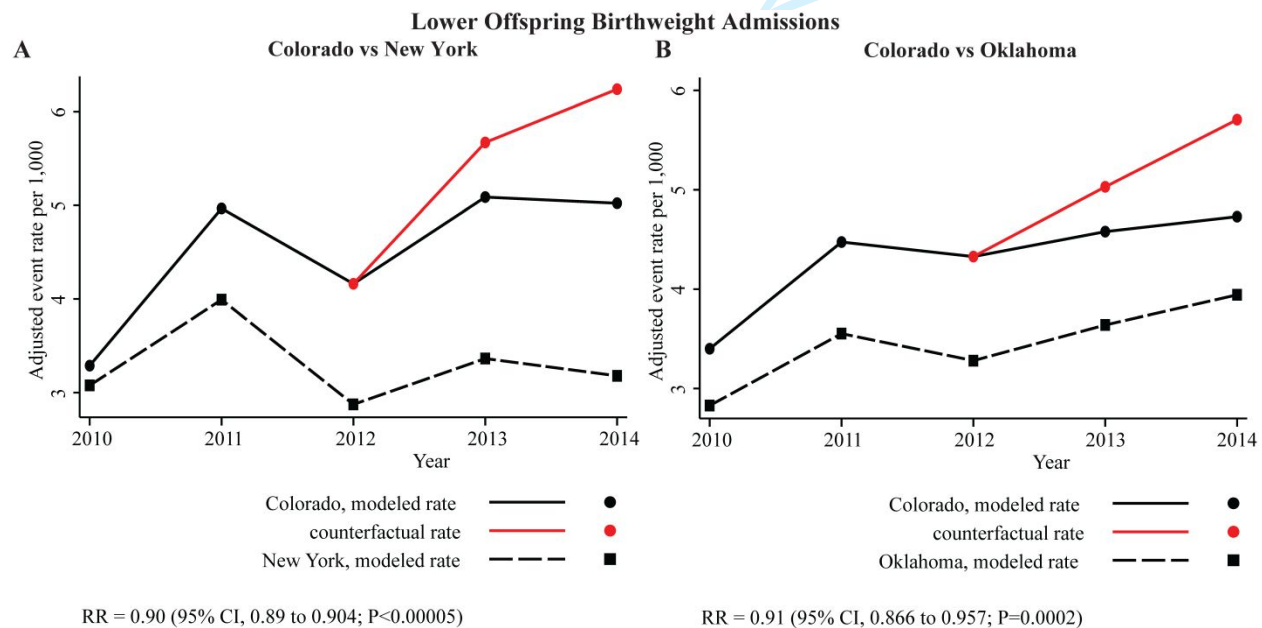
eFigure 27. Multivariate adjusted rates of admissions for increased appetite and weight gain over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



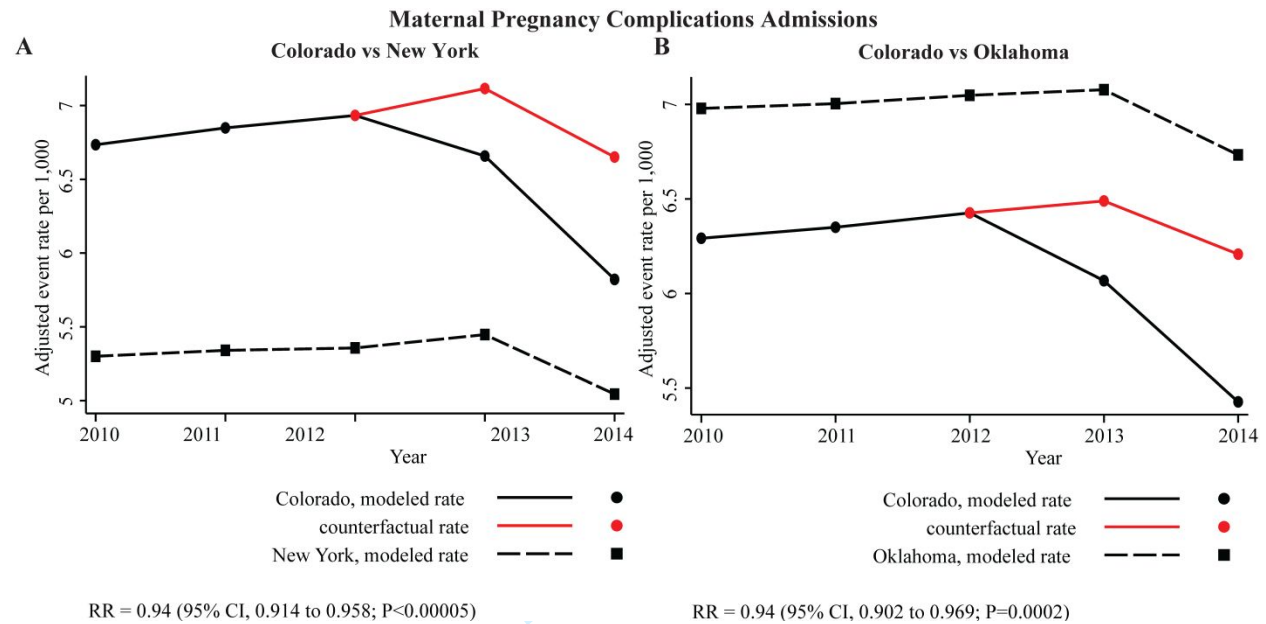
eFigure 28. Multivariate adjusted rates of admissions for tobacco use over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



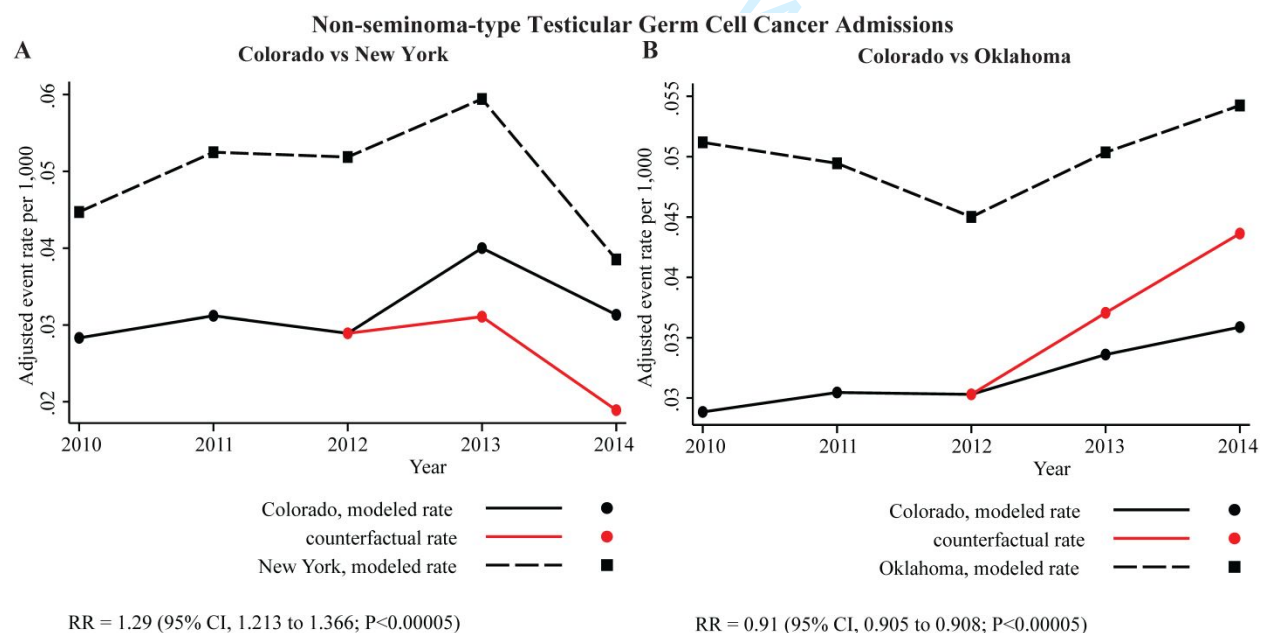
eFigure 29. Multivariate adjusted rates of admissions for lower offspring birthweight over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eFigure 30. Multivariate adjusted rates of admissions for maternal pregnancy complications over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eFigure 31. Multivariate adjusted rates of admissions for non-seminoma-type testicular germ cell cancer over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5, 6, 7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5, 6, 7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	5, 6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6, 7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7
Bias	9	Describe any efforts to address potential sources of bias	7, 8
Study size	10	Explain how the study size was arrived at	5, 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8, 9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7, 8, 9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest	9

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(c) Summarise follow-up time (eg, average and total amount)

Outcome data	15*	Report numbers of outcome events or summary measures over time	9
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1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10, 11, 12
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
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11	Discussion			
12				
13	Key results	18	Summarise key results with reference to study objectives	12, 13
14				
15	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13, 14
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17	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14, 15
18				
19				
20	Generalisability	21	Discuss the generalisability (external validity) of the study results	14, 15
21				
22	Other information			
23				
24	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16
25				

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

BMJ Open

Does Cannabis Legalization Change Healthcare Utilization? A Population-based Study Using the Healthcare Cost and Utilization Project

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3 1 **Does Cannabis Legalization Change Healthcare Utilization? A Population-based**
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5 2 **Study Using the Healthcare Cost and Utilization Project**
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3 25 **ABSTRACT**
4

5 26 **OBJECTIVE:** To assess the effect of cannabis legalization on health effects and healthcare
6
7 27 utilization in Colorado (CO), the first state to legalize recreational cannabis, when compared
8
9 28 with 2 control states, New York (NY) and Oklahoma (OK).
10

11
12 29 **DESIGN:** We used the 2010-2014 Healthcare Cost and Utilization Project (HCUP) inpatient
13
14 30 databases to compare changes in rates of healthcare utilization and diagnoses in CO versus NY
15
16 31 and OK.
17

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19 32 **SETTING:** Population-based, inpatient.
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21
22 33 **PARTICIPANTS:** HCUP state-wide data comprising over 28 million individuals and over 16
23
24 34 million hospitalizations across 3 states.
25

26 35 **MAIN OUTCOME MEASURES:** We used International Classification of Diseases-9th Edition
27
28 36 (ICD-9) codes to assess changes in healthcare utilization specific to various medical diagnoses
29
30 37 potentially treated by or exacerbated by cannabis. Diagnoses were classified based on weight
31
32 38 of evidence from the National Academy of Science (NAS). Negative binomial models were used
33
34 39 to compare rates of admissions between states.
35
36

37 40 **RESULTS:** In CO compared to NY and OK, respectively, cannabis abuse increased (risk ratio
38
39 41 [RR], 1.27; 95% confidence interval [CI], 1.26 to 1.28 and RR 1.16; 95% CI 1.15 to 1.17; both
40
41 42 $P<0.0005$) post-legalization. In CO, there was a reduction in total admissions but only when
42
43 43 compared to OK (RR 0.97; 95% CI 0.96 to 0.98; $P<0.0005$). Length of stay and costs did not
44
45 44 change significantly in CO compared to NY or OK. Post-legalization changes most consistent
46
47 45 with NAS-based evidence included an increase in motor vehicle accidents, alcohol abuse,
48
49 46 overdose injury, and a reduction in chronic pain (all $P<0.05$ compared to each control state).
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53 47 **CONCLUSIONS:** Recreational cannabis legalization is associated with neutral effects on
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55 48 healthcare utilization. In line with previously established evidence, cannabis liberalization is
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49 linked to an increase in motor vehicle accidents, alcohol abuse, overdose injuries and a
50 decrease in chronic pain. Such population-level effects may help guide future decisions
51 regarding cannabis use, prescription, and policy.

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53 **Strengths and limitations of this study**

- 54 • The study focuses on the impact of recreational cannabis legalization on health
55 care utilization instead of its legal or societal effects
- 56 • This study utilizes HCUP data comprising over 28 million individuals and over 16
57 million hospitalizations
- 58 • Stringent standards were employed to address possible false positives due to
59 multiple hypotheses testing
- 60 • Follow up data after the 2012 Amendment 64 only includes two subsequent
61 years
- 62 • Physician coding with ICD-9 codes does not capture potentially important
63 mediators related to cannabis use

64 INTRODUCTION

65 Over 147 million people, or 2.5 percent of the world's population, use cannabis
66 (marijuana),¹ and more than 20 million Americans have reported the use of cannabis in
67 the past 30 days.¹ Because cannabis use is a federal crime, clinical studies have been
68 challenging to pursue, resulting in substantial knowledge gaps regarding actual health
69 consequences. Thirty states and the District of Columbia now allow cannabis for the
70 treatment of medical conditions.² Of these, 9 have recently legalized cannabis for
71 recreational use. Given such pervasive policy changes, understanding potential shifts in
72 healthcare utilization is vital.

73 Recently, an extensive and rigorous summary of the current evidence on health
74 effects of cannabis was developed by a committee of experts appointed by the US
75 National Academy of Science (NAS) focusing on systematic reviews and high-quality
76 primary research.³ The health endpoints assessed in the NAS summary included
77 oncologic, cardiometabolic, respiratory, immunologic, and psychiatric disorders as well
78 as outcomes related to injury and death (i.e. motor-vehicle accidents). While the NAS
79 summary represents a valuable starting place that makes use of the available data, we
80 do not yet know whether that evidence, based largely on small studies, will translate into
81 real-world ramifications after legalization of recreational cannabis.

82 On December 10, 2012, Colorado enacted *Colorado Amendment 64*, legalizing
83 recreational cannabis. Following this date, adults aged 21 or older could grow cannabis
84 plants privately, legally possess all cannabis from these plants, and give cannabis as a
85 gift to other adults aged 21 or older.⁴ After January 1, 2014, recreational cannabis could
86 be legally purchased in retail stores.⁵ We hypothesized that changes in healthcare

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3 87 utilization and diagnoses most consistent with NAS-based evidence occur when access
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5 88 to recreational cannabis becomes liberalized.
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10 90 **METHODS**

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12 91 We used the Agency for Healthcare Research and Quality (AHRQ)-funded Healthcare
13
14 92 Cost and Utilization Project (HCUP) database to measure inpatient healthcare utilization
15
16 93 and diagnoses in Colorado (CO) between 2010 and 2014. HCUP is a state-wide
17
18 94 database containing all listed inpatient diagnoses and procedures, discharge status,
19
20 95 patient demographics, and charges for all patients, regardless of payer (e.g., Medicare,
21
22 96 Medicaid, private insurance, uninsured).
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26 97 Comparisons were made with 2 control states in order to address possible secular
27
28 98 trends. New York (NY), the most populous state with inpatient HCUP data available up
29
30 99 to 2014 was selected, and, to counter this coastal and largely urban state, we also
31
32 100 selected Oklahoma (OK), a predominately rural state directly adjacent to CO with HCUP
33
34 101 hospitalization data up to 2014. We used separate HCUP databases for CO, NY and
35
36 102 OK. Unlike the National Inpatient Sample (NIS), which is (by definition) a sample, these
37
38 103 state-specific databases include data from every actual admission, providing direct and
39
40 104 complete information regarding all healthcare utilization. Both primary and secondary
41
42 105 diagnoses were extracted from each HCUP database for each admission used: up to 30
43
44 106 ICD-9 codes in CO, 25 in NY, and 16 in OK were provided for each encounter. Annual
45
46 107 demographic data, including age, sex, and race, was obtained from the United States
47
48 108 Census Bureau. Only month and year were available in all HCUP databases; as
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50 109 legalization took effect on December 10, 2012, hospitalizations following December,
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3 110 2012 were considered “after” enactment of the law. Patients with missing information on
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5 111 age, sex, race, and year of encounter were excluded.

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7 112 Age, sex, race, income level, and insurance payer were recorded at each
8
9 113 healthcare encounter. Hispanic ethnicity was not coded in the OK State Department of
10
11 114 Health data source. In order to use comparable categorizations across the 3 states, we
12
13 115 separated race into white, black, Native American, and other. In addition to the
14
15 116 population-level variables age, sex and race, we obtained the following covariates at the
16
17 117 individual level for each age, sex and race population strata: 1) income level 2)
18
19 118 proportion of HCUP individuals living in an urban versus rural setting, 3) with tobacco
20
21 119 use, 4) alcohol abuse, and 5) psychiatric disorders. The latter 3 covariates were
22
23 120 available from ICD-9 codes. Income level was categorized by quartiles using the
24
25 121 median household income for each patient’s ZIP code. Income level was not available
26
27 122 for OK.

28
29 123 We first performed a validation analysis to assess changes in cannabis abuse
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31 124 diagnoses in CO after versus before recreational cannabis legalization and compared
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33 125 those rates to changes in NY and OK over the same time period. To determine changes
34
35 126 in overall healthcare utilization, we assessed changes in total number of
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37 127 hospitalizations, length of inpatient stay, and healthcare costs. We estimated the cost of
38
39 128 each hospitalization by multiplying the charges by a cost-to-charge ratio for the
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41 129 admitting hospital for the given year. For NY and CO, we used the all-payer cost-to-
42
43 130 charge ratios provided by HCUP. When the all-payer cost-to-charge ratio was missing,
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45 131 we applied the average cost-to-charge ratio particular to state and year. As HCUP does
46
47 132 not provide cost-to-charge ratios for OK, we assumed a constant state-wide cost-to-
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3 133 charge ratio (0.3119 as derived from the Institute for Health and Socio-Economic Policy
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5 134 calculations of federal cost reports) to estimate healthcare costs in OK;⁶ we then
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7 135 conducted a sensitivity analysis setting the cost-to-charge ratio for OK to equal to the
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9 136 average for NY and CO for the corresponding year. See online supplementary
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11 137 eMethods and eTable 1 for additional details.

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14 138 We used International Classification of Diseases-9th Edition (ICD-9) codes
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16 139 (eTable 2) to assess changes in healthcare utilization specific to various medical
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18 140 diagnoses potentially treated by or exacerbated by cannabis use as identified by the
19
20 141 NAS summary. For each health endpoint of interest in the NAS review, the weight of
21
22 142 evidence regarding the statistical association of recreational cannabis with a specific
23
24 143 health endpoint or the therapeutic use of cannabis had previously been categorized into
25
26 144 substantial, moderate, limited or no evidence.³ We opted to focus on NAS health
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28 145 endpoints with either substantial or moderate evidence.

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31 146 Because diagnoses of alcohol or other substance abuse “in remission” may have
32
33 147 been incidental and not directly responsible for the hospitalization, we performed a
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35 148 sensitivity analysis where we removed “in remission” diagnoses from the group of ICD-9
36
37 149 codes defining alcohol abuse and other substance abuse (eTable 2).

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40 150 Finally, to take into account the additional effect of recreational cannabis related
41
42 151 to availability in retail stores we performed sensitivity analyses for all health care
43
44 152 utilization (total number of admissions, length of stay, costs) and NAS-evidence based
45
46 153 outcomes investigations utilizing January 1, 2014 as the change of policy date.

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49 154 Certification to use de-identified HCUP data was obtained from the University of
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51 155 California, San Francisco Committee on Human Research.

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157 Statistical Analysis

158 Demographic and lifestyle characteristics are presented as mean \pm standard deviation
159 (SD) or n (% of total admissions) and were compared between states using linear,
160 logistic, and multinomial models as appropriate. Rates of admissions for NAS diagnoses
161 (with the population size as the denominator) were compared between states using
162 negative binomial models.

163 To assess the effects of recreational cannabis legalization, we used negative
164 binomial models for the number of admissions, both overall and for particular
165 diagnoses, with the log of the subgroup population sizes as an offset and the use of
166 robust standard errors. Analogous linear models were utilized for length of stay and
167 cost, which were both log-transformed in order to meet normality assumptions. All
168 models were adjusted for age, race, sex, income level, urbanicity, alcohol abuse,
169 tobacco use and psychiatric disorders. Adjustment for psychiatric disorders was not
170 performed in the presence of a psychiatric outcome. In order to relax the linearity
171 assumption, each 5-year age range was included as a separate category. To flexibly
172 model secular patterns, year was included as a categorical rather than continuous
173 variable (with a category for each year between 2010 and 2014). The crucial predictors
174 in our model included an indicator for CO (versus the comparison state) and interactions
175 of this indicator with 2 continuous linear spline basis functions, year-2012, and max (0,
176 year-2012). The main effect for CO estimated the between-state risk ratio (RR) in 2012,
177 the first interaction estimated the slope of the between-state RR in 2010-12, and the
178 second estimated the change in slope after 2012. The first interaction was used to

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3 179 project the counterfactual 2013-2014 rates in CO that would be expected in the absence
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5 180 of legalization, while the second was used to capture the legalization effect. Like a
6
7 181 standard interrupted time series (ITS) model, our model assumed that the between-
8
9 182 state RR changed linearly at different rates before and after the intervention, but used
10
11 183 the categorical indicator for year to relax the standard ITS assumption of piecewise
12
13 184 linear trends in the underlying state-specific rates, substantially improving model fit. The
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15 185 same model was used in the sensitivity analysis using January 1, 2014 (date of legal
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17 186 retail cannabis sales) as change of policy date.

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21 187 A 2-tailed $P < 0.05$ was considered statistically significant for the validation
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23 188 analysis (cannabis use), and analyses related to overall healthcare utilization. In order
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25 189 to minimize false positive results and to account for secular trends that might differ
26
27 190 across different populations, we assessed for validation in comparisons versus NY and
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29 191 then OK separately.

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33 192 In order to address possible false positives due to multiple hypotheses testing in
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35 193 assessing the diagnoses with moderate or substantial evidence described in the NAS
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37 194 document, we employed stringent standards: to be considered “positive,” the
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39 195 comparisons between CO and *each* of the other 2 states needed to be in the direction
40
41 196 expected from the NAS report, each exhibiting statistical significance using a two-tailed
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43 197 alpha of 0.05. A “positive” designation also required absence of a statistically significant
44
45 198 difference between NY versus OK using a two-tailed alpha of 0.05. All analyses were
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47 199 performed using Stata 15 (StataCorp, College Station, TX).

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52 53 54 201 **Patient and Public Involvement**

202 The patients and public were not involved in the study.

203

204 RESULTS

205 Baseline Characteristics

206 The total number of admissions between 2010 and 2014 are shown for each state in
207 **table 1**. Patients in CO were generally younger, more commonly female, and less
208 ethnically diverse. Wealth in CO was less equally distributed, with a higher proportion of
209 individuals with lower income in CO compared to NY. Finally, admission rates were
210 lower in CO than the control states for most NAS diagnoses, with exceptions for pre-
211 diabetes and post-traumatic stress disorder.

212

213 Study Validation

214 Over 2010-2014, the change in rates of cannabis abuse admissions after versus before
215 recreational cannabis legalization in 2012 was greater in CO than in NY and OK (risk
216 ratio [RR], 1.27; 95% confidence interval [CI], 1.26 to 1.28 and RR 1.16; 95% CI 1.15 to
217 1.17; both $P < 0.0005$, respectively) (**figure 1A-B**). No significant changes comparing the
218 two control states, NY and OK, were observed over the same time period (RR 0.93;
219 95% CI 0.87 to 1.00; $P = 0.05$).

220

221 Inpatient Healthcare Utilization after Cannabis Legalization

222 *Number of admissions*

223 In unadjusted analyses, CO, NY, and OK had a similar number of total admissions
224 before versus after recreational cannabis legalization (**figure 2A**). After adjusting for

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3 225 covariates, there was a reduction of number of admissions following cannabis
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5 226 legalization in CO when compared to OK (RR 0.97; 95% CI 0.96 to 0.98; $P<0.0005$).
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7 227 The point estimate was similar when comparing CO to NY, but did not reach statistical
8
9 228 significance (RR 0.99; 95% CI 0.98 to 1.01; $P=0.47$). Results were similar in sensitivity
10
11 229 analysis using January 1, 2014 as change of policy date (CO versus OK: RR 0.96; 95%
12
13 230 CI 0.96 to 0.96; $P<0.0005$, and CO versus NY: RR 0.99; 95% CI 0.96 to 1.02; $P=0.59$).
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19 232 *Length of stay*

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21 233 The median length of stay also remained similar after cannabis legalization across the 3
22
23 234 states in unadjusted analyses (**figure 2B**). After adjusting for covariates, length of
24
25 235 inpatient stay did not change significantly in CO following the law change when
26
27 236 compared with each of the 2 control states (1.75% annual reduction; 95% CI -12.25% to
28
29 237 10.01% in CO versus NY, and 3.46% annual reduction, 95% CI -16.48% to 37.90%
30
31 238 versus OK; $P= 0.30$ and $P=0.20$, respectively). Length of stay did not change
32
33 239 significantly in CO compared with the control states when we used January 1, 2014 as
34
35 240 change of policy date.
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42 242 *Healthcare Costs*

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44 243 In unadjusted analyses, the 3 states exhibited similar total costs across the study time
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46 244 period (**figure 2C** and eTable 2). In multivariate analyses, healthcare costs remained
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48 245 similar in state comparisons (2.99%; 95% CI -7.55% to 14.74%; $P=0.18$ versus NY and
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50 246 3.45%; 95% CI -7.31% to 15.46%; $P=0.16$ versus OK) after cannabis legalization. No
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53 247 meaningful differences of healthcare costs were observed in the sensitivity analyses
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3 248 with January 1, 2014 as change of policy date or when we assumed the cost-to-charge
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5 249 ratio for OK was equal to the average of the other states.
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9 10 251 **Changes in Specific Diagnoses Highlighted by the National Academy of Sciences**

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12 252 Among the diagnoses with either substantial or moderate evidence of influence by
13
14 253 cannabis per the NAS, we distinguished between: 1) a group with no statistically
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16 254 significant post-legalization differences between control states (NY versus OK $P>0.05$),
17
18 255 suggesting that secular trends unlikely explained differences between CO and control
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20 256 states (**figure 3**); and 2) a group with significant differences in diagnoses post-
21
22 257 legalization between control states (NY versus OK $P<0.05$) (eFigure 1).
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26 258 In the NY versus OK $P>0.05$ group (**figure 3**), changes in rates of diagnoses
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28 259 after cannabis legalization reflected NAS-based evidence for most health outcomes.
29
30 260 Among the diagnoses most consistent with NAS-based evidence, there was an increase
31
32 261 in motor vehicle accidents, alcohol abuse, overdose injury and a decrease of chronic
33
34 262 pain after recreational cannabis legalization (each meeting statistical significance for
35
36 263 both comparisons with control states) . When using less stringent criteria ($P<0.05$ for
37
38 264 both comparisons with NY and OK but where the relative risk for only one comparison
39
40 265 was in the same direction as NAS), admissions for abuse of other substances and
41
42 266 social anxiety disorder also increased with recreational cannabis legalization (**figure 3**).
43
44 267 Effects of cannabis liberalization on psychiatric outcomes (schizophrenia and bipolar
45
46 268 disorders) were either not consistent or weakly consistent with NAS (**figure 3**). When
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48 269 differences between the two control states (NY and OK) were also significantly different
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50 270 (suggesting effects potentially related to secular trends)(eFigure 1), changes in
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3 271 diagnoses were mostly not concordant with NAS findings or one of the comparisons
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5 272 between CO and either NY or OK did not exhibit statistical significance. Changes of the
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7 273 risk over time with counterfactuals are shown for each NAS diagnosis in online
8
9
10 274 supplementary eFigures 2-15.

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12 275 In the sensitivity analysis using January 1, 2014 as change of policy date (eTable
13
14 276 3), the main findings highlighted in the primary analysis using our stringent criteria
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16 277 (increase of alcohol abuse, motor vehicle accidents, overdose injury and decrease of
17
18 278 chronic pain) again met the same criteria in favor of significant associations, except for
19
20 279 overdose injury and chronic pain (the latter meeting 2 of the 3 criteria described in the
21
22 280 Methods). In sensitivity analyses removing “in remission” diagnoses, no meaningful
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24 281 changes were observed (relevant to alcohol abuse and abuse of other substances).
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31 283 **DISCUSSION**

32 33 284 **Principal findings**

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35 285 Legalization of recreational cannabis was associated with more cannabis abuse, and
36
37 286 minimal effects on overall healthcare utilization. Changes in specific medical diagnoses
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39 287 post-legalization reflected previously published substantial or moderate evidence on the
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41 288 health effects of cannabis, including an increase in alcohol abuse, overdose injury and a
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43 289 decrease of chronic pain.
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47 290 The increased frequency of cannabis abuse diagnoses in CO helps to validate
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49 291 the concept that legalization would result in greater use.
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51 292 Effects of recreational cannabis legalization on healthcare utilization appeared to
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53 293 be overall neutral. There was no evidence that either the length of stay or healthcare
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3 294 costs changed following liberalization of recreational cannabis. There was a reduction of
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5 295 overall hospitalizations in CO when compared to OK but not compared to NY,
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7 296 potentially because unaccounted state-level characteristics may have driven overall
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10 297 admissions differently.

11
12 298 Following legalization of recreational cannabis, changes in rates of medical
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14 299 diagnoses reflected NAS-based evidence for most health outcomes. The absence of
15
16 300 statistically significant differences in these outcomes between the two control states (NY
17
18 301 and OK) over the same time period provides some evidence that these observed
19
20 302 differences were less likely related to broader secular trends. After legalization of
21
22 303 recreational cannabis, there was an increase in motor vehicle accidents, alcohol abuse,
23
24 304 overdose injury and a decrease of chronic pain. In addition to information provided in
25
26 305 the NAS summary,³ the association of cannabis with motor vehicle accidents has been
27
28 306 highlighted by recent literature.^{7, 8} Consistent with our findings, a substantial
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30
31 307 bidirectional comorbidity between cannabis use and alcohol use has been previously
32
33 308 demonstrated, resulting in a moderate level of evidence designation for this relationship
34
35 309 per the NAS.⁹ Also compatible with the NAS summary, we report that recreational
36
37 310 cannabis legalization was associated with an increasing number of admissions for
38
39 311 overdose injury. These included overdose of analgesics, barbiturates, sedative,
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41 312 hypnotics and psychotropic drugs (eTable 2). This finding underlines the association of
42
43 313 cannabis use with other behaviors of drug addiction as highlighted by a recent cross-
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45 314 sectional survey of over 30 thousand community-living US adults.¹⁰ Finally, reduction of
46
47 315 chronic pain, especially neuropathic pain, in cannabis users is well known, although
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49 316 prior literature has focused on medical rather than recreational cannabis.^{11, 12}
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3 317 Except for social anxiety, the effects of recreational cannabis legalization on
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5 318 psychiatric outcomes (schizophrenia, bipolar disorder, depression) were weakly or not
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7 319 consistent with prior NAS-evidence. This finding may be related to residual confounding
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9 320 by state-level characteristics, unaccounted secular trends, or insufficient longitudinal
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11 321 follow-up.

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14 322 We demonstrate that abuse of alcohol or other substances remains higher after
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16 323 recreational cannabis legalization in a sensitivity analysis without “in remission”
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18 324 diagnoses. Overall, these findings suggest that when the substance use disorder is in
19
20 325 remission, it does not play a significant role in overall results.

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22
23 326 In our primary analysis, we used December 10, 2012 as the date of recreational
24
25 327 cannabis legalization. Following this date, private possession and growth of cannabis
26
27 328 became legal in Colorado. After January 1, 2014, recreational cannabis could be legally
28
29 329 purchased in retail stores.⁵ To take the additional effect of retail sales of recreational
30
31 330 cannabis into account, we performed sensitivity analyses using January 2014 as the
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33 331 “change of policy” date. We did not observe any meaningful difference in the majority of
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35 332 the outcomes studied, suggesting that the effect of recreational cannabis on healthcare
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37 333 utilization was independent of availability in stores.

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43 44 335 **Strengths and Weaknesses**

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46 336 Although several studies have investigated the health effects of cannabis,¹³ they have
47
48 337 relied on small sample sizes or have generated conflicting data.¹⁴⁻¹⁶ In contrast, our
49
50 338 findings are derived from HCUP state-wide data comprising over 28 million individuals
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52 339 and over 16 million hospitalizations across CO, site of the 2012 *Amendment 64*, and 2

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3 340 controls states without cannabis legalization over the same time period. As NY and OK
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5 341 are very different geographically and demographically, we believe their inclusion as
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7 342 control states represents a strength of our manuscript. Specifically, their selection
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9 343 allowed us to demonstrate that the effects of recreational cannabis legalization on
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11 344 health care utilization were likely independent of living in an urban or rural setting.
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14 345 Several limitations should be acknowledged. The HCUP database relies on
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16 346 physician coding; however, such coding for several medical diagnoses listed in **table 1**
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18 347 have been shown to be highly specific with variable sensitivity¹⁷⁻²⁰ and HCUP has
19
20 348 proven to be a powerful tool in large population studies.²⁰⁻²⁴ Some potentially important
21
22 349 mediators are not captured by ICD-9 codes, such as quantity of cannabis used or
23
24 350 formulation (oral versus other), although these may be more relevant to identifying
25
26 351 mechanisms and their absence would likely not lead to false positive results. Patients
27
28 352 may be more likely to disclose cannabis use following legalization of recreational
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30 353 cannabis and clinicians may be more inclined to test for it. Hence, we cannot completely
31
32 354 exclude detection bias in the validation analysis showing an increase in cannabis abuse
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34 355 diagnoses following legalization of recreational cannabis. Moreover, we cannot exclude
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36 356 that the increased frequency of cannabis abuse hospitalizations is simply related to
37
38 357 severity of cannabis abuse rather than to a greater prevalence of cannabis use.
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44 358 As with any observational study, we cannot exclude residual confounding as an
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46 359 explanation of our findings. However, we adjusted for conventionally recognized
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48 360 confounders as appropriate and as available, and, as this was largely a study of the
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50 361 same populations pre- and post-legalization, many of the limitations inherent to
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52 362 conventional individual-level analyses are likely less relevant.
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3 363 We did not select all US states as controls. Most states do not have HCUP data
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5 364 up until the end of 2014, each requires a separate HCUP application, and each carries
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7 365 significant costs. We acknowledge this represents a limitation as we could not fully
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9 366 account for secular trends that might influence results. However, we have adjusted all
10
11 367 analyses for urbanicity and other state-level differences in order to minimize the impact
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13 368 of secular trends. We also acknowledge that CO had legalized medical cannabis prior to
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15 369 legalization of recreational cannabis on December 10, 2012. However, control states
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17 370 NY and OK had not. We could have selected control states that had already
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19 371 medicalized cannabis instead of NY and OK, but we acknowledge that complex
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21 372 differences exist among medical legalization regimens among states.²⁵ Hence, we
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23 373 believe selection of control states with diverse medical legalization regimens would
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25 374 have primarily reduced our power to detect a real difference rather than contribute to
26
27 375 any false positive spurious results. In our study, we demonstrate that legalization of
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29 376 recreational cannabis is associated with more cannabis abuse or cannabis use disorder.
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31 377 Prior large, multi-state, population-based analyses have shown that legalization of
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33 378 medical cannabis is associated with increased cannabis use, but not increased
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35 379 cannabis use disorder.²⁶ One could speculate that medical cannabis consumption is
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37 380 more controlled and rationed when compared to recreational cannabis, the latter
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39 381 available in both retail stores and private homes and therefore perhaps more easily
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41 382 abused. Further studies are needed to quantify the amount of cannabis consumption (in
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43 383 grams) in states where only medical cannabis is legal versus states where both medical
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45 384 and recreational cannabis are allowed.
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3 385 The HCUP database does not capture information regarding outpatient activity
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5 386 and therefore these findings are restricted to hospital-based medicine.
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8 387 Our use of stringent criteria in assessing changes related to NAS diagnoses may
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10 388 have been too conservative, leading to a sacrifice of false negatives in order to avoid
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12 389 false positives.
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15 390 Finally, our study was limited to two-year follow-up after recreational cannabis
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17 391 legalization, and we therefore cannot comment on long-term effects that may result.
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21 393 **Conclusions**

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24 394 In conclusion, recreational cannabis legalization is associated with an expected
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26 395 increase in cannabis abuse. Overall effects on inpatient healthcare utilization appear to
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28 396 be neutral, with subtle changes in various components of that utilization likely occurring
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30 397 due to changes in the types of admissions observed. Measurable effects of recreational
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32 398 cannabis legalization on increasing motor vehicle accidents, alcohol abuse, overdose
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34 399 injury and reducing chronic pain are consistent with previously established evidence.
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38 400 These data provide the first description of population-level effects that may help guide
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40 401 future decisions regarding cannabis policy, individuals considering using cannabis, and
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42 402 physicians caring for those who may choose to consume it.
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3 403 **Contributors** FND and GMM had full access to all of the data in the study and take
4
5 404 responsibility for the integrity of the data and the accuracy of the data analysis. FND
6
7 405 and GMM were responsible for the study concept and design. All authors (FND, EV,
8
9 406 TAD, MJP, JEO, GN, KA, CDF, ESL, SMF, DSK, and GMM) contributed to data
10
11 407 acquisition, analysis, and interpretation. EV, GN, and GMM completed the statistical
12
13 408 analysis. FND and GMM drafted the manuscript and were responsible for the critical
14
15 409 revision of the manuscript for important intellectual content. GMM obtained funding for
16
17 410 the study. All authors contributed to the administrative, technical, and material support
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19 411 for the study and approved the final version of the manuscript.
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23
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25
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27
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29
30 415 study; data analysis or interpretation; preparation of the manuscript; or the decision to
31
32 416 submit the manuscript for publication.
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35 417 **Competing interests** None declared.
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38 418 **Patient consent** Not required.
39

40 419 **Ethics approval** Ethical approval to use de-identified HCUP data was obtained from
41
42 420 the University of California, San Francisco Committee on Human Research.
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45 421 **Data sharing** Data consist of deidentified participant data (i.e. ICD-9 admission
46
47 422 diagnoses) available from the Healthcare Cost and Utilization Project (HCUP) for a fee.
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49 423 Information about how to obtain the data and for what time period can be found at:
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51 424 <https://www.hcup-us.ahrq.gov/>
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500 **FIGURE LEGENDS**

501 **Figure 1.** Multivariate adjusted rates of admissions for cannabis abuse over 2010-2014
502 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy,
503 compared with New York (A) and Oklahoma (B), control states without cannabis
504 legalization. Red lines show the predicted rates of admissions for cannabis abuse had
505 the cannabis legalization policy not been instituted. The comparison between Colorado
506 and the control states with regards to change of risk ratio (RR) slope within the 2010-
507 2012 period (pre-legalization) and 2012-2014 period (post-legalization), as well of the
508 overall RR slope change, are also represented for the Colorado versus New York (A)
509 and Colorado versus Oklahoma (B) comparisons. Red lines show the predicted rates of
510 admissions for cannabis abuse had the cannabis legalization policy not been instituted.
511 Each model was adjusted for age, gender, and race and state-level characteristics (see
512 Methods section for further details). CI = confidence interval; vs = versus.

513
514 **Figure 2.** Healthcare utilization over 2010-2014 in Colorado, site of implementation of
515 the 2012 recreational cannabis legalization policy, and in New York and Oklahoma,
516 control states without cannabis legalization. The total number of admissions/1000
517 population per year, the median length of stay per year, and the median costs per
518 individual per year are shown in panels A, B, and C, respectively for the 3 states. Error
519 bars denote interquartile ranges. LOS = length of stay.

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521 **Figure 3.** Health outcomes with substantial or moderate evidence of a statistical
522 association with cannabis use based on the National Academy of Science (NAS)

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3 523 summary statement. Medical diagnoses are identified based on a non-significant
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5 524 ($P>0.05$) comparison between New York (NY) and Oklahoma (OK) (control states
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8 525 without cannabis legalization) with regards to the change of admission rates for such
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10 526 diagnoses following cannabis legalization. P values for the comparison between
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12 527 Colorado (CO) (site of cannabis legalization) and NY (rhomboid symbol), or between
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14 528 CO and OK (circular symbol) are shown as either <0.05 , or > 0.05 using a gray scale for
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17 529 evidence of cannabis benefit (risk ratio [RR] < 1 shown on the left) and cannabis harm
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19 530 (RR >1 shown on the right); 95% confidence intervals are shown for the comparison
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22 531 between CO and NY and between CO and OK as solid and dotted lines, respectively.
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24 532 Progressively darker shades of green or red indicate greater weight of evidence in the
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26 533 direction of proposed benefit versus harm, respectively, by the NAS.
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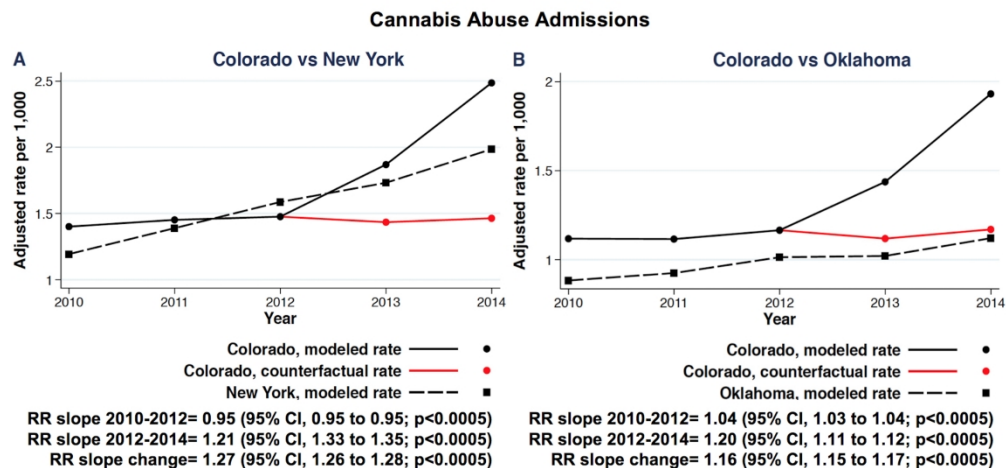
Table 1. Clinical characteristics of the 3 study states over the 2010-2014 period.

	Colorado	New York	Oklahoma	<i>P</i> value
Total population	5,197,237	19,594,599	3,819,383	
Total admissions	2,088,909	11,726,283	2,334,988	
Total admissions/1,000 population	402±0.27	598±0.17	611±0.40	0.0001
Demographics				
Age – yr	45 ± 28	49 ± 28	48 ± 28	0.0001
Male – no. (%)	870,573 (42)	5,087,181 (41)	954,848 (43)	0.0001
Race – no. (%)				0.0001
White	1,548,099 (74)	6,406,582 (55)	1,879,727 (81)	
Black	102,444 (5)	2,083,366 (18)	202,420 (9)	
Native American	13,143 (1)	36,216 (0.3)	131,714 (6)	
Other	425,223 (20)	3,200,119 (27)	121,127 (5)	
Lifestyle				
Median Household Income, dollars (quartiles for patient ZIP code) – no. (%)				0.0001
Quartile 1	617,537 (30)	3,087,192 (28)	No data	
Quartile 2	558,760 (27)	2,623,087 (24)		
Quartile 3	470,051 (23)	2,673,153 (24)		
Tobacco use – no. (%)	251,566 (12)	1,717,940 (10)	235,685 (14)	0.0001
Alcohol abuse – no. (%)	112,715 (5)	652,608 (6)	71,931 (3)	0.0001
NAS Diagnoses				
Non-seminoma type testicular germ cell cancer – no. (%)	405 (0.02)	2,487 (0.02)	480 (0.02)	0.0001
Acute myocardial infarction – no. (%)	39,513 (1.9)	271,285 (2.3)	60,413 (2.6)	0.0001
Brain hemorrhage – no. (%)	10,963 (0.5)	58,278 (0.5)	10,245 (0.4)	0.0001
Ischemic stroke – no. (%)	27,986 (1.3)	194,478 (1.7)	45,602 (2)	0.0001

Metabolic syndrome & diabetes – no. (%)	294,821 (14)	2,301,835 (20)	465,353 (20)	0.0001
Prediabetes – no. (%)	42,544 (2)	73,407 (0.6)	24,246 (1)	0.0001
Bronchitis – no. (%)	65,265 (3)	429,230 (4)	131,343 (6)	0.0001
Motor vehicle accidents – no. (%)	14,941 (0.7)	59,686 (0.5)	13,692 (0.6)	0.0001
Overdose injury – no. (%)	10,933 (0.5)	40,226 (0.3)	12,147 (0.5)	0.0001
Substance use disorder – no. (%)	158,244 (7.6)	974,856 (8.3)	109,305 (4.7)	0.0001
Anxiety disorders – no. (%)	131,426 (6.4)	595,478 (5.2)	139,627 (6.1)	0.0001
Anxiety disorders (except social anxiety) – no. (%)	51,913 (2.5)	283,280 (2.4)	65,279 (2.8)	0.0016
Bipolar disorders – no. (%)	52,348 (2.5)	287,735 (2.5)	61,411 (2.6)	0.0001
Depressive disorders – no. (%)	213,851 (10)	827,932 (7)	190,083 (8)	0.0001
Schizophrenia or other psychoses – no. (%)	53,652 (2.6)	352,533 (3)	68,385 (2.9)	0.0001
Positive symptoms of schizophrenia (i.e. hallucinations) – no. (%)	2,653 (0.1)	9,482 (0.1)	3,531 (0.2)	0.0001
Post-traumatic stress disorder – no. (%)	28,582 (1.4)	75,608 (0.6)	17,101 (0.7)	0.0001
Social anxiety disorder – no. (%)	295 (0.01)	1,090 (0.01)	135 (0.01)	0.0295
Suicide – no. (%)	4,957 (0.2)	15,646 (0.1)	4,407 (0.2)	0.0001
Low offspring birthweight – no. (%)	2,842 (0.1)	7,462 (0.1)	1,742 (0.1)	0.0002
Maternal pregnancy complications – no. (%)	39,343 (1.9)	144,353 (1.2)	40,938 (1.8)	0.0001
Unemployment/low income – no. (%)	3,134 (0.2)	76,789 (0.7)	730 (0.03)	0.0001
Nausea or vomiting – no. (%)	63,806 (3)	162,11(1.4)	58,706 (2.5)	0.0001
Chronic pain – no. (%)	140,209 (6)	234,160 (2)	123,563 (5)	0.0001
Spasticity – no. (%)	5,759 (0.3)	12,517 (0.1)	5,371 (0.2)	0.0001

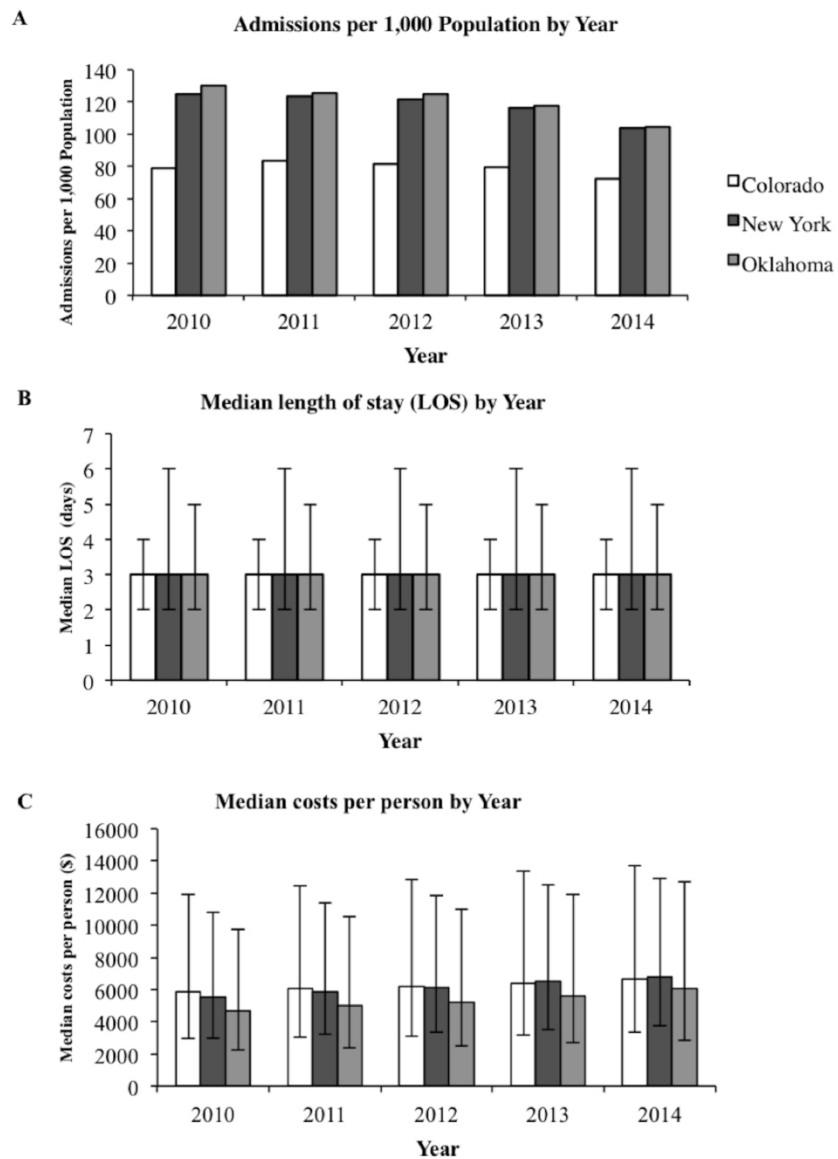
Short-term sleep – no. (%)	652 (0.03)	3,364 (0.03)	357 (0.02)	0.0001
Tourette syndrome – no. (%)	428 (0.02)	2,784 (0.02)	336 (0.01)	0.0001
Increased appetite & weight gain – no. (%)	1,022 (0.05)	3,017 (0.03)	651 (0.03)	0.0001

534 NAS = National Academy of Science. Admission diagnoses listed were based on those
 535 found influenced by cannabis in the 2017 NAS review.³ Substance use disorder includes
 536 dependence or abuse of alcohol, tobacco, or other illicit drug. All variables pertain to the
 537 2010-2014 period. Plus-minus values are means \pm SD. No. (%) indicates number of
 538 admissions with a specific demographic/lifestyle characteristic or NAS diagnosis (% of
 539 total admissions). A *P* value less than 0.05 is considered statistically significant.



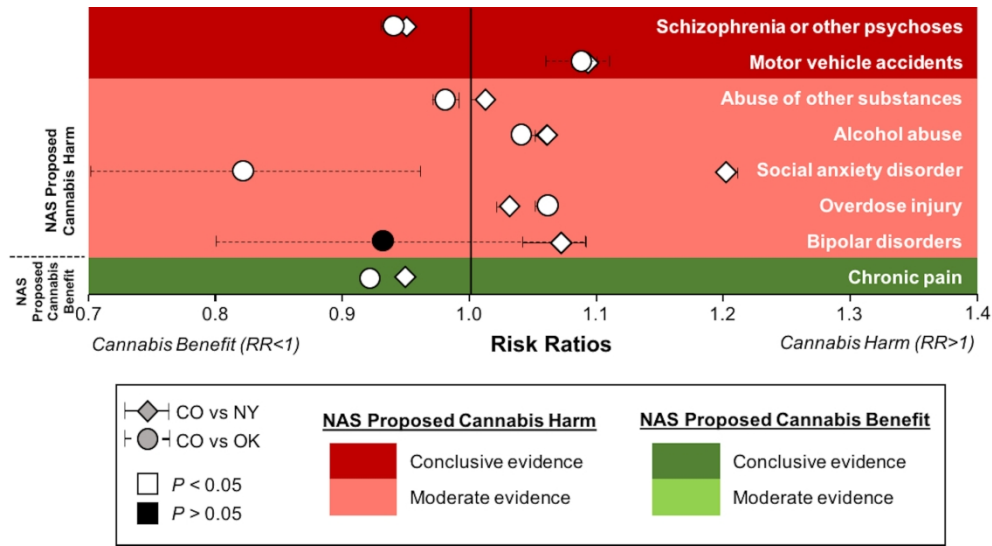
Multivariate adjusted rates of admissions for cannabis abuse over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, compared with New York (A) and Oklahoma (B), control states without cannabis legalization. Red lines show the predicted rates of admissions for cannabis abuse had the cannabis legalization policy not been instituted. The comparison between Colorado and the control states with regards to change of risk ratio (RR) slope within the 2010-2012 period (pre-legalization) and 2012-2014 period (post-legalization), as well as the overall RR slope change, are also represented for the Colorado versus New York (A) and Colorado versus Oklahoma (B) comparisons. Red lines show the predicted rates of admissions for cannabis abuse had the cannabis legalization policy not been instituted. Each model was adjusted for age, gender, and race and state-level characteristics (see Methods section for further details). CI = confidence interval; vs = versus.

663x316mm (300 x 300 DPI)



Healthcare utilization over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, and in New York and Oklahoma, control states without cannabis legalization. The total number of admissions/1000 population per year, the median length of stay per year, and the median costs per individual per year are shown in panels A, B, and C, respectively for the 3 states. Error bars denote interquartile ranges. LOS = length of stay.

160x221mm (300 x 300 DPI)



Health outcomes with substantial or moderate evidence of a statistical association with cannabis use based on the National Academy of Science (NAS) summary statement. Medical diagnoses are identified based on a non-significant ($P > 0.05$) comparison between New York (NY) and Oklahoma (OK) (control states without cannabis legalization) with regards to the change of admission rates for such diagnoses following cannabis legalization. P values for the comparison between Colorado (CO) (site of cannabis legalization) and NY (rhomboid symbol), or between CO and OK (circular symbol) are shown as either < 0.05 , or > 0.05 using a gray scale for evidence of cannabis benefit (risk ratio [RR] < 1 shown on the left) and cannabis harm (RR > 1 shown on the right); 95% confidence intervals are shown for the comparison between CO and NY and between CO and OK as solid and dotted lines, respectively. Progressively darker shades of green or red indicate greater weight of evidence in the direction of proposed benefit versus harm, respectively, by the NAS.

188x101mm (300 x 300 DPI)

Supplementary Appendix

Changes in Inpatient Healthcare Utilization after Legalization of Recreational Cannabis

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This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Cost Analysis

Cost Estimations

The inpatient cost for each hospitalization in New York and Colorado was estimated by multiplying the total charges (TOTCHG) obtained from HCUP State Inpatient Database with the institution-specific all-payer cost-to-charge ratio (APICC) obtained from the Cost-to-Charge Ratio file. Hospital ID was used as a linkage to merge both files. Total inpatient costs were calculated as the sum of the cost for all hospitalizations in a given state for a particular year. The databases contained 186,226 (8.7%) encounters with non-matched/missing hospital ID for NY and 1,132,696 (9.6%) encounters with non-matched/missing hospital ID for Colorado; for these encounters. In order to estimate the cost of these hospitalizations (for which we had charges but no cost-to-charge ratio) we applied the average cost-to-charge ratio for that state-year. This was estimated by dividing the sum of costs for all hospitalizations for which cost-to-charge ratios were available by the sum of charges for all hospitalizations for which cost-to-charge ratios were available in a given state-year (eTable 2).

Oklahoma Total Cost Estimate

HCUP does not produce SID and CCR file for Oklahoma. We obtained these data from Oklahoma State Department of Health – this dataset contains information about total charges but not cost-to-charge ratios. We estimated total inpatient costs in Oklahoma in two ways. First, we used a state-wide constant cost-to-charge ratio (0.3119) to estimate the total cost (ratio derived from the Institute for Health and Socio-Economic Policy calculations of federal cost reports). We then conducted a sensitivity analysis in which we used the average of the cost-to-charge ratios of New York and Colorado for any given state-year (eTable 2).

eTable 1. Yearly costs and charges for the 3 study states

Colorado	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	397,505	428,912	424,640	418,952	418,900	2,088,909
Hospitalizations for which CCR is available, n (%)	396,433 (99.7%)	301,586 (70.3%)	382,021 (90.0%)	412,483 (98.5%)	413,160 (98.6%)	1,905,683 (91.2%)
Total charges for hospitalizations for which CCR is available	\$14,382,791,648	\$11,170,040,412	\$15,821,232,608	\$19,349,895,615	\$20,370,018,114	\$81,093,978,397
Total costs for hospitalizations for which CCR is available	\$4,104,443,164	\$3,033,915,324	\$3,963,892,093	\$4,619,884,886	\$4,700,380,255	\$20,422,515,722
Average CCR*	0.2854	0.2716	0.2505	0.2388	0.2309	
Hospitalizations for which CCR is not available, n (%)	1,072 (0.3%)	127,326 (29.7%)	42,619 (10.0%)	6,469 (1.5%)	5,740 (1.4%)	183,226 (8.8%)
Total charges for hospitalizations for which CCR is not available	\$55,039,614	\$5,704,285,087	\$2,494,379,901	\$241,011,451	\$211,228,665	\$8,705,944,718
Total costs for hospitalizations for which CCR is not available†	\$15,708,306	\$1,549,283,830	\$624,842,165	\$57,553,535	\$48,772,699	\$2,296,160,534
Total inpatient costs	\$4,120,151,470	\$4,583,199,154	\$4,588,734,258	\$4,677,438,421	\$4,749,152,954	\$22,718,676,256

*Average CCR was estimated by dividing the total of costs for all hospitalizations for which cost-to-charge ratios were available by the total charges for hospitalizations for which cost-to-charge ratios were available in a given state-year.

†Total charges for hospitalization for which CCR is not available multiplied by Average CCR in a given state-year.

New York	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	2,417,298	2,414,985	2,389,701	2,290,502	2,213,797	11,726,283
Hospitalizations for which CCR is available, n (%)	2,189,513 (90.6%)	2,157,629 (89.3%)	2,168,880 (90.8%)	2,056,367 (89.8%)	2,021,199 (91.3%)	10,593,588 (90.3%)
Total charges for hospitalizations for which CCR is available	\$66,303,900,691	\$69,885,515,755	\$74,728,795,811	\$77,680,292,105	\$79,252,368,106	\$367,850,872,468
Total costs for hospitalizations for which CCR is available	\$22,376,381,374	\$23,448,311,348	\$24,539,963,919	\$24,331,920,273	\$23,892,478,440	\$118,589,055,354
Average CCR*	0.3375	0.3355	0.3283	0.3132	0.3014	
Hospitalizations for which CCR is not available, n (%)	227,785 (9.4%)	257,356 (10.7%)	220,821 (9.2%)	234,135 (10.2%)	192,598 (8.7%)	1,132,695 (9.7%)
Total charges for hospitalizations for which CCR is not available	\$4,168,104,163	\$4,821,903,339	\$4,088,909,686	\$5,687,320,556	\$5,336,461,039	\$24,102,698,783
Total costs for hospitalizations for which CCR is not available†	\$1,406,735,155	\$1,617,748,571	\$1,342,797,941	\$1,781,268,798	\$1,608,409,357	\$7,756,959,821
Total inpatient costs	\$23,783,116,529	\$25,066,059,919	\$25,882,761,860	\$26,113,189,071	\$25,500,887,797	\$126,346,015,175

*Average CCR was estimated by dividing the total of costs for all hospitalizations for which cost-to-charge ratios were available by the total charges for hospitalizations for which cost-to-charge ratios were available in a given state-year.

†Total charges for hospitalization for which CCR is not available multiplied by Average CCR in a given state-year.

Oklahoma	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	489,724	476,605	476,728	452,724	439,207	2,334,988
Hospitalizations for which CCR is available, n (%)	489724 (100%)	476605 (100%)	476728 (100%)	452724 (100%)	439207 (100%)	2334988 (100%)
Total charges for hospitalizations for which CCR is available	\$13,927,214,520	\$14,645,751,657	\$15,247,598,300	\$15,596,643,583	\$15,003,967,132	\$74,421,175,192
Total costs for hospitalizations for which CCR is available	\$4,343,898,209	\$4,568,009,942	\$4,755,725,910	\$4,864,593,134	\$5,001,131,977	\$23,533,359,171
Average CCR*	0.3119	0.3119	0.3119	0.3119	0.3119	

*Statewide constant CCR (0.3119) used to estimate the total cost across years.

Oklahoma (sensitivity analysis)	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalization, n	489,724	476,605	476,728	452,724	439,207	2,334,988
Hospitalization for which CCR is available, n (%)	489724 (100%)	476605 (100%)	476728 (100%)	452724 (100%)	439207 (100%)	2334988 (100%)
Total charges for hospitalization for which CCR is available	\$13,927,214,520	\$14,645,751,657	\$15,247,598,300	\$15,596,643,583	\$15,003,967,132	\$74,421,175,192
Total costs for hospitalization for which CCR is available	\$4,337,630,962	\$4,445,717,915	\$4,413,417,328	\$4,304,673,629	\$4,267,557,794	\$21,768,997,628
Average CCR*	0.3114	0.3036	0.2895	0.276	0.2662	

*Average of the CCRs of New York and Colorado for any given state-year.

eTable 2. International Classification of Diseases-9th Edition (ICD-9) codes defining each medical diagnosis.

Chronic pain

ICD-9 Code	Short Description	Long Description
338.21	Chronic pain d/t trauma	Chronic pain due to trauma
338.22	Chronic post-thoracot pain	Chronic post-thoracotomy pain
338.28	Chronic postop pain NEC	Other chronic postoperative pain
338.29	Chronic pain NEC	Other chronic pain
338.4	Chronic pain syndrome	Chronic pain syndrome

Nausea or vomiting

ICD-9 Code	Short Description	Long Description
787.03	Vomiting alone	Vomiting alone
787.02	Nausea alone	Nausea alone
787.01	Nausea with vomiting	Nausea with vomiting

Spasticity

ICD-9 Code	Short Description	Long Description
728.85	Spasm of muscle	Spasm of muscle

Short-term sleep disorders

ICD-9 Code	Short Description	Long Description
307.4	Nonorganic sleep dis NOS	Nonorganic sleep disorder, unspecified
307.41	Transient insomnia	Transient disorder of initiating or maintaining sleep
307.42	Persistent insomnia	Persistent disorder of initiating or maintaining sleep
307.45	Nonorganic circadian rhy	Circadian rhythm sleep disorder of nonorganic origin
307.47	Sleep stage dysfunc NEC	Other dysfunctions of sleep stages or arousal from sleep
307.49	Nonorganic sleep dis NEC	Other specific disorders of sleep of nonorganic origin

Increased appetite and weight gain

ICD-9 Code	Short Description	Long Description
783.1	Abnormal weight gain	Abnormal weight gain
783.6	Polyphagia	Polyphagia

Tourette's syndrome

ICD-9 Code	Short Description	Long Description
307.23	Tourette's disorder	Tourette's disorder

Posttraumatic stress disorder

ICD-9 Code	Short Description	Long Description
309.81	Posttraumatic stress dis	Posttraumatic stress disorder

Non-seminoma-type testicular germ cell cancer

ICD-9 Code	Short Description	Long Description
186.9	Malig neo testis NEC	Malignant neoplasm of other and unspecified testis

Acute myocardial infarction

ICD-9 Code	Short Description	Long Description
410	AMI anterolateral,unspec	Acute myocardial infarction of anterolateral wall, episode of care unspecified
410.01	AMI anterolateral, init	Acute myocardial infarction of anterolateral wall, initial episode of care
410.02	AMI anterolateral,subseq	Acute myocardial infarction of anterolateral wall, subsequent episode of care
410.1	AMI anterior wall,unspec	Acute myocardial infarction of other anterior wall, episode of care unspecified
410.11	AMI anterior wall, init	Acute myocardial infarction of other anterior wall, initial episode of care
410.12	AMI anterior wall,subseq	Acute myocardial infarction of other anterior wall, subsequent episode of care
410.2	AMI inferolateral,unspec	Acute myocardial infarction of inferolateral wall, episode of care unspecified
410.21	AMI inferolateral, init	Acute myocardial infarction of inferolateral wall, initial episode of care
410.22	AMI inferolateral,subseq	Acute myocardial infarction of inferolateral wall, subsequent episode of care
410.3	AMI inferopost, unspec	Acute myocardial infarction of inferoposterior wall, episode of care unspecified
410.31	AMI inferopost, initial	Acute myocardial infarction of inferoposterior wall, initial episode of care
410.32	AMI inferopost, subseq	Acute myocardial infarction of inferoposterior wall, subsequent episode of care
410.4	AMI inferior wall,unspec	Acute myocardial infarction of other inferior wall, episode of care unspecified
410.41	AMI inferior wall, init	Acute myocardial infarction of other inferior wall, initial episode of care
410.42	AMI inferior wall,subseq	Acute myocardial infarction of other inferior wall, subsequent episode of care
410.5	AMI lateral NEC, unspec	Acute myocardial infarction of other lateral wall, episode of care unspecified
410.51	AMI lateral NEC, initial	Acute myocardial infarction of other lateral wall, initial episode of care
410.52	AMI lateral NEC, subseq	Acute myocardial infarction of other lateral wall, subsequent episode of care
410.6	True post infarct,unspec	True posterior wall infarction, episode of care unspecified
410.61	True post infarct, init	True posterior wall infarction, initial episode of care

410.62	True post infarct,subseq	True posterior wall infarction, subsequent episode of care
410.7	Subendo infarct, unspec	Subendocardial infarction, episode of care unspecified
410.71	Subendo infarct, initial	Subendocardial infarction, initial episode of care
410.72	Subendo infarct, subseq	Subendocardial infarction, subsequent episode of care
410.8	AMI NEC, unspecified	Acute myocardial infarction of other specified sites, episode of care unspecified
410.81	AMI NEC, initial	Acute myocardial infarction of other specified sites, initial episode of care
410.82	AMI NEC, subsequent	Acute myocardial infarction of other specified sites, subsequent episode of care
410.9	AMI NOS, unspecified	Acute myocardial infarction of unspecified site, episode of care unspecified
410.91	AMI NOS, initial	Acute myocardial infarction of unspecified site, initial episode of care
410.92	AMI NOS, subsequent	Acute myocardial infarction of unspecified site, subsequent episode of care

Ischemic stroke

ICD-9 Code	Short Description	Long Description
435.8	Trans cereb ischemia NEC	Other specified transient cerebral ischemias
435.9	Trans cereb ischemia NOS	Unspecified transient cerebral ischemia
433.01	Ocl bslr art w infrc	Occlusion and stenosis of basilar artery with cerebral infarction
433.11	Ocl crtd art w infrc	Occlusion and stenosis of carotid artery with cerebral infarction
433.21	Ocl vrtb art w infrc	Occlusion and stenosis of vertebral artery with cerebral infarction
433.31	Ocl mlt bi art w infrc	Occlusion and stenosis of multiple and bilateral precerebral arteries with cerebral infarction
433.81	Ocl spcf art w infrc	Occlusion and stenosis of other specified precerebral artery with cerebral infarction
433.91	Ocl art NOS w infrc	Occlusion and stenosis of unspecified precerebral artery with cerebral infarction
434.91	Crbl art ocl NOS w infrc	Cerebral artery occlusion, unspecified with cerebral infarction

Brain hemorrhage

ICD-9 Code	Short Description	Long Description
430	Subarachnoid hemorrhage	Subarachnoid hemorrhage
431	Intracerebral hemorrhage	Intracerebral hemorrhage
432	Nontraum extradural hem	Nontraumatic extradural hemorrhage
432.1	Subdural hemorrhage	Subdural hemorrhage
432.9	Intracranial hemorr NOS	Unspecified intracranial hemorrhage

Metabolic syndrome and diabetes

ICD-9 Code	Short Description	Long Description
277.7	Dysmetabolic syndrome x	Dysmetabolic syndrome X
250	DMII wo cmp nt st uncntr	Diabetes mellitus without mention of complication, type II or unspecified type, not stated as uncontrolled
250.02	DMII wo cmp uncntrld	Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled
250.1	DMII keto nt st uncntrld	Diabetes with ketoacidosis, type II or unspecified type, not stated as uncontrolled
250.12	DMII ketoacd uncntrld	Diabetes with ketoacidosis, type II or unspecified type, uncontrolled
250.2	DMII hprsm nt st uncntrl	Diabetes with hyperosmolarity, type II or unspecified type, not stated as uncontrolled
250.22	DMII hprosmrlr uncntrld	Diabetes with hyperosmolarity, type II or unspecified type, uncontrolled
250.3	DMII o cm nt st uncntrld	Diabetes with other coma, type II or unspecified type, not stated as uncontrolled
250.32	DMII oth coma uncntrld	Diabetes with other coma, type II or unspecified type, uncontrolled
250.4	DMII renl nt st uncntrld	Diabetes with renal manifestations, type II or unspecified type, not stated as uncontrolled
250.42	DMII renal uncntrld	Diabetes with renal manifestations, type II or unspecified type, uncontrolled
250.5	DMII ophth nt st uncntrl	Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled
250.52	DMII ophth uncntrld	Diabetes with ophthalmic manifestations, type II or unspecified type, uncontrolled
250.6	DMII neuro nt st uncntrl	Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled
250.62	DMII neuro uncntrld	Diabetes with neurological manifestations, type II or unspecified type, uncontrolled
250.7	DMII circ nt st uncntrld	Diabetes with peripheral circulatory disorders, type II or unspecified type, not stated as uncontrolled
250.72	DMII circ uncntrld	Diabetes with peripheral circulatory disorders, type II or unspecified type, uncontrolled
250.8	DMII oth nt st uncntrld	Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled
250.82	DMII oth uncntrld	Diabetes with other specified manifestations, type II or unspecified type, uncontrolled
250.9	DMII unspf nt st uncntrl	Diabetes with unspecified complication, type II or unspecified type, not stated as uncontrolled

250.92	DMII unspf uncntrld	Diabetes with unspecified complication, type II or unspecified type, uncontrolled
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Prediabetes

ICD-9 Code	Short Description	Long Description
790.29	Abnormal glucose NEC	Other abnormal glucose

Bronchitis

ICD-9 Code	Short Description	Long Description
466	Acute bronchitis	Acute bronchitis
490	Bronchitis NOS	Bronchitis, not specified as acute or chronic
491	Simple chr bronchitis	Simple chronic bronchitis
491.1	Mucopurul chr bronchitis	Mucopurulent chronic bronchitis
491.2	Obst chr bronc w/o exac	Obstructive chronic bronchitis without exacerbation
491.21	Obs chr bronc w(ac) exac	Obstructive chronic bronchitis with (acute) exacerbation
491.22	Obs chr bronc w ac bronc	Obstructive chronic bronchitis with acute bronchitis
491.8	Chronic bronchitis NEC	Other chronic bronchitis
491.9	Chronic bronchitis NOS	Unspecified chronic bronchitis

Motor vehicle accidents

ICD-9 Code	Short Description	Long Description
E812.0	Mv collision NOS-driver	Other motor vehicle traffic accident involving collision with motor vehicle injuring driver of motor vehicle other than motorcycle
E812.1	Mv collision NOS-pasngr	Other motor vehicle traffic accident involving collision with motor vehicle injuring passenger in motor vehicle other than motorcycle
E812.2	Mv collis NOS-motorcycl	Other motor vehicle traffic accident involving collision with motor vehicle injuring motorcyclist
E812.3	Mv coll NOS-mcycl psngr	Other motor vehicle traffic accident involving collision with motor vehicle injuring passenger on motorcycle
E812.4	Mv collision NOS-st car	Other motor vehicle traffic accident involving collision with motor vehicle injuring occupant of streetcar
E812.5	Mv coll NOS-anim rid	Other motor vehicle traffic accident involving collision with motor vehicle injuring rider of animal; occupant of animal-drawn vehicle
E812.6	Mv coll NOS-ped cycl	Other motor vehicle traffic accident involving collision with motor vehicle injuring pedal cyclist
E812.7	Mv collision NOS-pedest	Other motor vehicle traffic accident involving collision with motor vehicle injuring pedestrian

E812.8	Mv collis NOS-pers NEC	Other motor vehicle traffic accident involving collision with motor vehicle injuring other specified person
E812.9	Mv collis NOS-pers NOS	Other motor vehicle traffic accident involving collision with motor vehicle injuring unspecified person
E813.0	Mv-oth veh coll-driver	Motor vehicle traffic accident involving collision with other vehicle injuring driver of motor vehicle other than motorcycle
E813.1	Mv-oth veh coll-pasngr	Motor vehicle traffic accident involving collision with other vehicle injuring passenger in motor vehicle other than motorcycle
E813.2	Mv-oth veh coll-motcycl	Motor vehicle traffic accident involving collision with other vehicle injuring motorcyclist
E813.3	Mv-oth veh coll-mcyc psg	Motor vehicle traffic accident involving collision with other vehicle injuring passenger on motorcycle
E813.4	Mv-oth veh coll-st car	Motor vehicle traffic accident involving collision with other vehicle injuring occupant of streetcar
E813.5	Mv-oth veh coll-anim rid	Motor vehicle traffic accident involving collision with other vehicle injuring rider of animal; occupant of animal-drawn vehicle
E813.6	Mv-oth veh coll-ped cycl	Motor vehicle traffic accident involving collision with other vehicle injuring pedal cyclist
E813.7	Mv-oth veh coll-pedest	Motor vehicle traffic accident involving collision with other vehicle injuring pedestrian
E813.8	Mv-oth veh coll-pers NEC	Motor vehicle traffic accident involving collision with other vehicle injuring other specified person
E813.9	Mv-oth veh coll-pers NOS	Motor vehicle traffic accident involving collision with other vehicle injuring unspecified person
E814.0	Mv coll w pedest-driver	Motor vehicle traffic accident involving collision with pedestrian injuring driver of motor vehicle other than motorcycle
E814.1	Mv coll w pedest-pasngr	Motor vehicle traffic accident involving collision with pedestrian injuring passenger in motor vehicle other than motorcycle
E814.2	Mv coll w pedest-motcycl	Motor vehicle traffic accident involving collision with pedestrian injuring motorcyclist
E814.3	Mv coll w ped-mcycl psgr	Motor vehicle traffic accident involving collision with pedestrian injuring passenger on motorcycle
E814.4	Mv coll w pedest-st car	Motor vehicle traffic accident involving collision with pedestrian injuring occupant of streetcar
E814.5	Mv coll w ped-anim rid	Motor vehicle traffic accident involving collision with pedestrian injuring rider of animal; occupant of animal drawn vehicle
E814.6	Mv coll w ped-ped cycl	Motor vehicle traffic accident involving collision with pedestrian injuring pedal cyclist

E814.7	Mv coll w pedest-pedest	Motor vehicle traffic accident involving collision with pedestrian injuring pedestrian
E814.8	Mv coll w pedes-pers NEC	Motor vehicle traffic accident involving collision with pedestrian injuring other specified person
E814.9	Mv coll w pedes-pers NOS	Motor vehicle traffic accident involving collision with pedestrian injuring unspecified person
E815.0	Mv coll w oth obj-driver	Other motor vehicle traffic accident involving collision on the highway injuring driver of motor vehicle other than motorcycle
E815.1	Mv coll w oth obj-pasngr	Other motor vehicle traffic accident involving collision on the highway injuring passenger in motor vehicle other than motorcycle
E815.2	Mv coll w oth obj-mocycl	Other motor vehicle traffic accident involving collision on the highway injuring motorcyclist
E815.3	Mv coll w obj-mcycl psgr	Other motor vehicle traffic accident involving collision on the highway injuring passenger on motorcycle
E815.4	Mv coll w obj-st car	Other motor vehicle traffic accident involving collision on the highway injuring occupant of streetcar
E815.5	Mv coll w obj-anim rider	Other motor vehicle traffic accident involving collision on the highway injuring rider of animal; occupant of animal-drawn vehicle
E815.6	Mv coll w obj-ped cycl	Other motor vehicle traffic accident involving collision on the highway injuring pedal cyclist
E815.7	Mv coll w obj-pedest	Other motor vehicle traffic accident involving collision on the highway injuring pedestrian
E815.8	Mv coll w obj-pers NEC	Other motor vehicle traffic accident involving collision on the highway injuring other specified person
E815.9	Mv coll w obj-pers NOS	Other motor vehicle traffic accident involving collision on the highway injuring unspecified person
E816.0	Loss control mv acc-driv	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring driver of motor vehicle other than motorcycle
E816.1	Loss control mv acc-psgr	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring passenger in motor vehicle other than motorcycle
E816.2	Loss control mv-mocycl	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring motorcyclist
E816.3	Loss control mv-mcyc psg	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring passenger on motorcycle

E816.4	Loss cont mv acc-st car	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring occupant of streetcar
E816.5	Loss cont mv-anim rider	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring rider of animal; occupant of animal-drawn vehicle
E816.6	Loss control mv-ped cycl	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring pedal cyclist
E816.7	Loss control mv-pedest	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring pedestrian
E816.8	Loss control mv-pers NEC	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring other specified person
E816.9	Loss control mv-pers NOS	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring unspecified person
E819.0	Traffic acc NOS-driver	Motor vehicle traffic accident of unspecified nature injuring driver of motor vehicle other than motorcycle
E819.1	Traffic acc NOS-pasngr	Motor vehicle traffic accident of unspecified nature injuring passenger in motor vehicle other than motorcycle
E819.2	Traffic acc NOS-motcycl	Motor vehicle traffic accident of unspecified nature injuring motorcyclist
E819.3	Traff acc NOS-mcycl psgr	Motor vehicle traffic accident of unspecified nature injuring passenger on motorcycle
E819.4	Traffic acc NOS-st car	Motor vehicle traffic accident of unspecified nature injuring occupant of streetcar
E819.5	Traff acc NOS-anim rider	Motor vehicle traffic accident of unspecified nature injuring rider of animal; occupant of animal-drawn vehicle
E819.6	Traffic acc NOS-ped cycl	Motor vehicle traffic accident of unspecified nature injuring pedal cyclist
E819.7	Traffic acc NOS-pedest	Motor vehicle traffic accident of unspecified nature injuring pedestrian
E819.8	Traffic acc NOS-pers NEC	Motor vehicle traffic accident of unspecified nature injuring other specified person
E819.9	Traffic acc NOS-pers NOS	Motor vehicle traffic accident of unspecified nature injuring unspecified person

Overdose injuries

ICD-9 Code	Short Description	Long Description
E950.0	Poison-analgesics	Suicide and self-inflicted poisoning by analgesics, antipyretics, and antirheumatics

E950.1	Poison-barbiturates	Suicide and self-inflicted poisoning by barbiturates
E950.2	Poison-sedat/hypnotic	Suicide and self-inflicted poisoning by other sedatives and hypnotics
E950.3	Poison-psychotropic agt	Suicide and self-inflicted poisoning by tranquilizers and other psychotropic agents
E950.4	Poison-drug/medicin NEC	Suicide and self-inflicted poisoning by other specified drugs and medicinal substances
E950.5	Poison-drug/medicin NOS	Suicide and self-inflicted poisoning by unspecified drug or medicinal substance

Assault-based gunshot injuries

ICD-9 Code	Short Description	Long Description
E965.0	Assault-handgun	Assault by handgun
E965.1	Assault-shotgun	Assault by shotgun
E965.2	Assault-hunting rifle	Assault by hunting rifle
E965.3	Assault-military weapon	Assault by military firearms
E965.4	Assault-firearm NEC	Assault by other and unspecified firearm

Low offspring birthweight

ICD-9 Code	Short Description	Long Description
764.9	Fet growth retard wtNOS	Fetal growth retardation, unspecified, unspecified [weight]
764.91	Fet growth retard <500g	Fetal growth retardation, unspecified, less than 500 grams
764.92	Fet growth ret 500-749g	Fetal growth retardation, unspecified, 500-749 grams
764.93	Fet growth ret 750-999g	Fetal growth retardation, unspecified, 750-999 grams
764.94	Fet grwth ret 1000-1249g	Fetal growth retardation, unspecified, 1,000-1,249 grams
764.95	Fet grwth ret 1250-1499g	Fetal growth retardation, unspecified, 1,250-1,499 grams
764.96	Fet grwth ret 1500-1749g	Fetal growth retardation, unspecified, 1,500-1,749 grams
764.97	Fet grwth ret 1750-1999g	Fetal growth retardation, unspecified, 1,750-1,999 grams
764.98	Fet grwth ret 2000-2499g	Fetal growth retardation, unspecified, 2,000-2,499 grams
764.99	Fet growth ret 2500+g	Fetal growth retardation, unspecified, 2,500 grams and over

Maternal pregnancy complications

ICD-9 Code	Short Description	Long Description
640.8	Hem early preg NEC-unsp	Other specified hemorrhage in early pregnancy, unspecified as to episode of care or not applicable

640.81	Hem early preg NEC-deliv	Other specified hemorrhage in early pregnancy, delivered, with or without mention of antepartum condition
640.83	Hem early pg NEC-anteapar	Other specified hemorrhage in early pregnancy, antepartum condition or complication
640.9	Hemorr early preg-unspec	Unspecified hemorrhage in early pregnancy, unspecified as to episode of care or not applicable
640.91	Hem early preg-delivered	Unspecified hemorrhage in early pregnancy, delivered, with or without mention of antepartum condition
640.93	Hem early preg-anteapart	Unspecified hemorrhage in early pregnancy, antepartum condition or complication
641	Placenta previa-unspec	Placenta previa without hemorrhage, unspecified as to episode of care or not applicable
641.01	Placenta previa-deliver	Placenta previa without hemorrhage, delivered, with or without mention of antepartum condition
641.03	Placenta previa-anteapart	Placenta previa without hemorrhage, antepartum condition or complication
641.1	Placenta prev hem-unspec	Hemorrhage from placenta previa, unspecified as to episode of care or not applicable
641.11	Placenta prev hem-deliv	Hemorrhage from placenta previa, delivered, with or without mention of antepartum condition
641.13	Placen prev hem-anteapart	Hemorrhage from placenta previa, antepartum condition or complication
641.2	Prem separ placen-unspec	Premature separation of placenta, unspecified as to episode of care or not applicable
641.21	Prem separ placen-deliv	Premature separation of placenta, delivered, with or without mention of antepartum condition
641.23	Prem separ plac-anteapart	Premature separation of placenta, antepartum condition or complication
642	Essen hyperten preg-unsp	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, unspecified as to episode of care or not applicable
642.01	Essen hyperten-delivered	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, delivered, with or without mention of antepartum condition
642.02	Essen hyperten-del w p/p	Benign essential hypertension, complicating pregnancy, childbirth, and the puerperium, delivered, with mention of postpartum complication
642.03	Essen hyperten-anteapart	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, antepartum condition or complication

642.04	Essen hyperten-postpart	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, postpartum condition or complication
642.3	Trans hyperten preg-unsp	Transient hypertension of pregnancy, unspecified as to episode of care or not applicable
642.31	Trans hyperten-delivered	Transient hypertension of pregnancy, delivered , with or without mention of antepartum condition
642.32	Trans hyperten-del w p/p	Transient hypertension of pregnancy, delivered, with mention of postpartum complication
642.33	Trans hyperten-antepart	Transient hypertension of pregnancy, antepartum condition or complication
642.34	Trans hyperten-postpart	Transient hypertension of pregnancy, postpartum condition or complication
642.4	Mild/NOS preeclamp-unsp	Mild or unspecified pre-eclampsia, unspecified as to episode of care or not applicable
642.41	Mild/NOS preeclamp-deliv	Mild or unspecified pre-eclampsia, delivered, with or without mention of antepartum condition
642.42	Mild preeclamp-del w p/p	Mild or unspecified pre-eclampsia, delivered, with mention of postpartum complication
642.43	Mild/NOS preeclamp-antep	Mild or unspecified pre-eclampsia, antepartum condition or complication
642.44	Mild/NOS preeclamp-p/p	Mild or unspecified pre-eclampsia, postpartum condition or complication
642.5	Severe preeclamp-unspec	Severe pre-eclampsia, unspecified as to episode of care or not applicable
642.51	Severe preeclamp-deliver	Severe pre-eclampsia, delivered, with or without mention of antepartum condition
642.52	Sev preeclamp-del w p/p	Severe pre-eclampsia, delivered, with mention of postpartum complication
642.53	Sev preeclamp-antepartum	Severe pre-eclampsia, antepartum condition or complication
642.54	Sev preeclamp-postpartum	Severe pre-eclampsia, postpartum condition or complication
642.6	Eclampsia-unspecified	Eclampsia, unspecified as to episode of care or not applicable
642.61	Eclampsia-delivered	Eclampsia, delivered, with or without mention of antepartum condition
642.62	Eclampsia-deliv w p/p	Eclampsia, delivered, with mention of postpartum complication
642.63	Eclampsia-antepartum	Eclampsia, antepartum condition or complication
642.64	Eclampsia-postpartum	Eclampsia, postpartum condition or complication
642.7	Tox w old hyperten-unsp	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, unspecified as to episode of care or not applicable
642.71	Tox w old hyperten-deliv	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with or without mention of antepartum condition

642.72	Tox w old hyp-del w p/p	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with mention of postpartum complication
642.73	Tox w old hyper-ante part	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, antepartum condition or complication
642.74	Tox w old hyper-postpart	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, postpartum condition or complication
642.9	Hyperten preg NOS-unspec	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, unspecified as to episode of care or not applicable
642.91	Hypertens NOS-delivered	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, delivered, with or without mention of antepartum condition
642.92	Hypertens NOS-del w p/p	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, delivered, with mention of postpartum complication
642.93	Hypertens NOS-ante partum	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, antepartum condition or complication
642.94	Hypertens NOS-postpartum	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, postpartum condition or complication
646.8	Preg compl NEC-unspec	Other specified complications of pregnancy, unspecified as to episode of care or not applicable
646.81	Preg compl NEC-delivered	Other specified complications of pregnancy, delivered, with or without mention of antepartum condition
646.82	Preg compl NEC-del w p/p	Other specified complications of pregnancy, delivered, with mention of postpartum complication
646.83	Preg compl NEC-ante part	Other specified complications of pregnancy, antepartum condition or complication
646.84	Preg compl NEC-postpart	Other specified complications of pregnancy, postpartum condition or complication
646.9	Preg compl NOS-unspec	Unspecified complication of pregnancy, unspecified as to episode of care or not applicable

Unemployment or low income

ICD-9 Code	Short Description	Long Description
V62.0	Unemployment	Unemployment

Schizophrenia or other psychoses

ICD-9 Code	Short Description	Long Description
295	Simpl schizophren-unspec	Simple type schizophrenia, unspecified
295.01	Simpl schizophren-subchr	Simple type schizophrenia, subchronic
295.02	Simple schizophren-chr	Simple type schizophrenia, chronic
295.03	Simp schiz-subchr/exacer	Simple type schizophrenia, subchronic with acute exacerbation
295.04	Simpl schizo-chr/exacerb	Simple type schizophrenia, chronic with acute exacerbation
295.05	Simpl schizophren-remiss	Simple type schizophrenia, in remission
295.1	Hebephrenia-unspec	Disorganized type schizophrenia, unspecified
295.11	Hebephrenia-subchronic	Disorganized type schizophrenia, subchronic
295.12	Hebephrenia-chronic	Disorganized type schizophrenia, chronic
295.13	Hebephren-subchr/exacerb	Disorganized type schizophrenia, subchronic with acute exacerbation
295.14	Hebephrenia-chr/exacerb	Disorganized type schizophrenia, chronic with acute exacerbation
295.15	Hebephrenia-remission	Disorganized type schizophrenia, in remission
295.2	Catatonia-unspec	Catatonic type schizophrenia, unspecified
295.21	Catatonia-subchronic	Catatonic type schizophrenia, subchronic
295.22	Catatonia-chronic	Catatonic type schizophrenia, chronic
295.23	Catatonia-subchr/exacerb	Catatonic type schizophrenia, subchronic with acute exacerbation
295.24	Catatonia-chr/exacerb	Catatonic type schizophrenia, chronic with acute exacerbation
295.25	Catatonia-remission	Catatonic type schizophrenia, in remission
295.3	Paranoid schizo-unspec	Paranoid type schizophrenia, unspecified
295.31	Paranoid schizo-subchr	Paranoid type schizophrenia, subchronic
295.32	Paranoid schizo-chronic	Paranoid type schizophrenia, chronic
295.33	Paran schizo-subchr/exac	Paranoid type schizophrenia, subchronic with acute exacerbation
295.34	Paran schizo-chr/exacerb	Paranoid type schizophrenia, chronic with acute exacerbation
295.35	Paranoid schizo-remiss	Paranoid type schizophrenia, in remission
295.4	Schizophreniform dis NOS	Schizophreniform disorder, unspecified
295.41	Schizophrenic dis-subchr	Schizophreniform disorder, subchronic
295.42	Schizophren dis-chronic	Schizophreniform disorder, chronic
295.43	Schizo dis-subchr/exacer	Schizophreniform disorder, subchronic with acute exacerbation
295.44	Schizophr dis-chr/exacer	Schizophreniform disorder, chronic with acute exacerbation
295.45	Schizophrenic dis-remiss	Schizophreniform disorder, in remission
295.5	Latent schizophren-unsp	Latent schizophrenia, unspecified
295.51	Lat schizophren-subchr	Latent schizophrenia, subchronic
295.52	Latent schizophren-chr	Latent schizophrenia, chronic

295.53	Lat schizo-subchr/exacer	Latent schizophrenia, subchronic with acute exacerbation
295.54	Latent schizo-chr/exacer	Latent schizophrenia, chronic with acute exacerbation
295.55	Lat schizophren-remiss	Latent schizophrenia, in remission
295.6	Schizophr dis resid NOS	Schizophrenic disorders, residual type, unspecified
295.61	Schizophr dis resid-subch	Schizophrenic disorders, residual type, subchronic
295.62	Schizophr dis resid-chr	Schizophrenic disorders, residual type, chronic
295.63	Schizo resid subchr/exac	Schizophrenic disorders, residual type, subchronic with acute exacerbation
295.64	Schizophr resid-chro/exac	Schizophrenic disorders, residual type, chronic with acute exacerbation
295.65	Schizophr dis resid-remis	Schizophrenic disorders, residual type, in remission
296.2	Depress psychosis-unspec	Major depressive affective disorder, single episode, unspecified
296.21	Depress psychosis-mild	Major depressive affective disorder, single episode, mild
296.22	Depressive psychosis-mod	Major depressive affective disorder, single episode, moderate
296.23	Depress psychosis-severe	Major depressive affective disorder, single episode, severe, without mention of psychotic behavior
296.24	Depr psychos-sev w psych	Major depressive affective disorder, single episode, severe, specified as with psychotic behavior
296.25	Depr psychos-part remiss	Major depressive affective disorder, single episode, in partial or unspecified remission
296.26	Depr psychos-full remiss	Major depressive affective disorder, single episode, in full remission
296.3	Recurr depr psychos-unsp	Major depressive affective disorder, recurrent episode, unspecified
296.31	Recurr depr psychos-mild	Major depressive affective disorder, recurrent episode, mild
296.32	Recurr depr psychos-mod	Major depressive affective disorder, recurrent episode, moderate
296.33	Recur depr psych-severe	Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior
296.34	Rec depr psych-psychotic	Major depressive affective disorder, recurrent episode, severe, specified as with psychotic behavior
296.35	Recur depr psyc-part rem	Major depressive affective disorder, recurrent episode, in partial or unspecified remission

296.36	Recur depr psyc-full rem	Major depressive affective disorder, recurrent episode, in full remission
298	React depress psychosis	Depressive type psychosis
298.1	Excitativ type psychosis	Excitative type psychosis
298.4	Psychogen paranoid psych	Psychogenic paranoid psychosis
298.8	React psychosis NEC/NOS	Other and unspecified reactive psychosis
298.9	Psychosis NOS	Unspecified psychosis

Depressive disorders

ICD-9 Code	Short Description	Long Description
296.82	Atypical depressive dis	Atypical depressive disorder
311	Depressive disorder NEC	Depressive disorder, not elsewhere classified

Suicide

ICD-9 Code	Short Description	Long Description
E950.6	Poison-agricult agent	Suicide and self-inflicted poisoning by agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E950.7	Poison-corrosiv/caustic	Suicide and self-inflicted poisoning by corrosive and caustic substances
E950.8	Poison-arsenic	Suicide and self-inflicted poisoning by arsenic and its compounds
E950.9	Poison-solid/liquid NEC	Suicide and self-inflicted poisoning by other and unspecified solid and liquid substances
E951.0	Poison-piped gas	Suicide and self-inflicted poisoning by gas distributed by pipeline
E951.1	Poison-gas in container	Suicide and self-inflicted poisoning by liquefied petroleum gas distributed in mobile containers
E951.8	Poison-utility gas NEC	Suicide and self-inflicted poisoning by other utility gas
E952.0	Poison-exhaust gas	Suicide and self-inflicted poisoning by motor vehicle exhaust gas
E952.1	Poison-co NEC	Suicide and self-inflicted poisoning by other carbon monoxide
E952.8	Poison-gas/vapor NEC	Suicide and self-inflicted poisoning by other specified gases and vapors
E952.9	Poison-gas/vapor NOS	Suicide and self-inflicted poisoning by unspecified gases and vapors
E953.0	Injury-hanging	Suicide and self-inflicted injury by hanging
E953.1	Injury-suff w plas bag	Suicide and self-inflicted injury by suffocation by plastic bag
E953.8	Injury-strang/suff NEC	Suicide and self-inflicted injury by other specified means
E953.9	Injury-strang/suff NOS	Suicide and self-inflicted injury by unspecified means

E954.	Injury-submersion	Suicide and self-inflicted injury by submersion [drowning]
E955.0	Injury-handgun	Suicide and self-inflicted injury by handgun
E955.1	Injury-shotgun	Suicide and self-inflicted injury by shotgun
E955.2	Injury-hunting rifle	Suicide and self-inflicted injury by hunting rifle
E955.3	Injury-military firearm	Suicide and self-inflicted injury by military firearms
E955.4	Injury-firearm NEC	Suicide and self-inflicted injury by other and unspecified firearm
E955.5	Injury-explosives	Suicide and self-inflicted injury by explosives
E955.6	Self inflict acc-air gun	Suicide and self-inflicted injury by air gun
E955.7	Self inj-paintball gun	Suicide and self-inflicted injury by paintball gun
E955.9	Injury-firearm/expl NOS	Suicide and self-inflicted injury by firearms and explosives, unspecified
E956.	Injury-cut instrument	Suicide and self-inflicted injury by cutting and piercing instrument
E957.0	Injury-jump fm residence	Suicide and self-inflicted injuries by jumping from residential premises
E957.1	Injury-jump fm struc NEC	Suicide and self-inflicted injuries by jumping from other man-made structures
E957.2	Injury-jump fm natur sit	Suicide and self-inflicted injuries by jumping from natural sites
E957.9	Injury-jump NEC	Suicide and self-inflicted injuries by jumping from unspecified site
E958.0	Injury-moving object	Suicide and self-inflicted injury by jumping or lying before moving object
E958.1	Injury-burn, fire	Suicide and self-inflicted injury by burns, fire
E958.2	Injury-scald	Suicide and self-inflicted injury by scald
E958.3	Injury-extreme cold	Suicide and self-inflicted injury by extremes of cold
E958.4	Injury-electrocution	Suicide and self-inflicted injury by electrocution
E958.5	Injury-motor veh crash	Suicide and self-inflicted injury by crashing of motor vehicle
E958.6	Injury-aircraft crash	Suicide and self-inflicted injury by crashing of aircraft
E958.7	Injury-caustic substance	Suicide and self-inflicted injury by caustic substances, except poisoning
E958.8	Injury-NEC	Suicide and self-inflicted injury by other specified means
E958.9	Injury-NOS	Suicide and self-inflicted injury by unspecified means

Social anxiety disorder

ICD-9 Code	Short Description	Long Description
300.23	Social phobia	Social phobia

Anxiety disorders

ICD-9 Code	Short Description	Long Description
293.84	Anxiety disorder oth dis	Anxiety disorder in conditions classified elsewhere
300	Anxiety state NOS	Anxiety state, unspecified

Anxiety disorders (except social anxiety)

ICD-9 Code	Short Description	Long Description
300.01	Panic dis w/o agorophobia	Panic disorder without agoraphobia
300.02	Generalized anxiety dis	Generalized anxiety disorder
300.09	Anxiety state NEC	Other anxiety states
300.1	Hysteria NOS	Hysteria, unspecified
300.11	Conversion disorder	Conversion disorder
300.12	Dissociative amnesia	Dissociative amnesia
300.13	Dissociative fugue	Dissociative fugue
300.14	Dissociative identity dis	Dissociative identity disorder
300.15	Dissociative react NOS	Dissociative disorder or reaction, unspecified
300.16	Factitious dis w symptom	Factitious disorder with predominantly psychological signs and symptoms
300.19	Factitious ill NEC/NOS	Other and unspecified factitious illness
300.2	Phobia NOS	Phobia, unspecified
300.21	Agoraphobia w panic dis	Agoraphobia with panic disorder
300.22	Agoraphobia w/o panic	Agoraphobia without mention of panic attacks
300.29	Isolated/spec phobia NEC	Other isolated or specific phobias
300.3	Obsessive-compulsive dis	Obsessive-compulsive disorders
300.4	Dysthymic disorder	Dysthymic disorder
300.5	Neurasthenia	Neurasthenia
300.6	Depersonalization disord	Depersonalization disorder
300.7	Hypochondriasis	Hypochondriasis
300.81	Somatization disorder	Somatization disorder
300.82	Undiff somatoform disrd	Undifferentiated somatoform disorder
300.89	Somatoform disorders NEC	Other somatoform disorders
300.9	Nonpsychotic disord NOS	Unspecified nonpsychotic mental disorder

Positive symptoms of schizophrenia (i.e., hallucinations)

ICD-9 Code	Short Description	Long Description
780.1	Hallucinations	
293.81	Psy dis w delus oth dis	Psychotic disorder with delusions in conditions classified elsewhere
333.99	Extrapyramidal dis NEC	Other extrapyramidal diseases and abnormal movement disorders

Bipolar disorders

ICD-9 Code	Short Description	Long Description
296.5	Bipol I cur depres NOS	Bipolar I disorder, most recent episode (or current) depressed, unspecified

296.51	Bipol I cur depress-mild	Bipolar I disorder, most recent episode (or current) depressed, mild
296.52	Bipol I cur depress-mod	Bipolar I disorder, most recent episode (or current) depressed, moderate
296.53	Bipol I curr dep w/o psy	Bipolar I disorder, most recent episode (or current) depressed, severe, without mention of psychotic behavior
296.54	Bipol I currnt dep w psy	Bipolar I disorder, most recent episode (or current) depressed, severe, specified as with psychotic behavior
296.55	Bipol I cur dep rem NOS	Bipolar I disorder, most recent episode (or current) depressed, in partial or unspecified remission
296.56	Bipol I currnt dep remis	Bipolar I disorder, most recent episode (or current) depressed, in full remission
296.6	Bipol I currnt mixed NOS	Bipolar I disorder, most recent episode (or current) mixed, unspecified
296.61	Bipol I currnt mix-mild	Bipolar I disorder, most recent episode (or current) mixed, mild
296.62	Bipol I currnt mixed-mod	Bipolar I disorder, most recent episode (or current) mixed, moderate
296.63	Bipol I cur mix w/o psy	Bipolar I disorder, most recent episode (or current) mixed, severe, without mention of psychotic behavior
296.64	Bipol I cur mixed w psy	Bipolar I disorder, most recent episode (or current) mixed, severe, specified as with psychotic behavior
296.65	Bipol I cur mix-part rem	Bipolar I disorder, most recent episode (or current) mixed, in partial or unspecified remission
296.66	Bipol I cur mixed remiss	Bipolar I disorder, most recent episode (or current) mixed, in full remission
296.7	Bipolar I current NOS	Bipolar I disorder, most recent episode (or current) unspecified
296.8	Bipolar disorder NOS	Bipolar disorder, unspecified
296	Bipol I single manic NOS	Bipolar I disorder, single manic episode, unspecified
296.01	Bipol I single manic-mild	Bipolar I disorder, single manic episode, mild
296.02	Bipol I single manic-mod	Bipolar I disorder, single manic episode, moderate
296.03	Bipol I sing-sev w/o psy	Bipolar I disorder, single manic episode, severe, without mention of psychotic behavior
296.04	Bipo I sin man-sev w psy	Bipolar I disorder, single manic episode, severe, specified as with psychotic behavior
296.05	Bipol I sing man rem NOS	Bipolar I disorder, single manic episode, in partial or unspecified remission
296.06	Bipol I single manic rem	Bipolar I disorder, single manic episode, in full remission

296.4	Bipol I currnt manic NOS	Bipolar I disorder, most recent episode (or current) manic, unspecified
296.41	Bipol I curnt manic-mild	Bipolar I disorder, most recent episode (or current) manic, mild
296.42	Bipol I currnt manic-mod	Bipolar I disorder, most recent episode (or current) manic, moderate
296.43	Bipol I manc-sev w/o psy	Bipolar I disorder, most recent episode (or current) manic, severe, without mention of psychotic behavior
296.44	Bipol I manic-sev w psy	Bipolar I disorder, most recent episode (or current) manic, severe, specified as with psychotic behavior
296.45	Bipol I cur man part rem	Bipolar I disorder, most recent episode (or current) manic, in partial or unspecified remission
296.46	Bipol I cur man full rem	Bipolar I disorder, most recent episode (or current) manic, in full remission

Substance dependence or abuse of alcohol, tobacco, and other illicit drugs

ICD-9 Code	Short Description	Long Description
303.9	Alcoh dep NEC/NOS-unspec	Other and unspecified alcohol dependence, unspecified
303.91	Alcoh dep NEC/NOS-contin	Other and unspecified alcohol dependence, continuous
303.92	Alcoh dep NEC/NOS-episod	Other and unspecified alcohol dependence, episodic
303.93	Alcoh dep NEC/NOS-remiss	Other and unspecified alcohol dependence, in remission
304	Opioid dependence-unspec	Opioid type dependence, unspecified
304.01	Opioid dependence-contin	Opioid type dependence, continuous
304.02	Opioid dependence-episod	Opioid type dependence, episodic
304.03	Opioid dependence-remiss	Opioid type dependence, in remission
304.1	Sed,hyp,anxiolyt dep-NOS	Sedative, hypnotic or anxiolytic dependence, unspecified
304.11	Sed,hyp,anxiolyt dep-con	Sedative, hypnotic or anxiolytic dependence, continuous
304.12	Sed,hyp,anxiolyt dep-epi	Sedative, hypnotic or anxiolytic dependence, episodic
304.13	Sed,hyp,anxiolyt dep-rem	Sedative, hypnotic or anxiolytic dependence, in remission
304.2	Cocaine depend-unspec	Cocaine dependence, unspecified
304.21	Cocaine depend-contin	Cocaine dependence, continuous
304.22	Cocaine depend-episodic	Cocaine dependence, episodic
304.23	Cocaine depend-remiss	Cocaine dependence, in remission
304.3	Cannabis depend-unspec	Cannabis dependence, unspecified
304.31	Cannabis depend-contin	Cannabis dependence, continuous
304.32	Cannabis depend-episodic	Cannabis dependence, episodic

304.33	Cannabis depend-remiss	Cannabis dependence, in remission
304.4	Amphetamin depend-unspec	Amphetamine and other psychostimulant dependence, unspecified
304.41	Amphetamin depend-contin	Amphetamine and other psychostimulant dependence, continuous
304.42	Amphetamin depend-episod	Amphetamine and other psychostimulant dependence, episodic
304.43	Amphetamin depend-remiss	Amphetamine and other psychostimulant dependence, in remission
304.5	Hallucinogen dep-unspec	Hallucinogen dependence, unspecified
304.51	Hallucinogen dep-contin	Hallucinogen dependence, continuous
304.52	Hallucinogen dep-episod	Hallucinogen dependence, episodic
304.53	Hallucinogen dep-remiss	Hallucinogen dependence, in remission
304.6	Drug depend NEC-unspec	Other specified drug dependence, unspecified
304.61	Drug depend NEC-contin	Other specified drug dependence, continuous
304.62	Drug depend NEC-episodic	Other specified drug dependence, episodic
304.63	Drug depend NEC-in rem	Other specified drug dependence, in remission
304.7	Opioid/other dep-unspec	Combinations of opioid type drug with any other drug dependence, unspecified
304.71	Opioid/other dep-contin	Combinations of opioid type drug with any other drug dependence, continuous
304.72	Opioid/other dep-episod	Combinations of opioid type drug with any other drug dependence, episodic
304.73	Opioid/other dep-remiss	Combinations of opioid type drug with any other drug dependence, in remission
304.8	Comb drug dep NEC-unspec	Combinations of drug dependence excluding opioid type drug, unspecified
304.81	Comb drug dep NEC-contin	Combinations of drug dependence excluding opioid type drug, continuous
304.82	Comb drug dep NEC-episod	Combinations of drug dependence excluding opioid type drug, episodic
304.83	Comb drug dep NEC-remiss	Combinations of drug dependence excluding opioid type drug, in remission
304.9	Drug depend NOS-unspec	Unspecified drug dependence, unspecified
304.91	Drug depend NOS-contin	Unspecified drug dependence, continuous
304.92	Drug depend NOS-episodic	Unspecified drug dependence, episodic
304.93	Drug depend NOS-remiss	Unspecified drug dependence, in remission
305	Alcohol abuse-unspec	Alcohol abuse, unspecified
305.01	Alcohol abuse-continuous	Alcohol abuse, continuous
305.02	Alcohol abuse-episodic	Alcohol abuse, episodic
305.03	Alcohol abuse-in remiss	Alcohol abuse, in remission
305.3	Hallucinog abuse-unspec	Hallucinogen abuse, unspecified
305.31	Hallucinog abuse-contin	Hallucinogen abuse, continuous
305.32	Hallucinog abuse-episod	Hallucinogen abuse, episodic
305.33	Hallucinog abuse-remiss	Hallucinogen abuse, in remission

305.4	Sed,hyp,anxiolytc ab-NOS	Sedative, hypnotic or anxiolytic abuse, unspecified
305.41	Sed,hyp,anxiolytc ab-con	Sedative, hypnotic or anxiolytic abuse, continuous
305.42	Sed,hyp,anxiolytc ab-epi	Sedative, hypnotic or anxiolytic abuse, episodic
305.43	Sed,hyp,anxiolytc ab-rem	Sedative, hypnotic or anxiolytic abuse, in remission
305.5	Opioid abuse-unspec	Opioid abuse, unspecified
305.51	Opioid abuse-continuous	Opioid abuse, continuous
305.52	Opioid abuse-episodic	Opioid abuse, episodic
305.53	Opioid abuse-in remiss	Opioid abuse, in remission
305.6	Cocaine abuse-unspec	Cocaine abuse, unspecified
305.61	Cocaine abuse-continuous	Cocaine abuse, continuous
305.62	Cocaine abuse-episodic	Cocaine abuse, episodic
305.63	Cocaine abuse-in remiss	Cocaine abuse, in remission
305.7	Amphetamine abuse-unspec	Amphetamine or related acting sympathomimetic abuse, unspecified
305.71	Amphetamine abuse-contin	Amphetamine or related acting sympathomimetic abuse, continuous
305.72	Amphetamine abuse-episod	Amphetamine or related acting sympathomimetic abuse, episodic
305.73	Amphetamine abuse-remiss	Amphetamine or related acting sympathomimetic abuse, in remission
305.8	Antidepress abuse-unspec	Antidepressant type abuse, unspecified
305.81	Antidepress abuse-contin	Antidepressant type abuse, continuous
305.82	Antidepress abuse-episod	Antidepressant type abuse, episodic
305.83	Antidepress abuse-remiss	Antidepressant type abuse, in remission

Cannabis abuse

ICD-9 Code	Short Description	Long Description
305.2	Cannabis abuse-unspec	Cannabis abuse, unspecified
305.21	Cannabis abuse-contin	Cannabis abuse, continuous
305.22	Cannabis abuse-episodic	Cannabis abuse, episodic
305.23	Cannabis abuse-in remiss	Cannabis abuse, in remission

Tobacco use

ICD-9 Code	Short Description	Long Description
305.1	Tobacco use disorder	Tobacco use disorder

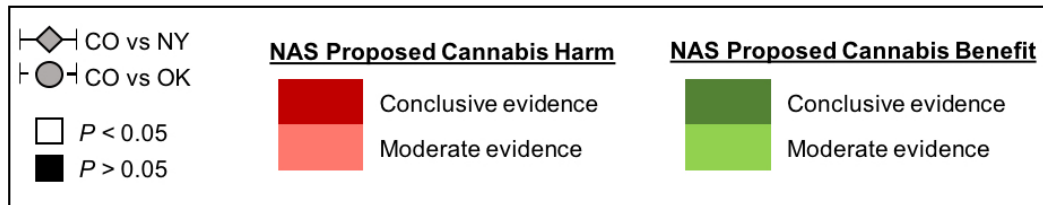
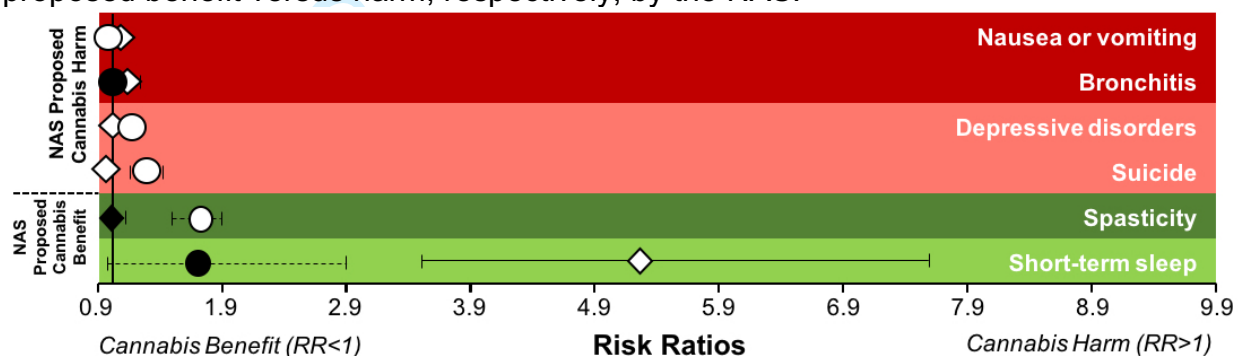
Alcohol abuse

ICD-9 Code	Short Description	Long Description
303.9	Alcoh dep NEC/NOS-unspec	Other and unspecified alcohol dependence, unspecified
303.91	Alcoh dep NEC/NOS-contin	Other and unspecified alcohol dependence, continuous
303.92	Alcoh dep NEC/NOS-episod	Other and unspecified alcohol dependence, episodic

303.93	Alcoh dep NEC/NOS-remiss	Other and unspecified alcohol dependence, in remission
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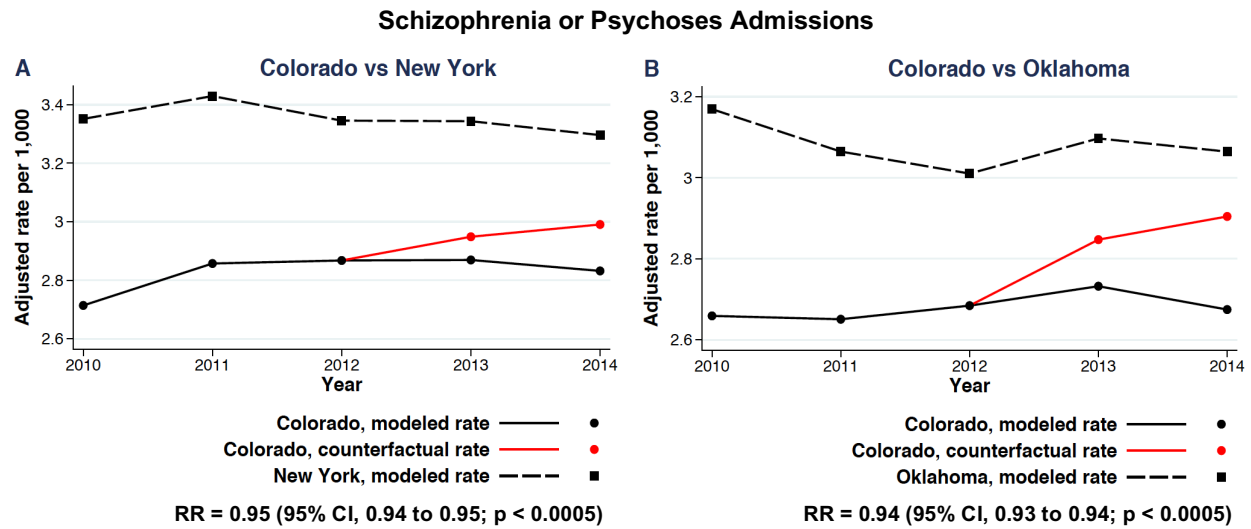
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eFigure 1. Health outcomes with substantial or moderate evidence of a statistical association with cannabis use based on the National Academy of Science (NAS) summary statement. Medical diagnoses are identified based on a significant ($P < 0.05$) comparison between New York (NY) and Oklahoma (OK) (control states without cannabis legalization) with regards to the change of admission rates for such diagnoses following cannabis legalization. P values for the comparison between Colorado (CO) (site of cannabis legalization) and NY (rhomboid symbol), or between CO and OK (circular symbol) are shown as either < 0.05 , or > 0.05 using a gray scale for evidence of cannabis benefit (risk ratio [RR] < 1 shown on the left) and cannabis harm (RR > 1 shown on the right); 95% confidence intervals are shown for the comparison between CO and NY and between CO and OK as solid and dotted lines, respectively. Progressively darker shades of green or red indicate greater weight of evidence in the direction of proposed benefit versus harm, respectively, by the NAS.

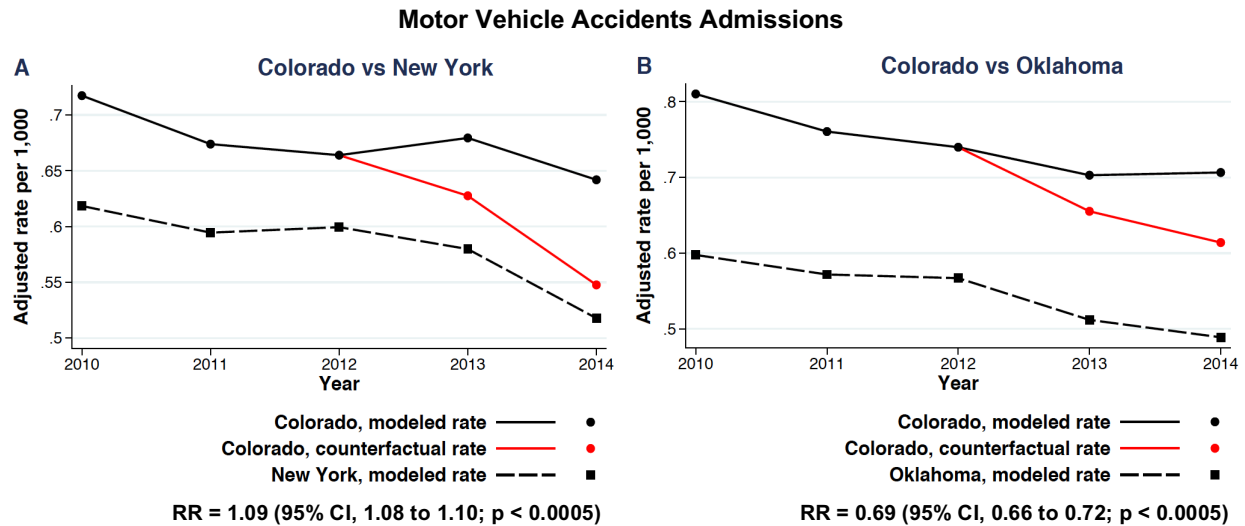


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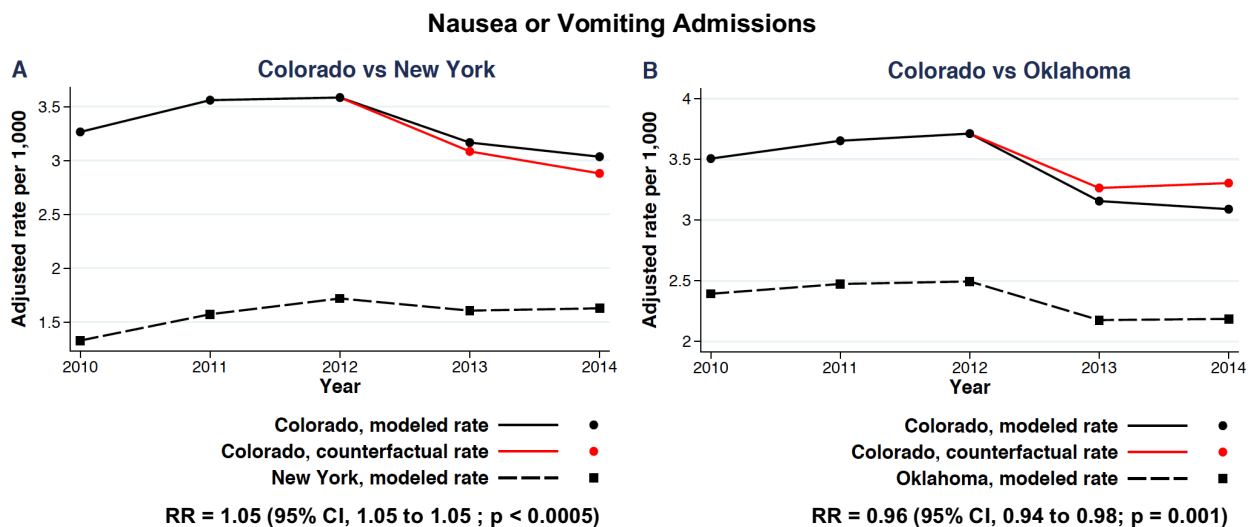
eFigure 2. Multivariate adjusted rates of total hospital admissions over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, compared with New York (A) and Oklahoma (B), control states without cannabis legalization. Red lines show the predicted rates of admissions for schizophrenia or other psychoses (and all remaining medical diagnoses plotted in eFigures 2-15) had the cannabis legalization policy not been instituted. RR = risk ratio; CI = confidence interval.



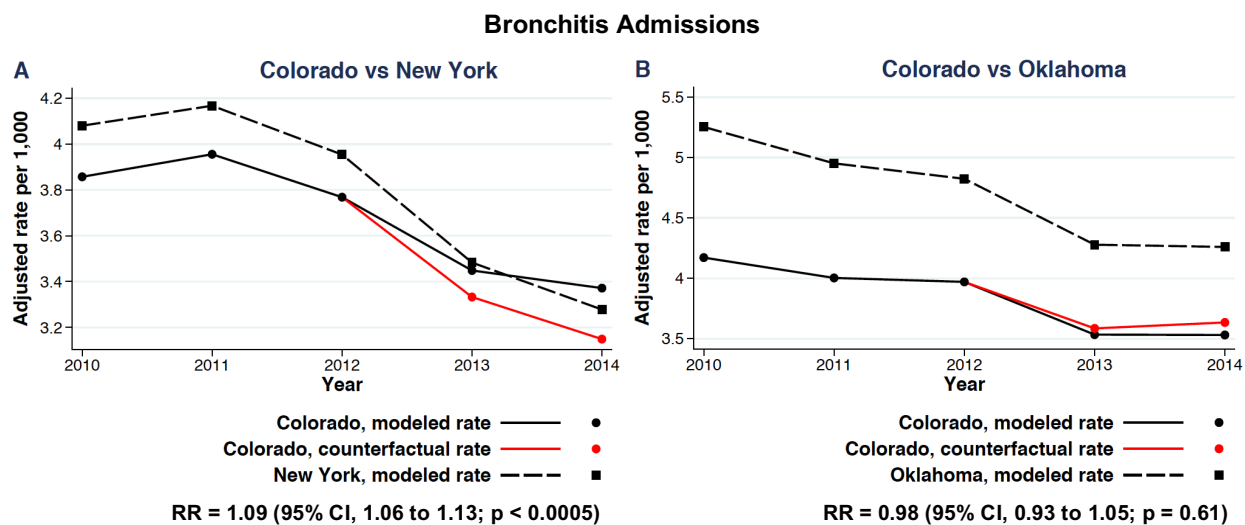
eFigure 3. Multivariate adjusted rates of admissions for motor vehicle accidents over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



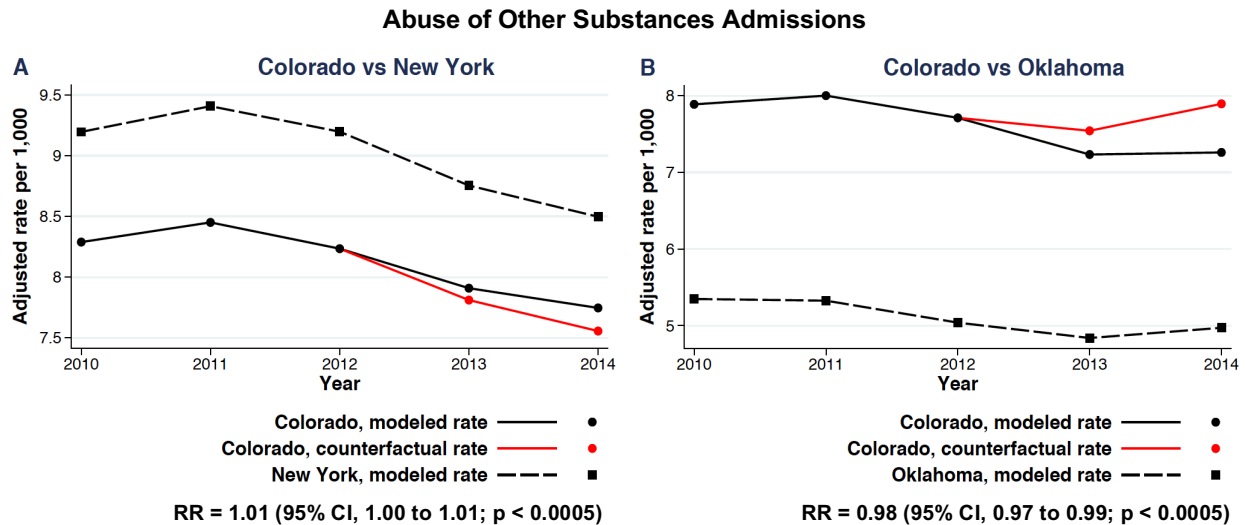
eFigure 4. Multivariate adjusted rates of admissions for nausea or vomiting over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



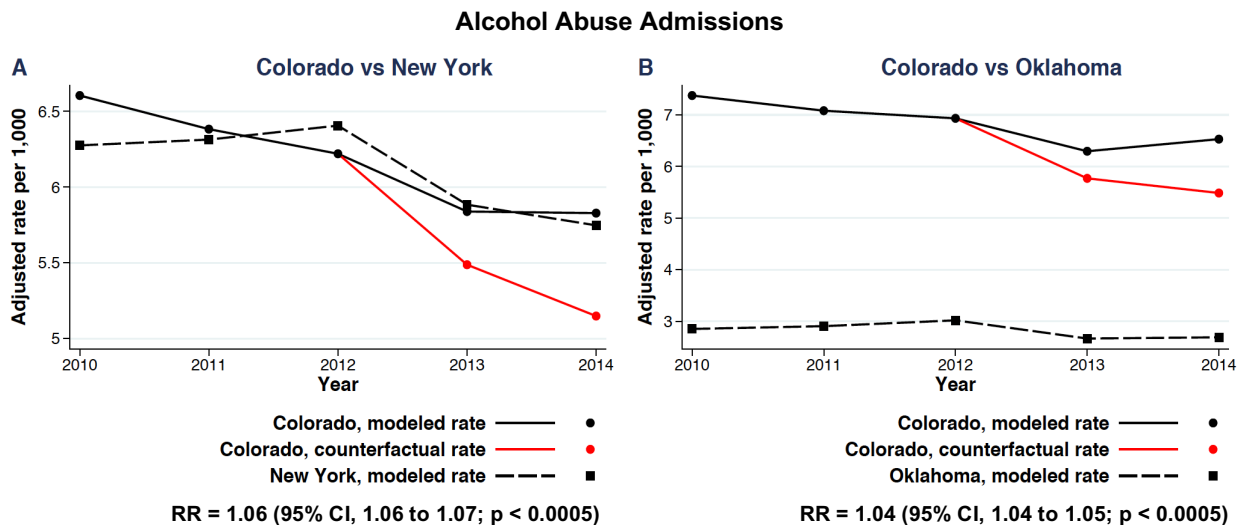
eFigure 5. Multivariate adjusted rates of admissions for bronchitis over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



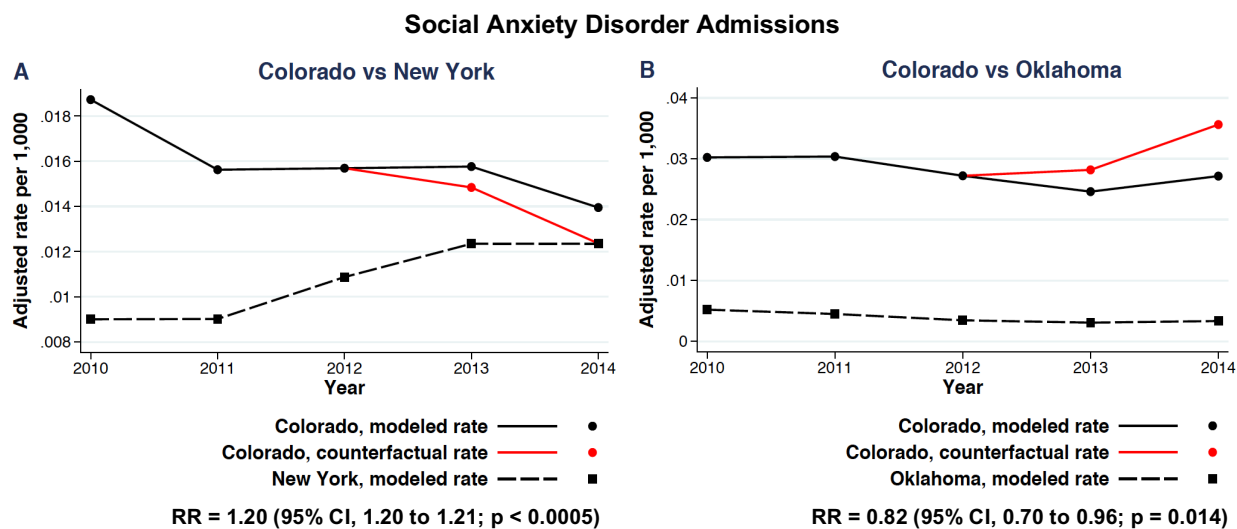
eFigure 6. Multivariate adjusted rates of admissions for abuse of other substances over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



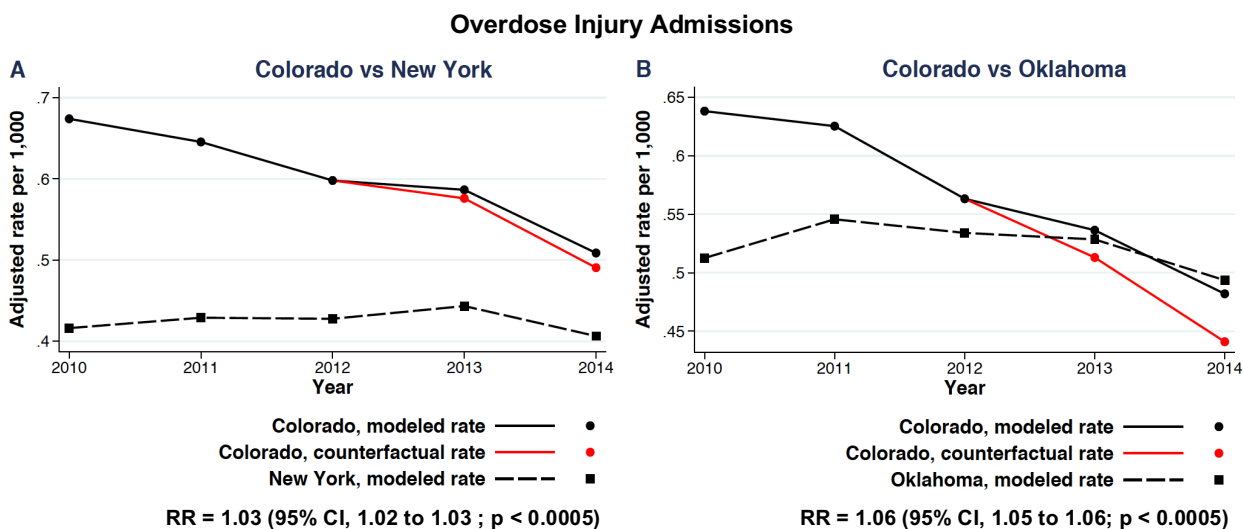
eFigure 7. Multivariate adjusted rates of admissions for alcohol abuse over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



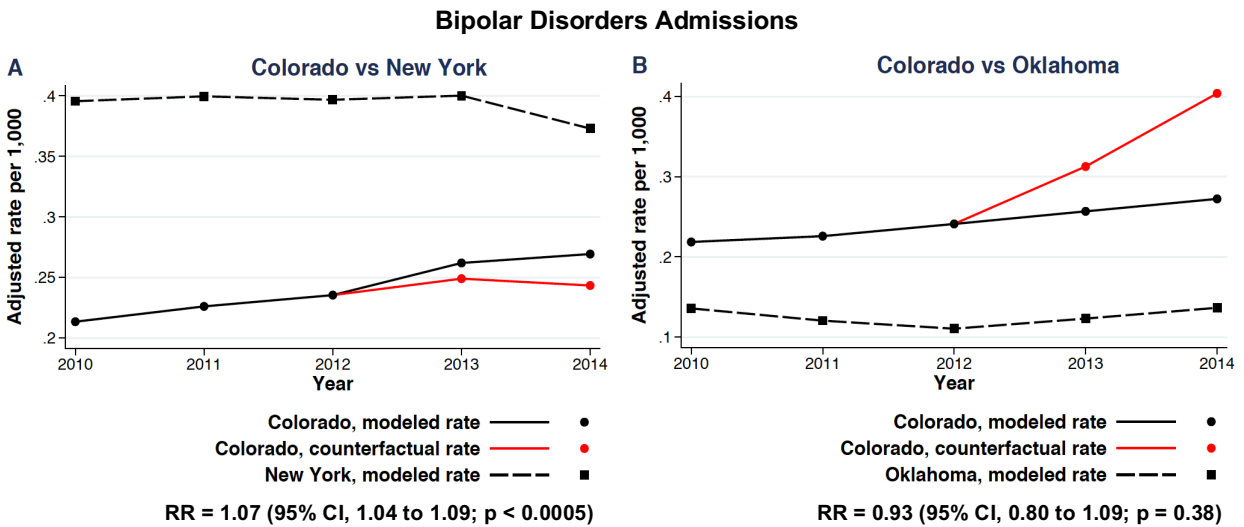
eFigure 8. Multivariate adjusted rates of admissions for social anxiety disorder over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



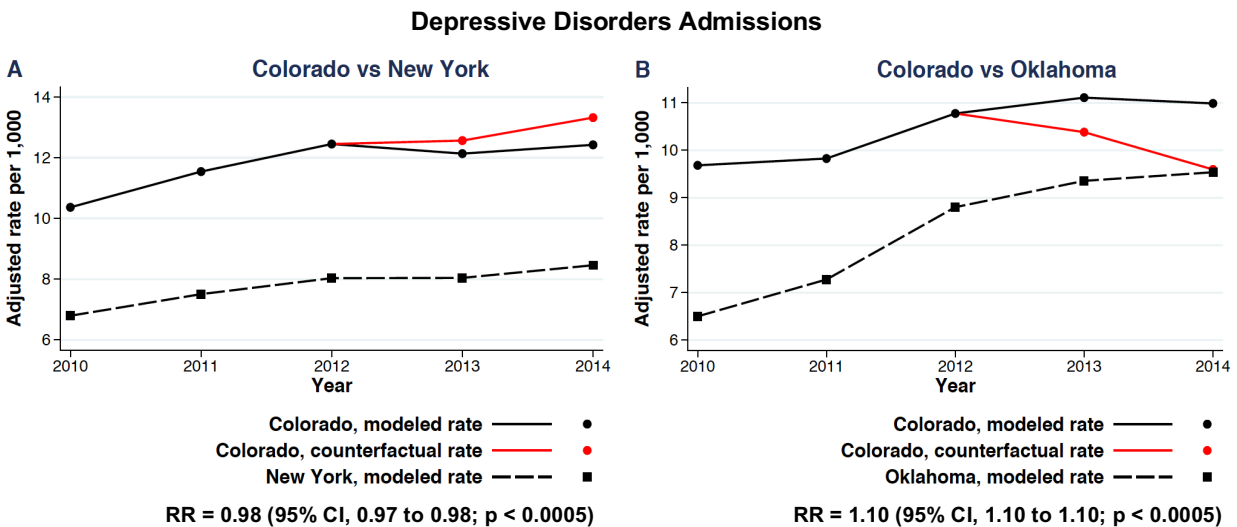
eFigure 9. Multivariate adjusted rates of admissions for overdose injury over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



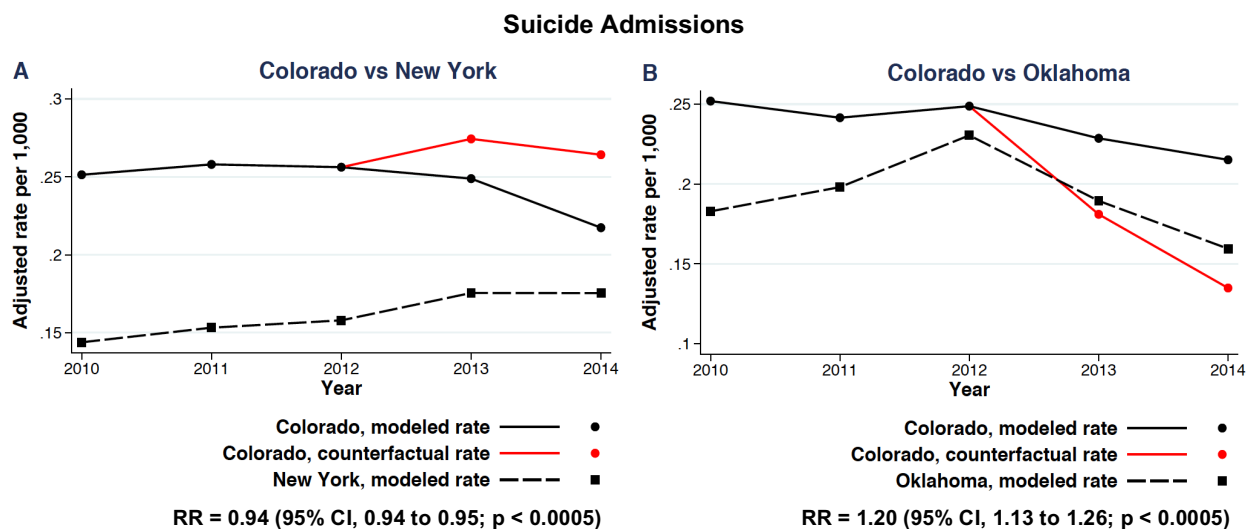
eFigure 10. Multivariate adjusted rates of admissions for bipolar disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



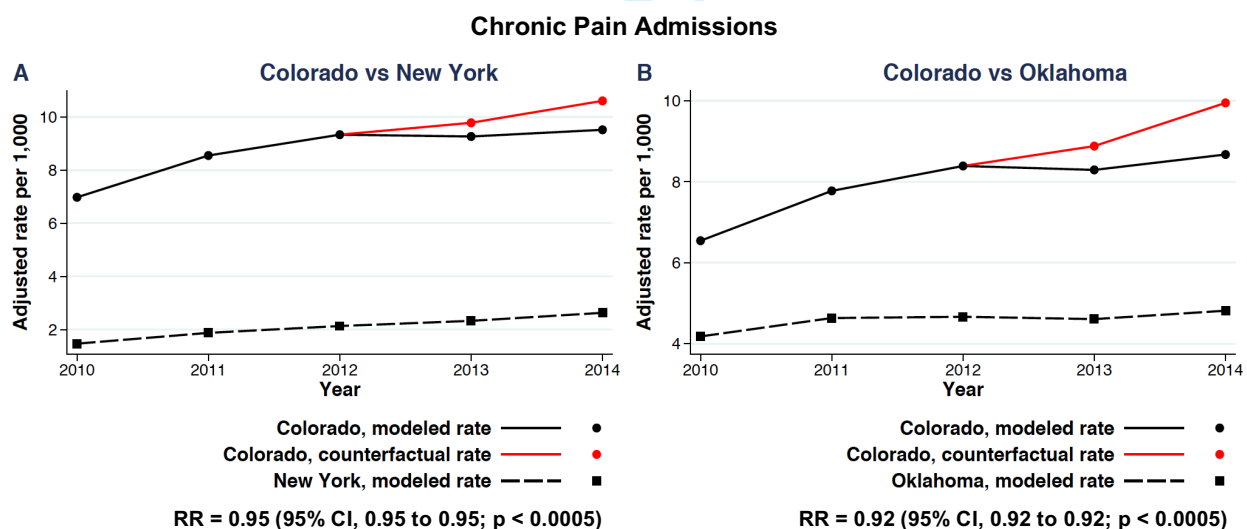
eFigure 11. Multivariate adjusted rates of admissions for depressive disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



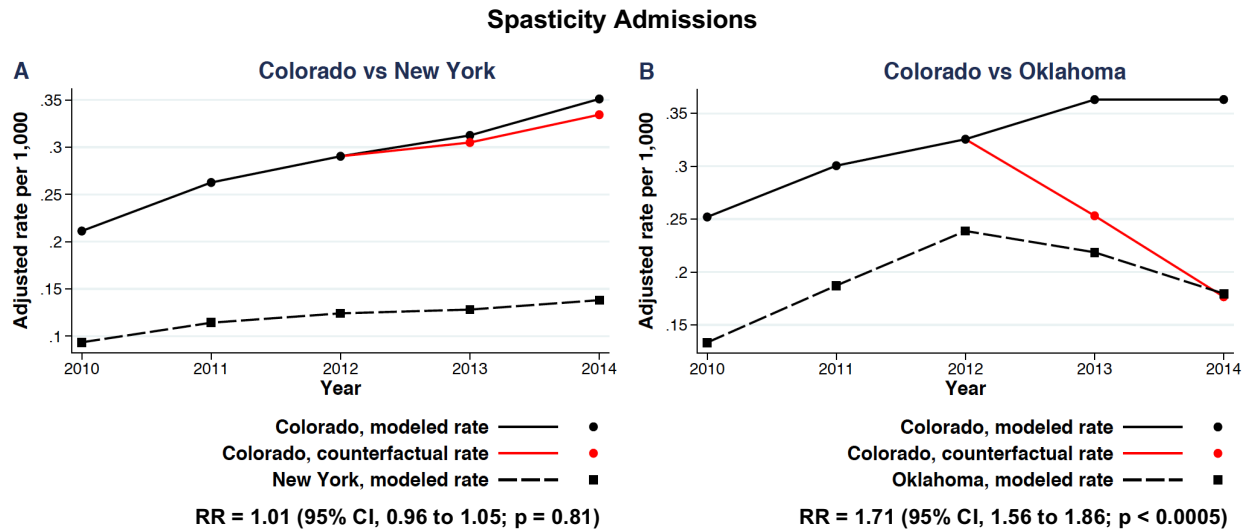
eFigure 12. Multivariate adjusted rates of admissions for suicide over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



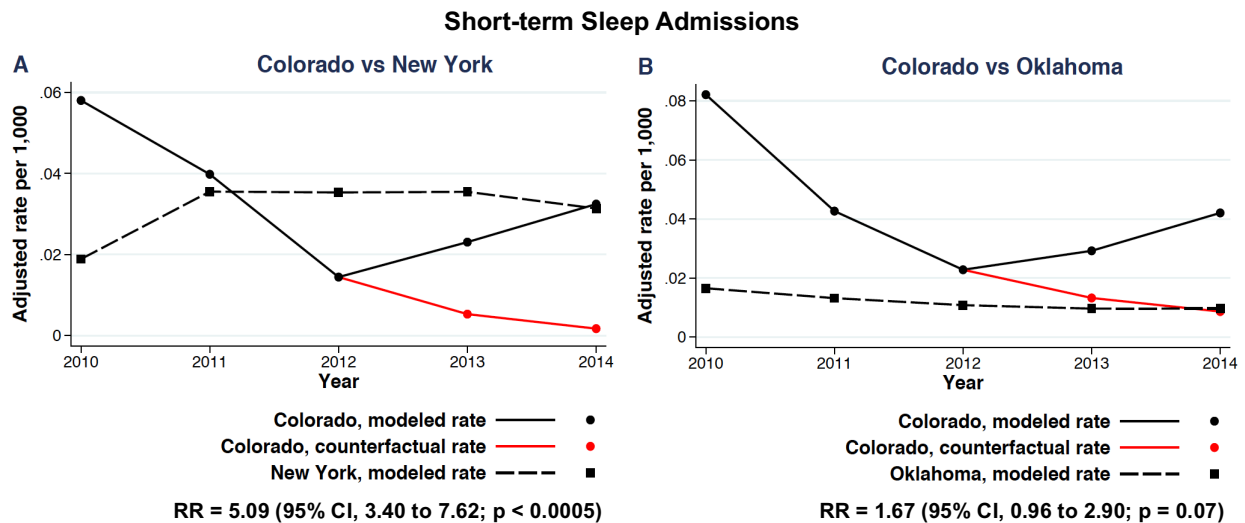
eFigure 13. Multivariate adjusted rates of admissions for chronic pain over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eFigure 14. Multivariate adjusted rates of admissions for spasticity over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eFigure 15. Multivariate adjusted rates of admissions for short-term sleep disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eTable 3. Changes in specific NAS outcomes in a sensitivity analysis using January 2014 as the date of recreational cannabis legalization

NAS Outcome	State Comparisons	RR	95% CI	P value
Motor vehicle accidents	CO vs NY	1.22	(1.16, 1.28)	<0.0005
	CO vs OK	1.18	(1.02, 1.37)	0.026
	NY vs OK	1.04	(0.77, 1.40)	0.81
Overdose injury	CO vs NY	1.11	(1.09, 1.14)	<0.0005
	CO vs OK	1.03	(0.98, 1.09)	0.25
	NY vs OK	0.98	(0.80, 1.19)	0.81
Bipolar disorders	CO vs NY	1.08	(1.06, 1.09)	<0.0005
	CO vs OK	0.81	(0.73, 0.90)	<0.0005
	NY vs OK	0.77	(0.75, 0.78)	<0.0005
Depressive disorders	CO vs NY	1.01	(0.99, 1.03)	0.59
	CO vs OK	1.23	(1.20, 1.25)	<0.0005
	NY vs OK	1.16	(1.07, 1.26)	<0.0005
Schizophrenia or psychoses	CO vs NY	0.84	(0.82, 0.86)	<0.0005
	CO vs OK	0.80	(0.79, 0.80)	<0.0005
	NY vs OK	0.88	(0.87, 0.90)	<0.0005
Social anxiety disorder	CO vs NY	1.45	(1.43, 1.48)	<0.0005
	CO vs OK	0.58	(0.47, 0.71)	<0.0005
	NY vs OK	0.46	(0.29, 0.74)	0.001
Suicide	CO vs NY	1.09	(1.03, 1.15)	0.002
	CO vs OK	1.26	(1.12, 1.41)	<0.0005
	NY vs OK	1.11	(1.04, 1.18)	0.001
Bronchitis	CO vs NY	1.19	(1.15, 1.23)	<0.0005
	CO vs OK	1.03	(0.97, 1.10)	0.33
	NY vs OK	0.82	(0.78, 0.87)	<0.0005
Abuse of other substances	CO vs NY	1.04	(1.03, 1.05)	<0.0005
	CO vs OK	0.99	(0.97, 1.01)	0.45
	NY vs OK	0.94	(0.90, 0.98)	0.007
Nausea or vomiting	CO vs NY	1.08	(1.06, 1.10)	<0.0005
	CO vs OK	0.95	(0.97, 1.01)	<0.0005
	NY vs OK	0.89	(0.90, 0.98)	0.01
Chronic pain	CO vs NY	0.94	(0.93, 0.96)	<0.0005
	CO vs OK	0.92	(0.91, 0.93)	<0.0005
	NY vs OK	0.93	(0.90, 0.96)	<0.0005
Spasticity	CO vs NY	0.75	(0.71, 0.79)	<0.0005
	CO vs OK	1.56	(1.14, 2.14)	0.006
	NY vs OK	2.12	(1.64, 2.76)	<0.0005
Short-term sleep	CO vs NY	11.7	(7.36, 18.59)	<0.0005
	CO vs OK	3.44	(1.32, 8.99)	0.012
	NY vs OK	0.45	(0.06, 3.22)	0.42

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6, 7, 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6, 7, 8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6, 7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6, 7, 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7, 8
Bias	9	Describe any efforts to address potential sources of bias	7, 8
Study size	10	Explain how the study size was arrived at	6, 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	9, 10 6, 7 8, 10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	11, 12, 13
Outcome data	15*	Report numbers of outcome events or summary measures over time	13, 14

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-14
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12, 14
10				
11	Discussion			
12				
13	Key results	18	Summarise key results with reference to study objectives	14-16
14				
15	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-19
16				
17	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-19
18				
19				
20	Generalisability	21	Discuss the generalisability (external validity) of the study results	19
21				
22	Other information			
23	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20
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27 *Give information separately for exposed and unexposed groups.

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29 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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BMJ Open

Does Cannabis Legalization Change Healthcare Utilization? A Population-based Study Using the Healthcare Cost and Utilization Project in Colorado, USA

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Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Public health
Keywords:	Healthcare utilization, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Cannabis legalization

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3 1 **Does Cannabis Legalization Change Healthcare Utilization? A Population-based**
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5 2 **Study Using the Healthcare Cost and Utilization Project in Colorado, USA**
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10 4 Francesca N. Delling, MD, MPH;¹ Eric Vittinghoff, PhD;¹ Thomas A. Dewland, MD;²
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3 25 **ABSTRACT**
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5 26 **OBJECTIVE:** To assess the effect of cannabis legalization on health effects and healthcare
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7 27 utilization in Colorado (CO), the first state to legalize recreational cannabis, when compared
8
9 28 with 2 control states, New York (NY) and Oklahoma (OK).
10

11
12 29 **DESIGN:** We used the 2010-2014 Healthcare Cost and Utilization Project (HCUP) inpatient
13
14 30 databases to compare changes in rates of healthcare utilization and diagnoses in CO versus NY
15
16 31 and OK.
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19 32 **SETTING:** Population-based, inpatient.
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22 33 **PARTICIPANTS:** HCUP state-wide data comprising over 28 million individuals and over 16
23
24 34 million hospitalizations across 3 states.
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26 35 **MAIN OUTCOME MEASURES:** We used International Classification of Diseases-9th Edition
27
28 36 (ICD-9) codes to assess changes in healthcare utilization specific to various medical diagnoses
29
30 37 potentially treated by or exacerbated by cannabis. Diagnoses were classified based on weight
31
32 38 of evidence from the National Academy of Science (NAS). Negative binomial models were used
33
34 39 to compare rates of admissions between states.
35
36

37 40 **RESULTS:** In CO compared to NY and OK, respectively, cannabis abuse hospitalizations
38
39 41 increased (risk ratio [RR], 1.27; 95% confidence interval [CI], 1.26 to 1.28 and RR 1.16; 95% CI
40
41 42 1.15 to 1.17; both $P<0.0005$) post-legalization. In CO, there was a reduction in total admissions
42
43 43 but only when compared to OK (RR 0.97; 95% CI 0.96 to 0.98; $P<0.0005$). Length of stay and
44
45 44 costs did not change significantly in CO compared to NY or OK. Post-legalization changes most
46
47 45 consistent with NAS included an increase in motor vehicle accidents, alcohol abuse, overdose
48
49 46 injury, and a reduction in chronic pain admissions (all $P<0.05$ compared to each control state).
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53 47 **CONCLUSIONS:** Recreational cannabis legalization is associated with neutral effects on
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55 48 healthcare utilization. In line with previous evidence, cannabis liberalization is linked to an
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49 increase in motor vehicle accidents, alcohol abuse, overdose injuries and a decrease in chronic
50 pain admissions. Such population-level effects may help guide future decisions regarding
51 cannabis use, prescription, and policy.

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53 **Strengths and limitations of this study**

- 54 • The study focuses on the impact of recreational cannabis legalization on hospital
55 admissions instead of its legal or societal effects
- 56 • This study utilizes state-wide hospital admission data comprising over 28 million
57 individuals and over 16 million hospitalizations
- 58 • Effects on hospital admissions are evaluated in Colorado, the first state to legalize
59 recreational cannabis, but compared with only 2 control states, New York and
60 Oklahoma
- 61 • Follow up data after recreational cannabis legalization only includes 2
62 subsequent years
- 63 • Physician coding with ICD-9 codes does not capture potentially important
64 mediators related to cannabis use

65 INTRODUCTION

66 Over 147 million people, or 2.5 percent of the world's population, use cannabis
67 (marijuana),¹ and more than 20 million Americans have reported the use of cannabis in
68 the past 30 days.¹ Because cannabis use is a federal crime, clinical studies have been
69 challenging to pursue, resulting in substantial knowledge gaps regarding actual health
70 consequences. Thirty-three states and the District of Columbia now allow cannabis for
71 the treatment of medical conditions.² Of these, 9 have recently legalized cannabis for
72 recreational use. Given such pervasive policy changes, understanding potential shifts in
73 healthcare utilization is vital.

74 Recently, an extensive and rigorous summary of the current evidence on health
75 effects of cannabis was developed by a committee of experts appointed by the US
76 National Academy of Science (NAS) focusing on systematic reviews and high-quality
77 primary research.³ The health endpoints assessed in the NAS summary included
78 oncologic, cardiometabolic, respiratory, immunologic, and psychiatric disorders as well
79 as outcomes related to injury and death (i.e. motor-vehicle accidents). While the NAS
80 summary represents a valuable starting place that makes use of the available data, we
81 do not yet know whether that evidence, based largely on small studies, will translate into
82 real-world ramifications after legalization of recreational cannabis.

83 On December 10, 2012, Colorado enacted *Colorado Amendment 64*, legalizing
84 recreational cannabis. Following this date, adults aged 21 or older could grow cannabis
85 plants privately, legally possess all cannabis from these plants, and give cannabis as a
86 gift to other adults aged 21 or older.⁴ After January 1, 2014, recreational cannabis could
87 be legally purchased in retail stores.⁵ We hypothesized that changes in healthcare

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3 88 utilization and diagnoses most consistent with NAS-based evidence occur when access
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5 89 to recreational cannabis becomes liberalized.
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91 **METHODS**

92 We used the Agency for Healthcare Research and Quality (AHRQ)-funded Healthcare
93 Cost and Utilization Project (HCUP) database to measure inpatient healthcare utilization
94 and diagnoses in Colorado (CO) between 2010 and 2014. HCUP is a state-wide
95 database containing all listed inpatient diagnoses and procedures, discharge status,
96 patient demographics, and charges for all patients, regardless of payer (e.g., Medicare,
97 Medicaid, private insurance, uninsured).

98 Comparisons were made with 2 control states in order to address possible secular
99 trends. New York (NY), the most populous state with inpatient HCUP data available up
100 to 2014 was selected, and, to counter this coastal and largely urban state, we also
101 selected Oklahoma (OK), a predominately rural state directly adjacent to CO with HCUP
102 hospitalization data up to 2014. We used separate HCUP databases for CO, NY and
103 OK. Unlike the National Inpatient Sample (NIS), which is (by definition) a sample, these
104 state-specific databases include data from every actual admission, providing direct and
105 complete information regarding all healthcare utilization. Both primary and secondary
106 diagnoses were extracted from each HCUP database for each admission used: up to 30
107 ICD-9 codes in CO, 25 in NY, and 16 in OK were provided for each encounter. Annual
108 demographic data, including age, sex, and race, was obtained from the United States
109 Census Bureau. Only month and year were available in all HCUP databases; as
110 legalization took effect on December 10, 2012, hospitalizations following December,

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3 111 2012 were considered “after” enactment of the law. Patients with missing information on
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5 112 age, sex, race, and year of encounter were excluded.

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7 113 Age, sex, race, income level, and insurance payer were recorded at each
8
9 114 healthcare encounter. Hispanic ethnicity was not coded in the OK State Department of
10
11 115 Health data source. In order to use comparable categorizations across the 3 states, we
12
13 116 separated race into white, black, Native American, and other. In addition to the
14
15 117 population-level variables age, sex and race, we obtained the following covariates at the
16
17 118 individual level for each age, sex and race population strata: 1) income level 2)
18
19 119 proportion of HCUP individuals living in an urban versus rural setting, 3) with a
20
21 120 diagnosis of tobacco use, 4) alcohol abuse, and 5) psychiatric disorders. The latter 3
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23 121 covariates were available from ICD-9 codes. Income level was categorized by quartiles
24
25 122 using the median household income for each patient’s ZIP code. Income level was not
26
27 123 available for OK.

28
29 124 We first performed a validation analysis to assess changes in cannabis abuse
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31 125 diagnoses in CO after versus before recreational cannabis legalization and compared
32
33 126 those rates to changes in NY and OK over the same time period. To determine changes
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35 127 in overall healthcare utilization, we assessed changes in total number of
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37 128 hospitalizations, length of inpatient stay, and healthcare costs. We estimated the cost of
38
39 129 each hospitalization by multiplying the charges by a cost-to-charge ratio for the
40
41 130 admitting hospital for the given year. For NY and CO, we used the all-payer cost-to-
42
43 131 charge ratios provided by HCUP. When the all-payer cost-to-charge ratio was missing,
44
45 132 we applied the average cost-to-charge ratio particular to state and year. As HCUP does
46
47 133 not provide cost-to-charge ratios for OK, we assumed a constant state-wide cost-to-
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3 134 charge ratio (0.3119 as derived from the Institute for Health and Socio-Economic Policy
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5 135 calculations of federal cost reports) to estimate healthcare costs in OK;⁶ we then
6
7 136 conducted a sensitivity analysis setting the cost-to-charge ratio for OK to equal to the
8
9 137 average for NY and CO for the corresponding year. See online supplementary
10
11 138 eMethods and eTable 1 for additional details.

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14 139 We used International Classification of Diseases-9th Edition (ICD-9) codes
15
16 140 (eTable 2) to assess changes in healthcare utilization specific to various medical
17
18 141 diagnoses potentially treated by or exacerbated by cannabis use as identified by the
19
20 142 NAS summary. For each health endpoint of interest in the NAS review, the weight of
21
22 143 evidence regarding the statistical association of recreational cannabis with a specific
23
24 144 health endpoint or the therapeutic use of cannabis had previously been categorized into
25
26 145 substantial, moderate, limited or no evidence.³ We opted to focus on NAS health
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28 146 endpoints with either substantial or moderate evidence.

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31 147 Because diagnoses of alcohol or other substance abuse “in remission” may have
32
33 148 been incidental and not directly responsible for the hospitalization, we performed a
34
35 149 sensitivity analysis where we removed “in remission” diagnoses from the group of ICD-9
36
37 150 codes defining alcohol abuse and other substance abuse (eTable 2).

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40 151 Finally, to take into account the additional effect of recreational cannabis related
41
42 152 to availability in retail stores we performed sensitivity analyses for all health care
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44 153 utilization (total number of admissions, length of stay, costs) and NAS-evidence based
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46 154 outcomes investigations utilizing January 1, 2014 as the change of policy date.

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49 155 Certification to use de-identified HCUP data was obtained from the University of
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51 156 California, San Francisco Committee on Human Research.

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158 Statistical Analysis

159 Demographic and lifestyle characteristics are presented as mean \pm standard deviation
160 (SD) or n (% of total admissions) and were compared between states using linear,
161 logistic, and multinomial models as appropriate. Rates of admissions for NAS diagnoses
162 (with the population size as the denominator) were compared between states using
163 negative binomial models.

164 To assess the effects of recreational cannabis legalization, we used negative
165 binomial models for the number of admissions, both overall and for particular
166 diagnoses, with the log of the subgroup population sizes as an offset and the use of
167 robust standard errors. Analogous linear models were utilized for length of stay and
168 cost, which were both log-transformed in order to meet normality assumptions. All
169 models were adjusted for age, race, sex, income level, urbanicity, diagnosis of alcohol
170 abuse, tobacco use and psychiatric disorders. Adjustment for diagnosis of psychiatric
171 disorders was not performed in the presence of a psychiatric outcome. In order to relax
172 the linearity assumption, each 5-year age range was included as a separate category.
173 To flexibly model secular patterns, year was included as a categorical rather than
174 continuous variable (with a category for each year between 2010 and 2014). The crucial
175 predictors in our model included an indicator for CO (versus the comparison state) and
176 interactions of this indicator with 2 continuous linear spline basis functions, year-2012,
177 and max (0, year-2012). The main effect for CO estimated the between-state risk ratio
178 (RR) in 2012, the first interaction estimated the slope of the between-state RR in 2010-
179 12, and the second estimated the change in slope after 2012. The first interaction was

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3 180 used to project the counterfactual 2013-2014 rates in CO that would be expected in the
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5 181 absence of legalization, while the second was used to capture the legalization effect.
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7 182 Like a standard interrupted time series (ITS) model, our model assumed that the
8
9 183 between-state RR changed linearly at different rates before and after the intervention,
10
11 184 but used the categorical indicator for year to relax the standard ITS assumption of
12
13 185 piecewise linear trends in the underlying state-specific rates, substantially improving
14
15 186 model fit. The same model was used in the sensitivity analysis using January 1, 2014
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17 187 (date of legal retail cannabis sales) as change of policy date.
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22 188 A 2-tailed $P < 0.05$ was considered statistically significant for the validation
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24 189 analysis (cannabis use), and analyses related to overall healthcare utilization. In order
25
26 190 to minimize false positive results and to account for secular trends that might differ
27
28 191 across different populations, we assessed for validation in comparisons versus NY and
29
30 192 then OK separately.
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33 193 In order to address possible false positives due to multiple hypotheses testing in
34
35 194 assessing the diagnoses with moderate or substantial evidence described in the NAS
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37 195 document, we employed stringent standards: to be considered “positive,” the
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39 196 comparisons between CO and *each* of the other 2 states needed to be in the direction
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41 197 expected from the NAS report, each exhibiting statistical significance using a two-tailed
42
43 198 alpha of 0.05. A “positive” designation also required absence of a statistically significant
44
45 199 difference between NY versus OK using a two-tailed alpha of 0.05. All analyses were
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47 200 performed using Stata 15 (StataCorp, College Station, TX).
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53 54 202 **Patient and Public Involvement**

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3 203 The patients and public were not involved in the study.
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7 8 205 **RESULTS**

9 10 206 **Baseline Characteristics**

11
12 207 The total number of admissions between 2010 and 2014 are shown for each state in
13
14 208 **table 1**. Patients in CO were generally younger, more commonly female, and less
15
16 209 ethnically diverse. Wealth in CO was less equally distributed, with a higher proportion of
17
18 210 individuals with lower income in CO compared to NY. Finally, admission rates were
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20 211 lower in CO than the control states for most NAS diagnoses, with exceptions for pre-
21
22 212 diabetes and post-traumatic stress disorder.
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27 28 214 **Study Validation**

29
30 215 Over 2010-2014, the change in rates of cannabis abuse admissions after versus before
31
32 216 recreational cannabis legalization in 2012 was greater in CO than in NY and OK (risk
33
34 217 ratio [RR], 1.27; 95% confidence interval [CI], 1.26 to 1.28 and RR 1.16; 95% CI 1.15 to
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36 218 1.17; both $P < 0.0005$, respectively) (**figure 1A-B**). No significant changes comparing the
37
38 219 two control states, NY and OK, were observed over the same time period (RR 0.93;
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40 220 95% CI 0.87 to 1.00; $P = 0.05$).
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46 47 222 **Inpatient Healthcare Utilization after Cannabis Legalization**

48 49 223 *Number of admissions*

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51 224 In unadjusted analyses, CO, NY, and OK had a similar number of total admissions
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53 225 before versus after recreational cannabis legalization (**figure 2A**). After adjusting for
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3 226 covariates, there was a reduction of number of admissions following cannabis
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5 227 legalization in CO when compared to OK (RR 0.97; 95% CI 0.96 to 0.98; $P<0.0005$).
6
7 228 The point estimate was similar when comparing CO to NY, but did not reach statistical
8
9 229 significance (RR 0.99; 95% CI 0.98 to 1.01; $P=0.47$). Results were similar in sensitivity
10
11 230 analysis using January 1, 2014 as change of policy date (CO versus OK: RR 0.96; 95%
12
13 231 CI 0.96 to 0.96; $P<0.0005$, and CO versus NY: RR 0.99; 95% CI 0.96 to 1.02; $P=0.59$).
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19 233 *Length of stay*

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21 234 The median length of stay also remained similar after cannabis legalization across the 3
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23 235 states in unadjusted analyses (**figure 2B**). After adjusting for covariates, length of
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25 236 inpatient stay did not change significantly in CO following the law change when
26
27 237 compared with each of the 2 control states (1.75% annual reduction; 95% CI -12.25% to
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29 238 10.01% in CO versus NY, and 3.46% annual reduction, 95% CI -16.48% to 37.90%
30
31 239 versus OK; $P=0.30$ and $P=0.20$, respectively). Length of stay did not change
32
33 240 significantly in CO compared with the control states when we used January 1, 2014 as
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35 241 change of policy date.
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42 243 *Healthcare Costs*

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44 244 In unadjusted analyses, the 3 states exhibited similar total costs across the study time
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46 245 period (**figure 2C** and eTable 2). In multivariate analyses, healthcare costs remained
47
48 246 similar in state comparisons (2.99%; 95% CI -7.55% to 14.74%; $P=0.18$ versus NY and
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50 247 3.45%; 95% CI -7.31% to 15.46%; $P=0.16$ versus OK) after cannabis legalization. No
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52 248 meaningful differences of healthcare costs were observed in the sensitivity analyses
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249 with January 1, 2014 as change of policy date or when we assumed the cost-to-charge
250 ratio for OK was equal to the average of the other states.

251 252 **Changes in Specific Diagnoses Highlighted by the National Academy of Sciences**

253 Among the diagnoses with either substantial or moderate evidence of influence by
254 cannabis per the NAS, we distinguished between: 1) a group with no statistically
255 significant post-legalization differences between control states (NY versus OK $P>0.05$),
256 suggesting that secular trends unlikely explained differences between CO and control
257 states (**figure 3**); and 2) a group with significant differences in diagnoses post-
258 legalization between control states (NY versus OK $P<0.05$) (eFigure 1).

259 In the NY versus OK $P>0.05$ group (**figure 3**), changes in rates of diagnoses
260 after cannabis legalization reflected NAS-based evidence for most health outcomes.
261 Among the diagnoses most consistent with NAS-based evidence, there was an increase
262 in hospital admissions for motor vehicle accidents, alcohol abuse, overdose injury and a
263 decrease of chronic pain hospitalizations after recreational cannabis legalization (each
264 meeting statistical significance for both comparisons with control states). When using
265 less stringent criteria ($P<0.05$ for both comparisons with NY and OK but where the
266 relative risk for only one comparison was in the same direction as NAS), admissions for
267 abuse of other substances and social anxiety disorder also increased with recreational
268 cannabis legalization (**figure 3**). Effects of cannabis liberalization on psychiatric
269 outcomes (schizophrenia and bipolar disorders) were either not consistent or weakly
270 consistent with NAS (**figure 3**). When differences between the two control states (NY
271 and OK) were also significantly different (suggesting effects potentially related to

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3 272 secular trends)(eFigure 1), changes in diagnoses were mostly not concordant with NAS
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5 273 findings or one of the comparisons between CO and either NY or OK did not exhibit
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7 274 statistical significance. Changes of the risk over time with counterfactuals are shown for
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9
10 275 each NAS diagnosis in online supplementary eFigures 2-15.

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12 276 In the sensitivity analysis using January 1, 2014 as change of policy date (eTable
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14 277 3), the main findings highlighted in the primary analysis using our stringent criteria
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16 278 (increase of admissions for alcohol abuse, motor vehicle accidents, overdose injury and
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18 279 decrease of chronic pain hospitalizations) again met the same criteria in favor of
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20 280 significant associations, except for overdose injury and chronic pain admissions (the
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22 281 latter meeting 2 of the 3 criteria described in the Methods). In sensitivity analyses
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24 282 removing “in remission” diagnoses, no meaningful changes were observed (relevant to
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26 283 alcohol abuse and abuse of other substances).
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32 33 285 **DISCUSSION**

34 35 286 **Principal findings**

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37 287 Legalization of recreational cannabis was associated with more cannabis abuse, and
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39 288 minimal effects on overall healthcare utilization. Changes in specific medical diagnoses
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41 289 post-legalization reflected previously published substantial or moderate evidence on the
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43 290 health effects of cannabis, including an increase in alcohol abuse, overdose injury and a
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45 291 decrease of chronic pain admissions.
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49 292 The increased frequency of hospitalizations for cannabis abuse in CO helps to
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51 293 validate the concept that legalization would result in greater use.
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3 294 Effects of recreational cannabis legalization on healthcare utilization appeared to
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6 295 be overall neutral. There was no evidence that either the length of stay or healthcare
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8 296 costs changed following liberalization of recreational cannabis. There was a reduction of
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10 297 overall hospitalizations in CO when compared to OK but not compared to NY,
11
12 298 potentially because unaccounted state-level characteristics may have driven overall
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14 299 admissions differently. Moreover, in the US healthcare system, hospitalized individuals
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17 300 tend to be sicker, with more severe forms of specific illnesses and higher inpatient costs
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19 301 compared to outpatients. Therefore, our conclusions on overall neutral effects of
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21 302 recreational cannabis on healthcare costs only reflect higher inpatient costs and not
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23
24 303 overall costs. Outpatient costs may include use of specific medications or substance
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26 304 detoxification programs that are not captured in our study and may be more cost-
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28 305 effective compared to inpatient treatments.

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31 306 Following legalization of recreational cannabis, changes in rates of medical
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33 307 diagnoses reflected NAS-based evidence for most health outcomes. The absence of
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35 308 statistically significant differences in these outcomes between the two control states (NY
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38 309 and OK) over the same time period provides some evidence that these observed
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40 310 differences were less likely related to broader secular trends. After legalization of
41
42 311 recreational cannabis, there was an increase in motor vehicle accidents, alcohol abuse,
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45 312 overdose injury and a decrease of chronic pain admissions. In addition to information
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47 313 provided in the NAS summary,³ the association of cannabis with motor vehicle
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49 314 accidents has been highlighted by recent literature.^{7, 8} Consistent with our findings, a
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51 315 substantial bidirectional comorbidity between cannabis use and alcohol use has been
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54 316 previously demonstrated, resulting in a moderate level of evidence designation for this

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3 317 relationship per the NAS.⁹ Also compatible with the NAS summary, we report that
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5 318 recreational cannabis legalization was associated with an increasing number of
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7 319 admissions for overdose injury. These included overdose of analgesics, barbiturates,
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9 320 sedative, hypnotics and psychotropic drugs (eTable 2). This finding underlines the
10
11 321 association of cannabis use with other behaviors of drug addiction as highlighted by a
12
13 322 recent cross-sectional survey of over 30 thousand community-living US adults.¹⁰ Finally,
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15 323 reduction of chronic pain, especially neuropathic pain, in cannabis users is well known,
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17 324 although prior literature has focused on medical rather than recreational cannabis.^{11, 12}
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22 325 Except for social anxiety, the effects of recreational cannabis legalization on
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24 326 admissions for psychiatric disorders (schizophrenia, bipolar disorder, depression) were
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26 327 weakly or not consistent with prior NAS-evidence. This finding may be related to
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28 328 residual confounding by state-level characteristics, unaccounted secular trends, or
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30 329 insufficient longitudinal follow-up.
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33 330 We demonstrate that admissions for abuse of alcohol or other substances
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35 331 remains higher after recreational cannabis legalization in a sensitivity analysis without
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37 332 “in remission” diagnoses. Overall, these findings suggest that when the substance use
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39 333 disorder is in remission, it does not play a significant role in overall results.
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42 334 In our primary analysis, we used December 10, 2012 as the date of recreational
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44 335 cannabis legalization. Following this date, private possession and growth of cannabis
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46 336 became legal in Colorado. After January 1, 2014, recreational cannabis could be legally
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48 337 purchased in retail stores.⁵ To take the additional effect of retail sales of recreational
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50 338 cannabis into account, we performed sensitivity analyses using January 2014 as the
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52 339 “change of policy” date. We did not observe any meaningful difference in the majority of
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3 340 the outcomes studied, suggesting that the effect of recreational cannabis on healthcare
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5 341 utilization was independent of availability in stores.
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10 343 **Strengths and Weaknesses**

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12 344 Although several studies have investigated the health effects of cannabis,¹³ they have
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14 345 relied on small sample sizes or have generated conflicting data.¹⁴⁻¹⁶ In contrast, our
15
16 346 findings are derived from HCUP state-wide data comprising over 28 million individuals
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18 347 and over 16 million hospitalizations across CO, site of the 2012 *Amendment 64*, and 2
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20 348 controls states without cannabis legalization over the same time period. As NY and OK
21
22 349 are very different geographically and demographically, we believe their inclusion as
23
24 350 control states represents a strength of our manuscript. Specifically, their selection
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26 351 allowed us to demonstrate that the effects of recreational cannabis legalization on
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28 352 health care utilization were likely independent of living in an urban or rural setting.
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32
33 353 Several limitations should be acknowledged. The HCUP database relies on
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35 354 physician coding; however, such coding for several medical diagnoses listed in **table 1**
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37 355 have been shown to be highly specific with variable sensitivity¹⁷⁻²⁰ and HCUP has
38
39 356 proven to be a powerful tool in large population studies.²⁰⁻²⁴ Some potentially important
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41 357 mediators are not captured by ICD-9 codes, such as quantity of cannabis used or
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43 358 formulation (oral versus other), although these may be more relevant to identifying
44
45 359 mechanisms and their absence would likely not lead to false positive results. Patients
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47 360 may be more likely to disclose cannabis use following legalization of recreational
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49 361 cannabis and clinicians may be more inclined to test for it. Hence, we cannot completely
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51 362 exclude detection bias in the validation analysis showing an increase in cannabis abuse
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3 363 admissions following legalization of recreational cannabis. Moreover, we cannot exclude
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5 364 that the increased frequency of cannabis abuse hospitalizations is simply related to
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8 365 severity of cannabis abuse rather than to a greater prevalence of cannabis use.
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10 366 As with any observational study, we cannot exclude residual confounding as an
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12 367 explanation of our findings. However, we adjusted for conventionally recognized
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14 368 confounders as appropriate and as available, and, as this was largely a study of the
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16
17 369 same populations pre- and post-legalization, many of the limitations inherent to
18
19 370 conventional individual-level analyses are likely less relevant.
20

21 371 We did not select all US states as controls. Most states do not have HCUP data
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23 372 up until the end of 2014, each requires a separate HCUP application, and each carries
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25 373 significant costs. We acknowledge this represents a limitation as we could not fully
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28 374 account for secular trends that might influence results. However, we have adjusted all
29
30 375 analyses for urbanicity and other state-level differences in order to minimize the impact
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33 376 of secular trends. We also acknowledge that CO had legalized medical cannabis prior to
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35 377 legalization of recreational cannabis on December 10, 2012. However, control states
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38 378 NY and OK had not. We could have selected control states that had already
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40 379 medicalized cannabis instead of NY and OK, but we acknowledge that complex
41
42 380 differences exist among medical legalization regimens among states.²⁵ Hence, we
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44
45 381 believe selection of control states with diverse medical legalization regimens would
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47 382 have primarily reduced our power to detect a real difference rather than contribute to
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49 383 any false positive spurious results. In our study, we demonstrate that legalization of
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51 384 recreational cannabis is associated with more admissions for cannabis abuse or
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54 385 cannabis use disorder. Prior large, multi-state, population-based analyses have shown
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3 386 that legalization of medical cannabis is associated with increased cannabis use, but not
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5 387 increased cannabis use disorder.²⁶ One could speculate that medical cannabis
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7 388 consumption is more controlled and rationed when compared to recreational cannabis,
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9
10 389 the latter available in both retail stores and private homes and therefore perhaps more
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12 390 easily abused. Further studies are needed to quantify the amount of cannabis
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14 391 consumption (in grams) in states where only medical cannabis is legal versus states
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16 392 where both medical and recreational cannabis are allowed.

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19 393 The HCUP database does not capture information regarding outpatient activity
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21 394 and therefore these findings are restricted to hospital-based medicine. However, even
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23 395 inclusion of outpatient data would not capture individuals with a specific condition or
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25 396 diagnosis who are not in formal treatment. Indeed, treatment databases do not capture
26
27 397 all individuals in the population. This gap may be especially large for substance use
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29 398 disorders. Many individuals with substance use disorders may never enter treatment;
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31 399 even those who do more likely receive outpatient treatment, rather than a
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33 400 hospitalization, so they may not have been included in our study.

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38 401 Our use of stringent criteria in assessing changes related to NAS diagnoses may
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40 402 have been too conservative, leading to a sacrifice of false negatives in order to avoid
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42 403 false positives.

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45 404 Finally, our study was limited to two-year follow-up after recreational cannabis
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47 405 legalization, and we therefore cannot comment on long-term effects that may result.

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51 52 407 **Conclusions**

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3 408 In conclusion, recreational cannabis legalization is associated with an expected
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5 409 increase in cannabis use disorder. Overall effects on inpatient healthcare utilization
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7 410 appear to be neutral, with subtle changes in various components of that utilization likely
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9 411 occurring due to changes in the types of admissions observed. Measurable effects of
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11 412 recreational cannabis legalization on increasing hospitalizations for motor vehicle
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13 413 accidents, alcohol abuse, overdose injury and reducing chronic pain admissions are
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15 414 consistent with previously published evidence. These data provide the first description
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17 415 of population-level effects that may help guide future decisions regarding cannabis
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19 416 policy, individuals considering using cannabis, and physicians caring for those who may
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24 417 choose to consume it.
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3 418 **Contributors** FND and GMM had full access to all of the data in the study and take
4
5 419 responsibility for the integrity of the data and the accuracy of the data analysis. FND
6
7 420 and GMM were responsible for the study concept and design. All authors (FND, EV,
8
9 421 TAD, MJP, JEO, GN, KA, CDF, ESL, SMF, DSK, and GMM) contributed to data
10
11 422 acquisition, analysis, and interpretation. EV, GN, and GMM completed the statistical
12
13 423 analysis. FND and GMM drafted the manuscript and were responsible for the critical
14
15 424 revision of the manuscript for important intellectual content. GMM obtained funding for
16
17 425 the study. All authors contributed to the administrative, technical, and material support
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19 426 for the study and approved the final version of the manuscript.

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21
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27
28 430 study; data analysis or interpretation; preparation of the manuscript; or the decision to
29
30 431 submit the manuscript for publication.

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32
33 432 **Competing interests** None declared.

34
35 433 **Patient consent** Not required.

36
37 434 **Ethics approval** Ethical approval to use de-identified HCUP data was obtained from
38
39 435 the University of California, San Francisco Committee on Human Research.

40
41 436 **Data sharing** Data consist of deidentified participant data (i.e. ICD-9 admission
42
43 437 diagnoses) available from the Healthcare Cost and Utilization Project (HCUP) for a fee.
44
45 438 Information about how to obtain the data and for what time period can be found at:
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47 439 <https://www.hcup-us.ahrq.gov/>

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For peer review only

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3 515 **FIGURE LEGENDS**
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5 516 **Figure 1.** Multivariate adjusted rates of admissions for cannabis abuse over 2010-2014
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7 517 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy,
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9 518 compared with New York (A) and Oklahoma (B), control states without cannabis
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11 519 legalization. Red lines show the predicted rates of admissions for cannabis abuse had
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13 520 the cannabis legalization policy not been instituted. The comparison between Colorado
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15 521 and the control states with regards to change of risk ratio (RR) slope within the 2010-
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17 522 2012 period (pre-legalization) and 2012-2014 period (post-legalization), as well of the
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19 523 overall RR slope change, are also represented for the Colorado versus New York (A)
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21 524 and Colorado versus Oklahoma (B) comparisons. Red lines show the predicted rates of
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23 525 admissions for cannabis abuse had the cannabis legalization policy not been instituted.
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25 526 Each model was adjusted for age, gender, and race and state-level characteristics (see
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27 527 Methods section for further details). CI = confidence interval; vs = versus.
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35 529 **Figure 2.** Healthcare utilization over 2010-2014 in Colorado, site of implementation of
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37 530 the 2012 recreational cannabis legalization policy, and in New York and Oklahoma,
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39 531 control states without cannabis legalization. The total number of admissions/1000
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41 532 population per year, the median length of stay per year, and the median costs per
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43 533 individual per year are shown in panels A, B, and C, respectively for the 3 states. Error
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45 534 bars denote interquartile ranges. LOS = length of stay.
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51 536 **Figure 3.** Health outcomes with substantial or moderate evidence of a statistical
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53 537 association with cannabis use based on the National Academy of Science (NAS)
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3 538 summary statement. Medical diagnoses are identified based on a non-significant
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5 539 ($P>0.05$) comparison between New York (NY) and Oklahoma (OK) (control states
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7 540 without cannabis legalization) with regards to the change of admission rates for such
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15 544 evidence of cannabis benefit (risk ratio [RR] < 1 shown on the left) and cannabis harm
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17 545 (RR >1 shown on the right); 95% confidence intervals are shown for the comparison
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19 546 between CO and NY and between CO and OK as solid and dotted lines, respectively.
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22 547 Progressively darker shades of green or red indicate greater weight of evidence in the
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24 548 direction of proposed benefit versus harm, respectively, by the NAS.
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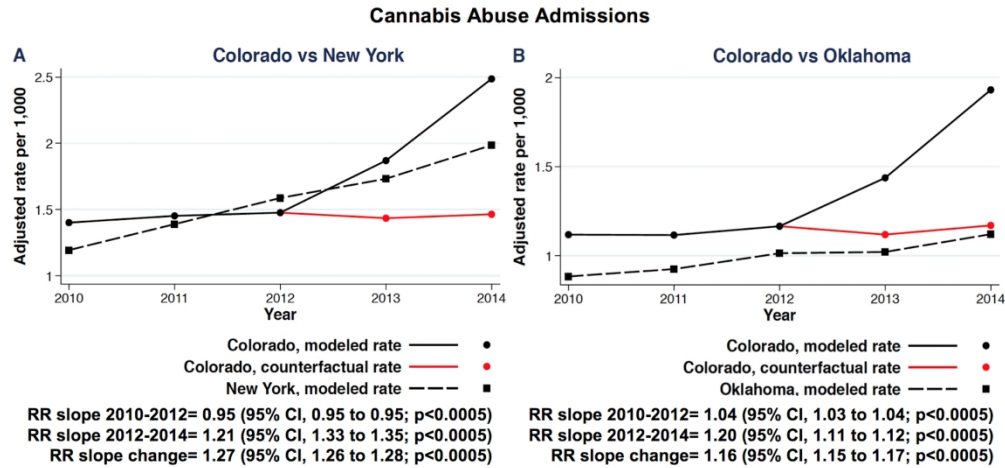
Table 1. Clinical characteristics of the 3 study states over the 2010-2014 period.

	Colorado	New York	Oklahoma	<i>P</i> value
Total population	5,197,237	19,594,599	3,819,383	
Total admissions	2,088,909	11,726,283	2,334,988	
Total admissions/1,000 population	402±0.27	598±0.17	611±0.40	0.0001
Demographics				
Age – yr	45 ± 28	49 ± 28	48 ± 28	0.0001
Male – no. (%)	870,573 (42)	5,087,181 (41)	954,848 (43)	0.0001
Race – no. (%)				0.0001
White	1,548,099 (74)	6,406,582 (55)	1,879,727 (81)	
Black	102,444 (5)	2,083,366 (18)	202,420 (9)	
Native American	13,143 (1)	36,216 (0.3)	131,714 (6)	
Other	425,223 (20)	3,200,119 (27)	121,127 (5)	
Lifestyle				
Median Household Income, dollars (quartiles for patient ZIP code) – no. (%)				0.0001
Quartile 1	617,537 (30)	3,087,192 (28)	No data	
Quartile 2	558,760 (27)	2,623,087 (24)		
Quartile 3	470,051 (23)	2,673,153 (24)		
Tobacco use – no. (%)	251,566 (12)	1,717,940 (10)	235,685 (14)	0.0001
Alcohol abuse – no. (%)	112,715 (5)	652,608 (6)	71,931 (3)	0.0001
NAS Diagnoses				
Non-seminoma type testicular germ cell cancer – no. (%)	405 (0.02)	2,487 (0.02)	480 (0.02)	0.0001
Acute myocardial infarction – no. (%)	39,513 (1.9)	271,285 (2.3)	60,413 (2.6)	0.0001
Brain hemorrhage – no. (%)	10,963 (0.5)	58,278 (0.5)	10,245 (0.4)	0.0001
Ischemic stroke – no. (%)	27,986 (1.3)	194,478 (1.7)	45,602 (2)	0.0001

Metabolic syndrome & diabetes – no. (%)	294,821 (14)	2,301,835 (20)	465,353 (20)	0.0001
Prediabetes – no. (%)	42,544 (2)	73,407 (0.6)	24,246 (1)	0.0001
Bronchitis – no. (%)	65,265 (3)	429,230 (4)	131,343 (6)	0.0001
Motor vehicle accidents – no. (%)	14,941 (0.7)	59,686 (0.5)	13,692 (0.6)	0.0001
Overdose injury – no. (%)	10,933 (0.5)	40,226 (0.3)	12,147 (0.5)	0.0001
Substance use disorder – no. (%)	158,244 (7.6)	974,856 (8.3)	109,305 (4.7)	0.0001
Anxiety disorders – no. (%)	131,426 (6.4)	595,478 (5.2)	139,627 (6.1)	0.0001
Anxiety disorders (except social anxiety) – no. (%)	51,913 (2.5)	283,280 (2.4)	65,279 (2.8)	0.0016
Bipolar disorders – no. (%)	52,348 (2.5)	287,735 (2.5)	61,411 (2.6)	0.0001
Depressive disorders – no. (%)	213,851 (10)	827,932 (7)	190,083 (8)	0.0001
Schizophrenia or other psychoses – no. (%)	53,652 (2.6)	352,533 (3)	68,385 (2.9)	0.0001
Positive symptoms of schizophrenia (i.e. hallucinations) – no. (%)	2,653 (0.1)	9,482 (0.1)	3,531 (0.2)	0.0001
Post-traumatic stress disorder – no. (%)	28,582 (1.4)	75,608 (0.6)	17,101 (0.7)	0.0001
Social anxiety disorder – no. (%)	295 (0.01)	1,090 (0.01)	135 (0.01)	0.0295
Suicide – no. (%)	4,957 (0.2)	15,646 (0.1)	4,407 (0.2)	0.0001
Low offspring birthweight – no. (%)	2,842 (0.1)	7,462 (0.1)	1,742 (0.1)	0.0002
Maternal pregnancy complications – no. (%)	39,343 (1.9)	144,353 (1.2)	40,938 (1.8)	0.0001
Unemployment/low income – no. (%)	3,134 (0.2)	76,789 (0.7)	730 (0.03)	0.0001
Nausea or vomiting – no. (%)	63,806 (3)	162,11(1.4)	58,706 (2.5)	0.0001
Chronic pain – no. (%)	140,209 (6)	234,160 (2)	123,563 (5)	0.0001
Spasticity – no. (%)	5,759 (0.3)	12,517 (0.1)	5,371 (0.2)	0.0001

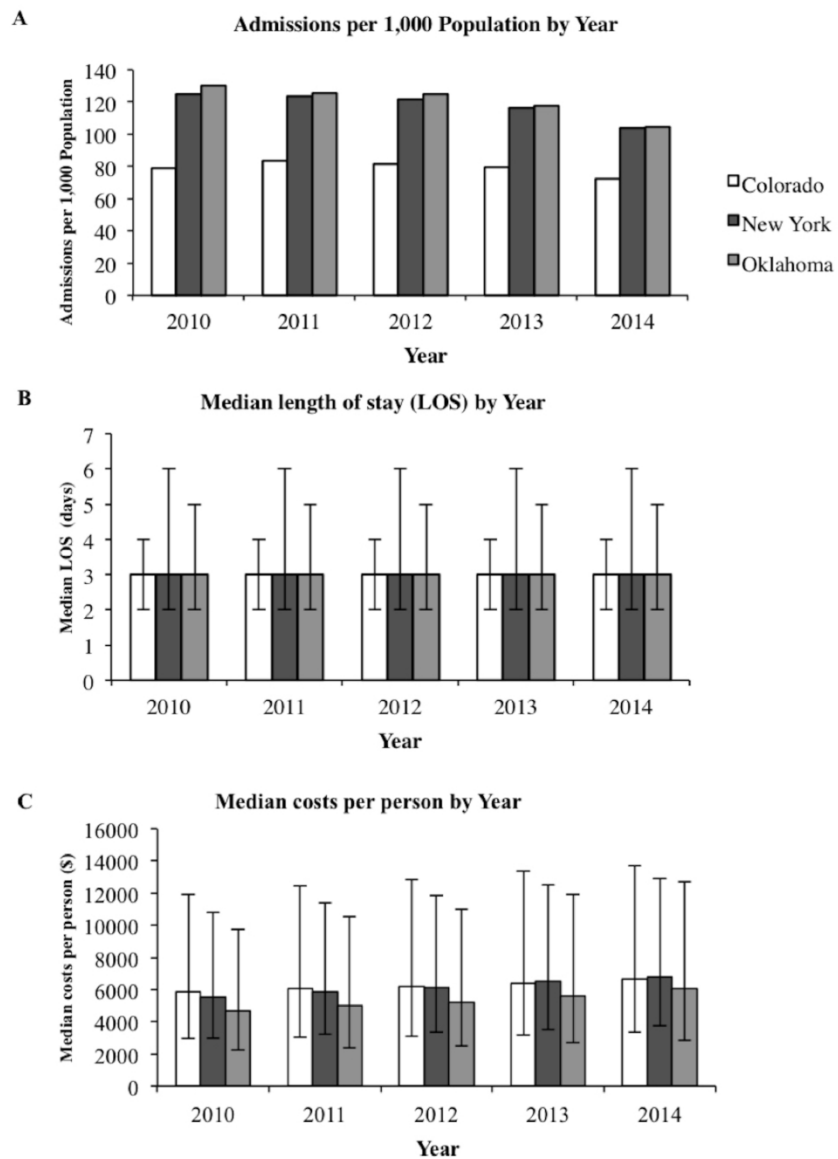
Short-term sleep – no. (%)	652 (0.03)	3,364 (0.03)	357 (0.02)	0.0001
Tourette syndrome – no. (%)	428 (0.02)	2,784 (0.02)	336 (0.01)	0.0001
Increased appetite & weight gain – no. (%)	1,022 (0.05)	3,017 (0.03)	651 (0.03)	0.0001

549 NAS = National Academy of Science. Admission diagnoses listed were based on those
 550 found influenced by cannabis in the 2017 NAS review.³ Substance use disorder includes
 551 dependence or abuse of alcohol, tobacco, or other illicit drug. All variables pertain to the
 552 2010-2014 period. Plus-minus values are means \pm SD. No. (%) indicates number of
 553 admissions with a specific demographic/lifestyle characteristic or NAS diagnosis (% of
 554 total admissions). A *P* value less than 0.05 is considered statistically significant.



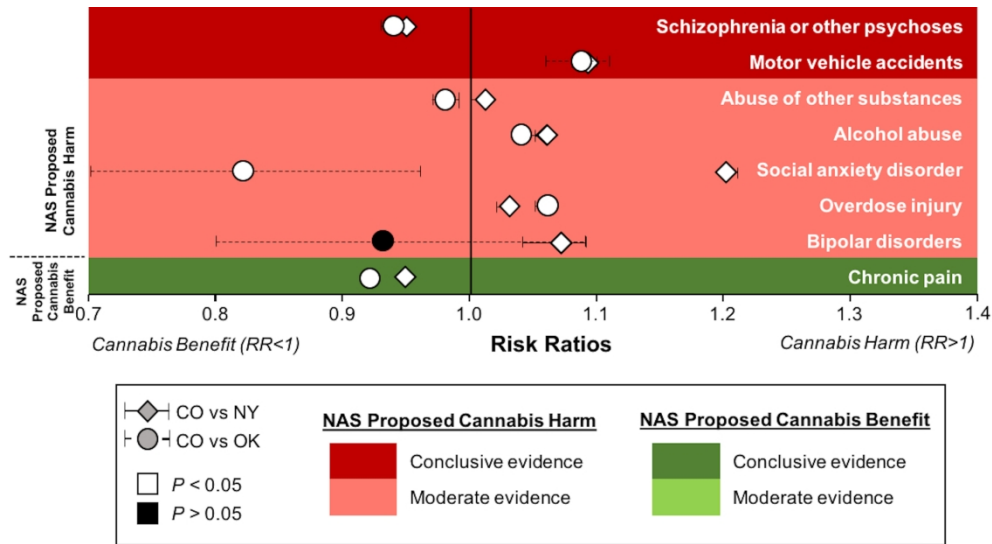
Multivariate adjusted rates of admissions for cannabis abuse over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, compared with New York (A) and Oklahoma (B), control states without cannabis legalization. Red lines show the predicted rates of admissions for cannabis abuse had the cannabis legalization policy not been instituted. The comparison between Colorado and the control states with regards to change of risk ratio (RR) slope within the 2010-2012 period (pre-legalization) and 2012-2014 period (post-legalization), as well as the overall RR slope change, are also represented for the Colorado versus New York (A) and Colorado versus Oklahoma (B) comparisons. Red lines show the predicted rates of admissions for cannabis abuse had the cannabis legalization policy not been instituted. Each model was adjusted for age, gender, and race and state-level characteristics (see Methods section for further details). CI = confidence interval; vs = versus.

663x316mm (300 x 300 DPI)



Healthcare utilization over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, and in New York and Oklahoma, control states without cannabis legalization. The total number of admissions/1000 population per year, the median length of stay per year, and the median costs per individual per year are shown in panels A, B, and C, respectively for the 3 states. Error bars denote interquartile ranges. LOS = length of stay.

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Health outcomes with substantial or moderate evidence of a statistical association with cannabis use based on the National Academy of Science (NAS) summary statement. Medical diagnoses are identified based on a non-significant ($P > 0.05$) comparison between New York (NY) and Oklahoma (OK) (control states without cannabis legalization) with regards to the change of admission rates for such diagnoses following cannabis legalization. P values for the comparison between Colorado (CO) (site of cannabis legalization) and NY (rhomboid symbol), or between CO and OK (circular symbol) are shown as either < 0.05 , or > 0.05 using a gray scale for evidence of cannabis benefit (risk ratio [RR] < 1 shown on the left) and cannabis harm (RR > 1 shown on the right); 95% confidence intervals are shown for the comparison between CO and NY and between CO and OK as solid and dotted lines, respectively. Progressively darker shades of green or red indicate greater weight of evidence in the direction of proposed benefit versus harm, respectively, by the NAS.

188x101mm (300 x 300 DPI)

Supplementary Appendix

Changes in Inpatient Healthcare Utilization after Legalization of Recreational Cannabis

Francesca N. Delling, MD, MPH;¹ Eric Vittinghoff, PhD;¹ Thomas A. Dewland, MD;² Mark J. Pletcher, MD, MPH;¹ Jeffrey E. Olgin, MD;¹ Gregory Nah, MA;¹ Kirstin Aschbacher, PhD;¹ Christina Fang, BA;¹ Emily S. Lee, BA;¹ Shannon M. Fan, BA;¹ Dhruv S. Kazi, MD, MS;¹ and Gregory M. Marcus, MD, MAS.¹

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eTable 3. Changes in specific NAS outcomes in a sensitivity analysis using January 2014 as the date of recreational cannabis legalization

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Cost Analysis

Cost Estimations

The inpatient cost for each hospitalization in New York and Colorado was estimated by multiplying the total charges (TOTCHG) obtained from HCUP State Inpatient Database with the institution-specific all-payer cost-to-charge ratio (APICC) obtained from the Cost-to-Charge Ratio file. Hospital ID was used as a linkage to merge both files. Total inpatient costs were calculated as the sum of the cost for all hospitalizations in a given state for a particular year. The databases contained 186,226 (8.7%) encounters with non-matched/missing hospital ID for NY and 1,132,696 (9.6%) encounters with non-matched/missing hospital ID for Colorado; for these encounters. In order to estimate the cost of these hospitalizations (for which we had charges but no cost-to-charge ratio) we applied the average cost-to-charge ratio for that state-year. This was estimated by dividing the sum of costs for all hospitalizations for which cost-to-charge ratios were available by the sum of charges for all hospitalizations for which cost-to-charge ratios were available in a given state-year (eTable 2).

Oklahoma Total Cost Estimate

HCUP does not produce SID and CCR file for Oklahoma. We obtained these data from Oklahoma State Department of Health – this dataset contains information about total charges but not cost-to-charge ratios. We estimated total inpatient costs in Oklahoma in two ways. First, we used a state-wide constant cost-to-charge ratio (0.3119) to estimate the total cost (ratio derived from the Institute for Health and Socio-Economic Policy calculations of federal cost reports). We then conducted a sensitivity analysis in which we used the average of the cost-to-charge ratios of New York and Colorado for any given state-year (eTable 2).

eTable 1. Yearly costs and charges for the 3 study states

Colorado	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	397,505	428,912	424,640	418,952	418,900	2,088,909
Hospitalizations for which CCR is available, n (%)	396,433 (99.7%)	301,586 (70.3%)	382,021 (90.0%)	412,483 (98.5%)	413,160 (98.6%)	1,905,683 (91.2%)
Total charges for hospitalizations for which CCR is available	\$14,382,791,648	\$11,170,040,412	\$15,821,232,608	\$19,349,895,615	\$20,370,018,114	\$81,093,978,397
Total costs for hospitalizations for which CCR is available	\$4,104,443,164	\$3,033,915,324	\$3,963,892,093	\$4,619,884,886	\$4,700,380,255	\$20,422,515,722
Average CCR*	0.2854	0.2716	0.2505	0.2388	0.2309	
Hospitalizations for which CCR is not available, n (%)	1,072 (0.3%)	127,326 (29.7%)	42,619 (10.0%)	6,469 (1.5%)	5,740 (1.4%)	183,226 (8.8%)
Total charges for hospitalizations for which CCR is not available	\$55,039,614	\$5,704,285,087	\$2,494,379,901	\$241,011,451	\$211,228,665	\$8,705,944,718
Total costs for hospitalizations for which CCR is not available†	\$15,708,306	\$1,549,283,830	\$624,842,165	\$57,553,535	\$48,772,699	\$2,296,160,534
Total inpatient costs	\$4,120,151,470	\$4,583,199,154	\$4,588,734,258	\$4,677,438,421	\$4,749,152,954	\$22,718,676,256

*Average CCR was estimated by dividing the total of costs for all hospitalizations for which cost-to-charge ratios were available by the total charges for hospitalizations for which cost-to-charge ratios were available in a given state-year.

†Total charges for hospitalization for which CCR is not available multiplied by Average CCR in a given state-year.

New York	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	2,417,298	2,414,985	2,389,701	2,290,502	2,213,797	11,726,283
Hospitalizations for which CCR is available, n (%)	2,189,513 (90.6%)	2,157,629 (89.3%)	2,168,880 (90.8%)	2,056,367 (89.8%)	2,021,199 (91.3%)	10,593,588 (90.3%)
Total charges for hospitalizations for which CCR is available	\$66,303,900,691	\$69,885,515,755	\$74,728,795,811	\$77,680,292,105	\$79,252,368,106	\$367,850,872,468
Total costs for hospitalizations for which CCR is available	\$22,376,381,374	\$23,448,311,348	\$24,539,963,919	\$24,331,920,273	\$23,892,478,440	\$118,589,055,354
Average CCR*	0.3375	0.3355	0.3283	0.3132	0.3014	
Hospitalizations for which CCR is not available, n (%)	227,785 (9.4%)	257,356 (10.7%)	220,821 (9.2%)	234,135 (10.2%)	192,598 (8.7%)	1,132,695 (9.7%)
Total charges for hospitalizations for which CCR is not available	\$4,168,104,163	\$4,821,903,339	\$4,088,909,686	\$5,687,320,556	\$5,336,461,039	\$24,102,698,783
Total costs for hospitalizations for which CCR is not available†	\$1,406,735,155	\$1,617,748,571	\$1,342,797,941	\$1,781,268,798	\$1,608,409,357	\$7,756,959,821
Total inpatient costs	\$23,783,116,529	\$25,066,059,919	\$25,882,761,860	\$26,113,189,071	\$25,500,887,797	\$126,346,015,175

*Average CCR was estimated by dividing the total of costs for all hospitalizations for which cost-to-charge ratios were available by the total charges for hospitalizations for which cost-to-charge ratios were available in a given state-year.

†Total charges for hospitalization for which CCR is not available multiplied by Average CCR in a given state-year.

Oklahoma	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalizations, n	489,724	476,605	476,728	452,724	439,207	2,334,988
Hospitalizations for which CCR is available, n (%)	489724 (100%)	476605 (100%)	476728 (100%)	452724 (100%)	439207 (100%)	2334988 (100%)
Total charges for hospitalizations for which CCR is available	\$13,927,214,520	\$14,645,751,657	\$15,247,598,300	\$15,596,643,583	\$15,003,967,132	\$74,421,175,192
Total costs for hospitalizations for which CCR is available	\$4,343,898,209	\$4,568,009,942	\$4,755,725,910	\$4,864,593,134	\$5,001,131,977	\$23,533,359,171
Average CCR*	0.3119	0.3119	0.3119	0.3119	0.3119	

*Statewide constant CCR (0.3119) used to estimate the total cost across years.

Oklahoma (sensitivity analysis)	2010	2011	2012	2013	2014	2010 to 2014
Total hospitalization, n	489,724	476,605	476,728	452,724	439,207	2,334,988
Hospitalization for which CCR is available, n (%)	489724 (100%)	476605 (100%)	476728 (100%)	452724 (100%)	439207 (100%)	2334988 (100%)
Total charges for hospitalization for which CCR is available	\$13,927,214,520	\$14,645,751,657	\$15,247,598,300	\$15,596,643,583	\$15,003,967,132	\$74,421,175,192
Total costs for hospitalization for which CCR is available	\$4,337,630,962	\$4,445,717,915	\$4,413,417,328	\$4,304,673,629	\$4,267,557,794	\$21,768,997,628
Average CCR*	0.3114	0.3036	0.2895	0.276	0.2662	

*Average of the CCRs of New York and Colorado for any given state-year.

eTable 2. International Classification of Diseases-9th Edition (ICD-9) codes defining each medical diagnosis.

Chronic pain

ICD-9 Code	Short Description	Long Description
338.21	Chronic pain d/t trauma	Chronic pain due to trauma
338.22	Chron post-thoracot pain	Chronic post-thoracotomy pain
338.28	Chronic postop pain NEC	Other chronic postoperative pain
338.29	Chronic pain NEC	Other chronic pain
338.4	Chronic pain syndrome	Chronic pain syndrome

Nausea or vomiting

ICD-9 Code	Short Description	Long Description
787.03	Vomiting alone	Vomiting alone
787.02	Nausea alone	Nausea alone
787.01	Nausea with vomiting	Nausea with vomiting

Spasticity

ICD-9 Code	Short Description	Long Description
728.85	Spasm of muscle	Spasm of muscle

Short-term sleep disorders

ICD-9 Code	Short Description	Long Description
307.4	Nonorganic sleep dis NOS	Nonorganic sleep disorder, unspecified
307.41	Transient insomnia	Transient disorder of initiating or maintaining sleep
307.42	Persistent insomnia	Persistent disorder of initiating or maintaining sleep
307.45	Nonorganic circadian rhy	Circadian rhythm sleep disorder of nonorganic origin
307.47	Sleep stage dysfunc NEC	Other dysfunctions of sleep stages or arousal from sleep
307.49	Nonorganic sleep dis NEC	Other specific disorders of sleep of nonorganic origin

Increased appetite and weight gain

ICD-9 Code	Short Description	Long Description
783.1	Abnormal weight gain	Abnormal weight gain
783.6	Polyphagia	Polyphagia

Tourette's syndrome

ICD-9 Code	Short Description	Long Description
307.23	Tourette's disorder	Tourette's disorder

Posttraumatic stress disorder

ICD-9 Code	Short Description	Long Description
309.81	Posttraumatic stress dis	Posttraumatic stress disorder

Non-seminoma-type testicular germ cell cancer

ICD-9 Code	Short Description	Long Description
186.9	Malig neo testis NEC	Malignant neoplasm of other and unspecified testis

Acute myocardial infarction

ICD-9 Code	Short Description	Long Description
410	AMI anterolateral,unspec	Acute myocardial infarction of anterolateral wall, episode of care unspecified
410.01	AMI anterolateral, init	Acute myocardial infarction of anterolateral wall, initial episode of care
410.02	AMI anterolateral,subseq	Acute myocardial infarction of anterolateral wall, subsequent episode of care
410.1	AMI anterior wall,unspec	Acute myocardial infarction of other anterior wall, episode of care unspecified
410.11	AMI anterior wall, init	Acute myocardial infarction of other anterior wall, initial episode of care
410.12	AMI anterior wall,subseq	Acute myocardial infarction of other anterior wall, subsequent episode of care
410.2	AMI inferolateral,unspec	Acute myocardial infarction of inferolateral wall, episode of care unspecified
410.21	AMI inferolateral, init	Acute myocardial infarction of inferolateral wall, initial episode of care
410.22	AMI inferolateral,subseq	Acute myocardial infarction of inferolateral wall, subsequent episode of care
410.3	AMI inferopost, unspec	Acute myocardial infarction of inferoposterior wall, episode of care unspecified
410.31	AMI inferopost, initial	Acute myocardial infarction of inferoposterior wall, initial episode of care
410.32	AMI inferopost, subseq	Acute myocardial infarction of inferoposterior wall, subsequent episode of care
410.4	AMI inferior wall,unspec	Acute myocardial infarction of other inferior wall, episode of care unspecified
410.41	AMI inferior wall, init	Acute myocardial infarction of other inferior wall, initial episode of care
410.42	AMI inferior wall,subseq	Acute myocardial infarction of other inferior wall, subsequent episode of care
410.5	AMI lateral NEC, unspec	Acute myocardial infarction of other lateral wall, episode of care unspecified
410.51	AMI lateral NEC, initial	Acute myocardial infarction of other lateral wall, initial episode of care
410.52	AMI lateral NEC, subseq	Acute myocardial infarction of other lateral wall, subsequent episode of care
410.6	True post infarct,unspec	True posterior wall infarction, episode of care unspecified
410.61	True post infarct, init	True posterior wall infarction, initial episode of care

410.62	True post infarct,subseq	True posterior wall infarction, subsequent episode of care
410.7	Subendo infarct, unspec	Subendocardial infarction, episode of care unspecified
410.71	Subendo infarct, initial	Subendocardial infarction, initial episode of care
410.72	Subendo infarct, subseq	Subendocardial infarction, subsequent episode of care
410.8	AMI NEC, unspecified	Acute myocardial infarction of other specified sites, episode of care unspecified
410.81	AMI NEC, initial	Acute myocardial infarction of other specified sites, initial episode of care
410.82	AMI NEC, subsequent	Acute myocardial infarction of other specified sites, subsequent episode of care
410.9	AMI NOS, unspecified	Acute myocardial infarction of unspecified site, episode of care unspecified
410.91	AMI NOS, initial	Acute myocardial infarction of unspecified site, initial episode of care
410.92	AMI NOS, subsequent	Acute myocardial infarction of unspecified site, subsequent episode of care

Ischemic stroke

ICD-9 Code	Short Description	Long Description
435.8	Trans cereb ischemia NEC	Other specified transient cerebral ischemias
435.9	Trans cereb ischemia NOS	Unspecified transient cerebral ischemia
433.01	Ocl bslr art w infrc	Occlusion and stenosis of basilar artery with cerebral infarction
433.11	Ocl crtd art w infrc	Occlusion and stenosis of carotid artery with cerebral infarction
433.21	Ocl vrtb art w infrc	Occlusion and stenosis of vertebral artery with cerebral infarction
433.31	Ocl mlt bi art w infrc	Occlusion and stenosis of multiple and bilateral precerebral arteries with cerebral infarction
433.81	Ocl spcf art w infrc	Occlusion and stenosis of other specified precerebral artery with cerebral infarction
433.91	Ocl art NOS w infrc	Occlusion and stenosis of unspecified precerebral artery with cerebral infarction
434.91	Crbl art ocl NOS w infrc	Cerebral artery occlusion, unspecified with cerebral infarction

Brain hemorrhage

ICD-9 Code	Short Description	Long Description
430	Subarachnoid hemorrhage	Subarachnoid hemorrhage
431	Intracerebral hemorrhage	Intracerebral hemorrhage
432	Nontraum extradural hem	Nontraumatic extradural hemorrhage
432.1	Subdural hemorrhage	Subdural hemorrhage
432.9	Intracranial hemorr NOS	Unspecified intracranial hemorrhage

Metabolic syndrome and diabetes

ICD-9 Code	Short Description	Long Description
277.7	Dysmetabolic syndrome x	Dysmetabolic syndrome X
250	DMII wo cmp nt st uncntr	Diabetes mellitus without mention of complication, type II or unspecified type, not stated as uncontrolled
250.02	DMII wo cmp uncntrld	Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled
250.1	DMII keto nt st uncntrld	Diabetes with ketoacidosis, type II or unspecified type, not stated as uncontrolled
250.12	DMII ketoacd uncntrld	Diabetes with ketoacidosis, type II or unspecified type, uncontrolled
250.2	DMII hprsm nt st uncntrl	Diabetes with hyperosmolarity, type II or unspecified type, not stated as uncontrolled
250.22	DMII hprosmrlr uncntrld	Diabetes with hyperosmolarity, type II or unspecified type, uncontrolled
250.3	DMII o cm nt st uncntrld	Diabetes with other coma, type II or unspecified type, not stated as uncontrolled
250.32	DMII oth coma uncntrld	Diabetes with other coma, type II or unspecified type, uncontrolled
250.4	DMII renl nt st uncntrld	Diabetes with renal manifestations, type II or unspecified type, not stated as uncontrolled
250.42	DMII renal uncntrld	Diabetes with renal manifestations, type II or unspecified type, uncontrolled
250.5	DMII ophth nt st uncntrl	Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled
250.52	DMII ophth uncntrld	Diabetes with ophthalmic manifestations, type II or unspecified type, uncontrolled
250.6	DMII neuro nt st uncntrl	Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled
250.62	DMII neuro uncntrld	Diabetes with neurological manifestations, type II or unspecified type, uncontrolled
250.7	DMII circ nt st uncntrld	Diabetes with peripheral circulatory disorders, type II or unspecified type, not stated as uncontrolled
250.72	DMII circ uncntrld	Diabetes with peripheral circulatory disorders, type II or unspecified type, uncontrolled
250.8	DMII oth nt st uncntrld	Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled
250.82	DMII oth uncntrld	Diabetes with other specified manifestations, type II or unspecified type, uncontrolled
250.9	DMII unspf nt st uncntrl	Diabetes with unspecified complication, type II or unspecified type, not stated as uncontrolled

250.92	DMII unspf uncntrld	Diabetes with unspecified complication, type II or unspecified type, uncontrolled
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Prediabetes

ICD-9 Code	Short Description	Long Description
790.29	Abnormal glucose NEC	Other abnormal glucose

Bronchitis

ICD-9 Code	Short Description	Long Description
466	Acute bronchitis	Acute bronchitis
490	Bronchitis NOS	Bronchitis, not specified as acute or chronic
491	Simple chr bronchitis	Simple chronic bronchitis
491.1	Mucopurul chr bronchitis	Mucopurulent chronic bronchitis
491.2	Obst chr bronc w/o exac	Obstructive chronic bronchitis without exacerbation
491.21	Obs chr bronc w(ac) exac	Obstructive chronic bronchitis with (acute) exacerbation
491.22	Obs chr bronc w ac bronc	Obstructive chronic bronchitis with acute bronchitis
491.8	Chronic bronchitis NEC	Other chronic bronchitis
491.9	Chronic bronchitis NOS	Unspecified chronic bronchitis

Motor vehicle accidents

ICD-9 Code	Short Description	Long Description
E812.0	Mv collision NOS-driver	Other motor vehicle traffic accident involving collision with motor vehicle injuring driver of motor vehicle other than motorcycle
E812.1	Mv collision NOS-pasngr	Other motor vehicle traffic accident involving collision with motor vehicle injuring passenger in motor vehicle other than motorcycle
E812.2	Mv collis NOS-motorcycl	Other motor vehicle traffic accident involving collision with motor vehicle injuring motorcyclist
E812.3	Mv coll NOS-mcycl psngr	Other motor vehicle traffic accident involving collision with motor vehicle injuring passenger on motorcycle
E812.4	Mv collision NOS-st car	Other motor vehicle traffic accident involving collision with motor vehicle injuring occupant of streetcar
E812.5	Mv coll NOS-anim rid	Other motor vehicle traffic accident involving collision with motor vehicle injuring rider of animal; occupant of animal-drawn vehicle
E812.6	Mv coll NOS-ped cycl	Other motor vehicle traffic accident involving collision with motor vehicle injuring pedal cyclist
E812.7	Mv collision NOS-pedest	Other motor vehicle traffic accident involving collision with motor vehicle injuring pedestrian

E812.8	Mv collis NOS-pers NEC	Other motor vehicle traffic accident involving collision with motor vehicle injuring other specified person
E812.9	Mv collis NOS-pers NOS	Other motor vehicle traffic accident involving collision with motor vehicle injuring unspecified person
E813.0	Mv-oth veh coll-driver	Motor vehicle traffic accident involving collision with other vehicle injuring driver of motor vehicle other than motorcycle
E813.1	Mv-oth veh coll-pasngr	Motor vehicle traffic accident involving collision with other vehicle injuring passenger in motor vehicle other than motorcycle
E813.2	Mv-oth veh coll-motcycl	Motor vehicle traffic accident involving collision with other vehicle injuring motorcyclist
E813.3	Mv-oth veh coll-mcyc psg	Motor vehicle traffic accident involving collision with other vehicle injuring passenger on motorcycle
E813.4	Mv-oth veh coll-st car	Motor vehicle traffic accident involving collision with other vehicle injuring occupant of streetcar
E813.5	Mv-oth veh coll-anim rid	Motor vehicle traffic accident involving collision with other vehicle injuring rider of animal; occupant of animal-drawn vehicle
E813.6	Mv-oth veh coll-ped cycl	Motor vehicle traffic accident involving collision with other vehicle injuring pedal cyclist
E813.7	Mv-oth veh coll-pedest	Motor vehicle traffic accident involving collision with other vehicle injuring pedestrian
E813.8	Mv-oth veh coll-pers NEC	Motor vehicle traffic accident involving collision with other vehicle injuring other specified person
E813.9	Mv-oth veh coll-pers NOS	Motor vehicle traffic accident involving collision with other vehicle injuring unspecified person
E814.0	Mv coll w pedest-driver	Motor vehicle traffic accident involving collision with pedestrian injuring driver of motor vehicle other than motorcycle
E814.1	Mv coll w pedest-pasngr	Motor vehicle traffic accident involving collision with pedestrian injuring passenger in motor vehicle other than motorcycle
E814.2	Mv coll w pedest-motcycl	Motor vehicle traffic accident involving collision with pedestrian injuring motorcyclist
E814.3	Mv coll w ped-mcycl psgr	Motor vehicle traffic accident involving collision with pedestrian injuring passenger on motorcycle
E814.4	Mv coll w pedest-st car	Motor vehicle traffic accident involving collision with pedestrian injuring occupant of streetcar
E814.5	Mv coll w ped-anim rid	Motor vehicle traffic accident involving collision with pedestrian injuring rider of animal; occupant of animal drawn vehicle
E814.6	Mv coll w ped-ped cycl	Motor vehicle traffic accident involving collision with pedestrian injuring pedal cyclist

E814.7	Mv coll w pedest-pedest	Motor vehicle traffic accident involving collision with pedestrian injuring pedestrian
E814.8	Mv coll w pedes-pers NEC	Motor vehicle traffic accident involving collision with pedestrian injuring other specified person
E814.9	Mv coll w pedes-pers NOS	Motor vehicle traffic accident involving collision with pedestrian injuring unspecified person
E815.0	Mv coll w oth obj-driver	Other motor vehicle traffic accident involving collision on the highway injuring driver of motor vehicle other than motorcycle
E815.1	Mv coll w oth obj-pasngr	Other motor vehicle traffic accident involving collision on the highway injuring passenger in motor vehicle other than motorcycle
E815.2	Mv coll w oth obj-mocycl	Other motor vehicle traffic accident involving collision on the highway injuring motorcyclist
E815.3	Mv coll w obj-mcycl psgr	Other motor vehicle traffic accident involving collision on the highway injuring passenger on motorcycle
E815.4	Mv coll w obj-st car	Other motor vehicle traffic accident involving collision on the highway injuring occupant of streetcar
E815.5	Mv coll w obj-anim rider	Other motor vehicle traffic accident involving collision on the highway injuring rider of animal; occupant of animal-drawn vehicle
E815.6	Mv coll w obj-ped cycl	Other motor vehicle traffic accident involving collision on the highway injuring pedal cyclist
E815.7	Mv coll w obj-pedest	Other motor vehicle traffic accident involving collision on the highway injuring pedestrian
E815.8	Mv coll w obj-pers NEC	Other motor vehicle traffic accident involving collision on the highway injuring other specified person
E815.9	Mv coll w obj-pers NOS	Other motor vehicle traffic accident involving collision on the highway injuring unspecified person
E816.0	Loss control mv acc-driv	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring driver of motor vehicle other than motorcycle
E816.1	Loss control mv acc-psgr	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring passenger in motor vehicle other than motorcycle
E816.2	Loss control mv-mocycl	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring motorcyclist
E816.3	Loss control mv-mcyc psg	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring passenger on motorcycle

E816.4	Loss cont mv acc-st car	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring occupant of streetcar
E816.5	Loss cont mv-anim rider	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring rider of animal; occupant of animal-drawn vehicle
E816.6	Loss control mv-ped cycl	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring pedal cyclist
E816.7	Loss control mv-pedest	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring pedestrian
E816.8	Loss control mv-pers NEC	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring other specified person
E816.9	Loss control mv-pers NOS	Motor vehicle traffic accident due to loss of control, without collision on the highway, injuring unspecified person
E819.0	Traffic acc NOS-driver	Motor vehicle traffic accident of unspecified nature injuring driver of motor vehicle other than motorcycle
E819.1	Traffic acc NOS-pasngr	Motor vehicle traffic accident of unspecified nature injuring passenger in motor vehicle other than motorcycle
E819.2	Traffic acc NOS-motcycl	Motor vehicle traffic accident of unspecified nature injuring motorcyclist
E819.3	Traff acc NOS-mcycl psgr	Motor vehicle traffic accident of unspecified nature injuring passenger on motorcycle
E819.4	Traffic acc NOS-st car	Motor vehicle traffic accident of unspecified nature injuring occupant of streetcar
E819.5	Traff acc NOS-anim rider	Motor vehicle traffic accident of unspecified nature injuring rider of animal; occupant of animal-drawn vehicle
E819.6	Traffic acc NOS-ped cycl	Motor vehicle traffic accident of unspecified nature injuring pedal cyclist
E819.7	Traffic acc NOS-pedest	Motor vehicle traffic accident of unspecified nature injuring pedestrian
E819.8	Traffic acc NOS-pers NEC	Motor vehicle traffic accident of unspecified nature injuring other specified person
E819.9	Traffic acc NOS-pers NOS	Motor vehicle traffic accident of unspecified nature injuring unspecified person

Overdose injuries

ICD-9 Code	Short Description	Long Description
E950.0	Poison-analgesics	Suicide and self-inflicted poisoning by analgesics, antipyretics, and antirheumatics

E950.1	Poison-barbiturates	Suicide and self-inflicted poisoning by barbiturates
E950.2	Poison-sedat/hypnotic	Suicide and self-inflicted poisoning by other sedatives and hypnotics
E950.3	Poison-psychotropic agt	Suicide and self-inflicted poisoning by tranquilizers and other psychotropic agents
E950.4	Poison-drug/medicin NEC	Suicide and self-inflicted poisoning by other specified drugs and medicinal substances
E950.5	Poison-drug/medicin NOS	Suicide and self-inflicted poisoning by unspecified drug or medicinal substance

Assault-based gunshot injuries

ICD-9 Code	Short Description	Long Description
E965.0	Assault-handgun	Assault by handgun
E965.1	Assault-shotgun	Assault by shotgun
E965.2	Assault-hunting rifle	Assault by hunting rifle
E965.3	Assault-military weapon	Assault by military firearms
E965.4	Assault-firearm NEC	Assault by other and unspecified firearm

Low offspring birthweight

ICD-9 Code	Short Description	Long Description
764.9	Fet growth retard wtNOS	Fetal growth retardation, unspecified, unspecified [weight]
764.91	Fet growth retard <500g	Fetal growth retardation, unspecified, less than 500 grams
764.92	Fet growth ret 500-749g	Fetal growth retardation, unspecified, 500-749 grams
764.93	Fet growth ret 750-999g	Fetal growth retardation, unspecified, 750-999 grams
764.94	Fet grwth ret 1000-1249g	Fetal growth retardation, unspecified, 1,000-1,249 grams
764.95	Fet grwth ret 1250-1499g	Fetal growth retardation, unspecified, 1,250-1,499 grams
764.96	Fet grwth ret 1500-1749g	Fetal growth retardation, unspecified, 1,500-1,749 grams
764.97	Fet grwth ret 1750-1999g	Fetal growth retardation, unspecified, 1,750-1,999 grams
764.98	Fet grwth ret 2000-2499g	Fetal growth retardation, unspecified, 2,000-2,499 grams
764.99	Fet growth ret 2500+g	Fetal growth retardation, unspecified, 2,500 grams and over

Maternal pregnancy complications

ICD-9 Code	Short Description	Long Description
640.8	Hem early preg NEC-unsp	Other specified hemorrhage in early pregnancy, unspecified as to episode of care or not applicable

640.81	Hem early preg NEC-deliv	Other specified hemorrhage in early pregnancy, delivered, with or without mention of antepartum condition
640.83	Hem early pg NEC-anteapar	Other specified hemorrhage in early pregnancy, antepartum condition or complication
640.9	Hemorr early preg-unspec	Unspecified hemorrhage in early pregnancy, unspecified as to episode of care or not applicable
640.91	Hem early preg-delivered	Unspecified hemorrhage in early pregnancy, delivered, with or without mention of antepartum condition
640.93	Hem early preg-anteapart	Unspecified hemorrhage in early pregnancy, antepartum condition or complication
641	Placenta previa-unspec	Placenta previa without hemorrhage, unspecified as to episode of care or not applicable
641.01	Placenta previa-deliver	Placenta previa without hemorrhage, delivered, with or without mention of antepartum condition
641.03	Placenta previa-anteapart	Placenta previa without hemorrhage, antepartum condition or complication
641.1	Placenta prev hem-unspec	Hemorrhage from placenta previa, unspecified as to episode of care or not applicable
641.11	Placenta prev hem-deliv	Hemorrhage from placenta previa, delivered, with or without mention of antepartum condition
641.13	Placen prev hem-anteapart	Hemorrhage from placenta previa, antepartum condition or complication
641.2	Prem separ placen-unspec	Premature separation of placenta, unspecified as to episode of care or not applicable
641.21	Prem separ placen-deliv	Premature separation of placenta, delivered, with or without mention of antepartum condition
641.23	Prem separ plac-anteapart	Premature separation of placenta, antepartum condition or complication
642	Essen hyperten preg-unsp	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, unspecified as to episode of care or not applicable
642.01	Essen hyperten-delivered	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, delivered, with or without mention of antepartum condition
642.02	Essen hyperten-del w p/p	Benign essential hypertension, complicating pregnancy, childbirth, and the puerperium, delivered, with mention of postpartum complication
642.03	Essen hyperten-anteapart	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, antepartum condition or complication

642.04	Essen hyperten-postpart	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium, postpartum condition or complication
642.3	Trans hyperten preg-unsp	Transient hypertension of pregnancy, unspecified as to episode of care or not applicable
642.31	Trans hyperten-delivered	Transient hypertension of pregnancy, delivered , with or without mention of antepartum condition
642.32	Trans hyperten-del w p/p	Transient hypertension of pregnancy, delivered, with mention of postpartum complication
642.33	Trans hyperten-antepart	Transient hypertension of pregnancy, antepartum condition or complication
642.34	Trans hyperten-postpart	Transient hypertension of pregnancy, postpartum condition or complication
642.4	Mild/NOS preeclamp-unsp	Mild or unspecified pre-eclampsia, unspecified as to episode of care or not applicable
642.41	Mild/NOS preeclamp-deliv	Mild or unspecified pre-eclampsia, delivered, with or without mention of antepartum condition
642.42	Mild preeclamp-del w p/p	Mild or unspecified pre-eclampsia, delivered, with mention of postpartum complication
642.43	Mild/NOS preeclamp-antep	Mild or unspecified pre-eclampsia, antepartum condition or complication
642.44	Mild/NOS preeclamp-p/p	Mild or unspecified pre-eclampsia, postpartum condition or complication
642.5	Severe preeclamp-unspec	Severe pre-eclampsia, unspecified as to episode of care or not applicable
642.51	Severe preeclamp-deliver	Severe pre-eclampsia, delivered, with or without mention of antepartum condition
642.52	Sev preeclamp-del w p/p	Severe pre-eclampsia, delivered, with mention of postpartum complication
642.53	Sev preeclamp-antepartum	Severe pre-eclampsia, antepartum condition or complication
642.54	Sev preeclamp-postpartum	Severe pre-eclampsia, postpartum condition or complication
642.6	Eclampsia-unspecified	Eclampsia, unspecified as to episode of care or not applicable
642.61	Eclampsia-delivered	Eclampsia, delivered, with or without mention of antepartum condition
642.62	Eclampsia-deliv w p/p	Eclampsia, delivered, with mention of postpartum complication
642.63	Eclampsia-antepartum	Eclampsia, antepartum condition or complication
642.64	Eclampsia-postpartum	Eclampsia, postpartum condition or complication
642.7	Tox w old hyperten-unsp	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, unspecified as to episode of care or not applicable
642.71	Tox w old hyperten-deliv	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with or without mention of antepartum condition

642.72	Tox w old hyp-del w p/p	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, delivered, with mention of postpartum complication
642.73	Tox w old hyper-ante part	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, antepartum condition or complication
642.74	Tox w old hyper-postpart	Pre-eclampsia or eclampsia superimposed on pre-existing hypertension, postpartum condition or complication
642.9	Hyperten preg NOS-unspec	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, unspecified as to episode of care or not applicable
642.91	Hypertens NOS-delivered	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, delivered, with or without mention of antepartum condition
642.92	Hypertens NOS-del w p/p	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, delivered, with mention of postpartum complication
642.93	Hypertens NOS-ante partum	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, antepartum condition or complication
642.94	Hypertens NOS-postpartum	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium, postpartum condition or complication
646.8	Preg compl NEC-unspec	Other specified complications of pregnancy, unspecified as to episode of care or not applicable
646.81	Preg compl NEC-delivered	Other specified complications of pregnancy, delivered, with or without mention of antepartum condition
646.82	Preg compl NEC-del w p/p	Other specified complications of pregnancy, delivered, with mention of postpartum complication
646.83	Preg compl NEC-ante part	Other specified complications of pregnancy, antepartum condition or complication
646.84	Preg compl NEC-postpart	Other specified complications of pregnancy, postpartum condition or complication
646.9	Preg compl NOS-unspec	Unspecified complication of pregnancy, unspecified as to episode of care or not applicable

Unemployment or low income

ICD-9 Code	Short Description	Long Description
V62.0	Unemployment	Unemployment

Schizophrenia or other psychoses

ICD-9 Code	Short Description	Long Description
295	Simpl schizophren-unspec	Simple type schizophrenia, unspecified
295.01	Simpl schizophren-subchr	Simple type schizophrenia, subchronic
295.02	Simple schizophren-chr	Simple type schizophrenia, chronic
295.03	Simp schiz-subchr/exacer	Simple type schizophrenia, subchronic with acute exacerbation
295.04	Simpl schizo-chr/exacerb	Simple type schizophrenia, chronic with acute exacerbation
295.05	Simpl schizophren-remiss	Simple type schizophrenia, in remission
295.1	Hebephrenia-unspec	Disorganized type schizophrenia, unspecified
295.11	Hebephrenia-subchronic	Disorganized type schizophrenia, subchronic
295.12	Hebephrenia-chronic	Disorganized type schizophrenia, chronic
295.13	Hebephren-subchr/exacerb	Disorganized type schizophrenia, subchronic with acute exacerbation
295.14	Hebephrenia-chr/exacerb	Disorganized type schizophrenia, chronic with acute exacerbation
295.15	Hebephrenia-remission	Disorganized type schizophrenia, in remission
295.2	Catatonia-unspec	Catatonic type schizophrenia, unspecified
295.21	Catatonia-subchronic	Catatonic type schizophrenia, subchronic
295.22	Catatonia-chronic	Catatonic type schizophrenia, chronic
295.23	Catatonia-subchr/exacerb	Catatonic type schizophrenia, subchronic with acute exacerbation
295.24	Catatonia-chr/exacerb	Catatonic type schizophrenia, chronic with acute exacerbation
295.25	Catatonia-remission	Catatonic type schizophrenia, in remission
295.3	Paranoid schizo-unspec	Paranoid type schizophrenia, unspecified
295.31	Paranoid schizo-subchr	Paranoid type schizophrenia, subchronic
295.32	Paranoid schizo-chronic	Paranoid type schizophrenia, chronic
295.33	Paran schizo-subchr/exac	Paranoid type schizophrenia, subchronic with acute exacerbation
295.34	Paran schizo-chr/exacerb	Paranoid type schizophrenia, chronic with acute exacerbation
295.35	Paranoid schizo-remiss	Paranoid type schizophrenia, in remission
295.4	Schizophreniform dis NOS	Schizophreniform disorder, unspecified
295.41	Schizophrenic dis-subchr	Schizophreniform disorder, subchronic
295.42	Schizophren dis-chronic	Schizophreniform disorder, chronic
295.43	Schizo dis-subchr/exacer	Schizophreniform disorder, subchronic with acute exacerbation
295.44	Schizophr dis-chr/exacer	Schizophreniform disorder, chronic with acute exacerbation
295.45	Schizophrenic dis-remiss	Schizophreniform disorder, in remission
295.5	Latent schizophren-unsp	Latent schizophrenia, unspecified
295.51	Lat schizophren-subchr	Latent schizophrenia, subchronic
295.52	Latent schizophren-chr	Latent schizophrenia, chronic

295.53	Lat schizo-subchr/exacer	Latent schizophrenia, subchronic with acute exacerbation
295.54	Latent schizo-chr/exacer	Latent schizophrenia, chronic with acute exacerbation
295.55	Lat schizophren-remiss	Latent schizophrenia, in remission
295.6	Schizophr dis resid NOS	Schizophrenic disorders, residual type, unspecified
295.61	Schizophr dis resid-subch	Schizophrenic disorders, residual type, subchronic
295.62	Schizophr dis resid-chr	Schizophrenic disorders, residual type, chronic
295.63	Schizo resid subchr/exac	Schizophrenic disorders, residual type, subchronic with acute exacerbation
295.64	Schizophr resid-chro/exac	Schizophrenic disorders, residual type, chronic with acute exacerbation
295.65	Schizophr dis resid-remis	Schizophrenic disorders, residual type, in remission
296.2	Depress psychosis-unspec	Major depressive affective disorder, single episode, unspecified
296.21	Depress psychosis-mild	Major depressive affective disorder, single episode, mild
296.22	Depressive psychosis-mod	Major depressive affective disorder, single episode, moderate
296.23	Depress psychosis-severe	Major depressive affective disorder, single episode, severe, without mention of psychotic behavior
296.24	Depr psychos-sev w psych	Major depressive affective disorder, single episode, severe, specified as with psychotic behavior
296.25	Depr psychos-part remiss	Major depressive affective disorder, single episode, in partial or unspecified remission
296.26	Depr psychos-full remiss	Major depressive affective disorder, single episode, in full remission
296.3	Recurr depr psychos-unsp	Major depressive affective disorder, recurrent episode, unspecified
296.31	Recurr depr psychos-mild	Major depressive affective disorder, recurrent episode, mild
296.32	Recurr depr psychos-mod	Major depressive affective disorder, recurrent episode, moderate
296.33	Recur depr psych-severe	Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior
296.34	Rec depr psych-psychotic	Major depressive affective disorder, recurrent episode, severe, specified as with psychotic behavior
296.35	Recur depr psyc-part rem	Major depressive affective disorder, recurrent episode, in partial or unspecified remission

296.36	Recur depr psyc-full rem	Major depressive affective disorder, recurrent episode, in full remission
298	React depress psychosis	Depressive type psychosis
298.1	Excitativ type psychosis	Excitative type psychosis
298.4	Psychogen paranoid psych	Psychogenic paranoid psychosis
298.8	React psychosis NEC/NOS	Other and unspecified reactive psychosis
298.9	Psychosis NOS	Unspecified psychosis

Depressive disorders

ICD-9 Code	Short Description	Long Description
296.82	Atypical depressive dis	Atypical depressive disorder
311	Depressive disorder NEC	Depressive disorder, not elsewhere classified

Suicide

ICD-9 Code	Short Description	Long Description
E950.6	Poison-agricult agent	Suicide and self-inflicted poisoning by agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E950.7	Poison-corrosiv/caustic	Suicide and self-inflicted poisoning by corrosive and caustic substances
E950.8	Poison-arsenic	Suicide and self-inflicted poisoning by arsenic and its compounds
E950.9	Poison-solid/liquid NEC	Suicide and self-inflicted poisoning by other and unspecified solid and liquid substances
E951.0	Poison-piped gas	Suicide and self-inflicted poisoning by gas distributed by pipeline
E951.1	Poison-gas in container	Suicide and self-inflicted poisoning by liquefied petroleum gas distributed in mobile containers
E951.8	Poison-utility gas NEC	Suicide and self-inflicted poisoning by other utility gas
E952.0	Poison-exhaust gas	Suicide and self-inflicted poisoning by motor vehicle exhaust gas
E952.1	Poison-co NEC	Suicide and self-inflicted poisoning by other carbon monoxide
E952.8	Poison-gas/vapor NEC	Suicide and self-inflicted poisoning by other specified gases and vapors
E952.9	Poison-gas/vapor NOS	Suicide and self-inflicted poisoning by unspecified gases and vapors
E953.0	Injury-hanging	Suicide and self-inflicted injury by hanging
E953.1	Injury-suff w plas bag	Suicide and self-inflicted injury by suffocation by plastic bag
E953.8	Injury-strang/suff NEC	Suicide and self-inflicted injury by other specified means
E953.9	Injury-strang/suff NOS	Suicide and self-inflicted injury by unspecified means

E954.	Injury-submersion	Suicide and self-inflicted injury by submersion [drowning]
E955.0	Injury-handgun	Suicide and self-inflicted injury by handgun
E955.1	Injury-shotgun	Suicide and self-inflicted injury by shotgun
E955.2	Injury-hunting rifle	Suicide and self-inflicted injury by hunting rifle
E955.3	Injury-military firearm	Suicide and self-inflicted injury by military firearms
E955.4	Injury-firearm NEC	Suicide and self-inflicted injury by other and unspecified firearm
E955.5	Injury-explosives	Suicide and self-inflicted injury by explosives
E955.6	Self inflict acc-air gun	Suicide and self-inflicted injury by air gun
E955.7	Self inj-paintball gun	Suicide and self-inflicted injury by paintball gun
E955.9	Injury-firearm/expl NOS	Suicide and self-inflicted injury by firearms and explosives, unspecified
E956.	Injury-cut instrument	Suicide and self-inflicted injury by cutting and piercing instrument
E957.0	Injury-jump fm residence	Suicide and self-inflicted injuries by jumping from residential premises
E957.1	Injury-jump fm struc NEC	Suicide and self-inflicted injuries by jumping from other man-made structures
E957.2	Injury-jump fm natur sit	Suicide and self-inflicted injuries by jumping from natural sites
E957.9	Injury-jump NEC	Suicide and self-inflicted injuries by jumping from unspecified site
E958.0	Injury-moving object	Suicide and self-inflicted injury by jumping or lying before moving object
E958.1	Injury-burn, fire	Suicide and self-inflicted injury by burns, fire
E958.2	Injury-scald	Suicide and self-inflicted injury by scald
E958.3	Injury-extreme cold	Suicide and self-inflicted injury by extremes of cold
E958.4	Injury-electrocution	Suicide and self-inflicted injury by electrocution
E958.5	Injury-motor veh crash	Suicide and self-inflicted injury by crashing of motor vehicle
E958.6	Injury-aircraft crash	Suicide and self-inflicted injury by crashing of aircraft
E958.7	Injury-caustic substance	Suicide and self-inflicted injury by caustic substances, except poisoning
E958.8	Injury-NEC	Suicide and self-inflicted injury by other specified means
E958.9	Injury-NOS	Suicide and self-inflicted injury by unspecified means

Social anxiety disorder

ICD-9 Code	Short Description	Long Description
300.23	Social phobia	Social phobia

Anxiety disorders

ICD-9 Code	Short Description	Long Description
293.84	Anxiety disorder oth dis	Anxiety disorder in conditions classified elsewhere
300	Anxiety state NOS	Anxiety state, unspecified

Anxiety disorders (except social anxiety)

ICD-9 Code	Short Description	Long Description
300.01	Panic dis w/o agorophobia	Panic disorder without agorophobia
300.02	Generalized anxiety dis	Generalized anxiety disorder
300.09	Anxiety state NEC	Other anxiety states
300.1	Hysteria NOS	Hysteria, unspecified
300.11	Conversion disorder	Conversion disorder
300.12	Dissociative amnesia	Dissociative amnesia
300.13	Dissociative fugue	Dissociative fugue
300.14	Dissociative identity dis	Dissociative identity disorder
300.15	Dissociative react NOS	Dissociative disorder or reaction, unspecified
300.16	Factitious dis w symptom	Factitious disorder with predominantly psychological signs and symptoms
300.19	Factitious ill NEC/NOS	Other and unspecified factitious illness
300.2	Phobia NOS	Phobia, unspecified
300.21	Agoraphobia w panic dis	Agoraphobia with panic disorder
300.22	Agoraphobia w/o panic	Agoraphobia without mention of panic attacks
300.29	Isolated/spec phobia NEC	Other isolated or specific phobias
300.3	Obsessive-compulsive dis	Obsessive-compulsive disorders
300.4	Dysthymic disorder	Dysthymic disorder
300.5	Neurasthenia	Neurasthenia
300.6	Depersonalization disord	Depersonalization disorder
300.7	Hypochondriasis	Hypochondriasis
300.81	Somatization disorder	Somatization disorder
300.82	Undiff somatoform disrd	Undifferentiated somatoform disorder
300.89	Somatoform disorders NEC	Other somatoform disorders
300.9	Nonpsychotic disord NOS	Unspecified nonpsychotic mental disorder

Positive symptoms of schizophrenia (i.e., hallucinations)

ICD-9 Code	Short Description	Long Description
780.1	Hallucinations	
293.81	Psy dis w delus oth dis	Psychotic disorder with delusions in conditions classified elsewhere
333.99	Extrapyramidal dis NEC	Other extrapyramidal diseases and abnormal movement disorders

Bipolar disorders

ICD-9 Code	Short Description	Long Description
296.5	Bipol I cur depres NOS	Bipolar I disorder, most recent episode (or current) depressed, unspecified

296.51	Bipol I cur depress-mild	Bipolar I disorder, most recent episode (or current) depressed, mild
296.52	Bipol I cur depress-mod	Bipolar I disorder, most recent episode (or current) depressed, moderate
296.53	Bipol I curr dep w/o psy	Bipolar I disorder, most recent episode (or current) depressed, severe, without mention of psychotic behavior
296.54	Bipol I currnt dep w psy	Bipolar I disorder, most recent episode (or current) depressed, severe, specified as with psychotic behavior
296.55	Bipol I cur dep rem NOS	Bipolar I disorder, most recent episode (or current) depressed, in partial or unspecified remission
296.56	Bipol I currnt dep remis	Bipolar I disorder, most recent episode (or current) depressed, in full remission
296.6	Bipol I currnt mixed NOS	Bipolar I disorder, most recent episode (or current) mixed, unspecified
296.61	Bipol I currnt mix-mild	Bipolar I disorder, most recent episode (or current) mixed, mild
296.62	Bipol I currnt mixed-mod	Bipolar I disorder, most recent episode (or current) mixed, moderate
296.63	Bipol I cur mix w/o psy	Bipolar I disorder, most recent episode (or current) mixed, severe, without mention of psychotic behavior
296.64	Bipol I cur mixed w psy	Bipolar I disorder, most recent episode (or current) mixed, severe, specified as with psychotic behavior
296.65	Bipol I cur mix-part rem	Bipolar I disorder, most recent episode (or current) mixed, in partial or unspecified remission
296.66	Bipol I cur mixed remiss	Bipolar I disorder, most recent episode (or current) mixed, in full remission
296.7	Bipolar I current NOS	Bipolar I disorder, most recent episode (or current) unspecified
296.8	Bipolar disorder NOS	Bipolar disorder, unspecified
296	Bipol I single manic NOS	Bipolar I disorder, single manic episode, unspecified
296.01	Bipol I single manic-mild	Bipolar I disorder, single manic episode, mild
296.02	Bipol I single manic-mod	Bipolar I disorder, single manic episode, moderate
296.03	Bipol I sing-sev w/o psy	Bipolar I disorder, single manic episode, severe, without mention of psychotic behavior
296.04	Bipo I sin man-sev w psy	Bipolar I disorder, single manic episode, severe, specified as with psychotic behavior
296.05	Bipol I sing man rem NOS	Bipolar I disorder, single manic episode, in partial or unspecified remission
296.06	Bipol I single manic rem	Bipolar I disorder, single manic episode, in full remission

296.4	Bipol I currnt manic NOS	Bipolar I disorder, most recent episode (or current) manic, unspecified
296.41	Bipol I curnt manic-mild	Bipolar I disorder, most recent episode (or current) manic, mild
296.42	Bipol I currnt manic-mod	Bipolar I disorder, most recent episode (or current) manic, moderate
296.43	Bipol I manic-sev w/o psy	Bipolar I disorder, most recent episode (or current) manic, severe, without mention of psychotic behavior
296.44	Bipol I manic-sev w psy	Bipolar I disorder, most recent episode (or current) manic, severe, specified as with psychotic behavior
296.45	Bipol I cur man part rem	Bipolar I disorder, most recent episode (or current) manic, in partial or unspecified remission
296.46	Bipol I cur man full rem	Bipolar I disorder, most recent episode (or current) manic, in full remission

Substance dependence or abuse of alcohol, tobacco, and other illicit drugs

ICD-9 Code	Short Description	Long Description
303.9	Alcoh dep NEC/NOS-unspec	Other and unspecified alcohol dependence, unspecified
303.91	Alcoh dep NEC/NOS-contin	Other and unspecified alcohol dependence, continuous
303.92	Alcoh dep NEC/NOS-episod	Other and unspecified alcohol dependence, episodic
303.93	Alcoh dep NEC/NOS-remiss	Other and unspecified alcohol dependence, in remission
304	Opioid dependence-unspec	Opioid type dependence, unspecified
304.01	Opioid dependence-contin	Opioid type dependence, continuous
304.02	Opioid dependence-episod	Opioid type dependence, episodic
304.03	Opioid dependence-remiss	Opioid type dependence, in remission
304.1	Sed,hyp,anxiolyt dep-NOS	Sedative, hypnotic or anxiolytic dependence, unspecified
304.11	Sed,hyp,anxiolyt dep-con	Sedative, hypnotic or anxiolytic dependence, continuous
304.12	Sed,hyp,anxiolyt dep-epi	Sedative, hypnotic or anxiolytic dependence, episodic
304.13	Sed,hyp,anxiolyt dep-rem	Sedative, hypnotic or anxiolytic dependence, in remission
304.2	Cocaine depend-unspec	Cocaine dependence, unspecified
304.21	Cocaine depend-contin	Cocaine dependence, continuous
304.22	Cocaine depend-episodic	Cocaine dependence, episodic
304.23	Cocaine depend-remiss	Cocaine dependence, in remission
304.3	Cannabis depend-unspec	Cannabis dependence, unspecified
304.31	Cannabis depend-contin	Cannabis dependence, continuous
304.32	Cannabis depend-episodic	Cannabis dependence, episodic

304.33	Cannabis depend-remiss	Cannabis dependence, in remission
304.4	Amphetamin depend-unspec	Amphetamine and other psychostimulant dependence, unspecified
304.41	Amphetamin depend-contin	Amphetamine and other psychostimulant dependence, continuous
304.42	Amphetamin depend-episod	Amphetamine and other psychostimulant dependence, episodic
304.43	Amphetamin depend-remiss	Amphetamine and other psychostimulant dependence, in remission
304.5	Hallucinogen dep-unspec	Hallucinogen dependence, unspecified
304.51	Hallucinogen dep-contin	Hallucinogen dependence, continuous
304.52	Hallucinogen dep-episod	Hallucinogen dependence, episodic
304.53	Hallucinogen dep-remiss	Hallucinogen dependence, in remission
304.6	Drug depend NEC-unspec	Other specified drug dependence, unspecified
304.61	Drug depend NEC-contin	Other specified drug dependence, continuous
304.62	Drug depend NEC-episodic	Other specified drug dependence, episodic
304.63	Drug depend NEC-in rem	Other specified drug dependence, in remission
304.7	Opioid/other dep-unspec	Combinations of opioid type drug with any other drug dependence, unspecified
304.71	Opioid/other dep-contin	Combinations of opioid type drug with any other drug dependence, continuous
304.72	Opioid/other dep-episod	Combinations of opioid type drug with any other drug dependence, episodic
304.73	Opioid/other dep-remiss	Combinations of opioid type drug with any other drug dependence, in remission
304.8	Comb drug dep NEC-unspec	Combinations of drug dependence excluding opioid type drug, unspecified
304.81	Comb drug dep NEC-contin	Combinations of drug dependence excluding opioid type drug, continuous
304.82	Comb drug dep NEC-episod	Combinations of drug dependence excluding opioid type drug, episodic
304.83	Comb drug dep NEC-remiss	Combinations of drug dependence excluding opioid type drug, in remission
304.9	Drug depend NOS-unspec	Unspecified drug dependence, unspecified
304.91	Drug depend NOS-contin	Unspecified drug dependence, continuous
304.92	Drug depend NOS-episodic	Unspecified drug dependence, episodic
304.93	Drug depend NOS-remiss	Unspecified drug dependence, in remission
305	Alcohol abuse-unspec	Alcohol abuse, unspecified
305.01	Alcohol abuse-continuous	Alcohol abuse, continuous
305.02	Alcohol abuse-episodic	Alcohol abuse, episodic
305.03	Alcohol abuse-in remiss	Alcohol abuse, in remission
305.3	Hallucinog abuse-unspec	Hallucinogen abuse, unspecified
305.31	Hallucinog abuse-contin	Hallucinogen abuse, continuous
305.32	Hallucinog abuse-episod	Hallucinogen abuse, episodic
305.33	Hallucinog abuse-remiss	Hallucinogen abuse, in remission

305.4	Sed,hyp,anxiolytc ab-NOS	Sedative, hypnotic or anxiolytic abuse, unspecified
305.41	Sed,hyp,anxiolytc ab-con	Sedative, hypnotic or anxiolytic abuse, continuous
305.42	Sed,hyp,anxiolytc ab-epi	Sedative, hypnotic or anxiolytic abuse, episodic
305.43	Sed,hyp,anxiolytc ab-rem	Sedative, hypnotic or anxiolytic abuse, in remission
305.5	Opioid abuse-unspec	Opioid abuse, unspecified
305.51	Opioid abuse-continuous	Opioid abuse, continuous
305.52	Opioid abuse-episodic	Opioid abuse, episodic
305.53	Opioid abuse-in remiss	Opioid abuse, in remission
305.6	Cocaine abuse-unspec	Cocaine abuse, unspecified
305.61	Cocaine abuse-continuous	Cocaine abuse, continuous
305.62	Cocaine abuse-episodic	Cocaine abuse, episodic
305.63	Cocaine abuse-in remiss	Cocaine abuse, in remission
305.7	Amphetamine abuse-unspec	Amphetamine or related acting sympathomimetic abuse, unspecified
305.71	Amphetamine abuse-contin	Amphetamine or related acting sympathomimetic abuse, continuous
305.72	Amphetamine abuse-episod	Amphetamine or related acting sympathomimetic abuse, episodic
305.73	Amphetamine abuse-remiss	Amphetamine or related acting sympathomimetic abuse, in remission
305.8	Antidepress abuse-unspec	Antidepressant type abuse, unspecified
305.81	Antidepress abuse-contin	Antidepressant type abuse, continuous
305.82	Antidepress abuse-episod	Antidepressant type abuse, episodic
305.83	Antidepress abuse-remiss	Antidepressant type abuse, in remission

Cannabis abuse

ICD-9 Code	Short Description	Long Description
305.2	Cannabis abuse-unspec	Cannabis abuse, unspecified
305.21	Cannabis abuse-contin	Cannabis abuse, continuous
305.22	Cannabis abuse-episodic	Cannabis abuse, episodic
305.23	Cannabis abuse-in remiss	Cannabis abuse, in remission

Tobacco use

ICD-9 Code	Short Description	Long Description
305.1	Tobacco use disorder	Tobacco use disorder

Alcohol abuse

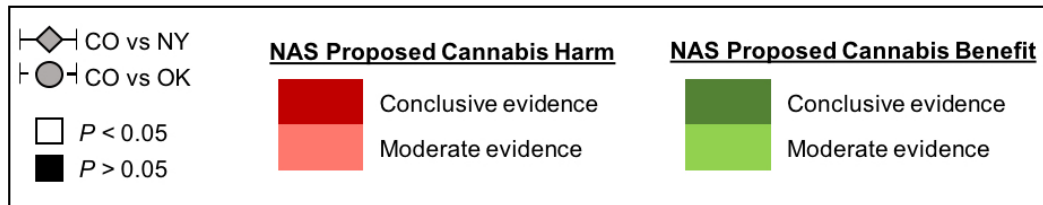
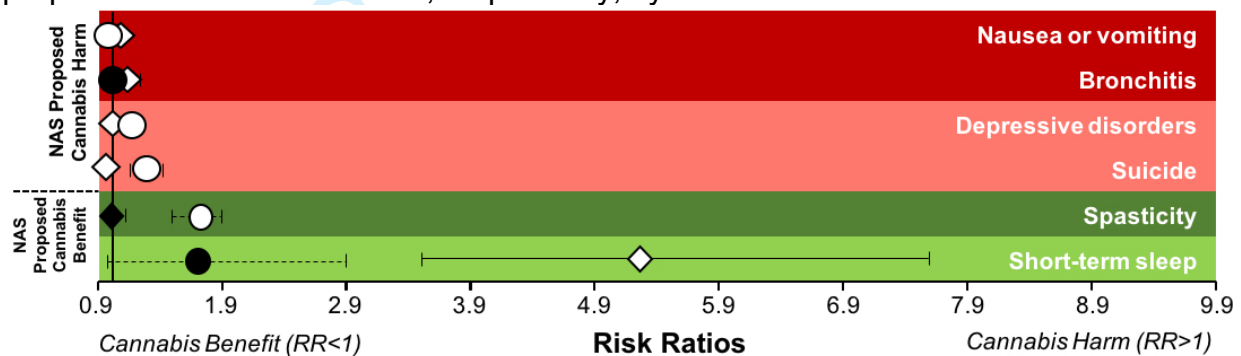
ICD-9 Code	Short Description	Long Description
303.9	Alcoh dep NEC/NOS-unspec	Other and unspecified alcohol dependence, unspecified
303.91	Alcoh dep NEC/NOS-contin	Other and unspecified alcohol dependence, continuous
303.92	Alcoh dep NEC/NOS-episod	Other and unspecified alcohol dependence, episodic

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303.93	Alcoh dep NEC/NOS-remiss	Other and unspecified alcohol dependence, in remission
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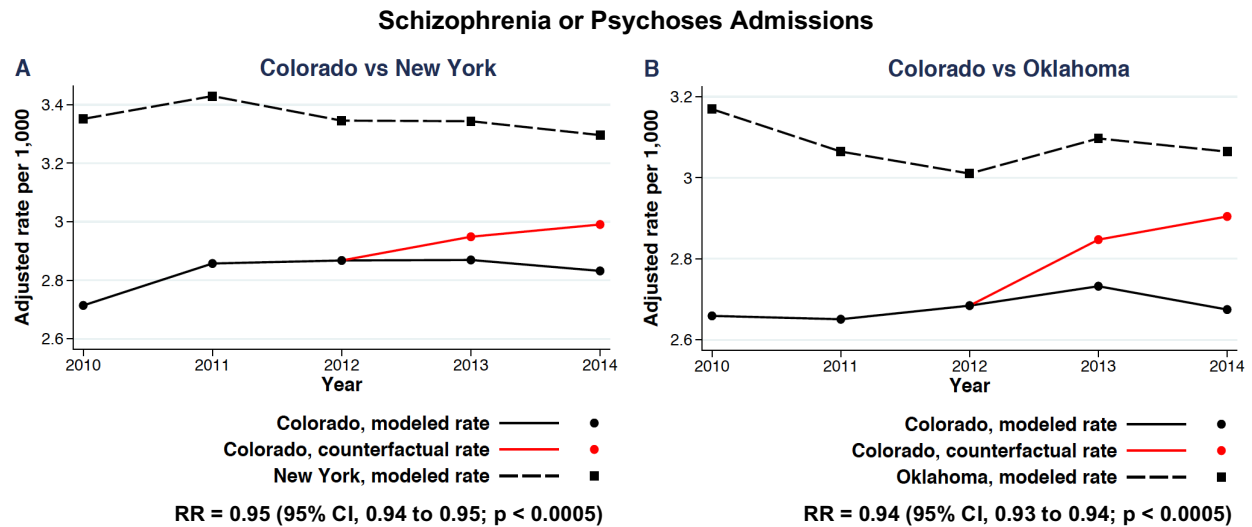
For peer review only

eFigure 1. Health outcomes with substantial or moderate evidence of a statistical association with cannabis use based on the National Academy of Science (NAS) summary statement. Medical diagnoses are identified based on a significant ($P < 0.05$) comparison between New York (NY) and Oklahoma (OK) (control states without cannabis legalization) with regards to the change of admission rates for such diagnoses following cannabis legalization. P values for the comparison between Colorado (CO) (site of cannabis legalization) and NY (rhomboid symbol), or between CO and OK (circular symbol) are shown as either < 0.05 , or > 0.05 using a gray scale for evidence of cannabis benefit (risk ratio [RR] < 1 shown on the left) and cannabis harm (RR > 1 shown on the right); 95% confidence intervals are shown for the comparison between CO and NY and between CO and OK as solid and dotted lines, respectively. Progressively darker shades of green or red indicate greater weight of evidence in the direction of proposed benefit versus harm, respectively, by the NAS.

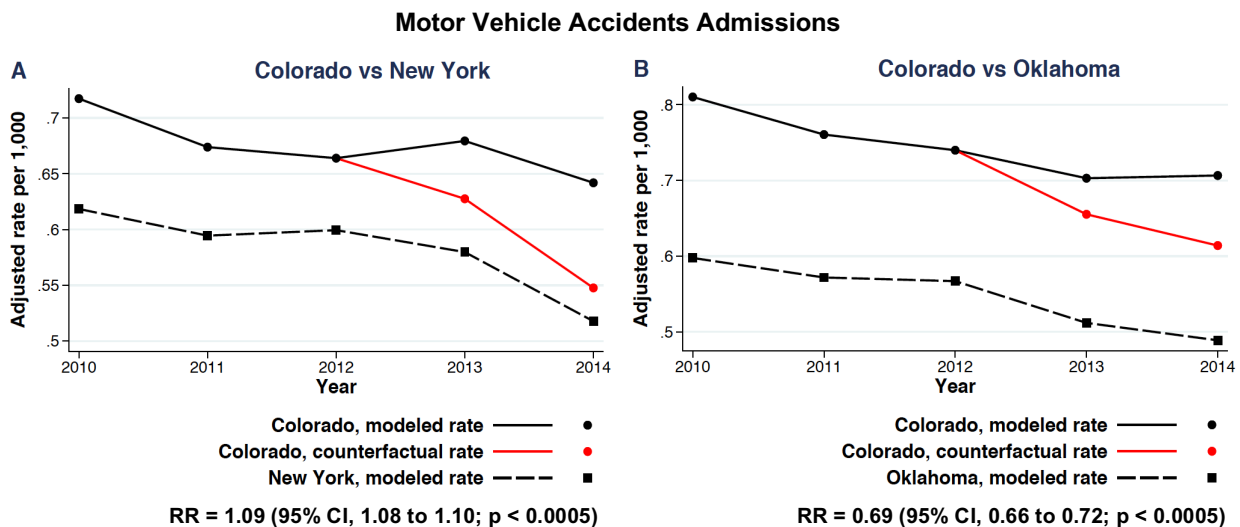


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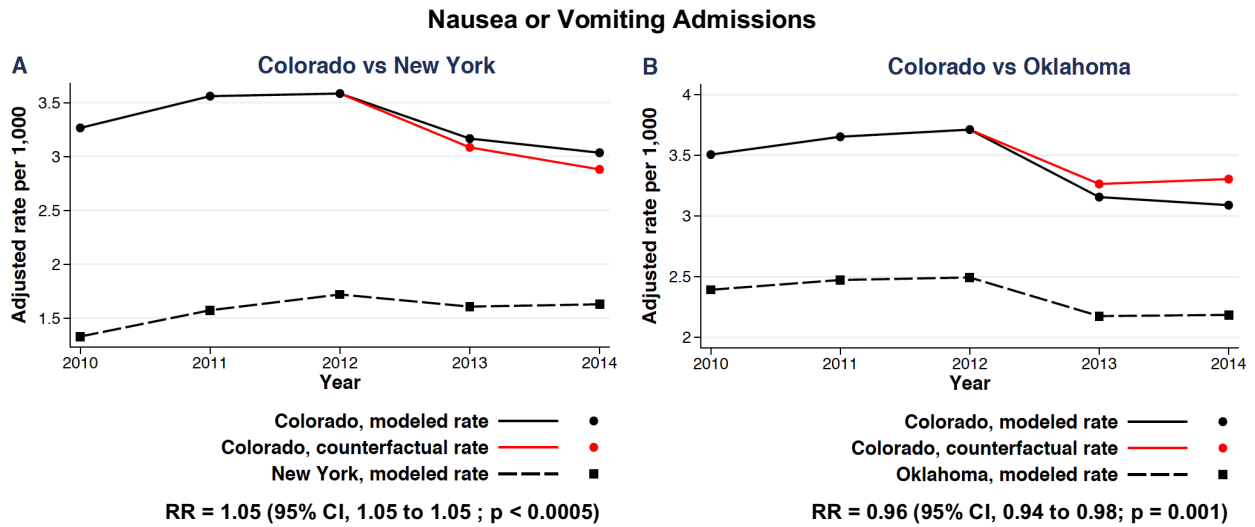
eFigure 2. Multivariate adjusted rates of total hospital admissions over 2010-2014 in Colorado, site of implementation of the 2012 recreational cannabis legalization policy, compared with New York (A) and Oklahoma (B), control states without cannabis legalization. Red lines show the predicted rates of admissions for schizophrenia or other psychoses (and all remaining medical diagnoses plotted in eFigures 2-15) had the cannabis legalization policy not been instituted. RR = risk ratio; CI = confidence interval.



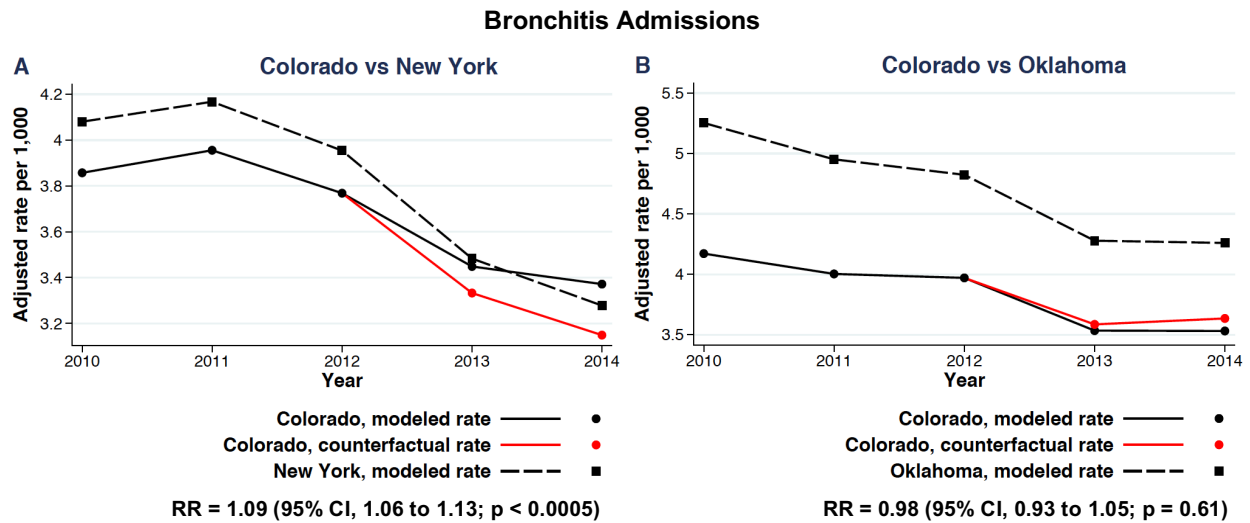
eFigure 3. Multivariate adjusted rates of admissions for motor vehicle accidents over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



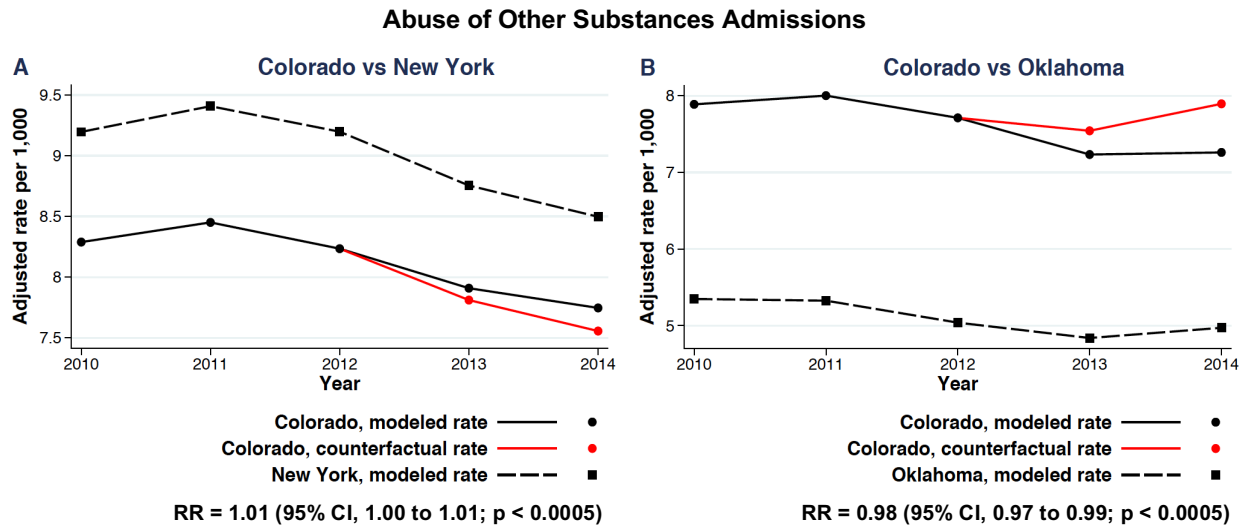
eFigure 4. Multivariate adjusted rates of admissions for nausea or vomiting over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



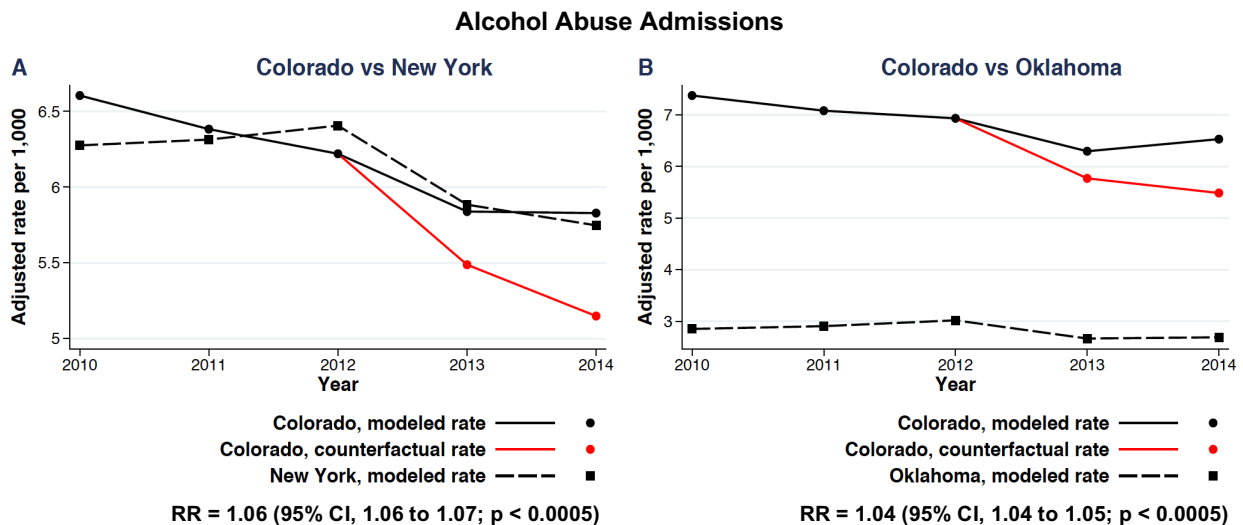
eFigure 5. Multivariate adjusted rates of admissions for bronchitis over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



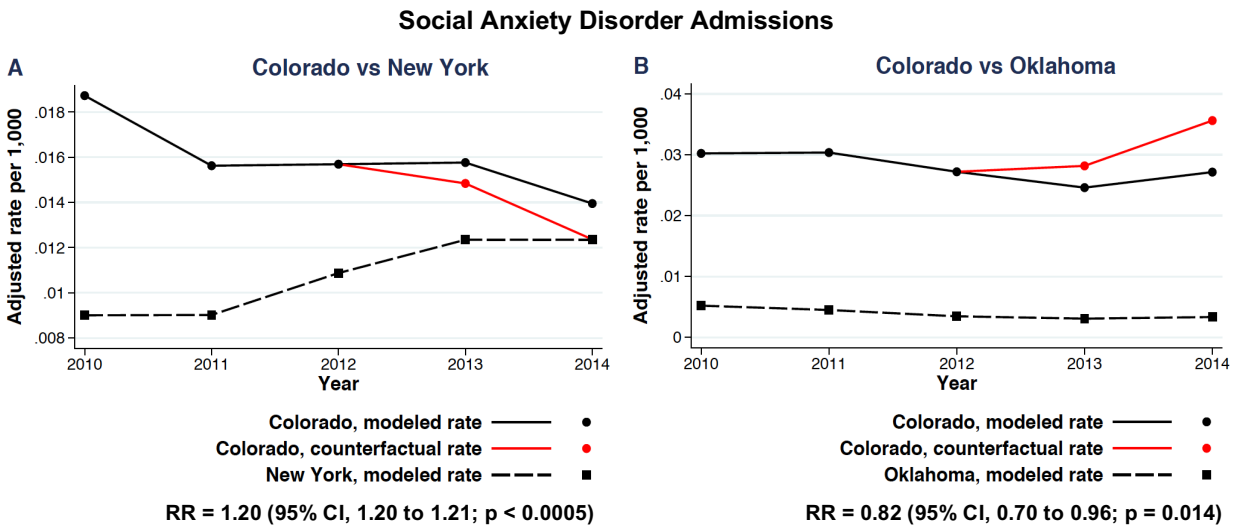
eFigure 6. Multivariate adjusted rates of admissions for abuse of other substances over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



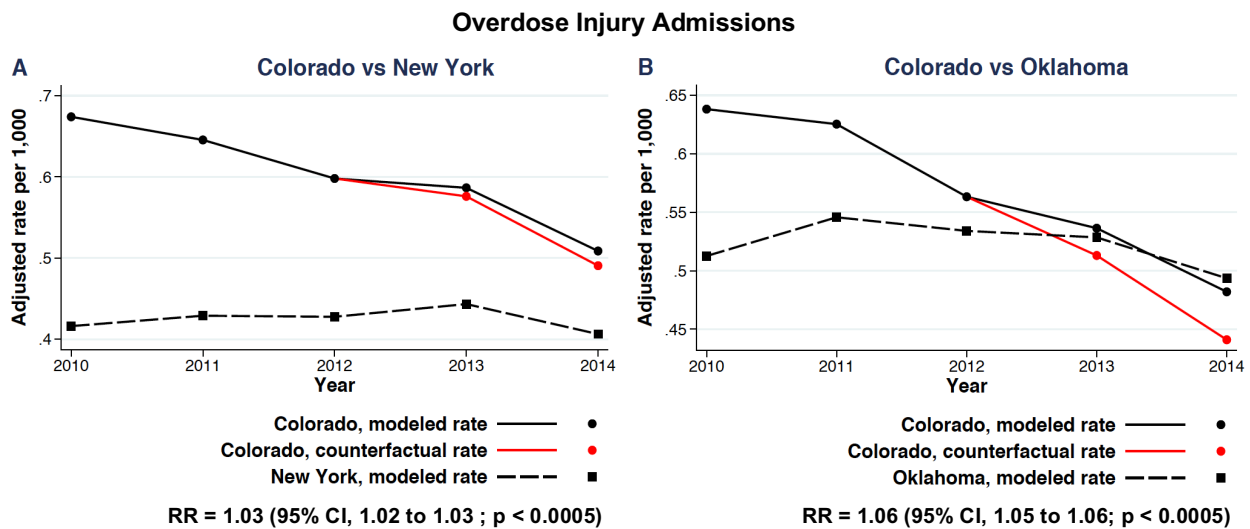
eFigure 7. Multivariate adjusted rates of admissions for alcohol abuse over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



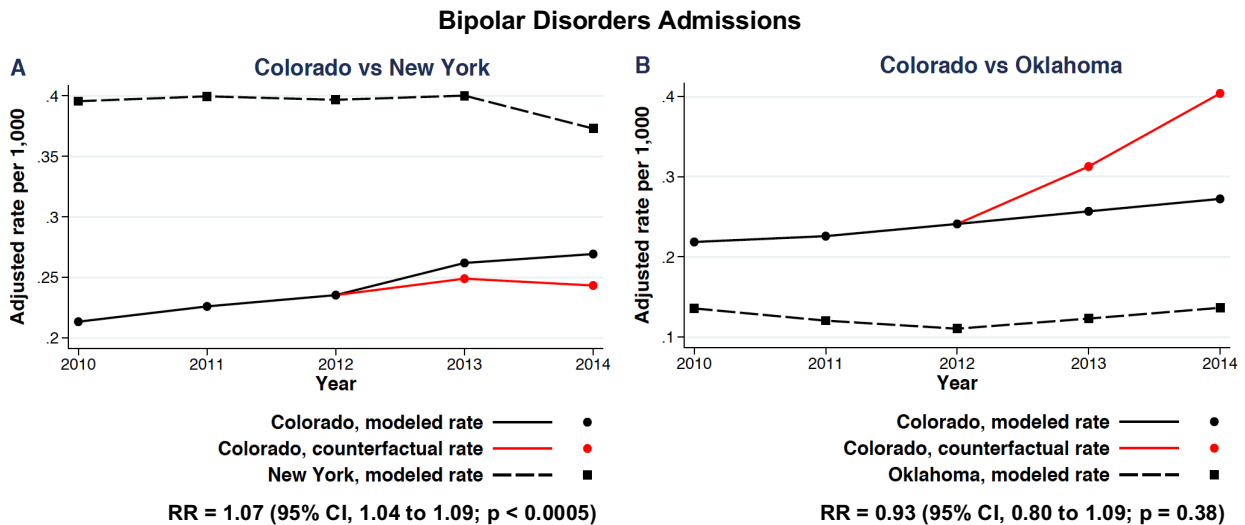
eFigure 8. Multivariate adjusted rates of admissions for social anxiety disorder over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



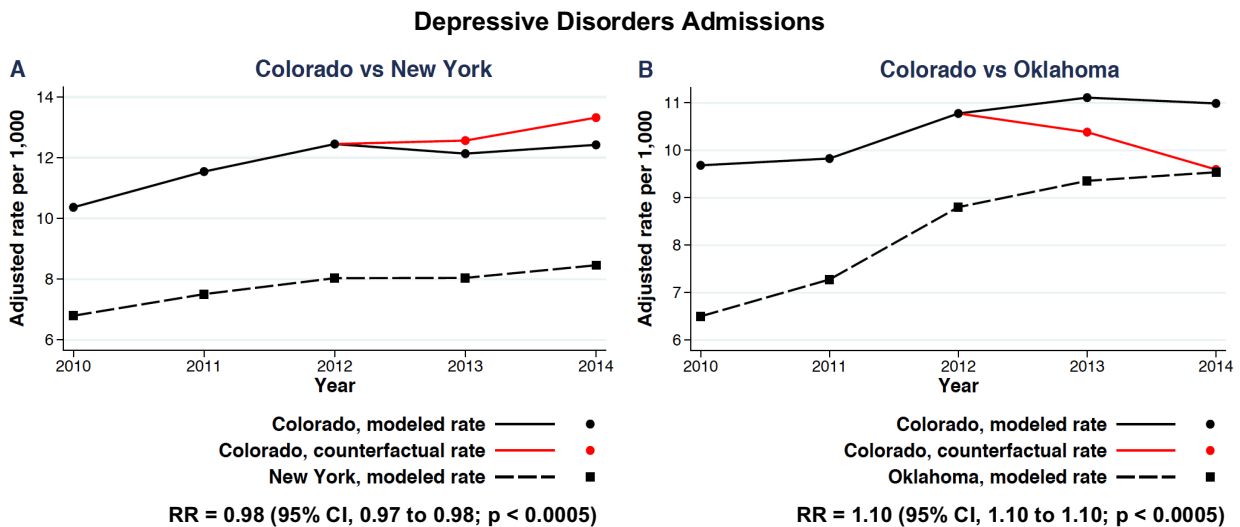
eFigure 9. Multivariate adjusted rates of admissions for overdose injury over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



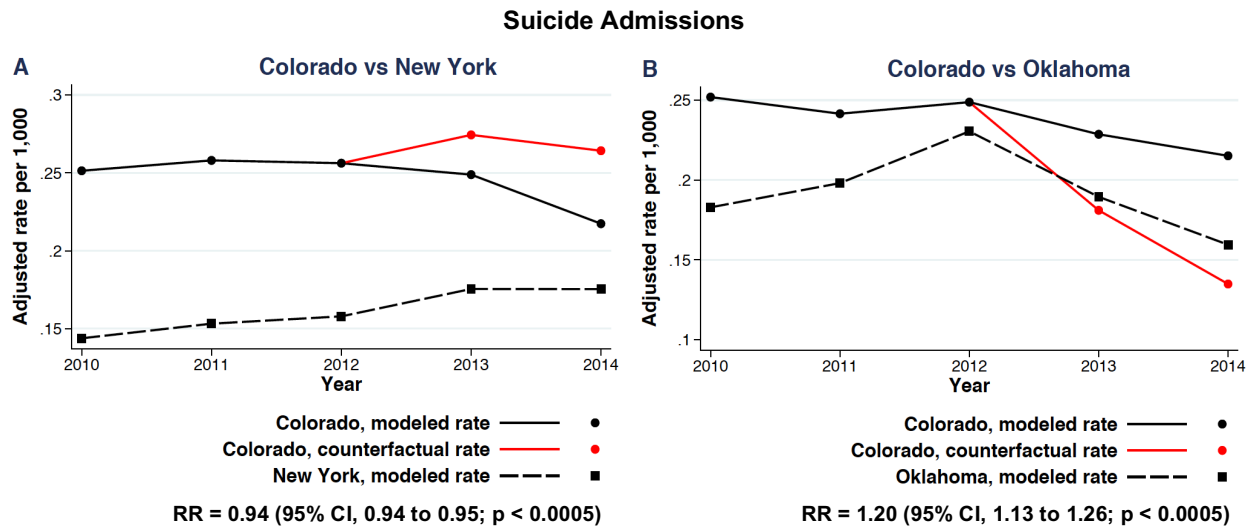
eFigure 10. Multivariate adjusted rates of admissions for bipolar disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



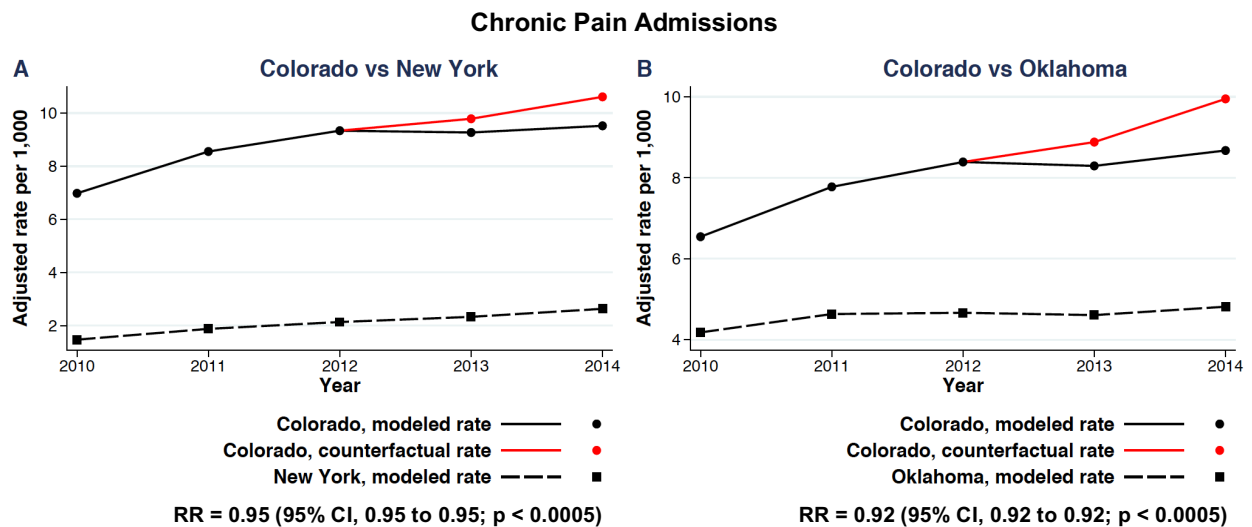
eFigure 11. Multivariate adjusted rates of admissions for depressive disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



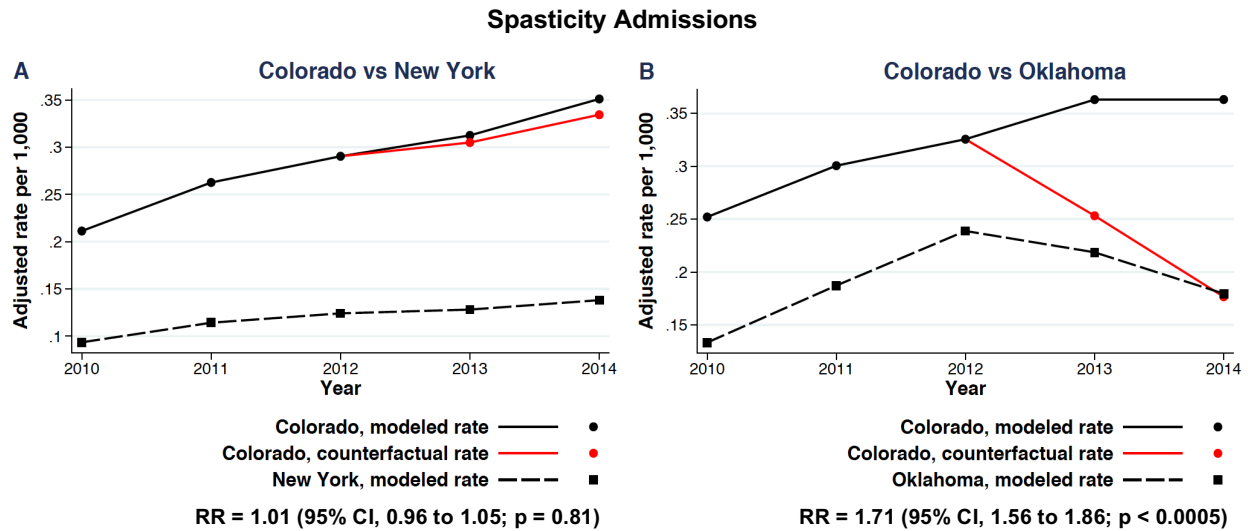
eFigure 12. Multivariate adjusted rates of admissions for suicide over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



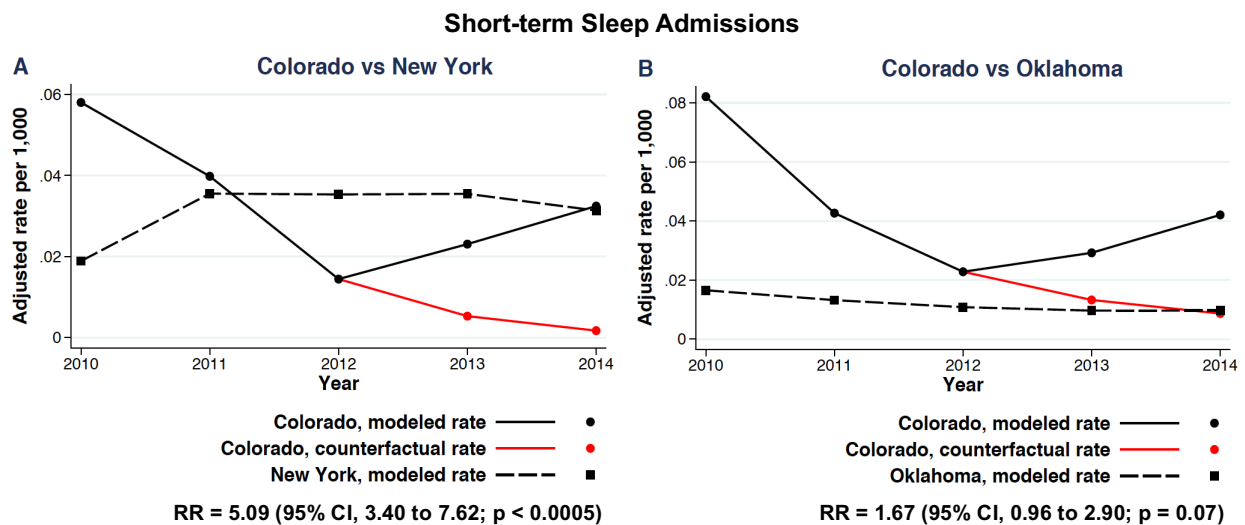
eFigure 13. Multivariate adjusted rates of admissions for chronic pain over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eFigure 14. Multivariate adjusted rates of admissions for spasticity over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eFigure 15. Multivariate adjusted rates of admissions for short-term sleep disorders over 2010-2014 in Colorado compared with New York (A) and Oklahoma (B). RR = risk ratio; CI = confidence interval.



eTable 3. Changes in specific NAS outcomes in a sensitivity analysis using January 2014 as the date of recreational cannabis legalization

NAS Outcome	State Comparisons	RR	95% CI	P value
Motor vehicle accidents	CO vs NY	1.22	(1.16, 1.28)	<0.0005
	CO vs OK	1.18	(1.02, 1.37)	0.026
	NY vs OK	1.04	(0.77, 1.40)	0.81
Overdose injury	CO vs NY	1.11	(1.09, 1.14)	<0.0005
	CO vs OK	1.03	(0.98, 1.09)	0.25
	NY vs OK	0.98	(0.80, 1.19)	0.81
Bipolar disorders	CO vs NY	1.08	(1.06, 1.09)	<0.0005
	CO vs OK	0.81	(0.73, 0.90)	<0.0005
	NY vs OK	0.77	(0.75, 0.78)	<0.0005
Depressive disorders	CO vs NY	1.01	(0.99, 1.03)	0.59
	CO vs OK	1.23	(1.20, 1.25)	<0.0005
	NY vs OK	1.16	(1.07, 1.26)	<0.0005
Schizophrenia or psychoses	CO vs NY	0.84	(0.82, 0.86)	<0.0005
	CO vs OK	0.80	(0.79, 0.80)	<0.0005
	NY vs OK	0.88	(0.87, 0.90)	<0.0005
Social anxiety disorder	CO vs NY	1.45	(1.43, 1.48)	<0.0005
	CO vs OK	0.58	(0.47, 0.71)	<0.0005
	NY vs OK	0.46	(0.29, 0.74)	0.001
Suicide	CO vs NY	1.09	(1.03, 1.15)	0.002
	CO vs OK	1.26	(1.12, 1.41)	<0.0005
	NY vs OK	1.11	(1.04, 1.18)	0.001
Bronchitis	CO vs NY	1.19	(1.15, 1.23)	<0.0005
	CO vs OK	1.03	(0.97, 1.10)	0.33
	NY vs OK	0.82	(0.78, 0.87)	<0.0005
Abuse of other substances	CO vs NY	1.04	(1.03, 1.05)	<0.0005
	CO vs OK	0.99	(0.97, 1.01)	0.45
	NY vs OK	0.94	(0.90, 0.98)	0.007
Nausea or vomiting	CO vs NY	1.08	(1.06, 1.10)	<0.0005
	CO vs OK	0.95	(0.97, 1.01)	<0.0005
	NY vs OK	0.89	(0.90, 0.98)	0.01
Chronic pain	CO vs NY	0.94	(0.93, 0.96)	<0.0005
	CO vs OK	0.92	(0.91, 0.93)	<0.0005
	NY vs OK	0.93	(0.90, 0.96)	<0.0005
Spasticity	CO vs NY	0.75	(0.71, 0.79)	<0.0005
	CO vs OK	1.56	(1.14, 2.14)	0.006
	NY vs OK	2.12	(1.64, 2.76)	<0.0005
Short-term sleep	CO vs NY	11.7	(7.36, 18.59)	<0.0005
	CO vs OK	3.44	(1.32, 8.99)	0.012
	NY vs OK	0.45	(0.06, 3.22)	0.42

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6, 7, 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6, 7, 8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6, 7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6, 7, 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7, 8
Bias	9	Describe any efforts to address potential sources of bias	7, 8
Study size	10	Explain how the study size was arrived at	6, 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	9, 10 6, 7 8, 10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	11, 12, 13
Outcome data	15*	Report numbers of outcome events or summary measures over time	13, 14

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-14
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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9	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12, 14
10				
11	Discussion			
12				
13	Key results	18	Summarise key results with reference to study objectives	14-16
14				
15	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17-19
16				
17	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-19
18				
19				
20	Generalisability	21	Discuss the generalisability (external validity) of the study results	20
21				
22	Other information			
23	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21
24				

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.